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AGU-FM12

December 03 - 07, 2012

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Monday, December 03, 2012

Time	Session Info
8:00 AM-12:20 PM, Hall A-C (Moscone South), **A11B. Atmospheric Sciences General Contributions: Understanding the Atmosphere Using Observations Posters**	
8:00-8:00 AM	**A11B-0048. Using satellite measurements of stable water isotopes to constrain hydrologic processes in the isotope-enabled Community Atmosphere Model.** J. Nusbaumer; C. Bardeen; D.C. Noone
8:00 AM-12:20 PM, Hall A-C (Moscone South), **ED11C. Education General Contributions I Posters**	
8:00-8:00 AM	**ED11C-0765. Antecedent Moisture Conditions and the Application to Runoff Prediction in a Low Relief Peatland** J. Gibson; J. Gibson; S.J. Birks
8:00 AM-12:20 PM, Hall A-C (Moscone South), **GC11C. Findings From Climate Change Assessments: Posters From the US National Climate Assessment and the North American Regional Climate Change Assessment Program**	
8:00-8:00 AM	**GC11C-1008. A Method for Downscaling Regional Climate Model Projections of Temperature and Precipitation Using Local Topographic Lapse Rates** S.J. Praskievicz; P.J. Bartlein
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H11D. Groundwater-Surface Water Interactions: Dynamics Across Spatial and Temporal Scales I Posters**	
8:00-8:00 AM	**H11D-1219. On the applicability of available methods for estimating daily evapotranspiration by using diurnal water table fluctuations** P. Wang; S.P. Pozdniakov; M. Lekhov; J. Yu
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H11E. Groundwater-Surface Water Interactions: Three Decades of Transient Storage Analysis to Understand River Transport and Watershed Connections Posters**	
8:00-8:00 AM	**H11E-1235. Thirty years of interpreting stream tracer data: A look back, a look sideways, and a look forward** ***(Invited)*** R.L. Runkel
8:00-8:00 AM	**H11E-1243. MODELING THE THERMAL BALANCE BETWEEN RIVER ICE AND GROUNDWATER SPRINGS** C. Jones; K. Kielland; L.D. Hinzman
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H11F. Hydrological, Geomorphological, Biological, and Geochemical Processes in Karst Aquifers Posters**	
8:00-8:00 AM	**H11F-1253. Groundwater surface water mixing in a semi-confined karst aquifer using field and particle tracking forward-model inversions** S.B. Meyerhoff; R.M. Maxwell; A. Revil; J.B. Martin; M. Karaoulis; W.D. Graham

8:00-8:00 AM	**H11F-1256. Comparison between limestone and glacial karst evolution mechanisms** ***(Invited)*** H. Rajaram
8:00 AM-12:20 PM, Hall A-C (Moscone South), **IN11B. Informatics in Hydrological Modeling and Information Communication Posters**	
8:00-8:00 AM	**IN11B-1462. Plug-and-Play Hydrologic Modeling: Is That Really Possible?** ***(Invited)*** S.D. Peckham
8:00-8:00 AM	**IN11B-1463. Advancing Cyberinfrastructure to support high resolution water resources modeling** ***(Invited)*** D.G. Tarboton; F.L. Ogden; N. Jones; J.S. Horsburgh
8:00-8:00 AM	**IN11B-1468. Integration of Earth System Models and Workflow Management under iRODS for the Northeast Regional Earth System Modeling Project** F. Lengyel; P. Yang; B. Rosenzweig; C.J. Vorosmarty
8:00-8:00 AM	**IN11B-1470. Design and Application of an Ontology for Component-Based Modeling of Water Systems** M. Elag; J.L. Goodall
8:00 AM-12:20 PM, Hall A-C (Moscone South), **IN11E. Standard Service Based Approaches to Hydrological Modeling and Workflows Posters**	
8:00-8:00 AM	**IN11E-1492. Application of the Open Geospatial Consortium (OGC) Web Processing Service (WPS) Standard for Exposing Water Models as Web Services** ***(Invited)*** J.L. Goodall; A.M. Castronova; N. Huynh; J.M. Caicedo
8:00 AM-12:20 PM, Hall A-C (Moscone South), **OS11D. Severe Weather and Estuarine/Coastal Ocean Dynamics Posters**	
8:00-8:00 AM	**OS11D-1691. The response of Long Island Sound Circulation to Nor'easters and Hurricanes** ***(Invited)*** J. O'Donnell; T. Fake; J. O'Donnell
8:00 AM-12:20 PM, Hall A-C (Moscone South), **T11B. Crustal Growth and the Geodynamics of Unstable Lithosphere I Posters**	
8:00-8:00 AM	**T11B-2566. Convective Removal of the Northeastern Portion of the North-American Tectospheric Root and the Late Cenozoic Uplift of the Appalachians** R. Moucha; D.B. Rowley; V.L. Levin; N.A. Simmons; A.M. Forte
8:00 AM-10:00 AM, 2020 (Moscone West), **IN11F. Open Source Technologies and Architectures Facilitating Science Data Center Collaboration and Management II**	
8:30-8:45 AM	**IN11F-03. Combining data from multiple sources using the CUAHSI Hydrologic Information System** ***(Invited)*** D.G. Tarboton; D.P. Ames; J.S. Horsburgh; J.L. Goodall
8:00 AM-10:00 AM, 2006 (Moscone West), **B11E.* New Mechanisms, Feedbacks, and Approaches for Improving Predictions of the Global Carbon Cycle in Earth System Models I**	

9:30-9:45 AM (Conflict)	**B11E-07. Mechanisms driving ocean carbon cycle response to rising atmospheric CO_2: results from the Community Earth System Model, version 1** M. Long; K.T. Lindsay; J.K. Moore; S.C. Doney
8:00 AM-10:00 AM, 3007 (Moscone West), **C11A. Exploration Geophysics and In Situ Monitoring of Glaciers and Ice Streams I**	
9:30-9:45 AM (Conflict)	**C11A-07. Seismicity and Subglacial Hydrological Processes During Early Melt Season, Engabreen, Norway** P.L. Moore; J. Winberry; K. Christianson; N.R. Iverson; S. Anandakrishnan; M. Jackson; D.O. Cohen
8:00 AM-10:00 AM, 3020 (Moscone West), **H11N. Remote Sensing Applications in Hydrology I**	
9:30-9:45 AM (Conflict)	**H11N-07. Downscaling Soil Moisture Product from SMOS for Monitoring Agricultural Droughts in South America** K. Nagarajan; C. Fu; J. Judge; C. Fraisse
8:00 AM-10:00 AM, 2007 (Moscone West), **P11G.* Planetary Atmospheres and Evolution I**	
9:30-9:45 AM (Conflict)	**P11G-07. Can waterbelt climates resolve the faint young Sun paradox?** E.T. Wolf; O.B. Toon
10:20 AM-12:20 PM, 3016 (Moscone West), **H12B. Groundwater-Surface Water Interactions: Quantifying Their Functional Relevance With Measurements and Models of Water and Solute Dynamics I**	
10:20-10:35 AM	**H12B-01. Intermediate-Timescale Vertical Exchange in a Peatland and Implications for Landscape Patterning *(Invited)*** L.G. Larsen; J.W. Harvey; M.M. Maglio
10:20 AM-12:20 PM, 310 (Moscone South), **V12B. Petrologic Insights on Magmatic Processes Controlling Shifts in Eruption Style I: Cosponsored by MSA**	
10:35-10:50 AM (Conflict)	**V12B-02. NanoSIMS results from olivine-hosted melt embayments: Modeling ascent rate in explosive basaltic eruptions** A.S. Lloyd; T. Plank; P. Ruprecht; E.H. Hauri; H.M. Gonnermann; W.I. Rose
10:20 AM-12:20 PM, 3001 (Moscone West), **GC12B. Sustainable Future: Climate, Resources, and Development I**	
10:40-10:50 AM (Conflict)	**GC12B-03. A Regional Earth System Model of the Northeast Corridor: Analyzing 21st Century Climate and Environment *(Invited)*** C.J. Vorosmarty; F. Duchin; J.M. Melillo; W.M. Wollheim; J. Gonzalez; D.W. Kicklighter; B. Rosenzweig; P. Yang; F. Lengyel; B.M. Fekete
10:20 AM-12:20 PM, 3024 (Moscone West), **OS12B. Nearshore Processes II**	
10:50-11:05 AM (Conflict)	**OS12B-03. Intermittent ephemeral river-breaching** A.J. Reniers; J.H. MacMahan; E.L. Gallagher; A. Shanks; S. Morgan; M. Jarvis; E.B. Thornton; J. Brown; A. Fujimura

10:20 AM-12:20 PM, 3001 (Moscone West), **GC12B. Sustainable Future: Climate, Resources, and Development I**	
11:00-11:10 AM (Conflict)	**GC12B-05. Sharing Water Data to Encourage Sustainable Choices in Areas of the Marcellus Shale** ***(Invited)*** S.L. Brantley; J.D. Abad; J. Vastine; D. Yoxtheimer; C. Wilderman; R. Vidic; R.P. Hooper; K. Brasier
10:20 AM-12:20 PM, 2020 (Moscone West), **IN12A. Free and Open Source Software (FOSS) for Geoinformatics and Geosciences I**	
11:05-11:20 AM (Conflict)	**IN12A-04. From Particles and Point Clouds to Voxel Models: High Resolution Modeling of Dynamic Landscapes in Open Source GIS** ***(Invited)*** H. Mitasova; E.J. Hardin; A. Kratochvilova; M. Landa
10:20 AM-12:20 PM, 2007 (Moscone West), **P12B.* Planetary Atmospheres and Evolution II**	
11:05-11:20 AM (Conflict)	**P12B-04. An upper limit on Early Mars atmospheric pressure from small ancient craters** E.S. Kite; J. Williams; A. Lucas; O. Aharonson
10:20 AM-12:20 PM, 2020 (Moscone West), **IN12A. Free and Open Source Software (FOSS) for Geoinformatics and Geosciences I**	
11:20-11:35 AM	**IN12A-05. A Modular GIS-Based Software Architecture for Model Parameter Estimation using the Method of Anchored Distributions (MAD)** D.P. Ames; C. Osorio-Murillo; M.W. Over; Y. Rubin
1:40 PM-6:00 PM, Hall A-C (Moscone South), **A13G. Atmospheric Boundary Layer Processes and Turbulence VI Posters**	
1:40-1:40 PM	**A13G-0269. A Model of Surface Energy Budget over Water, Snow and Ice Surfaces** J. Wang; R.L. Bras
1:40 PM-6:00 PM, Hall A-C (Moscone South), **A13I. Ice Nucleation and Properties of Cold Clouds III Posters**	
1:40-1:40 PM	**A13I-0302. Nanoscale ice measured through in-situ ellipsometry and ESEM.** A.L. Miller; N.B. Magee; M. Amaral
1:40 PM-6:00 PM, Hall A-C (Moscone South), **C13A. Cryosphere General Contributions Posters**	
1:40-1:40 PM	**C13A-0595. On Snowball Earth, were all inland-sea refugia created equal?** A.J. Campbell; E.D. Waddington; S.G. Warren
1:40 PM-6:00 PM, Hall A-C (Moscone South), **C13D. Modeling of the Cryosphere I Posters**	
1:40-1:40 PM	**C13D-0651. Modeling permafrost and hydrological cycle interactions in CESM** S.C. Swenson; D.M. Lawrence; A.G. Slater; H. Lee
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP13C. Earth and Planetary Surface Processes General Contributions III: Remote Sensing, Chronology, Aeolian, Planetary, Coastal, and Marine Posters**	

1:40-1:40 PM	**EP13C-0859. Multi-resolution estimation of lidar-DTM surface flow metrics to identify characteristic topographic length scales** H. Sangireddy; P. Passalacqua; C.P. Stark
1:40 PM-6:00 PM, Hall A-C (Moscone South), **GC13A. Assessing Local Impacts of Sea Level Rise to the Natural and Built Environment I Posters**	
1:40-1:40 PM	**GC13A-1050. Global wave climate change from a community ensemble of wind-wave projections** M.A. Hemer; Y. Fan; N. Mori; A. Semedo; X.L. Wang
1:40 PM-6:00 PM, Hall A-C (Moscone South), **GP13B. Magnetic Chronostratigraphies and Long-Term Behavior of the Field III Posters**	
1:40-1:40 PM	**GP13B-1129. Sherman Statistic Reveals Non-Random Behavior in the Phanerozoic Geomagnetic Polarity Time Scale** L.A. Hinnov; P. Olson; P.E. Driscoll
1:40 PM-6:00 PM, Hall A-C (Moscone South), **H13F. Pushing the Envelope in Remote Sensing for Hydrology: SMOS and Future Mission/Sensor Concepts I Posters**	
1:40-1:40 PM	**H13F-1425. An Intercomparison of RADARSAT-2, SMOS and Field Measured Soil Moisture in the Berambadi Watershed, South India** S.k. Tomer; A. Al Bitar; M. Sekhar; O. Merlin; S. Bandyopadhyay; Y.H. Kerr
1:40 PM-3:40 PM, 3007 (Moscone West), **C13G. In Situ and Field-Based Measurements of the Cryosphere: Avalanches and Other Applications I**	
2:10-2:25 PM (Conflict)	**C13G-03. High Resolution Radar Measurements of Snow Avalanches** J.N. McElwaine; N.M. Vriend; B. Sovilla; C.J. Keylock; P. Brennan; M. Ash
1:40 PM-3:40 PM, 303 (Moscone South), **V13G. Tracing Earth Surface and Deep Processes Using Innovative Isotopic Approaches I: Cosponsored by MSA**	
2:10-2:25 PM (Conflict)	**V13G-03. How does a single precipitation event erode a landscape? Clues from meteoric 7Be and 10Be analysis of suspended sediments and soils** M. Occhi; J.K. Willenbring; J.M. Kaste; M.A. Scholl; J.B. Shanley
1:40 PM-3:40 PM, 3010 (Moscone West), **A13Q. Dynamics and Chemistry of the Coupled Troposphere/Stratosphere System: General Stratospheric Dynamics and Chemistry**	
2:25-2:40 PM (Conflict)	**A13Q-04. Increased Anthropogenic Sulfur Dioxide Negligibly Impacts Stratospheric Aerosol Compared to Moderate Volcanoes during the decade 2000-2010** R.R. Neely; O.B. Toon; S. Solomon; C. Alvarez; J.M. English; K.H. Rosenlof; M.J. Mills; C. Bardeen; J.S. Daniel; J.P. Thayer
1:40 PM-3:40 PM, 3011 (Moscone West), **OS13G. Satellite Ocean and Coastal Applications—Current and Future I**	

2:25-2:40 PM (Conflict)	**OS13G-04. Detecting Suspended Sediments from Remote Sensed Data in the Northern Gulf of Mexico** D.M. Hardin; S.J. Graves; L. Hawkins; M. He; T. Smith; M. Drewry; S. Ebersole; A. Travis; J. Thorn; B. Brown
1:40 PM-3:40 PM, 3018 (Moscone West), **H13K. Integrated Observations, Modeling, and Predictions for Assessing Water and Energy Budgets at Global and Regional Scales and for a New Earth Observing Water Strategy II**	
3:10-3:25 PM	**H13K-07. Estimating Riverine Water and Constiuent Fluxes in a Data Assimilation Framework** B.M. Fekete; P. Saile
4:00 PM-6:00 PM, 3020 (Moscone West), **H14E. Remote Sensing Applications in Hydrology IV**	
4:00-4:15 PM	**H14E-01. Impact Assessment of Large Scale Floods Using Imaging Spectroscopy** D. Dutta; A.E. Goodwell; M. Umar; J. Greenberg; P. Kumar; R. Darmody; J.E. Garvey; R.B. Jacobson; D. Berretta
4:00 PM-6:00 PM, 2003 (Moscone West), **B14A. Biogeochemistry of the Deepwater Horizon Oil Spill I**	
4:15-4:30 PM	**B14A-02. Hydrocarbon biodegradation following Deepwater Horizon: A compound specific point of view *(Invited)*** D.L. Valentine; M.C. Redmond; S.D. Mendes; C. Aeppli; C.M. Reddy; T.B. Ryerson
4:00 PM-6:00 PM, 306 (Moscone South), **T14B. Crustal Growth and the Geodynamics of Unstable Lithosphere II**	
4:45-5:00 PM	**T14B-04. Linked uplift of the Central and Eastern Anatolian plateaus through slab break-off and upper mantle flow *(Invited)*** T. Schildgen; D. Cosentino; C. Yildirim; M.R. Strecker; H. Echtler; B. Rojay
4:45 PM-6:00 PM, 300 (Moscone South), **NG14B. Pattern Formation in Earth System Sciences II**	
5:15-5:30 PM	**NG14B-03. Multiple stable states and pattern formation in tidal environments *(Invited)*** M. Marani

Tuesday, December 04, 2012

Time	Session Info
8:00 AM-12:20 PM, Hall A-C (Moscone South), **A21A.* Aerosols and Air Quality in South Asia: Observations, Modeling, Impacts IV Posters**	
8:00-8:00 AM	**A21A-0013. FESEM Analysis showing evidence of aerosol Mixing over Indo-Gangetic Plains** R.P. Singh; J. Huth; T. Wagner; M. Sharma; A. Chauhan; S. Singh; S.N. Pandey

8:00 AM-12:20 PM, Hall A-C (Moscone South), **B21B. Climate Impacts on Ecosystems Quantified Using a Combination of Proxy Records and Instrumented Observatories II Posters**	
8:00-8:00 AM	**B21B-0348. Informing tree-ring reconstructions with automated dendrometer data: the case of single-leaf pinyon (Pinus monophylla) from Great Basin National Park, Nevada, USA** F. Biondi
8:00 AM-12:20 PM, Hall A-C (Moscone South), **B21D. Vulnerability of Permafrost Carbon to Climate Change III Posters**	
8:00-8:00 AM	**B21D-0391. The effects of forest fire on the frozen soil thermal state** E.E. Jafarov; H. Genet; V.E. Romanovsky; A.D. McGuire; S.S. Marchenko
8:00 AM-12:20 PM, Hall A-C (Moscone South), **C21C. Remote Sensing of the Cryosphere III Posters**	
8:00-8:00 AM	**C21C-0612. Validation and application of MODIS-derived clean snow albedo and dust radiative forcing** K.E. Rittger; A.C. Bryant; F.C. Seidel; E.H. Bair; M. Skiles; C.E. Goodale; P. Ramirez; C.A. Mattmann; J. Dozier; T. Painter
8:00 AM-12:20 PM, Hall A-C (Moscone South), **ED21C. Transformative Innovations in Earth, Oceans, and Atmospheric Science Education for Undergraduates Supported by the NSF TUES and CCLI Programs Posters**	
8:00-8:00 AM	**ED21C-0724. Collaborative Research: Bringing Problem Solving in the Field into the Classroom: Developing and Assessing Virtual Field Trips for Teaching Sedimentary and Introductory Geology** P. Wang; M. Caldwell
8:00 AM-12:20 PM, Hall A-C (Moscone South), **GC21E. Sustainable Future: Climate, Resources, and Development II Posters**	
8:00-8:00 AM	**GC21E-1012. The application of exergy to human-designed systems** P. Hamilton
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H21A. Advanced Computational Modeling Paradigms for Hydrologic Systems Posters**	
8:00-8:00 AM	**H21A-1158. CI-WATER HPC Model: Cyberinfrastructure to Advance High Performance Water Resources Modeling in the Intermountain Western U.S.** F.L. Ogden; W. Lai; C.C. Douglas; S.N. Miller; Y. Zhang
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H21C. How Valuable are Hydroclimatic Forecasts for Water Resources Systems Operation? Posters**	
8:00-8:00 AM	**H21C-1187. Risky Business: Development, Communication and Use of Hydroclimatic Forecasts** ***(Invited)*** U. Lall
8:00 AM-12:20 PM, Hall A-C (Moscone South), **NH21A. Coastal Inundation for Present and Future Climates I Posters**	

8:00-8:00 AM	**NH21A-1579. Potential Effects of SLR and Land-Cover Changes on Hurricane Surge and Damage** C. Ferreira; J.L. Irish; F. Olivera
8:00 AM-12:20 PM, Hall A-C (Moscone South), **OS21B. Nearshore Processes V Posters**	
8:00-8:00 AM	**OS21B-1691. Observations of Currents in Two Tidally Modulated Inlets** T.C. Lippmann; J.D. Irish; J. Hunt
8:00-8:00 AM	**OS21B-1733. Performance of a process-based hydrodynamic model in predicting shoreline change** I. SAFAK; J.C. Warner; J.H. List
8:00-8:00 AM	**OS21B-1749. Computer Simulations of Self-Organized Bedforms in Tidal Inlets and River Mouths** E. Gallagher
8:00 AM-12:20 PM, Hall A-C (Moscone South), **PP21B. The Climate of the Common Era III Posters**	
8:00-8:00 AM	**PP21B-1975. Using ice sheet models simulations of the last glacial period for the reconstruction of late Holocene ground surface temperatures from borehole temperature profiles** V. Rath; J. Álvarez-Solas; A. Robinson; M. Montoya-Redondo
8:00-8:00 AM	**PP21B-2012. Forest Composition and Biomass at Euroamerican Settlement in the Upper Great Lakes** J.W. Williams; S.J. Goring; W. Brooks; C. Cogbill; M.C. Dietze; S.T. Jackson; J.S. McLachlan; D.J. Mladenoff; C. Paciorek; A. Thurman; J. Zhu
8:00 AM-12:20 PM, Hall A-C (Moscone South), **SH21A. Multipoint Observations and Modeling of Solar Energetic Particle Events I Posters**	
8:00-8:00 AM	**SH21A-2166. Measurements of Charge States of Solar Energetic Ions Observed by the STEREO Instruments** W.F. Dietrich; A.J. Tylka
8:00 AM-10:00 AM, 2008 (Moscone West), **PP21C.* Continental Input Into the Atmosphere and Ocean, Present and Past II**	
8:15-8:30 AM (Conflict)	**PP21C-02. The magnitude, timing and abruptness of changes in North African dust deposition over the last 20,000 years: Insights into regional atmospheric circulation and dust-related climate impacts** D. McGee; P.B. deMenocal; G. Winckler; J.W. Stuut; L.I. Bradtmiller; N.M. Mahowald; S. Albani
8:00 AM-10:00 AM, 103 (Moscone South), **V21C.* A Comprehensive Understanding of the Melting Processes at Subduction Zones I (Video On-Demand)**	
8:15-8:30 AM (Conflict)	**V21C-02. Hot 'nough for ya?: Controls and Constraints on modeling flux melting in subduction zones *(Invited)*** M. Spiegelman; C.R. Wilson; P. van Keken; P.B. Kelemen; B.R. Hacker
8:00 AM-10:00 AM, 2010 (Moscone West), **PP21D. Extreme Climates and Mass Extinction Events: Mechanisms and Ecosystem Resilience I**	

8:36-8:52 AM (Conflict)	**PP21D-03. Geochemistry and Cyclostratigraphy of Magnetic Susceptibility data from the Frasnian-Famennian event interval in western Canada: Insights in the pattern and timing of a biotic crisis** M.T. Whalen; D. De Vleeschouwer; M.G. Sliwinski; P.F. Claeys; J.E. Day
8:00 AM-10:00 AM, 3003 (Moscone West), **GC21G. Assessing Local Impacts of Sea Level Rise to the Natural and Built Environment II**	
8:45-9:00 AM (Conflict)	**GC21G-04. Future sea level rise assessment by constrained extrapolation** ***(Invited)*** W.T. Pfeffer; B. Rajagopalan
8:00 AM-10:00 AM, 3011 (Moscone West), **OS21G. Marine Geohazards I**	
9:30-9:45 AM	**OS21G-07. Transport dynamics of mass failures along weakly cohesive clinoform foresets** A. Abeyta; C. Paola
10:20 AM-12:20 PM, 3008 (Moscone West), **GC22C. Geomorphology, Ecology, and Climate Coupling in Mountain Environments**	
10:50-11:05 AM (Conflict)	**GC22C-03. Coupled Modeling of Geomorphology and Ecohydrology: Topographic feedbacks driven by solar radiation** ***(Invited)*** E. Istanbulluoglu; J.H. Flores Cervantes; O. Yetemen
10:20 AM-12:20 PM, 2018 (Moscone West), **SM22D. Strategies and Innovative Approaches for the Future of Space Weather Forecasting: Science and Infrastructure I**	
10:56-11:04 AM (Conflict)	**SM22D-04. The Main Pillar: Assessment of Space Weather Observational Asset Performance Supporting Nowcasting, Forecasting and Research to Operations** A. Posner; M. Hesse; C. St.Cyr
10:20 AM-12:20 PM, 3011 (Moscone West), **G22A. 4-D LiDAR Topography and Geodetic Imaging I**	
11:05-11:20 AM	**G22A-04. Space-Time Cube Analytics of Evolving Landforms Captured by Airborne and Terrestrial Lidar** ***(Invited)*** H. Mitasova; M.J. Starek; E.J. Hardin; K.W. Wegmann; B.S. Blundell
10:20 AM-12:20 PM, 2020 (Moscone West), **IN22A. Data Stewardship, Citation With Confidence, and Preparing Next Generation of Data Managers I**	
11:20-11:35 AM	**IN22A-05. Use of Persistent Identifiers to link Heterogeneous Data Systems in the Integrated Earth Data Applications (IEDA) Facility** L. Hsu; K.A. Lehnert; S.M. Carbotte; R.A. Arko; V. Ferrini; S.H. O'hara; J.D. Walker
10:20 AM-12:20 PM, 3008 (Moscone West), **GC22C. Geomorphology, Ecology, and Climate Coupling in Mountain Environments**	
11:35-11:50 AM	**GC22C-06. Spatiotemporal characteristics of climatic forcing of erosion – examples from the southern Central Andes and the Himalaya** ***(Invited)*** B. Bookhagen; M.R. Strecker

1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP23A. Aeolian Processes and Desert Landscape Development: Feedbacks Among Atmospheric Boundary Layer Turbulence, Sediment Transport, and Morphodynamics I Posters**	
1:40-1:40 PM	**EP23A-0789. Explaining the surprisingly poor correlation between turbulent surface wind and aeolian sand flux** R.L. Martin; T.E. Barchyn; C. Hugenholtz; D.J. Jerolmack; J.F. Kok
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP23C. Biophysical Interactions in Riverine Landscapes I Posters**	
1:40-1:40 PM	**EP23C-0820. Riverine biophysical interactions in the form of channel-spanning logjams in the Colorado Front Range, USA** E.E. Wohl; N.D. Beckman
1:40-1:40 PM	**EP23C-0825. Can erosion control structures in large dryland arroyo channels lead to resilient riparian and cienega restoration? Observations from LiDAR, monitoring and modeling at Rancho San Bernardino, Sonora, MX** S. DeLong; W.M. Henderson
1:40-1:40 PM	**EP23C-0826. Biophysical Controls on Carbon Cycling in Restored and Unrestored Urban Streams** L.G. Larsen; J.W. Harvey; J.D. Singh; G.A. Sinclair; T. Langston; M.M. Maglio
1:40-1:40 PM	**EP23C-0834. Toward a Rapid Synthesis of Field and Desktop Data for Classifying Streams in the Pacific Northwest: Guiding the Sampling and Management of Salmonid Habitat** A. Kasprak; J.M. Wheaton; N. Bouwes; N.P. Weber; N.C. Trahan; C.E. Jordan
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP23D. Modeling Developments for Sediment Transport and Other Multiphase Flows: From Steep Upland Regions to Riverine, Estuary, and Coastal Environments I Posters**	
1:40-1:40 PM	**EP23D-0847. A Grain Scale Non-Equilibrium Sediment Transport Model for Unsteady Flow** J.G. Duan; S. Zhang
1:40-1:40 PM	**EP23D-0848. A combined non-linear and non-local model for sediment transport in depositional systems** F. Falcini; V. Ganti; C. Paola; E. Foufoula; V.R. Voller
1:40-1:40 PM	**EP23D-0849. Paradigm for Subgrid Scale Closure Modeling in Multiphase Geophysical Flows** J. Calantoni; J. Simeonov; A.M. Penko; S.P. Bateman; M.L. Palmsten; K. Holland
1:40-1:40 PM	**EP23D-0858. Simulation of Sediment Wave Generation and Maintenance** G.D. Hoffmann; E.H. Meiburg; M. Nasr-Azadani
1:40-1:40 PM	**EP23D-0859. Numerical simulation of turbulence and sediment transport of medium sand** M.W. Schmeeckle
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP23E. The Future of Human-Landscape Systems I Posters**	

<table>
<tr><td>1:40-1:40 PM</td><td>EP23E-0863. Liquidation sales: Land speculation and landscape change E. Lazarus</td></tr>
<tr><td>1:40-1:40 PM</td><td>EP23E-0865. Can human activities alter the drowning fate of barrier islands? J. Lorenzo-Trueba; A.D. Ashton; D. Jin; P. Hoagland; H. Kite-Powell</td></tr>
<tr><td colspan="2">1:40 PM-6:00 PM, Hall A-C (Moscone South), G23A. 4-D LiDAR Topography and Geodetic Imaging II Posters</td></tr>
<tr><td>1:40-1:40 PM</td><td>G23A-0887. Development of an Online Archive for Terrestrial Lidar Data C. Crosby; B.W. Lowry; J. McWhirter ; D.A. Phillips; C.M. Meertens</td></tr>
<tr><td colspan="2">1:40 PM-6:00 PM, Hall A-C (Moscone South), H23E. Reactive Transport in Permeable Media II Posters</td></tr>
<tr><td>1:40-1:40 PM</td><td>H23E-1428. Hydrodynamic Heat Transport Measured at the Field Scale M.W. Becker; B. Bauer; A. Hutchinson</td></tr>
<tr><td colspan="2">1:40 PM-6:00 PM, Hall A-C (Moscone South), H23F. Sociohydrology: Discovering Patterns in Coupled Human-Water Resource Systems II Posters</td></tr>
<tr><td>1:40-1:40 PM</td><td>H23F-1446. Impacts and socio-ecological feedbacks associated with regionalization of water supply in a suburban New England watershed W.M. Wollheim; R.J. Stewart; C. Polsky; R. Pontius; C. Hopkinson</td></tr>
<tr><td colspan="2">1:40 PM-6:00 PM, Hall A-C (Moscone South), SM23D. The Role of Magnetosphere-ionosphere Coupling in Producing Different Magnetospheric Convection Modes II Posters</td></tr>
<tr><td>1:40-1:40 PM</td><td>SM23D-2334. An introduction to MIT mission Y. Liu; C. Wang; J. Xu</td></tr>
<tr><td colspan="2">1:40 PM-6:00 PM, Hall A-C (Moscone South), T23D. How Well Do We Predict Fractures and Their Patterns? II Posters</td></tr>
<tr><td>1:40-1:40 PM</td><td>T23D-2702. Bounds on fault strength based on simulation of "rider block" structures emerging from brittle lithosphere extension E. Choi; W.R. Buck; L.L. Lavier; K. Petersen</td></tr>
<tr><td colspan="2">1:40 PM-3:40 PM, 3016 (Moscone West), H23L. Water Resources Management and Policy in a Changing World: Integrated Planning and Assessment</td></tr>
<tr><td>2:10-2:25 PM</td><td>H23L-03. Putting the Hydrology Back in Water Resources: Recent Efforts to Improve Representation of Physical Hydrology in Water Resources Planning and Operations Models I.M. Ferguson; N. Parker; A. Draper; E.C. Dogrul; L.E. Condon</td></tr>
<tr><td colspan="2">1:40 PM-3:40 PM, 3011 (Moscone West), OS23D. Oceanography, Sediment Transport, and Geomorphic Evolution of San Francisco Bay and Gulf of Farallones II</td></tr>
<tr><td>2:40-2:55 PM</td><td>OS23D-05. Simulating Sediment Transport Processes in San Francisco Bay Using Coupled Hydrodynamic, Wave, and Sediment Transport Models A.J. Bever; M. MacWilliams</td></tr>
</table>

4:00 PM-6:00 PM, 306 (Moscone South), **T24C. The Geodynamics of High Topography: Exploring the Interactions Between Solid Earth, Hydrosphere, and Atmosphere II**	
5:15-5:30 PM (Conflict)	**T24C-06. Deformation and incision of the western margin of the Central Andean Plateau, S. Peru and N. Chile** ***(Invited)*** T. Schildgen
4:00 PM-6:00 PM, 2022-2024 (Moscone West), **OS24C. Living on the Edge: Societies on the Front Line of Coastal Change I (Video On-Demand)**	
5:18-5:33 PM (Conflict)	**OS24C-07. How sea level rise and storm climate impact the looming morpho-economic bubble in coastal property value.** ***(Invited)*** D. McNamara; A. Keeler; M. Smith; S. Gopalakrishnan; A. Murray

Wednesday, December 05, 2012

Time	Session Info
8:00 AM-12:20 PM, Hall A-C (Moscone South), **A31A. Atmospheric Sciences General Contributions: Water Vapor Posters**	
8:00-8:00 AM	**A31A-0016. Surface measurements of upper tropospheric water vapor isotopic composition from the Chajnantor Plateau, Chile: First results from a long-term measurement program** J. Galewsky; D. Ward; A. Lechler
8:00 AM-12:20 PM, Hall A-C (Moscone South), **B31A. Disturbance Impacts and Responses III Posters**	
8:00-8:00 AM	**B31A-0401. Landscape Vulnerability Analysis from Historic Lower Mississippi River Flood in 2011** A.E. Goodwell; Z. Zhu; D. Dutta; J. Greenberg; P. Kumar; M.H. Garcia; B.L. Rhoads; G. Parker; D. Berretta; R.R. Holmes
8:00 AM-12:20 PM, Hall A-C (Moscone South), **C31A. Geological Controls on Ice Dynamics I Posters**	
8:00-8:00 AM	**C31A-0577. High Heat-Flow Beneath the Central Portion of the West Antarctic Ice Sheet** G.D. Clow; K.M. Cuffey; E.D. Waddington
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP31A. Advances in Numerical Modeling of River Fluxes Under Changing Environmental Conditions I Posters**	
8:00-8:00 AM	**EP31A-0795. Plunge location of sediment driven hyperpycnal river discharges considering bottom friction, lateral entrainment, and particle settling** K.B. Strom; J. Bhattacharya
8:00-8:00 AM	**EP31A-0800. Effects of lateral momentum transfer on the predication of river flow and flood inundation** D. Yu; J. Yin

8:00-8:00 AM	**EP31A-0802. Empirical estimates of the dominant environmental forcings on the relative sea level change of river delta systems** Z.D. Tessler; C.J. Vorosmarty
8:00-8:00 AM	**EP31A-0806. Capacity of river networks to buffer thermal impacts of power plants in the northeastern US** R.J. Stewart; W.M. Wollheim; A. Miara; B. Rosenzweig; C.J. Vorosmarty
8:00-8:00 AM	**EP31A-0807. Using numerical models to place constraints on fluvial input into glacial lakes, Southern Alps, New Zealand** P. Upton; M.J. Vandergoes; P. Stumpner; R.H. Levy; H.A. Roop; S. Fitzsimons; J.D. Howarth; A.R. Gorman; G. Dunbar; A. Kettner
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP31B. Ecogeomorphology: Footprints on a Landscape I Posters**	
8:00-8:00 AM	**EP31B-0808. The interaction between vegetation and channel dynamics based on experimental findings** R. Teske; W.M. Van Dijk; W. Van De Lageweg; M.G. Kleinhans
8:00-8:00 AM	**EP31B-0811. The Signature of Life in Stabilized Dune Topography** T.E. Barchyn; C. Hugenholtz
8:00-8:00 AM	**EP31B-0812. Alluvial deposits and plant distribution in an Amazonian lowland megafan** H. Zani; D. Rossetti; É. Cremon; M. Cohen; L.C. Pessenda
8:00-8:00 AM	**EP31B-0816. Does Moss Grow on a Rolling Stone? The Influence of Precipitation Phase on Streamflow Characteristics, Bed Particle Transport and Periphyton Development in 18 Mountain Channels, Central Idaho** C. Tennant; B.T. Crosby; C. Baxter
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP31C. Quantifying Hillslope and Fluvial Processes Through Change Detection Using High-Resolution, Multitemporal Topographic Data I Posters**	
8:00-8:00 AM	**EP31C-0822. Geomorphic Change Detection and Quantification Using LiDAR, SONAR and RTK-GPS of Sandbars along the Snake River in Hells Canyon** M.D. Morehead; T. Wilson; M. Butler; N. Seal
8:00-8:00 AM	**EP31C-0823. Dynamic Feedbacks Between Flow, Erosion and Evolving River Bank Roughness Revealed Through Repeat High-Resolution Topographic Surveys** J. Leyland; S.E. Darby; M. Rinaldi; L.B. Teruggi; D. Ostuni
8:00-8:00 AM	**EP31C-0832. Quantifying post-wildfire erosion patterns using terrestrial LiDAR** F. Rengers; G.E. Tucker; J.A. Moody
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP31D. Tracers, Transport, and Topography: Theory and Technology for Tractive Tracking I Posters**	

8:00-8:00 AM	**EP31D-0841. On the influence of varying stream discharge on bed topography and tracer migration in gravel bedded channels** A. Singh; K.E. Sweeney; P. Wilcock; E. Foufoula
8:00 AM-10:00 AM, 2003 (Moscone West), **EP31E. Aeolian Processes and Desert Landscape Development: Feedbacks Among Atmospheric Boundary Layer Turbulence, Sediment Transport, and Morphodynamics II**	
8:00-8:15 AM (Conflict)	**EP31E-01. Feedbacks between roughness and boundary-layer aerodynamics control desert dune field evolution** ***(Invited)*** D.J. Jerolmack; R.C. Ewing; F. Falcini; R.L. Martin; C. Masteller; C.B. Phillips; M.D. Reitz
8:00 AM-12:20 PM, Hall A-C (Moscone South), **GC31A. Environmental, Socioeconomic, and Climatic Change in Northern Eurasia and Their Feedbacks to the Global Earth System III Posters**	
8:00-8:00 AM	**GC31A-0966. A decision-tree-based method for reconstructing disturbance history in the Russia boreal forests over 30 years** D. Chen; T.V. Loboda
8:00 AM-12:20 PM, Hall A-C (Moscone South), **GC31B. Environmental, Socioeconomic, and Climatic Change in Northern Eurasia and Their Feedbacks to the Global Earth System IV Posters**	
8:00-8:00 AM	**GC31B-0989. Historical Snow Cover and Water Resources Change in central Asia** H. ZHOU; E. Aizen; V.B. Aizen
8:00-8:00 AM	**GC31B-0995. Bayesian Multimodel Projection of Temperature Change in Eurasia** C. Miao; Q. Duan; C. Wang
8:00 AM-10:00 AM, 3001 (Moscone West), **GC31D. Natural- and Human-induced Changes in Global Water Cycle and Implications for Water Resources I**	
8:00-8:15 AM (Conflict)	**GC31D-01. Water Cycle Change and the Human Fingerprint on the Water Landscape of the 21st Century: Observations from a Decade of GRACE** ***(Invited)*** J.S. Famiglietti
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H31C. Making the Connection: Development and Application of Climate Projections for Water Resources Planning and Operations Posters**	
8:00-8:00 AM	**H31C-1124. Development of climate projections for water resources planning** E.D. Gutmann; M.P. Clark; L.D. Brekke; J. Arnold; T. Pruitt; C. Liu; K. Ikeda; R. Rasmussen
8:00-8:00 AM	**H31C-1129. Evaluating the influence of summer monsoon intensity on the runoff of the middle Yellow River Basin** D. Chen; M. Lv
8:00 AM-10:00 AM, 3022 (Moscone West), **H31N. Recent Advances in Modeling Water in the Coupled Earth System I**	

8:00-8:15 AM (Conflict)	**H31N-01. Progress and opportunities in Earth System model coupling with emphasis on hydrological model components** ***(Invited)*** D.J. Gochis; S.D. Peckham; J.S. Arrigo; J.S. Famiglietti; C.M. Ammann; J.T. Reager; J. Edman
8:00 AM-12:20 PM, Hall A-C (Moscone South), **SH31A. Interaction of Coronal Mass Ejections With Coronal and Heliospheric Structures III Posters**	
8:00-8:00 AM	**SH31A-2200. The role of streamers in the deflection of coronal mass ejections: comparison between STEREO 3D reconstructions and numerical simulations** F.P. Zuccarello; A. Bemporad; C. Jacobs; M. Mierla; S. Poedts; F. Zuccarello
8:00 AM-10:00 AM, 2003 (Moscone West), **EP31E. Aeolian Processes and Desert Landscape Development: Feedbacks Among Atmospheric Boundary Layer Turbulence, Sediment Transport, and Morphodynamics II**	
8:15-8:30 AM	**EP31E-02. The role of dune interactions and wind fluctuations in the selection of dune sizes within barchan fields** ***(Invited)*** O. Duran Vinent; E.J. Parteli; H.J. Herrmann
8:00 AM-10:00 AM, 302 (Moscone South), **ED31C. Climate Literacy: Reaching Diverse Audiences Through Informal Education Experiences, Public Outreach, and Community Programs I**	
8:30-8:45 AM	**ED31C-03. The potential roles of science centers in climate change adaptation** P. Hamilton
8:00 AM-10:00 AM, 3009 (Moscone West), **G31C. Decade-Long Mass Flux Measurements From GRACE: Status and Future Prospects I**	
9:00-9:15 AM (Conflict)	**G31C-05. Contributions to Terrestrial and Global Hydrology from a Decade of GRACE Measurements** H. Kim; J.S. Famiglietti; M. Rodell; J.T. Reager; T.H. Syed; M. Lo; D.P. Chambers; S.C. Swenson
8:00 AM-10:00 AM, 3001 (Moscone West), **GC31D. Natural- and Human-induced Changes in Global Water Cycle and Implications for Water Resources I**	
9:00-9:15 AM (Conflict)	**GC31D-05. Advancing global hydro-climatological data archives to support climate change impact assessments on water resources** P. Saile
8:00 AM-10:00 AM, 3022 (Moscone West), **H31N. Recent Advances in Modeling Water in the Coupled Earth System I**	
9:00-9:15 AM (Conflict)	**H31N-05. Service-Oriented Approach to Coupling Earth System Models and Modeling Frameworks** ***(Invited)*** J.L. Goodall; K.D. Saint; M.B. Ercan; L.J. Briley; S. Murphy; H. You; C. DeLuca; R.B. Rood
9:45-10:00 AM	**H31N-08. The Essential Terrestrial Variables (ETV's) in Support of a National Framework for Numerical Watershed Prediction** ***(Invited)*** C. Duffy; L.N. Leonard; S. Ahalt; R. Idaszak; D. Tarboton; R.P. Hooper; L.E. Band

10:20 AM-12:20 PM, 3001 (Moscone West), **GC32B. Observed and Projected Climate Change Impacts on Water Resources and Agriculture I**	
10:20-10:35 AM (Conflict)	**GC32B-01. Shining India?: Assessing and addressing the risks from an unsustainable trajectory of climate, water, food, energy and income inequity** ***(Invited)*** U. Lall
10:20 AM-12:20 PM, 3024 (Moscone West), **OS32A. Interpretation of Tsunami and Storm Deposits I**	
10:20-10:35 AM (Conflict)	**OS32A-01. Combined Flow Bedforms: Descriptions and Implications for Understanding Ancient Storms Deposits** M.M. Perillo; S. David; J.L. Best; M.H. Garcia
10:20 AM-12:20 PM, 3007 (Moscone West), **C32B. Diagnosing Modeling Deficiencies and the Recent Advances in Monitoring, Measuring, and Modeling Snow Processes I**	
10:50-11:05 AM	**C32B-03. Evaluation of spatially distributed snow models for streamflow forecasting** ***(Invited)*** K.E. Rittger; J. Dozier; A. Kahl
10:20 AM-12:20 PM, 2002 (Moscone West), **B32D. Remote Characterization of Vegetation Structure, Function, and Condition I**	
11:50-12:05 PM (Conflict)	**B32D-08. Subcanopy Solar Radiation Model: an irradiation model for predicting light in heavily vegetated landscapes** C.A. Bode; M.P. Limm; J.C. Finlay; M. Power
10:20 AM-12:20 PM, 3005 (Moscone West), **C32A. Climate-Glacier Dynamics in the Himalaya II**	
11:56-12:08 PM (Conflict)	**C32A-07. Glacier surge triggered by massive rock avalanche: Teleseismic and satellite image study of long-runout landslide onto RGO Glacier, Pamirs** C.P. Stark; M. Wolovick; G. Ekstrom
10:20 AM-12:20 PM, 3022 (Moscone West), **H32E. Patterns in Soil-Vegetation-Atmosphere Systems: Monitoring, Modeling, and Data Assimilation I**	
12:05-12:20 PM (Conflict)	**H32E-08. Improving wind energy forecasts using an Ensemble Kalman Filter data assimilation technique in a fully coupled hydrologic and atmospheric model** J.L. Williams; R.M. Maxwell; L. Delle Monache
1:40 PM-6:00 PM, Hall A-C (Moscone South), **C33C. Quantifying Spatial Variability of Snow and Snow Processes II Posters**	
1:40-1:40 PM	**C33C-0677. A regression-based approach for blending remotely sensed and in-situ snow water equivalent estimates in the Colorado River Basin.** D. Schneider; N.P. Molotch
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP33B. Coastal Geomorphology and Morphodynamics I Posters**	

1:40-1:40 PM	**EP33B-0850. Relationship between environmental conditions and rates of coastal erosion in Arctic Alaska** K.R. Barnhart; R.S. Anderson; I. Overeem; C.W. Wobus; G.D. Clow; F.E. Urban; A.L. LeWinter; T.P. Stanton
1:40-1:40 PM	**EP33B-0854. Quantifying the transition from fluvial- to wave-dominance for river deltas with multiple active channels** J. Nienhuis; A.D. Ashton; L. Giosan
1:40-1:40 PM	**EP33B-0855. On a Neck, On a Spit** A.D. Ashton; J. Nienhuis
1:40-1:40 PM	**EP33B-0863. Influence of Climate Change on Wave Dissipation over Coral Reefs: Effects on Beach Morphology** A.E. Grady; L.J. Moore; C.D. Storlazzi; E. Elias; M.A. Reidenbach
1:40-1:40 PM	**EP33B-0865. The Role of Ecomorphodynamics in Barrier Island Response to Climate Change** L.J. Moore; O. Duran Vinent; D. Young
1:40-1:40 PM	**EP33B-0886. Salt marsh equilibrium states and transient dynamics in response to changing rates of sea level rise and sediment supply.** A. D'Alpaos; S.M. Mudd; L. Carniello
1:40-1:40 PM	**EP33B-0888. Modeling rates of bank erosion in sinuous tidal channel derived from event-based terrestrial lidar surveys in the Mont Saint Michel Bay** J. Leroux; D. Lague
1:40 PM-6:00 PM, Hall A-C (Moscone South), **H33A. A Vision for the Future: Exploring the Value of Geophysics in Hydrology I Posters**	
1:40-1:40 PM	**H33A-1287. Tree-like Representation of Hydrologic Time Series** S. Zanardo; I. Zaliapin; E. Foufoula
1:40 PM-6:00 PM, Hall A-C (Moscone South), **H33B. Advances in the Theory, Modeling, Measurement, and Remote Sensing of Evapotranspiration From Terrestrial Surfaces III Posters**	
1:40-1:40 PM	**H33B-1295. Comparing and Contrasting Water Use Pattern in the Colorado River Basin Using Landsat and MODIS-based Analyses** R.K. Singh; G.B. Senay; S. Bohms; M. Friedrichs; J.P. Verdin
1:40 PM-6:00 PM, Hall A-C (Moscone South), **H33H. Recent Advances in Modeling Water in the Coupled Earth System II Posters**	
1:40-1:40 PM	**H33H-1431. Estimation of regional hydrogeological properties for use in a hydrologic model of the Chesapeake Bay watershed** A. Seck; C. Welty
1:40 PM-6:00 PM, Hall A-C (Moscone South), **OS33B. Interpretation of Tsunami and Storm Deposits II Posters**	

1:40-1:40 PM	**OS33B-1820. Sedimentary Record and Morphological Effects of a Landslide-Generated Tsunami in a Polar Region: The 2000 AD Tsunami in Vaigat Strait, West Greenland** W. Szczucinski; N.J. Rosser; M.C. Strzelecki; A.J. Long; T. Lawrence; A. Buchwal; C. Chague-Goff; S. Woodroffe
1:40 PM-6:00 PM, Hall A-C (Moscone South), **T33C. Links Between Tectonics, Climate, Erosion, and Sedimentation in Orogenic Plateaus and Marginal Basins IV Posters**	
1:40-1:40 PM	**T33C-2673. Denudation Gradient Across the Eastern Margin of the Tibetan Plateau** C. Ansberque; V. Godard; O. Bellier; Z. Ren; J. Liu; Y. Li; J. de Sigoyer; D.L. Bourles
1:40-1:40 PM	**T33C-2679. Decadal deformation rates from SAR interferometry in the eastern Pamir-Tian Shan collision zone and implication for the growth and erosion of detachment folds.** A. Bufe; D.W. Burbank; B. Bookhagen
1:40 PM-3:40 PM, 2007 (Moscone West), **EP33C. Ecogeomorphology: Footprints on a Landscape II**	
1:55-2:10 PM (Conflict)	**EP33C-03. The role of vegetation in shaping dune morphology *(Invited)*** O. Duran Vinent; L.J. Moore; D. Young
1:40 PM-3:40 PM, 3020 (Moscone West), **H33P. Using Remote Sensing and Global Weather Data Sets for Hydrologic Modeling in Data-Scarce Regions: Opportunities and Challenges II**	
1:55-2:10 PM (Conflict)	**H33P-02. DFL-MaP: A Global Real-time Hydrological Modeling System for Drought-Flood-Landslide Monitoring and Prediction *(Invited)*** Y. Hong; X. Xue; J.J. Gourley; R.F. Adler
1:40 PM-3:40 PM, 2003 (Moscone West), **EP33E. Tracers, Transport, and Topography: Theory and Technology for Tractive Tracking II**	
2:40-2:55 PM	**EP33E-05. The Statistical Mechanics of the Bed Load Sediment Velocity Distribution *(Invited)*** D.J. Furbish; M.W. Schmeeckle
2:40 PM-3:40 PM, 2009 (Moscone West), **SH33E. Using Multispacecraft Observations for Simulating CME Propagation and Initiation I**	
2:55-3:10 PM	**SH33E-02. Numerical modeling of the initiation of coronal mass ejections in active region NOAA 9415 *(Invited)*** F.P. Zuccarello; Z. Meliani; S. Poedts
1:40 PM-3:40 PM, 2007 (Moscone West), **EP33C. Ecogeomorphology: Footprints on a Landscape II**	
3:10-3:25 PM (Conflict)	**EP33C-08. Ecogeomorphology: Impressions of organisms in critical zone evolution *(Invited)*** S.P. Anderson; N. Fierer; R.S. Gabor; H.R. Barnard; R.S. Anderson; B. Hoffman; D.M. McKnight

1:40 PM-3:40 PM, 2005 (Moscone West), **EP33D. Quantifying Hillslope and Fluvial Processes Through Change Detection Using High-Resolution, Multitemporal Topographic Data II**	
3:10-3:25 PM (Conflict)	**EP33D-07. Using TLS to measure braided river bar movement in the Pasig-Potrero River on Mt. Pinatubo** S.S. Day; K.B. Gran
1:40 PM-3:40 PM, 2018 (Moscone West), **NS33A. Near-Surface Geophysics General Contributions III**	
3:10-3:25 PM (Conflict)	**NS33A-07. Free online seismic data from a sand tank experiment** J.M. Lorenzo; D. Smolkin; C. White; S. Chollett; T. Sun
1:40 PM-3:40 PM, 2006 (Moscone West), **B33H.* Improving Terrestrial Biogeochemical Models Through Integrating Models With Data I**	
3:25-3:40 PM	**B33H-08. Multi-Scale Synthesis and Terrestrial Model Intercomparison Project – A Systematic Approach for Evaluating Land -Atmosphere Flux Estimates** D.N. Huntzinger; C. Schwalm; A.M. Michalak; W. Post; K.M. Schaefer; A.R. Jacobson; Y. Wei; R.B. Cook
4:00 PM-6:00 PM, 2003 (Moscone West), **EP34A. Advances in Numerical Modeling of River Fluxes Under Changing Environmental Conditions II**	
4:00-4:15 PM (Conflict)	**EP34A-01. Modeling Floodplain Depositional Patterns under Variable Flood Regimes *(Invited)*** I. Overeem; R.L. Boyd; A. Kettner; J.P. Syvitski
4:00 PM-6:00 PM, 3018 (Moscone West), **H34A. Anomalous Transport, Mixing, and Reaction in Hydrological Systems III**	
4:00-4:15 PM (Conflict)	**H34A-01. The intricate relationship between sediment dispersion and channel dynamics in straight and braider rivers: insights from numerical simulations *(Invited)*** P. Davy; D. Lague
4:00 PM-6:00 PM, 309 (Moscone South), **T34D. Theory and Practice in Studies of the Earthquake Cycle: Observations From the Deep Fault Drilling Project, Alpine Fault, and Coseismic Rupture Models IV**	
4:30-4:45 PM	**T34D-03. Topographic controls on stress state, thermal structure and fluid flow adjacent to the central Alpine Fault near DFDP-1 boreholes, New Zealand *(Invited)*** P. Upton; R. Sutherland; S. Cox; J. Townend
4:00 PM-6:00 PM, 2008 (Moscone West), **PP34B. Tropical Hydrology and the Hadley Circulation in Past Climates III**	
4:45-5:00 PM	**PP34B-04. Quantitative estimates of past changes in ITCZ position and cross-equatorial atmospheric heat transport *(Invited)*** D. McGee; A. Donohoe; J. Marshall; D. Ferreira
4:00 PM-6:00 PM, 2003 (Moscone West), **EP34A. Advances in Numerical Modeling of River Fluxes Under Changing Environmental Conditions II**	

5:30-5:45 PM	**EP34A-07. Numerical model of the lowermost Mississippi River as an alluvial-bedrock reach: preliminary results** E. Viparelli; J.A. Nittrouer; D.C. Mohrig; G. Parker
5:45-6:00 PM	**EP34A-08. Modeling the Effect of Changing Sediment Load on the Flow Regime of the Lower Mississippi River** ***(Invited)*** G. Parker; T. Yeh

Thursday, December 06, 2012

Time	Session Info
8:00 AM-12:20 PM, Hall A-C (Moscone South), **B41C.* Improving Terrestrial Biogeochemical Models Through Integrating Models With Data III Posters**	
8:00-8:00 AM	**B41C-0311. Modeling net ecosystem exchange of carbon dioxide in a beetle-attacked subalpine forest using a data-constrained ecosystem model** S.D. Peckham; B.E. Ewers; D.S. Mackay; J.M. Frank; W.J. Massman; M.G. Ryan; H. Scott; E. Pendall
8:00 AM-12:20 PM, Hall A-C (Moscone South), **B41E. Remote Characterization of Vegetation Structure, Function, and Condition IV Posters**	
8:00-8:00 AM	**B41E-0359. Study the Linkage of Allometric Scaling and Resource Limitation Model of Vegetation Structure with Stochastic Radiative Transfer Theory** L. Xu; R. Myneni; Y. Knyazikhin
8:00 AM-12:20 PM, Hall A-C (Moscone South), **C41B. Observational Needs for Polar Climate Modeling I Posters**	
8:00-8:00 AM	**C41B-0561. Arctic radiative processes and the influences of clouds and aerosol using CAM5** J.M. English; J.E. Kay; A. Gettelman
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP41A. Interactions of Vegetation, Water, and Sediment in Rivers and Wetlands I Posters**	
8:00-8:00 AM	**EP41A-0759. Predicting friction factor in herbaceous emergent wetlands** T. Wynn-Thompson; K. Hall
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP41B. Linking Geomorphology and Morphodynamics to Sediment Budgets, Sediment Caliber, and the Stratigraphic Record I Posters**	
8:00-8:00 AM	**EP41B-0777. Definition of mass-balance frameworks for interacting fluvial systems with application to Bangladesh** A.L. Petter; C. Paola; S.L. Goodbred; J. Pickering; L. Williams

8:00-8:00 AM	**EP41B-0787. Antecedent morphology and active tectonics in the upper Bengal Delta: Multi-temporal controls on river mobility and sediment preservation** J. Pickering; S.L. Goodbred; T. Hartzog; V. Spiess; T. Schwenk; L. Palamenghi; M.S. Steckler; L. Seeber; S.H. Akhter; D. Mondal; S. Hossain; A.L. Petter; C. Paola
8:00-8:00 AM	**EP41B-0789. Kinematic Controls On The Geometrical Structure Of The Preserved Cross-Sets** V. Ganti; C. Paola; E. Foufoula
8:00-8:00 AM	**EP41B-0798. Modes of Late Pleistocene Fine-Grain Sediment Dispersal in Canterbury Basin, South Island New Zealand** J.M. Jaeger; T.G. Villasenor Jorquera
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP41C. Natural and Controlled Experiments in Landscape Evolution I Posters**	
8:00-8:00 AM	**EP41C-0805. Tracing the Geomorphic Signature of Lateral Faulting** A.R. Duvall; G.E. Tucker
8:00-8:00 AM	**EP41C-0806. The influence of tectonic strain on geomorphic metrics** S.G. Roy; P.O. Koons; G.E. Tucker; P. Upton
8:00-8:00 AM	**EP41C-0810. Granular Mechanics of Debris-Flow Incision: Measuring and Modeling Grain-Scale Impact Forces** S.W. McCoy; G.E. Tucker; J.W. Kean; J.A. Coe
8:00-8:00 AM	**EP41C-0811. The emergence of topographic steady-state in perpetually dynamic topography.** L. Reinhardt; M.A. Ellis
8:00-8:00 AM	**EP41C-0814. Does rift lateral propagation depend on climate and surface processes?** P. Steer; R.S. Huismans; P.A. Cowie; V. ALLKEN; C. Thieulot
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP41D. Rock to Sediment: Biotic, Lithologic, and Climatic Controls on Regolith Production, Mixing, and Transport I Posters**	
8:00-8:00 AM	**EP41D-0824. Basin Wide Erosion and Soil Production Rates of a High Altitude Plateau in the Korean Peninsula Considered as an Uplifted Paleo Erosional Surface: Implications for Its Development Process and the Tectonics** J. Byun; Y. Seong
8:00-8:00 AM	**EP41D-0832. Weathering the deep Critical Zone, understanding the controls on carbon-mineral association in a first-order watershed** B. Wenell; K. Yoo; A.K. Aufdenkampe; E.A. Nater
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP41E. Roughness Controls on Landscape Process and Form I Posters**	
8:00-8:00 AM	**EP41E-0843. WHY ARE CHANNELS SINUOUS?** J.A. Constantine; E. Lazarus
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H41G. Threshold Hydrology: Hydrotopographic Analysis and Modeling Posters**	

8:00-8:00 AM	**H41G-1256. Sharp landscape features and their role in predictive hydrology and geomorphology** P. Belmont; E. Foufoula; P. Passalacqua
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H41I. Utilizing Precipitation Datasets in Hydrometeorological Applications I Posters**	
8:00-8:00 AM	**H41I-1290. US-Pakistan Cooperation on End-to-End Hydrometeorological Disaster Risk Assessment: Satellite Sensors, Super Computing and Sustainable communities (S3)** S.I. Khan; Y. Hong; J.J. Gourley; U.K. Khattak
8:00 AM-12:20 PM, Hall A-C (Moscone South), **IN41A. Data Discovery and Access Services I Posters**	
8:00-8:00 AM	**IN41A-1474. Arctic Research Mapping Application (ARMAP): 2D Maps and 3D Globes Support Arctic Science** C.E. Tweedie; R.P. Cody; A. Kassin; A. Gaylord; W.F. Manley; M. Dover; R. Score
8:00 AM-10:00 AM, 304 (Moscone South), **NH41C. The March 2011 Tohoku-oki Tsunami, Japan I**	
8:00-8:15 AM	**NH41C-01. Sediment Sources, Sedimentation Processes and Post-Depositional Changes of the 2011 Tohoku-Oki Tsunami Deposits on the Sendai Plain, Japan *(Invited)*** W. Szczucinski; C. Chague-Goff; K. Goto; D. Sugawara; R. Jagodzinski; M. Kokocinski; M. Cachao; B. Sternal; M. Rzeszewski; J.R. Goff; B.E. Jaffe
8:00 AM-10:00 AM, 3001 (Moscone West), **GC41E. The North American Monsoon: Past, Present, and Future II**	
8:45-9:00 AM	**GC41E-04. Current status of North American Monsoon Research *(Invited)*** D.J. Gochis
8:00 AM-10:00 AM, 2005 (Moscone West), **EP41G. Beyond Grain Size: Controls on Particle Transport II**	
9:00-9:15 AM (Conflict)	**EP41G-05. Intermittency in bedload transport: the importance of coherent flow structures and grain to grain interactions** E.M. Yager; J.S. Boyd; M.W. Schmeeckle; J.A. McKean
8:00 AM-10:00 AM, 2003 (Moscone West), **EP41H. Biophysical Interactions in Riverine Landscapes II**	
9:00-9:15 AM (Conflict)	**EP41H-05. Effects of Riparian Vegetation on Topographic Change During a Large Flood Event, Rio Puerco, New Mexico** M.C. Perignon; G.E. Tucker; E.R. Griffin; J.M. Friedman
8:00 AM-10:00 AM, 2005 (Moscone West), **EP41G. Beyond Grain Size: Controls on Particle Transport II**	

9:45-10:00 AM (Conflict)	**EP41G-08. Size matters. History too. The rest is detail.** P. Wilcock
8:00 AM-10:00 AM, 2008 (Moscone West), **EP41I. The Deep Critical Zone and the Inception of Surface Processes I**	
9:45-10:00 AM (Conflict)	**EP41I-08. The Influence of the Deep Critical Zone under Hillslopes on Hydrologic, Geomorphic, and Ecological Processes *(Invited)*** W. Dietrich; D.M. Rempe; J. Oshun
10:20 AM-12:20 PM, 2008 (Moscone West), **EP42D. Soil: The Terrestrial Critical Zone Biogeoreactor**	
10:20-10:35 AM	**EP42D-01. The co-evolution and spatial organisation of soils, landforms, vegetation, and hydrology** G.R. Willgoose; S. Cohen; G.R. Hancock; E.U. Hobley; P.M. Saco
10:20 AM-12:20 PM, 309 (Moscone South), **T42A. Evolution, Structure, and Sedimentary Record of the South China Sea I**	
10:35-10:50 AM	**T42A-02. Structure and Evolution of Northwest Corner of South China Sea: implications for Cenozoic tectonics in Southeast Asia** C. Lei; J. Ren; S. Willett; P.D. Clift
10:20 AM-11:20 AM, 2003 (Moscone West), **EP42A. Biophysical Interactions in Riverine Landscapes: Restoration**	
10:50-11:05 AM (Conflict)	**EP42A-03. Cheap and Cheerful Stream Restoration – An Example of System Wide Woody Addition Treatment** J.M. Wheaton; S.N. Bennett; N. Bouwes; R. Camp
10:20 AM-12:20 PM, 2018 (Moscone West), **H42D. Ecohydrology of Terrestrial and Aquatic Ecosystems in an Era of Rapid Change I**	
10:50-11:05 AM (Conflict)	**H42D-03. Novel or natural variation in ecohydrology-an example of smoldering combustion in the boreal forest.** E.A. Johnson; Y.E. Martin
10:20 AM-12:20 PM, 3003 (Moscone West), **GC42A. Climate Change Science for Sustainability Planning II**	
11:00-11:20 AM (Conflict)	**GC42A-03. Potential Climate Change Impacts on the Built Environment in the United States and Implications for Sustainability *(Invited)*** D. Quattrochi
10:20 AM-12:20 PM, 2018 (Moscone West), **H42D. Ecohydrology of Terrestrial and Aquatic Ecosystems in an Era of Rapid Change I**	
11:35-11:50 AM (Conflict)	**H42D-06. Water Presence in an Arid and Semi-arid River: Pattern, causes, mechanisms and change *(Invited)*** T. Meixner; C.D. Soto; H. Ajami; D. Turner; H. Richter; F. Dominguez
11:20 AM-12:20 PM, 2003 (Moscone West), **EP42C. Linking Geomorphology and Morphodynamics to Sediment Budgets, Sediment Caliber, and the Stratigraphic Record II**	

11:35-11:50 AM (Conflict)	**EP42C-02. Dynamic Flocculation of Muds in Fluvial to Marine Transitions** A. Keyvani; K.B. Strom
10:20 AM-12:20 PM, 2005 (Moscone West), **EP42B. Channel Processes and Forms at the Fluvial-Tidal Transition II**	
12:05-12:20 PM	**EP42B-08. Numerical modeling of the morphodynamic evolution of long tidally-dominated river estuaries.** A. Canestrelli; S. Fagherazzi; S. Lanzoni
1:40 PM-6:00 PM, Hall A-C (Moscone South), **B43F. The Bioatmospheric N Cycle: N Emissions, Transformations, Deposition, and Terrestrial and Aquatic Ecosystem Impacts III Posters**	
1:40-1:40 PM	**B43F-0477. Influence of aerosol chemical composition on N_2O_5 uptake: Airborne regional measurements in North-Western Europe** W. Morgan; J.D. Allan; E. Aruffo; M. Le Breton; P. Di Carlo; O. Kennedy; D. Lowe; J.B. Muller; B. Ouyang; R. Jones; G. McFiggans; C.J. Percival; H. Coe
1:40 PM-6:00 PM, Hall A-C (Moscone South), **C43C. Glacier, Ice Cap, and Ice Sheet Hydrology: Storage, Transport, and Impacts II Posters**	
1:40-1:40 PM	**C43C-0613. The role of melt, storage and tapping of supra glacial lakes in runoff from the Greenland Ice Sheet** A.B. Mikkelsen; A. Fitzpatrick; D. Van As; B. Hasholt; A. Hubbard; M.R. van den Broeke
1:40 PM-6:00 PM, Hall A-C (Moscone South), **ED43C. Undergraduate Research Program Design and Effectiveness in the Earth and Environmental Sciences II Posters**	
1:40-1:40 PM	**ED43C-0742. PROVIDING INTERNATIONAL RESEARCH EXPERIENCES IN WATER RESOURCES THROUGH A DISTRIBUTED REU PROGRAM** J. Judge; K. Sahrawat; R. Mylavarapu
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP43A. Soil: The Terrestrial Critical Zone Biogeoreactor Posters**	
1:40-1:40 PM	**EP43A-0865. Sensitivity Analysis for Assessing Effects of Tree Population Dynamics on Soil Bioturbation** Y.E. Martin; E.A. Johnson
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP43B. The Deep Critical Zone and the Inception of Surface Processes II Posters**	
1:40-1:40 PM	**EP43B-0868. Rock strength reductions during incipient weathering** P.J. Kelly; S.P. Anderson; A. Blum
1:40 PM-6:00 PM, Hall A-C (Moscone South), **GP43B. Potential-Field and EM Methods for Geologic Problems of the Mid and Upper Crust II Posters**	
1:40-1:40 PM	**GP43B-1142. Developments for 3D gravity and magnetic modeling in spherical coordinates** R.J. Lane; Q. Liang; C. Chen; Y. Li

1:40 PM-6:00 PM, Hall A-C (Moscone South), **H43B. Complexity, Falsifiability, Transparency, and Uncertainty in Environmental Modeling II Posters**	
1:40-1:40 PM	**H43B-1321. Transparency and Refutability: Why and How Demonstrated using a Synthetic, Highly Nonlinear Groundwater Transport Problem** M.C. Hill; R.T. Hanson; L.J. Kauffman
1:40 PM-6:00 PM, Hall A-C (Moscone South), **H43F. Surface Hydrology Posters**	
1:40-1:40 PM	**H43F-1429. Improving flash flood forecasting through coupling of a distributed hydrologic rainfall-runoff model (HL-RDHM) with a hydraulic model (BreZo)** P. Nguyen; S. Sorooshian; K. Hsu; A. AghaKouchak; B.F. Sanders; M.B. Smith; V. Koren
1:40 PM-6:00 PM, Hall A-C (Moscone South), **NG43B. Stochasticity, Multiplicity of Scales, Memory, and Statistical Mechanics in Geophysics II Posters**	
1:40-1:40 PM	**NG43B-1578. Diffusive evolution of experimental braided rivers** M.D. Reitz; E. Lajeunesse; D.J. Jerolmack; A. Limare; F. Metivier; O. Devauchelle
1:40 PM-6:00 PM, Hall A-C (Moscone South), **T43A. Connections Between Long-Term and Short-Term Tectonics and Geodynamics II Posters**	
1:40-1:40 PM	**T43A-2638. Investigating the strain accumulation of upper plate faults at the N-Chilean convergent plate boundary at different spatial and temporal scales** O. Ewiak; P. Victor; T. Ziegenhagen; O. Oncken
1:40 PM-3:40 PM, 2018 (Moscone West), **NS43A. Geophysical Imaging of Fractures and Fluid Flow: Advancing From Detection to Measurement I**	
1:45-2:05 PM	**NS43A-02. Coupled chemical alteration and mechanical deformation in fractures: Insights from laboratory-scale imaging** ***(Invited)*** R.L. Detwiler; J.E. Elkhoury; P. Ameli
1:40 PM-3:40 PM, 2003 (Moscone West), **EP43D. Linking Geomorphology and Morphodynamics to Sediment Budgets, Sediment Caliber, and the Stratigraphic Record III**	
2:25-2:40 PM	**EP43D-04. Topographic Surface-Based Modeling: Building Complex Stratigraphy with Geomorphic Surfaces** Z. Sylvester; A. Cantelli; N.C. Howes; Z.R. Jobe; M.A. Wolinsky; C. Pirmez; R. Smith
2:40-2:55 PM	**EP43D-05. Computer simulations of channel meandering and the formation of point bars: Linking channel dynamics to the preserved stratigraphy** T. Sun; J.A. Covault; M. Pyrcz; M. Sullivan
2:55-3:10 PM (Conflict)	**EP43D-06. Significance of Quaternary and Experimental Fluvial Systems to Interpretation of the Stratigraphic Record** ***(Invited)*** M.D. Blum; J.M. Martin
1:40 PM-3:40 PM, 2008 (Moscone West), **EP43E. Rock to Sediment: Biotic, Lithologic, and Climatic Controls on Regolith Production, Mixing, and Transport II**	

2:55-3:10 PM (Conflict)	**EP43E-06. Climate-dependent sediment production: numerical modeling and field observations of variable grain size distributions from heterogeneous hillslope weathering of fractured basalt flows, Kohala Peninsula, Hawaii** B.P. Murphy; J.P. Johnson
1:40 PM-3:40 PM, 2005 (Moscone West), **EP43C. Interactions of Vegetation, Water, and Sediment in Rivers and Wetlands II**	
3:10-3:25 PM (Conflict)	**EP43C-07. Experimental investigation of sediment transport through vegetated flow** C. Le Bouteiller; J.G. Venditti
1:40 PM-3:40 PM, 2003 (Moscone West), **EP43D. Linking Geomorphology and Morphodynamics to Sediment Budgets, Sediment Caliber, and the Stratigraphic Record III**	
3:10-3:25 PM (Conflict)	**EP43D-07. Building the coastline: Linking study of the modern and ancient depositional environments to predict the response of Mississippi River delta to environmental change** D.C. Mohrig; C. Armstrong
1:40 PM-3:40 PM, 2005 (Moscone West), **EP43C. Interactions of Vegetation, Water, and Sediment in Rivers and Wetlands II**	
3:25-3:40 PM	**EP43C-08. Turbulent and Mean Velocity Near Rigid and Flexible Plants, and Implications for Deposition** A.C. Ortiz; H.M. Nepf; A.D. Ashton
4:00 PM-6:00 PM, 2005 (Moscone West), **EP44B. Roughness Controls on Landscape Process and Form II**	
4:00-4:15 PM	**EP44B-01. First-order control of surface roughness at three scales: boundary layer dynamics, tracer dispersion and pebble abrasion *(Invited)*** D.J. Jerolmack; K.L. Litwin; C.B. Phillips; R.L. Martin
4:00 PM-6:00 PM, 3018 (Moscone West), **H44E. Uncertainties in Precipitation Measurements and Their Hydrological Impact II**	
4:30-4:45 PM	**H44E-03. A Global Hydrological Ensemble Forecasting System: Uncertainty Quantification and Data Assimilation *(Invited)*** Y. Hong; Y. Zhang; X. Xue; X. Wang; J.J. Gourley; P. Kirstetter
4:00 PM-6:00 PM, 2005 (Moscone West), **EP44B. Roughness Controls on Landscape Process and Form II**	
4:45-5:00 PM	**EP44B-04. Density Current over Rough and Uneven Bottoms** X. Liu; Y. Jiang
4:00 PM-6:00 PM, 2003 (Moscone West), **EP44A. Natural and Controlled Experiments in Landscape Evolution II**	
5:00-5:15 PM (Conflict)	**EP44A-05. Influence of variable lithology on landscape evolution** B.J. Yanites; T.A. Ehlers

4:00 PM-6:00 PM, 2005 (Moscone West), **EP44B. Roughness Controls on Landscape Process and Form II**	
5:00-5:15 PM (Conflict)	**EP44B-05. Effects of Small-scale Vegetation-related Roughness on Overland Flow and Infiltration in Semi-arid Grassland and Shrublands** D. Bedford

Friday, December 07, 2012

Time	Session Info
8:00 AM-12:20 PM, Hall A-C (Moscone South), **A51A.* Aerosol Observations at High Elevation II Posters**	
8:00-8:00 AM	**A51A-0010. Aerosol Optical Properties Over the High Altitude Station Hanle in the Western Himalayas** E.J. Larson; S.P. Bagare; S.S. Ningombam; R.B. Singh; N. Sinha
8:00 AM-12:20 PM, Hall A-C (Moscone South), **EP51A. Do Characteristic Landscape Features Correspond to a Unique Process? I Posters**	
8:00-8:00 AM	**EP51A-0974. Topography along the Smith River, OR provides insight into the process of bedrock river meandering and it's influence on adjacent hillslope lowering rates.** K.N. Johnson; N.J. Finnegan
8:00 AM-10:00 AM, 2003 (Moscone West), **EP51E. Climate Change and Landscape Response I**	
8:00-8:15 AM	**EP51E-01. Ice Age Geomorphology of North America** A.D. Wickert; R.S. Anderson; J.X. Mitrovica; K. Picard
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H51E. Landscape System Response Under Change I Posters**	
8:00-8:00 AM	**H51E-1405. Comparing Hydrologic Response Times Between a Forested and Mountaintop Mined Catchment** A.J. Miller; N. Zegre
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H51F. Optimizing Short-Term Reservoir Operations With Multiple Sources of Uncertainty II Posters**	
8:00-8:00 AM	**H51F-1418. Operational Displays for Short Term Reservoir Operations** E. Welles; M. Lemans; P. Gijsbers
8:00 AM-12:20 PM, Hall A-C (Moscone South), **H51I. Recent Advances in Understanding the Hydrology of the Great Lakes Region I Posters**	
8:00-8:00 AM	**H51I-1464. Assessment of differences in physical watershed characteristics between gaged and ungaged portions of the Great Lakes basin** T.S. Hunter; L.M. Fry; A.D. Gronewold; J.M. Kult

8:00 AM-12:20 PM, Hall A-C (Moscone South), **H51J. Water Quality and Quantity in Urban Systems Posters**	
8:00-8:00 AM	**H51J-1490. Watershed Hydrologic Response and Drainage Network Topology Across a Spectrum of Urban Development Patterns** A.J. Miller; G.A. Lindner; S.Z. Shamer; K.M. Schmidt; M.J. Kather; D. Jones; M.E. Baker; C. Welty
8:00 AM-12:20 PM, Hall A-C (Moscone South), **IN51D. Semantics and Cyberinfrastructures for Next Generation Science I Posters**	
8:00-8:00 AM	**IN51D-1707. CSDMS2.0: Computational Infrastructure for Community Surface Dynamics Modeling** J.P. Syvitski; E. Hutton; S.D. Peckham; I. Overeem; A. Kettner
8:00 AM-12:20 PM, Hall A-C (Moscone South), **NS51A. Exploring the High-Resolution Record of Surface Processes in Near-Shore and Inshore Water Bodies Posters**	
8:00-8:00 AM	**NS51A-1823. Developing Age Models to Utilize High Arctic Coastal Sediments for Paleoclimate Research: Results from the Colville Delta and Simpson Lagoon, Alaska** A.J. Miller; M.A. Allison; T.S. Bianchi; F. Marcantonio
8:00 AM-12:20 PM, Hall A-C (Moscone South), **OS51B. Marine Geological Processes, Present and Past III Posters**	
8:00-8:00 AM	**OS51B-1870. Effect of topography on contour currents and contourite drifts off italian promontories (Mediterranean Sea)** E. Martorelli; F. Falcini; E. Salusti; F.L. Chiocci
8:00 AM-12:20 PM, Hall A-C (Moscone South), **T51F. Understanding Deformation Phases of the India-Asia Continental Collision II Posters**	
8:00-8:00 AM	**T51F-2667. GPS Velocities and Structure Across the Burma Accretionary Prism and Shillong Anticline in Bangladesh** M.S. Steckler; S.H. Akhter; L. Seeber; R.G. Bilham; M.G. Kogan; F. Masson; T. Maurin; D. Mondal; N. Piana Agostinetti; C. Rangin; P. Saha
8:00-8:00 AM	**T51F-2668. Weak middle crust beneath central Tibet: constraints from shoreline deformation around Siling Co** X. Shi; E. Kirby; K.P. Furlong; E. Wang; K. Meng; S. Marrero; R.A. Robinson; F.M. Phillips
8:00 AM-10:00 AM, 3001 (Moscone West), **GC51F. Forest Hydrology Within the Context of Global Change and Forest Health**	
8:15-8:30 AM	**GC51F-02. The geography of forest drought vulnerability: Integrating modeling and measurements *(Invited)*** C. Tague
8:00 AM-10:00 AM, 2005 (Moscone West), **EP51F. Coevolution of Glaciation and Glaciated Mountains I**	

8:30-8:45 AM (Conflict)	**EP51F-03. Glaciation in a tectonically active environment: Preliminary observations from the Inylchek and Sary-Dzaz Valleys, Kyrgyz Tian Shan** N.A. Lifton; C. Beel; R. Blomdin; M.W. Caffee; Y. Chen; A. Codilean; B.M. Goehring; N. Gribenski; J. Harbor; C. Hattestrand; J. Heyman; M. Ivanov; C. Kassab; Y. Li; D. Petrakov; I. Rogozhina; A.P. Stroeven; R. Usubaliev; H. Wetzel
8:00 AM-10:00 AM, 3001 (Moscone West), **GC51F. Forest Hydrology Within the Context of Global Change and Forest Health**	
8:30-8:45 AM (Conflict)	**GC51F-03. Opportunities and challenges to conserve water on the landscape in snow-dominated forests: The quest for the radiative minima and more...** ***(Invited)*** T.E. Link; M. Kumar; J.W. Pomeroy; B. Seyednasrollah; C.R. Ellis; R. Lawler; R. Essery
8:00 AM-10:00 AM, 2005 (Moscone West), **EP51F. Coevolution of Glaciation and Glaciated Mountains I**	
8:45-9:00 AM	**EP51F-04. Impacts of alpine glacial erosion on the shapes of glacial valleys, heights of mountains, and sediment delivery to the foreland** ***(Invited)*** R.S. Anderson; M. Dühnforth; L.S. Anderson; W. Colgan
8:00 AM-10:00 AM, 2008 (Moscone West), **EP51D. Advances in Experimental Earth Surface Processes I**	
9:00-9:15 AM	**EP51D-05. Experiments Under Shallow-water Conditions in Meandering and Anabranching Channels** ***(Invited)*** J.D. Abad
8:00 AM-10:00 AM, 2002 (Moscone West), **B51H. Biogeodynamics and Earth System Sciences I**	
9:15-9:30 AM	**B51H-06. Biological-Physical Feedbacks Determine Coastal Environmental Response to Climate Change** ***(Invited)*** L.J. Moore; O. Duran Vinent; D. Walters; S. Fagherazzi; G. Mariotti; D. Young; C.V. Wolner
8:00 AM-10:00 AM, 2008 (Moscone West), **EP51D. Advances in Experimental Earth Surface Processes I**	
9:30-9:45 AM (Conflict)	**EP51D-07. The hills are alive: Earth surface dynamics in the University of Arizona Landscape Evolution Observatory** ***(Invited)*** S. DeLong; P.A. Troch; G.A. Barron-Gafford; T.E. Huxman; J.D. Pelletier; K. Dontsova; G. Niu; J. Chorover; X. Zeng
8:00 AM-10:00 AM, 2005 (Moscone West), **EP51F. Coevolution of Glaciation and Glaciated Mountains I**	
9:30-9:45 AM (Conflict)	**EP51F-07. Examining the effects of glacial erosion on the extent of glaciation** V.K. Pedersen; D. Egholm
10:20 AM-12:20 PM, 2008 (Moscone West), **EP52A. Advances in Field and Laboratory Measurement Methodologies for Quantifying Geophysical Flows I**	

10:40-11:00 AM	**EP52A-02. Coupling video and in situ observations in a field scale meandering channel** ***(Invited)*** J. Calantoni; M.L. Palmsten; J.L. Kozarek; D. Dobson; K. Holland
10:20 AM-12:20 PM, 2005 (Moscone West), **EP52E. Process-Oriented Multiapproach Erosion Analysis in High Mountains: Decade to Millennia Timescales I**	
11:05-11:20 AM	**EP52E-04. Tracking landslides and landscape evolution using airborne lidar, InSAR, historical air photos, cosmogenic radionuclides, and numerical models** ***(Invited)*** J.J. Roering; B.H. Mackey; D.A. Schmidt; A.L. Handwerger; A.M. Booth; C. Cerovski-Darriau
11:20 AM-12:20 PM, 2003 (Moscone West), **EP52D. Modeling Developments for Sediment Transport and Other Multiphase Flows: From Steep Upland Regions to Riverine, Estuary, and Coastal Environments II**	
11:20-11:35 AM	**EP52D-01. Gravity and Turbidity Currents Interacting with Submarine Topography** ***(Invited)*** E.H. Meiburg; M. Nasr-Azadani
11:35-11:50 AM	**EP52D-02. Eddy-resolving simulation of lofting turbidity currents** S. Radhakrishnan; E. Lenk; E.H. Meiburg
11:50-12:05 PM	**EP52D-03. THE ONSET OF CHANNELLING IN A FLUIDIZED MUD LAYER** T. Papanicolaou; A.G. Tsakiris; B.M. Billing
12:05-12:20 PM	**EP52D-04. Understanding the state of the muddy seabed - a numerical study utilizing multiphase flow approach** ***(Invited)*** T. Hsu; C.E. Ozdemir; X. Yu; S. Balachandar; J.R. Davis
12:30 PM-1:30 PM, 2009 (Moscone West), **TH52H. International Earth Science Organizations and You**	
12:30-1:30 PM	**International Earth Science Organizations and You** M.C. Hill; J.T. Freymueller; D.G. Marks; E. Sztein
1:40 PM-6:00 PM, Hall A-C (Moscone South), **A53K.* Nanoparticles in the Earth's Atmosphere I Posters**	
1:40-1:40 PM	**A53K-0295. Using self-consistent Gibbs free energy surfaces to calculate size distributions of neutral and charged clusters for the sulfuric acid-water binary system** J.A. Smith; K.D. Froyd; O.B. Toon
1:40 PM-6:00 PM, Hall A-C (Moscone South), **B53A. Biogeodynamics and Earth System Sciences II Posters**	
1:40-1:40 PM	**B53A-0651. On the geomorphic feedbacks between vegetation and topography in tidal marshes** C. Da Lio; A. D'Alpaos; M. Marani
1:40 PM-6:00 PM, Hall A-C (Moscone South), **B53E. Quantifying Heterogeneity of Landscapes and Ecosystems in Earth System Models II Posters**	

1:40-1:40 PM	**B53E-0707. Parameterization of an Active Thermal Erosion Site, Caribou Creek, Alaska** R. Busey; W.R. Bolton; J.E. Cherry; L.D. Hinzman
1:40-1:40 PM	**B53E-0710. Quantifying Interdependence among Processes and Characterizing Dynamic Controls across Spatial Scales by Linking Climate, Hydrology and Ecosystem Models** L.D. Hinzman; W.R. Bolton; J. Cable; B. Nijssen; D.D. Morton; D.P. Lettenmaier; S.D. Peckham
1:40 PM-6:00 PM, Hall A-C (Moscone South), **B53F. Resilience and Adaptation of Coupled Human and Natural Systems to Global Change II Posters**	
1:40-1:40 PM	**B53F-0751. Impacts of Global Change Scenarios on Ecosystem Services from the World's Rivers** C.J. Vorosmarty
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP53A. Advances in Experimental Earth Surface Processes II Posters**	
1:40-1:40 PM	**EP53A-1013. Sediment transport via needle ice: a new method for diffusive transport on laboratory-scale hillslopes** K.E. Sweeney; J.J. Roering; A.W. Rempel
1:40-1:40 PM	**EP53A-1014. Terrestrial Laser Scanning of a Stream Bank During Naturally and Experimentally Induced Erosion by Groundwater Seepage** N.J. Lyons; H. Mitasova; M.J. Starek; K.W. Wegmann
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP53C. Climate Change and Landscape Response III Posters**	
1:40-1:40 PM	**EP53C-1041. EROSION BY THE STORM HELENA ON BASSE TERRE ISLAND – GUADELOUPE: PAST CLIMATIC CONSEQUENCES** C. Delacourt; P. Allemand; E. Lajeunesse; O. Devauchelle
1:40-1:40 PM	**EP53C-1047. Long-term fluvial response to Hawaiian Island subsidence through the Pacific Trade-Wind Inversion** D. Ward; J. Galewsky
1:40-1:40 PM	**EP53C-1056. Interpreting climate-driven aggradation and incision along the fringes of a decaying mountain range** A. Langston; G.E. Tucker; R.S. Anderson; M.A. Foster; S.P. Anderson
1:40-1:40 PM	**EP53C-1057. Frequency-dependent Response of Landscapes to Climatic Forcings** V. Godard; G.E. Tucker; B. Fisher; D.W. Burbank; B. Bookhagen
1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP53D. Coevolution of Glaciation and Glaciated Mountains II Posters**	
1:40-1:40 PM	**EP53D-1070. Quantification of Glacial Erosion with Shallow Ice Approximation and Thermally-Coupled, Stokes Flow Landscape Evolution Models.** R.M. Headley; T.A. Ehlers

1:40 PM-6:00 PM, Hall A-C (Moscone South), **EP53E. Process-Oriented Multiapproach Erosion Analysis in High Mountains: Decade to Millennia Timescales II Posters**	
1:40-1:40 PM	**EP53E-1080. Decadal to Millennial scale erosion rates in the Nepal Himalayas** C. Andermann; S. Bonnet; R. Gloaguen; A. Crave; S. Merchel; R. Braucher; D.L. Bourles
1:40 PM-3:40 PM, 2010 (Moscone West), **EP53H. River Morphodynamics and Channel Patterns: How Do River Patterns Come to be Different? II**	
1:40-1:55 PM (Conflict)	**EP53H-01. Vegetal Encroachment on Point Bar Deposits as a Control on Width Variation in Meandering Rivers *(Invited)*** G. Parker; E. Eke; K. Asahi; Y. Shimizu; J.M. Nelson
1:40 PM-6:00 PM, Hall A-C (Moscone South), **GC53C. The Anthropocene: Confronting the Prospects of a +4°C World II Posters**	
1:40-1:40 PM	**GC53C-1292. Possible dynamics of technological metals in the Anthropocene** E. Goldstein
1:40-1:40 PM	**GC53C-1295. Human induced flooding of the Indus River in 2010: How it changed the landscape** A. Kettner; J.P. Syvitski; I. Overeem; G.R. Brakenridge
1:40-1:40 PM	**GC53C-1296. Early Anthropogenic Transformation of the Danube-Black Sea System** L. Giosan; M.J. Coolen; J.O. Kaplan; S. Constantinescu; F. Filip; M. Filipova-Marinova; A. Kettner; N. Thom
1:40-1:40 PM	**GC53C-1301. A distributed analysis of Human impact on global sediment dynamics** S. Cohen; A. Kettner; J.P. Syvitski
1:40 PM-6:00 PM, Hall A-C (Moscone South), **H53E. Stream Temperature: Understanding Drivers of Change and Improving Prediction III Posters**	
1:40-1:40 PM	**H53E-1581. Effect of catchment spatial characteristics on groundwater inflows influencing the thermal regimes of a Danish lowland stream using high resolution temperature measurements** K. Matheswaran; P. Thorn; D. Rosbjerg; E. Boegh
1:40 PM-3:40 PM, 3020 (Moscone West), **H53O. Wetlandscape Dynamics and Functions II**	
1:40-1:55 PM (Conflict)	**H53O-01. Spatial organization of bio-geomorphic features in tidal marshes *(Invited)*** M. Marani; C. Da Lio; A. D'Alpaos
1:40 PM-3:40 PM, 2020 (Moscone West), **IN53D. Semantics and Cyberinfrastructures for Next Generation Science II**	
1:40-1:55 PM (Conflict)	**IN53D-01. Providing Data Access for Interdisciplinary Research *(Invited)*** R.P. Hooper; A. Couch
1:40 PM-3:40 PM, 310 (Moscone South), **V53F. Earth Materials at the Mesoscale: Nature and Processes II: Cosponsored by MSA**	

1:55-2:10 PM	**V53F-02. Using Neutron Scattering to Understand How Porosity opens in Weathering Rocks to Form Regolith** ***(Invited)*** S.L. Brantley; E. Bazilevskaya; L. Jin; G. Rother; D.R. Cole; A. Sitchler; X. Gu
1:40 PM-3:40 PM, 2008 (Moscone West), **EP53F. Coastal Geomorphology and Morphodynamics II**	
2:25-2:40 PM (Conflict)	**EP53F-04. Variations of Morphologic Changes induced by Tropical Storm Debby along Three Barrier Island, West-Central Florida, USA** P. Wang; T. Roberts
1:40 PM-3:40 PM, 2010 (Moscone West), **EP53H. River Morphodynamics and Channel Patterns: How Do River Patterns Come to be Different? II**	
2:25-2:40 PM (Conflict)	**EP53H-04. River bifurcation: Learning from non-bifurcating experimental channels.** ***(Invited)*** W. Kim
2:55-3:10 PM	**EP53H-06. Records of transient avulsion-related river patterns in ancient deposits: evidence for different styles of channel-floodplain coupling** ***(Invited)*** E.A. Hajek; D. Edmonds; C. Millard; L. Toms; C. Fogaren
1:40 PM-3:40 PM, 2008 (Moscone West), **EP53F. Coastal Geomorphology and Morphodynamics II**	
3:10-3:25 PM	**EP53F-07. Morphodynamics and Sedimentology of a Falling Stage Sandy Fjord Delta, Goose River, Labrador** R. Slingerland; D.A. Edmonds; D.R. Parsons; J.L. Best; J. Royce; A. Burpee; J. Cederberg; R. Caldwell; A. Nijhuis; A. McGuffin
4:00 PM-6:00 PM, 2008 (Moscone West), **EP54A. Coastal Geomorphology and Morphodynamics III**	
4:00-4:15 PM	**EP54A-01. Morphodynamics of tidal networks: advances and challenges** ***(Invited)*** G. Coco; M. Olabarrieta; B. van Maanen; Z. Zhou; R. Tinoco
4:00 PM-6:00 PM, 3022 (Moscone West), **H54F. Water Quality and Quantity in Urban Systems: Arid Systems, Coupled Systems, and Climate Change**	
4:30-4:45 PM (Conflict)	**H54F-03. Integration of Urban Features into a Coupled Groundwater-Surface Water Model** A.S. Bhaskar; C. Welty; R.M. Maxwell
4:00 PM-6:00 PM, 103 (Moscone South), **S54D. Understanding Recent and Historical Seismicity in the Central and Eastern U.S. III (Video On-Demand)**	
4:30-4:45 PM (Conflict)	**S54D-03. Understanding Earthquake Processes in the Central and Eastern US and Implications for Nuclear Reactor Safety** D. Seber; S. Tabatabai
4:00 PM-6:00 PM, 104 (Moscone South), **IN54B. Designing a Road Map for Workflow Cyberinfrastructure in the Geosciences: From Big Data to the Long Tail (Video On-Demand)**	

5:00-5:15 PM	**IN54B-05. Modeling Frameworks, Workflows and Community Modeling: Where are we now and where do we go from here?** ***(Invited)*** S.D. Peckham
4:00 PM-6:00 PM, 2008 (Moscone West), **EP54A. Coastal Geomorphology and Morphodynamics III**	
5:15-5:30 PM (Conflict)	**EP54A-06. Overland flow in sand dunes: feedbacks between aeolian and hydrological processes** S. Fagherazzi; A.M. Priestas
4:00 PM-6:00 PM, 2005 (Moscone West), **EP54B. Do Characteristic Landscape Features Correspond to a Unique Process? II**	
5:15-5:30 PM (Conflict)	**EP54B-06. River channel lateral migration and strath terrace evolution: Quantitative predictions using a new bank coupling approach** A.B. Limaye; M.P. Lamb
4:00 PM-6:00 PM, 2020 (Moscone West), **IN54A. Advancing Partnerships, Collaborative Platforms, and Knowledge Networks in the Earth Sciences II**	
5:15-5:30 PM (Conflict)	**IN54A-06. The Community Surface Dynamics Modeling System: Experiences on Building a Collaborative Modeling Platform** ***(Invited)*** I. Overeem; E. Hutton; A. Kettner; S.D. Peckham; J.P. Syvitski
4:00 PM-6:00 PM, 2005 (Moscone West), **EP54B. Do Characteristic Landscape Features Correspond to a Unique Process? II**	
5:30-5:45 PM (Conflict)	**EP54B-07. Effects of Imposed Variable Rates of Lateral Subsidence on a Deltaic System** ***(Invited)*** W. Kim; J. Kopp
4:00 PM-6:00 PM, 3024 (Moscone West), **H54E. Recent Advances in Understanding the Hydrology of the Great Lakes Region II**	
5:30-5:45 PM (Conflict)	**H54E-07. Assessment of the Area Ratio Method and the value of gages for predicting runoff in intermittently gaged portions of the Great Lakes basin** L.M. Fry; T. Hunter; M.S. Phanikumar; V. Fortin; A.D. Gronewold
4:00 PM-6:00 PM, 2005 (Moscone West), **EP54B. Do Characteristic Landscape Features Correspond to a Unique Process? II**	
5:45-6:00 PM	**EP54B-08. Unique and Generic Signatures of Transient Wave Ripple Evolution** ***(Invited)*** J. Perron; P. Myrow; J.C. Kao; K.L. Huppert; A. Koss; A.D. Wickert

Final ID: A11B-0048

Using satellite measurements of stable water isotopes to constrain hydrologic processes in the isotope-enabled Community Atmosphere Model.

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2. CIRES, University of Colorado, Boulder, CO, United States.
3. Atmospheric Chemistry Division, NCAR, Boulder, CO, United States.

Body: The isotopic composition of water in the atmosphere can provide insight into the physical processes that modify and regulate clouds and water vapor. For example, cloud ice sublimation leaves a different isotopic signature in the water vapor than the evaporation of liquid droplets. Thus if one can simulate the isotopic values of atmospheric clouds and water vapor correctly, one may have additional confidence that they are simulating the related physical processes in an accurate way. Understanding these processes is vital for predicting future changes in water vapor and clouds, which can produce changes in precipitation, as well as global temperatures by modifying Earth's radiation balance. For the past several years, measurements of the isotopic composition of water vapor in the atmosphere have been measured by satellite, from nadir-viewing measurements of the lower troposphere to limb-viewing measurements of the upper troposphere and lower stratosphere. These types of measurements provide the spatial scales needed to use isotopes in the evaluation of climate models, particularly when the models have been modified to simulate water isotopes directly. This study will present results from a new, isotope-enabled version of NCAR's Community Atmosphere Model version 5 (CAM5), which is the atmospheric component of the Community Earth System Model (CESM). Simulations of stable water isotopes from this model will be compared to several different satellite datasets to provide evidence of model performance. Additional simulations with differently tuned or modified cloud parameters will also be shown. These parameters include the cloud detrainment rate and the ice fraction temperature dependence, which can be difficult to measure, but have a strong influence on the moisture distribution in the atmosphere. This will be done to demonstrate how isotopic information can help constrain these model physics that are otherwise poorly constrained, and thus potentially improve the atmospheric hydrologic cycle in climate models.

Final ID: ED11C-0765

Antecedent Moisture Conditions and the Application to Runoff Prediction in a Low Relief Peatland

J. Gibson; [1]; *J. Gibson;* [1]; *S. J. Birks;* [1];
1. University of Victoria, Victoria, BC, Canada.

Body: Vertical water balances have been used in the past to determine areas that will experience potential runoff where little to no relief exists. In the boreal plains this becomes a useful tool to predict runoff based on indexed precipitation events. By coupling runoff with precipitation indices and hydrograph response in different vegetation ecosystems a better understanding can be gained as to the role antecedent moisture plays in fens and bogs. This will be useful information as to determining flow and runoff of nutrients specifically the deposition of atmospheric sulphur and nitrogen on a surficial level in peatlands.

A peatland complex was examined comprised of a treed bog, and fen. The site was instrumented with meteorological stations, water table wells and water capacitance loggers in each of the vegetation ecosystems. In addition, surface water and rain event water was sampled for isotopic labelling of water (2H and 18O) and was used to aid in the tracing of the flow and runoff of the water. Results suggest the precipitation response in the treed bog is more muted than in the fen. As well, response changed based on antecedent moisture conditions.

Final ID: GC11C-1008

A Method for Downscaling Regional Climate Model Projections of Temperature and Precipitation Using Local Topographic Lapse Rates

S. J. Praskievicz; [1]; *P. J. Bartlein;* [1];

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Body: One of the major challenges of climate change impact analysis is the development of appropriate approaches for downscaling climate change scenarios. Output from regional climate models (RCMs) using general circulation model (GCM) output as boundary conditions provides dynamically downscaled scenarios, but the resolution of RCMs, while significantly less coarse than that of GCMs, is still often in the range of tens of kilometers. In mountainous regions, this resolution results in a smoothed topography and, consequently, inaccurate simulation of orographic effects on temperature and precipitation. In such regions, the simulated present and future climate is not necessarily well-represented by RCMs, which can bias impact analysis results. One approach for dealing with this bias is to adjust the model output to the real-world topography of a region, which requires the estimation of local topographic lapse rates for temperature and precipitation. Here we use the Parameter-elevation Regressions on Independent Slopes Model (PRISM) dataset, which consists of monthly temperature and precipitation for the contiguous United States on a 30-arc second (approximately 4-km) grid, based on regressions of observed climate station data against elevation, slope, aspect, and other topographic variables. We used the PRISM data to calculate local monthly topographic lapse rates for maximum and minimum temperature and precipitation for the northwestern United States through singular value decomposition regression of elevation against climatic variables within a neighborhood of grid cells. The resulting lapse rates show climatologically reasonable spatial patterns such as winter temperature inversions in valleys, positive summer temperature lapse rates in the coastal zone, and high positive precipitation lapse rates on the windward side of mountain ranges. We applied these lapse rates as a topographic correction of RCM output from the North American Regional Reanalysis (NARR) to produce high-resolution grids of temperature and precipitation for the NARR period and compared the resulting downscaled timeseries to station data. Skill scores indicate that this lapse rate-based approach performs well relative to simple interpolations of the NARR data to station locations or to average climatology or persistence. We then applied the lapse rate-based downscaling to RCM projections of future climate change from the North American Regional Climate Change Assessment Program (NARCCAP). The local topographic lapse rate downscaling approach can produce high-resolution, topographically corrected climate change scenarios for use in hydrological modeling or other applications. The method is especially useful in mountainous regions, in which RCMs have difficulty resolving steep local gradients of temperature and precipitation resulting from topography.

Final ID: H11D-1219

On the applicability of available methods for estimating daily evapotranspiration by using diurnal water table fluctuations

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1. Key Laboratory of Water Cycle & Related Land Surface Processes, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China.
2. Department of hydrogeology, Moscow State University, Moscow, Russian Federation.

Body: Shallow groundwater is mainly discharged by phreatophytes in many riparian ecosystems of arid and semiarid environment, while estimation of groundwater evapotranspiration (ETG) in these regions still remains a challenge for regional water resources assessment. Since White (1932) provided a method for estimating ETG based on diurnal groundwater dynamics, a number of modifications of White method were developed for calculating ETG; however, a major source of uncertainty in all these methods is associated with estimates groundwater recovery rate. In this study, we developed a criterion of quasi-steady conditions of groundwater evapotranspiration processes, which based on a coupled consideration of the water and energy balance. This criterion was tested by using the one dimensional saturated-unsaturated flow model, and use of these guidelines with the White method approaches could enable minimize uncertainty in estimating ETG. The developed methodology is illustrated by estimation of ETG rate using high-accuracy monitoring data of groundwater fluctuations for Goby environments in a typical arid region of northwest China.

Final ID: H11E-1235

Thirty years of interpreting stream tracer data: A look back, a look sideways, and a look forward *(Invited)*

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Body: The pioneering work of Bencala and Walters (Water Resources Research, 1983) spawned numerous studies in which stream tracer data have been used to characterize the hydrologic processes that govern solute transport. The primary focus of these studies is the quantification of "transient storage", the delay in mass transport attributable to slow-moving waters within the stream channel and hyporheic zone. Characterization of transient storage is often achieved through analysis of tracer breakthrough curves using a simulation model that quantifies the size of the storage zone and the rate of exchange between the storage zone and the advective channel. This approach has led to significant advancements in our understanding of groundwater-surface water interactions, nutrient spiraling, and contaminant transport. Despite this progress, several deficiencies in the overall approach have been identified and are the subject of recent investigations. These deficiencies include the use of a single storage zone to quantify both surface storage and hyporheic exchange, the use of an exponential residence time distribution, and the inability to characterize long hyporheic flowpaths. Although research related to these deficiencies is still ongoing, there is a need to develop and maintain standard methods that allow investigators to compare research results. Future research efforts should therefore focus on methods that can objectively quantify transient storage in a consistent manner.

Final ID: H11E-1243

MODELING THE THERMAL BALANCE BETWEEN RIVER ICE AND GROUNDWATER SPRINGS

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2. Inst. of Arctic Biology, Univ. of Alaska Fairbanks, Fairbanks, AK, United States.

Body: We modeled the thermal balance between groundwater discharge and ice-free areas in the Tanana River, located a region characterized as discontinuous permafrost, near Fairbanks, Alaska. Under degrading permafrost conditions, these areas have been hypothesized to have increased winter discharge due to increasing contributions from groundwater flow. In the winter, interior Alaskan rivers are fed almost entirely by groundwater, which also serves as an external source of heat energy to the system. Several reaches of the river fed by groundwater springs remain ice-free or have dangerously thin ice throughout the winter despite air temperatures that dip below -40 °C. These areas are dangerous for winter travelers who regularly use Alaskan rivers as wintertime travel corridors. Our model allows us to explore the relationship between seasonal groundwater flows and ice thickness under changing atmospheric conditions. Our model results explore how local and regional changes in groundwater flow can affect ice thickness by addressing two primary research questions: 1) What physical factors influence seasonal ice dynamics on the Tanana River? 2) How is the thermal balance maintained between changing groundwater flow and cold air temperatures? We show that the empirical estimates of heat flux due to upwelling may degrade river ice at a rate of nearly 1 cm/day, but that this rate of ice thinning is reduced by increasing temperature gradients between the air and water temperatures, but increased by greater snow depth. Our study considers how changing hydrologic conditions may affect inhabitants of northern latitudes under potential hydrologic scenarios associated with a changing climate.

Final ID: H11F-1253

Groundwater surface water mixing in a semi-confined karst aquifer using field and particle tracking forward-model inversions

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2. Department of Geophysics, Colorado School of Mines, Golden, CO, United States.
3. Université de Savoie, Le Bourget du Lac, France.
4. Department of Geological Sciences, University of Florida, Gainesville, FL, United States.
5. Water Institute , University of Florida, Gainesville, FL, United States.

Body: In the upper Santa Fe River Basin, surface water flows into karst conduits of the groundwater system. Surface water may then recharge and exchange with groundwater in porous matrix of the Floridan aquifer, depending on differences in the head in the conduits versus head in the matrix, which is controlled by discharge at the Santa Fe River sink-rise system. However, the spatial extent of mixing and exchange dynamics at different flow conditions is unknown. In our study, we directly examine the mixing of karst conduit and matrix waters and how spatial and temporal patterns of mixing change during high flow and baseflow conditions. Using an electrical resistivity tomography dataset, we quantify spatial mixing based on time-lapse electrical conductivities at two separate field sites. We then simulate flow gradients based on head between karst conduits and matrix to determine fractions of groundwater and surface water in matrix and conduit during high flow and baseflow using our particle-tracking model. These particles represent groundwater-surface water concentrations, which are used as a representation of resistivity. Using field and forward model time-lapse inversions we directly compare observations that reflect exchange dynamics, spatial mixing and flow conditions. This comparison provides details on matrix-conduit mixing and temporal dynamics at different flow conditions, illustrating the spatial extents of recharge to the porous matrix of a karst groundwater system.

Final ID: H11F-1256

Comparison between limestone and glacial karst evolution mechanisms ***(Invited)***

H. Rajaram;[1];

1. Civil Engineering, University of Colorado, Boulder, CO, United States.

Body: Karst systems in limestone evolve over geological time-scales by dissolution of limestone, driven by water flow through fractures. Glacial karst systems evolve on daily-seasonal time scales, by melt-driven enlargement of conduits and water passages. There are many similarities between the basic mechanisms involved in the development of these two types of karst systems: A positive feedback between increased water flow rates, higher undersaturation, and increased dissolution rates, facilitates conduit growth in karst systems; a positive feedback between increased flow rates and turbulent/viscous heat generation facilitates conduit growth in karst systems. Due to the inherent tendency of these positive feedback mechanisms to amplify differences, both systems are prone to unstable growth patterns that likely explain the formation of discrete passages/shafts/conduits. Both systems often evolve in tensile stress or low stress regimes, where closure of enlarged conduits is weak/slow. There are also some important differences between limestone and glacial karst systems: creep closure is an important process that constrains the growth of glacial karst systems, but is not a factor in limestone karst systems; hydrofracture propagation on short time scales plays an important role in the growth and propagation of glacial karst systems, but is seldom a factor in limestone karst systems. Glacial karst systems are also highly influenced by subtle thermodynamic processes occurring in the neighborhood of the pressure melting point, which varies with pressure. Thus the role of turbulent/viscous dissipation of mechanical energy to produce thermal energy is a uniquely important feature of glacial karst systems. I will present an overview of the fundamental governing equations for the development of limestone (both epigenic and hypogene) and glacial (both temperate and polythermal) karst systems. I also present examples of numerical simulations of prototype limestone and glacial karst evolution and relate simulation results to field observations.

Final ID: IN11B-1462

Plug-and-Play Hydrologic Modeling: Is That Really Possible? *(Invited)*

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Body: The vision of a community of modelers that shares reusable and well-tested process components that can easily be linked together to create new models is very appealing. In this vision, trying a new method for modeling a physical process, comparing two methods from different groups or coupling two models together to do something new is painless and straightforward. Scientists get to spend more time on understanding the natural world, making predictions and analyzing model results. Students quickly learn how different approaches differ and how sensitive models are to various input parameters. They begin to understand how the whole system works instead of just one part of it. Believe it or not, this vision is on the verge of becoming a reality but we aren't quite there yet.

In order for the hydrologic modeling community to achieve this vision and work together in this way it isn't necessary for us to drastically change the way we do things. However, we do need to agree on some minimum set of standards and these have mostly to do with providing standardized metadata decriptions of our models and our data sets. We already have great software tools for accommodating differences between models that allow them to be coupled and work together. These include tools for spatial regridding, time interpolation, unit conversion, format conversion and even computer language interoperability. But in order to write software that automatically invokes these tools when needed, we need standardized machine and human-readable metadata descriptions of our models and data sets. The purpose of this talk is to review some of the technical problems that have already been solved, including the tools mentioned above, and then explain why we need standardized metadata in order to achieve the vision of seamless model integration. A new standard called the CSDMS Standard Names that is being developed for the Community Surface Dynamics Modeling System (CSDMS) project to address this problem will also be introduced.

URL : http://csdms.colorado.edu

Final ID: IN11B-1463

Advancing Cyberinfrastructure to support high resolution water resources modeling *(Invited)*

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1. Civil and Environmental Engineering, Utah State University, Logan, UT, United States.
2. Civil and Architectural Engineering, University of Wyoming, Laramie, WY, United States.
3. Civil and Environmental Engineering, Brigham Young University, Provo, UT, United States.

Body: Addressing the problem of how the availability and quality of water resources at large scales are sensitive to climate variability, watershed alterations and management activities requires computational resources that combine data from multiple sources and support integrated modeling. Related cyberinfrastructure challenges include: 1) how can we best structure data and computer models to address this scientific problem through the use of high-performance and data-intensive computing, and 2) how can we do this in a way that discipline scientists without extensive computational and algorithmic knowledge and experience can take advantage of advances in cyberinfrastructure? This presentation will describe a new system called CI-WATER that is being developed to address these challenges and advance high resolution water resources modeling in the Western U.S. We are building on existing tools that enable collaboration to develop model and data interfaces that link integrated system models running within an HPC environment to multiple data sources. Our goal is to enhance the use of computational simulation and data-intensive modeling to better understand water resources. Addressing water resource problems in the Western U.S. requires simulation of natural and engineered systems, as well as representation of legal (water rights) and institutional constraints alongside the representation of physical processes. We are establishing data services to represent the engineered infrastructure and legal and institutional systems in a way that they can be used with high resolution multi-physics watershed modeling at high spatial resolution. These services will enable incorporation of location-specific information on water management infrastructure and systems into the assessment of regional water availability in the face of growing demands, uncertain future meteorological forcings, and existing prior-appropriations water rights. This presentation will discuss the informatics challenges involved with data management and easy-to-use access to high performance computing being tackled in this project.

URL : http://ci-water.org/

Final ID: IN11B-1468

Integration of Earth System Models and Workflow Management under iRODS for the Northeast Regional Earth System Modeling Project

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Body: The Northeast Regional Earth System Model (NE-RESM, NSF Award #1049181) integrates weather research and forecasting models, terrestrial and aquatic ecosystem models, a water balance/transport model, and mesoscale and energy systems input-out economic models developed by interdisciplinary research team from academia and government with expertise in physics, biogeochemistry, engineering, energy, economics, and policy. NE-RESM is intended to forecast the implications of planning decisions on the region's environment, ecosystem services, energy systems and economy through the 21st century. Integration of model components and the development of cyberinfrastructure for interacting with the system is facilitated with the integrated Rule Oriented Data System (iRODS), a distributed data grid that provides archival storage with metadata facilities and a rule-based workflow engine for automating and auditing scientific workflows.

Final ID: IN11B-1470

Design and Application of an Ontology for Component-Based Modeling of Water Systems

M. Elag; [1]; *J. L. Goodall;* [1];
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Body: Many Earth system modeling frameworks have adopted an approach of componentizing models so that a large model can be assembled by linking a set of smaller model components. These model components can then be more easily reused, extended, and maintained by a large group of model developers and end users. While there has been a notable increase in component-based model frameworks in the Earth sciences in recent years, there has been less work on creating framework-agnostic metadata and ontologies for model components. Well defined model component metadata is needed, however, to facilitate sharing, reuse, and interoperability both within and across Earth system modeling frameworks. To address this need, we have designed an ontology for the water resources community named the Water Resources Component (WRC) ontology in order to advance the application of component-based modeling frameworks across water related disciplines. Here we present the design of the WRC ontology and demonstrate its application for integration of model components used in watershed management. First we show how the watershed modeling system Soil and Water Assessment Tool (SWAT) can be decomposed into a set of hydrological and ecological components that adopt the Open Modeling Interface (OpenMI) standard. Then we show how the components can be used to estimate nitrogen losses from land to surface water for the Baltimore Ecosystem study area. Results of this work are (i) a demonstration of how the WRC ontology advances the conceptual integration between components of water related disciplines by handling the semantic and syntactic heterogeneity present when describing components from different disciplines and (ii) an investigation of a methodology by which large models can be decomposed into a set of model components that can be well described by populating metadata according to the WRC ontology.

Final ID: IN11E-1492

Application of the Open Geospatial Consortium (OGC) Web Processing Service (WPS) Standard for Exposing Water Models as Web Services *(Invited)*

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Body: Management of water systems often requires the integration of data and models across a range of sources and disciplinary expertise. Service-Oriented Architectures (SOA) have emerged as a powerful paradigm for providing this integration. Including models within a SOA presents challenges because services are not well suited for applications that require state management and large data transfers. Despite these challenges, thoughtful inclusion of models as resources within a SOA could have distinct advantages that center on the idea of abstracting complex computer hardware and software from service consumers while, at the same time, providing powerful resources to client applications. With these advantages and challenges of using models within SOA in mind, this work explores the potential of a modeling service standard as a means for integrating models as resources within SOA. Specifically, we investigate the use of the Open Geospatial Consortium (OGC) Web Processing Service (WPS) standard for exposing models as web services. Through extension of a Python-based implementation of WPS (called pyWPS), we present a demonstration of the methodology through a case study involving a storm event that floods roads and disrupts travel in Columbia, SC. The case study highlights the benefit of an urban infrastructure system with its various subsystems (stormwater, transportation, and structures) interacting and exchanging data seamlessly.

Final ID: OS11D-1691

The response of Long Island Sound Circulation to Nor'easters and Hurricanes *(Invited)*

J. O'Donnell; [1, 2]; *T. Fake;* [1, 2]; *J. O'Donnell;* [2];
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Body: Long Island Sound (LIS) is subject to two different kind of severe storms: extra-tropical (nor'easters) and tropical (hurricanes) cyclones. Extra-tropical cyclones generate much larger sea level anomalies in the western Sound because the locally generated setup augments the shelf response. As a result, 2m anomalies due to nor'easters are common. Hurricanes are infrequent and effect New England in the late summer. The direction of the winds they induce, and their rapid translation speeds does not lead to the same superposition of effects and the sea level response is similar throughout the Sound. Circulation models have been demonstrated to perform well when compared to sea level observations but comparisons to current profile measurements are few. We demonstrate the skill of an implementation of FVCOM for LIS by comparing predictions to 3 ADCP profile measurements and summarize characteristics of the circulation induced throughout the Sound.

Final ID: T11B-2566

Convective Removal of the Northeastern Portion of the North-American Tectospheric Root and the Late Cenozoic Uplift of the Appalachians

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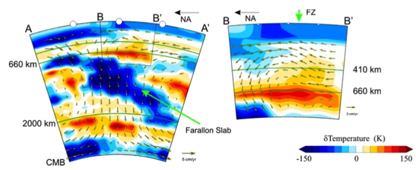
5. GEOTOP Dept Sci Terre & Atmos, Univ Quebec Montreal , Montreal, QC, Canada.

Body: The underlying cause of the present elevation of the Appalachians remains enigmatic. We explore the hypothesis that convective removal of the mantle tectospheric root of cratonic North America is, at least in part, responsible for the current elevation of the Appalachians. We utilize mantle convection models driven by buoyancy inferred from seismic tomography models that satisfy a combined set of geodynamic constraints related to the present-day plate-motions, surface gravity, dynamic topography anomalies, and excess core ellipticity (Simmons et al., 2007; 2009). The resulting present day flow depicts a dense subcrustal lithosphere that is being convectively removed by an influx of hot asthenospheric mantle from the east associated with a convection cell driven in part by the ongoing subduction of the Farallon slab deep in the mantle beneath Eastern North America. To study the evolution of this process, we employ backward-in-time mantle convection calculations that are based on a high-Rayleigh approximation to the time-dependent equation for conservation of (thermal) energy and examine its geologic and geophysical consequences. Our first order results are compatible with an early to mid-Miocene rejuvenation of the Appalachians.



Selected mantle structure and flow cross-sections for the Eastern US. Whole mantle west-east, surface to CMB, cross-section AA’ shows the location of Farallon slab. Cross-section BB’ is the west-east upper mantle region as outlined by the box in AA’. The relative direction of the North American (NA) plate is indicated for each cross-section, as is the location of the Fall Zone (FZ). Mantle heterogeneity is obtained from TX2007 (Simmons et al., 2007).

Final ID: IN11F-03

Combining data from multiple sources using the CUAHSI Hydrologic Information System *(Invited)*

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Body: The Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) has developed a Hydrologic Information System (HIS) to provide better access to data by enabling the publication, cataloging, discovery, retrieval, and analysis of hydrologic data using web services. The CUAHSI HIS is an Internet based system comprised of hydrologic databases and servers connected through web services as well as software for data publication, discovery and access. The HIS metadata catalog lists close to 100 web services registered to provide data through this system, ranging from large federal agency data sets to experimental watersheds managed by University investigators. The system's flexibility in storing and enabling public access to similarly formatted data and metadata has created a community data resource from governmental and academic data that might otherwise remain private or analyzed only in isolation. Comprehensive understanding of hydrology requires integration of this information from multiple sources. HydroDesktop is the client application developed as part of HIS to support data discovery and access through this system. HydroDesktop is founded on an open source GIS client and has a plug-in architecture that has enabled the integration of modeling and analysis capability with the functionality for data discovery and access. Model integration is possible through a plug-in built on the OpenMI standard and data visualization and analysis is supported by an R plug-in. This presentation will demonstrate HydroDesktop, showing how it provides an analysis environment within which data from multiple sources can be discovered, accessed and integrated.

URL : http://his.cuahsi.org

Final ID: B11E-07

Mechanisms driving ocean carbon cycle response to rising atmospheric CO_2: results from the Community Earth System Model, version 1

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2. Earth System Science, University of California, Irvine, Irvine, CA, United States.
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Body: We present results from simulations conducted with the Community Earth System Model, version 1 (CESM1 (BGC)), which includes marine ecosystem dynamics and ocean biogeochemistry. We consider fully-coupled 21st century integrations, forced with Representative Concentration Pathway (RCP) projections of radiatively-active atmospheric constituents. We characterize climate-carbon feedbacks on ocean CO$_2$ fluxes in these integrations, using control simulations that include the atmospheric CO$_2$ transient as a boundary condition for sea-air fluxes, but its radiative effects (and those of other transients) are turned off. In RCP8.5 under a constant climate, the ocean carbon sink for anthropogenic CO$_2$ began to stabilize around 2080, due to nonlinearities in carbonate chemistry. Climate change caused further reductions in the ocean carbon sink, such that by 2100, the ocean absorbed about 1 Pg C yr^{-1} less than under constant climate conditions. The carbon cycle response to climate change differed regionally. The North Atlantic was most strongly affected in a relative sense, experiencing a reduction in uptake due to climate change in excess of 40\% by 2100. Strong freshwater forcing in the Subpolar gyre and Labrador Sea regions caused diminished deep convection, which curtailed the supply of nutrients, thereby forcing reductions in biological carbon export and diminished CO$_2$ uptake. The Southern Ocean, by contrast, experienced a smaller, relative climate-induced reduction in CO$_2$ uptake: less than 20\%. In this region, climate change caused a poleward shift and intensification of the westerly winds, which enhanced the upper cell of the meridional overturning circulation; concomitant changes, however, resulted in a reduction in Antarctic Bottom Water formation. Shifting circulation patterns resulted in a net reduction in the resolved advective transport of carbon out of the surface ocean; increased eddy-induced mixing exacerbated this effect: eddy-induced mixing is parameterized (responsive to winds) and a net source of carbon to the surface of the Southern Ocean. Since the Southern Ocean is characterized by ample surface nutrient, reductions in vertical resupply due to enhanced stratification resulted in little change to biological export flux. Climate change caused a reduction in eastern equatorial Pacific outgassing, predominantly driven by enhanced biological production; the mechanisms for this are complex. Stratification resulted in greater macronutrient limitation in regions upstream of the eastern equatorial Pacific upwelling zone. Reduced production in these regions resulted in decreased iron utilization, thereby alleviating iron limitation in the eastern equatorial Pacific upwelling region.

Final ID: C11A-07

Seismicity and Subglacial Hydrological Processes During Early Melt Season, Engabreen, Norway

P. L. Moore; [1]; *J. Winberry;* [2]; *K. Christianson;* [3]; *N. R. Iverson;* [1]; *S. Anandakrishnan;* [4]; *M. Jackson;* [5]; *D. O. Cohen;* [1];

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2. Central Washington University, Ellensburg, WA, United States.
3. St. Olaf College, Northfield, MN, United States.
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Body: A broad array of mechanical and seismic instrumentation was deployed during May 2011 in subglacial tunnels beneath Engabreen, an outlet glacier of the Svartisen ice cap in northern Norway. Following a warm spell, increased melt supply to the glacier bed prompted several episodes of transient ice uplift and establishment of a more efficient basal hydraulic system. In each event, hydrological adjustment was accompanied by three distinct seismic sources, two of which have not been previously documented in glacial environments. High-frequency impulsive events with dominant Rayleigh-wave energy increased their rate-of-occurrence immediately prior to an abrupt change in basal water pressure and normal stress. These events are inferred represent propagation of water-filled crevasses permitting meltwater access to the bed. Ultra-long period (ULP, < 0.001 Hz) horizontal impulses occurred at the onset of basal pressure changes. The origin of these horizontal ULP events is not clear, but a preliminary hypothesis is that they reflect longitudinal stress transfer during hydraulic jacking. During recovery of basal water pressure, vertical ULP deflections were correlated with increases in basal water flux and doubling of local subglacial seismic noise. The increase in seismic noise may represent turbulent flow and bedload sediment transport through newly-opened subglacial meltwater passages. The vertical ULP signal therefore likely reflects meltwater-forced uplift of ice. Surprisingly, although there was direct evidence that jacking activated frictional slip at the bed, there was no clear seismic expression of slip. Thus, broadband seismometers appear to have captured the transit of meltwater through crevasses, into isolated pockets at the glacier bed and then, by promoting ice uplift, draining though newly-established meltwater passages along the bed. Similar seismic sources could be detected elsewhere with strategically-located broadband seismic instrumentation, providing a means of remotely monitoring the hydrological processes that control ice motion.

Final ID: H11N-07

Downscaling Soil Moisture Product from SMOS for Monitoring Agricultural Droughts in South America

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1. University of Florida, Gainesville, FL, United States.

Body: Availability of reliable near-surface soil moisture (SM) estimates at fine spatial resolutions of 1 km and at temporal resolutions of a few days is critical for accurate quantification of drought impacts on crop yields and recommending meaningful management and adaptation strategies. The recently launched European Space Agency-Soil Moisture and Ocean Salinity (ESA-SMOS) and the near-future NASA-Soil Moisture Active Passive (SMAP) missions provide unprecedented, global SM product every 2-3 days at spatial resolutions of ~50 km. In addition, the SMAP will provide a SM product at 10 km . Downscaling the above SM products to 1km is essential for any meaningful drought-related application in agricultural terrains. Optimal downscaling should retain information from higher-order moments and leverage information from auxiliary remote sensing products that are available at fine resolutions.

In this study, a novel downscaling methodology based upon information theory was implemented to obtain distributed SM at 1 km every 3 days, using the SM product from SMOS. Observations of land surface temperature (LST), leaf area index (LAI) and land cover (LC) at 1 km from MODIS, and precipitation at 25 km from TRMM, were used as auxiliary information to facilitate the downscaling process. The use of information-theory in downscaling provides a hierarchical decomposition of image data that is optimal in terms of the transfer of information across scales and is therefore a better alternative to methods that use second-order statistics only. The downscaling methodology was implemented over the agricultural regions in the lower La Plata Basin (L-LPB) in South America. The L-LPB region is of great economic value in South America, where agricultural cover makes up about 25% of the continent’s land area and is vulnerable to high losses in crop yields due to agricultural drought . Both remote sensing and in situ observations (precipitation, temperature, and soil moisture) obtained during the drought period of 2007-2008 were used to train the downscaling methodology. Observations obtained during the growing season of 2010, during which ESA-SMOS observations were available, was used to demonstrate the feasibility of the methodology for monitoring agricultural droughts.

Final ID: P11G-07

Can waterbelt climates resolve the faint young Sun paradox?

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Body: Ancient sediments indicate that liquid water and primitive life were ubiquitous on the Archean Earth despite the faint young Sun. However, energy balance and radiative-convective models require improbably high greenhouse gas abundances to obtain non-glacial climates, violating constraints from geochemical data. A self-consistent solution to the faint young Sun paradox has remained elusive. Here we use the NCAR Community Atmosphere Model version 3 with thermodynamic ocean and sea ice components to simulate the climate circa 2.8 billion years ago. To maintain present day surface temperatures, 0.06 bar of CO2 in a 1 bar atmosphere is required to compensate for a 20 percent reduction in the solar constant. However, waterbelt climates having stable low latitude sea ice margins can be maintained with as little as 500 ppm of CO2 and no additional trace greenhouse species. With 5000 ppm of CO2 nearly 60 percent of the planet remains free from ice. The early Earth is resistant to hard snowball glaciations instead favoring waterbelt climates. The coexistence of a faint young Sun and a weak greenhouse does not exclude the presence of liquid water at the Archean surface.

Final ID: H12B-01

Intermediate-Timescale Vertical Exchange in a Peatland and Implications for Landscape Patterning *(Invited)*

L. G. Larsen; [1, 2]; *J. W. Harvey;* [1]; *M. M. Maglio;* [1, 3];
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2. Geography, University of California, Berkeley, CA, United States.
3. USGS, Middleton, WI, United States.

Body: Stream tracer tests typically provide estimates of hyporheic exchange on timescales of minutes to days, relevant for addressing questions about rapid biogeochemical cycling and microbial uptake. Estimates of longer-timescale surface-subsurface exchange are also useful, particularly for assessing potential legacy effects of water contamination or nutrient enrichment, effects of seasonal forcing on macrophyte and geomorphic dynamics, and processes such as mineral dissolution or evaporative enrichment that occur over long flow paths. Increasingly, naturally occurring tracers such as ^{3}H, ^{3}He, ^{223}Ra and ^{224}Ra, D, and ^{18}O are being combined with inverse modeling approaches to quantify these exchange processes. In the Everglades, use of 3H/3He and Ra have revealed decadal and weekly to yearly timescales of vertical exchange between surface water and the subsurface limestone aquifer, suggesting that legacy effects of phosphorus contamination due to slow exchange between the aquifer and surface-water are likely, and that shorter-timescale mixing results from precipitation and water management activities. Here we add to the picture by using profiles of Cl^{-} to quantify monthly-timescale exchange between peat porewater and surface water in geomorphically distinct zones of slightly different elevation. Resulting quantification of vertical exchange fluxes allows a better assessment of how minor spatial differences in topography in an otherwise nearly flat landscape drives fluxes in the biogeochemically reactive peat layer that may impact freshwater storage, nutrient and vegetation community dynamics, and ultimately, the geomorphic patterning of vegetation and microtopography that underlies the highly valued biodiversity and connectivity of the Everglades ridge and slough landscape. Hyporheic flow patterns suggested a significant ridge-to-slough exchange of water and reactive nutrients during seasonal rewetting but—unlike in many boreal peatlands—did not evidence a subsurface biogeochemical control on landscape patterning.

Final ID: V12B-02

NanoSIMS results from olivine-hosted melt embayments: Modeling ascent rate in explosive basaltic eruptions

A. S. Lloyd; [1]; *T. Plank;* [1]; *P. Ruprecht;* [1]; *E. H. Hauri;* [2]; *H. M. Gonnermann;* [3]; *W. I. Rose;* [4];

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3. Earth Science, Rice University, Houston, TX, United States.
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Body: A critical parameter governing the explosivity of volcanic eruptions is the rate at which magma ascends and degases, because this affects bubble nucleation, coalescence, and ultimately fragmentation. Although several methods have been used to determine magma ascent rates, it remains a poorly constrained parameter for most eruptions. One promising method employs diffusion modeling of H2O and CO2 concentration gradients in melt embayments/open melt inclusions [1,2]. Here we utilize the fine spatial resolution of the nanoSIMS to obtain concentration gradients for five volatile species, improving upon previous efforts that were more limited in spatial resolution (FTIR, [1]) and in number of volatile analytes (H2O only by BSE, [2]). Focusing on explosive basaltic eruptions, for which very little is known about ascent rates, we chose ash and lapilli samples from the Oct 1974 sub-plinian eruption of Volcán de Fuego. Glassy, olivine-hosted embayments with evidence of outlet bubbles were analyzed by nanoSIMS at a minimum distance between spots of 15 µm. Major element zonation in the embayments was investigated by EMP, and high resolution BSE images were captured to complement the nanoSIMS spot measurements for H2O (as in [2]). We report analyses for 5 embayments that vary in length from 100 to 350 µm. Low-solubility volatiles (CO2, H2O, S) decrease towards the embayment outlet, consistent with diffusive reequilibration with the more-degassed surrounding melt. High-solubility volatiles (Cl, F) increase towards the outlet, apparently behaving as magmaphile elements. Major elements exhibit constant concentrations along the embayment, except for a 20-50 µm wide zone near the embayment outlet, perhaps representing a boundary layer at the outlet bubble, where concentrations vary consistent with olivine and clinopyroxene microlite growth. BSE grayscale values are thus affected by both H2O diffusion and major element zonation at the embayment outlet, and cannot be used to estimate H2O concentration gradients [2]. Forward modeling of CO2 and H2O profiles takes into account temperature- and composition-dependent diffusivities and a closed-system degassing path for the exterior magma (as observed in melt inclusions from the same sample). Assuming a constant decompression rate from 200 MPa and an initial composition of 600 ppm CO2 and 4.3 wt% H2O at 1030°C, models yield preliminary results with very rapid ascent times (100 s, or 2 MPa/s). A two-stage model, however, allows slower decompression during CO2 exsolution (0.1 MPa/s) and faster ascent when H2O begins to exsolve (1.5 MPa/s), for total ascent times on the order of 10 to 20 minutes. This example highlights the additional constraints that come from measuring multiple diffusing species. [1] Liu et al, JGR, 2007 [2] Humphreys et al, EPSL, 2008.

Final ID: GC12B-03

A Regional Earth System Model of the Northeast Corridor: Analyzing 21st Century Climate and Environment *(Invited)*

C. J. Vorosmarty; [1]; *F. Duchin;* [2]; *J. M. Melillo;* [3]; *W. M. Wollheim;* [4]; *J. Gonzalez;* [5]; *D. W. Kicklighter;* [3]; *B. Rosenzweig;* [1]; *P. Yang;* [1]; *F. Lengyel;* [1]; *B. M. Fekete;* [1];

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3. Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA, United States.
4. Dept. of Natural Resources, University of New Hampshire, Durham, NH, United States.
5. Dept. of Mechanical Engineering, City College of New York, New York, NY, United States.

Body: The Northeast region (NE) exhibits many of the changes taking place across the Nation's landscapes and watersheds, yet also provides a unique lens through which to assess options for managing large-scale natural resource systems. We report here on a regional NSF-funded Earth System Modeling (EaSM) project, which has assembled an interdisciplinary research team from academia and government with expertise in physics, biogeochemistry, engineering, energy, economics, and policy engagement. The team is simultaneously studying the evolution of regional human-environment systems and seeking to improve the translation of research findings to the planning community. We hypothesize that there are regionally-significant consequences of human decisions on environmental systems of the NE, expressed through the action of both natural and engineered human systems that dictate the region's biogeophysical state, ecosystem services, energy and economic output. Our central goal is: To build a Northeast Regional Earth System Model (NE-RESM) that improves understanding and capacity to forecast the implications of planning decisions on the region's environment, ecosystem services, energy systems and economy through the 21st century. We are using scenario experiments to test our hypothesis and to make forecasts about the future. We see the proposed research as a major step forward in developing a capacity to diagnose and understand the state of large, interacting human-natural systems. Major foci include: the application of meso-scale atmospheric physics models to drive terrestrial-aquatic ecosystem models; a linked ecosystem services accounting tool; geospatial modeling of anthropogenic GHG emissions and biotic source/sinks at improved space/time resolutions; and meso-economic input-output model to evaluate the impacts of ecosystem services constraints on subregional economies. The presentation will report on recent progress across three strategic planning fronts, which are important to the region and for which we have sufficient information, insights, and technical capabilities: (i) Biofuels, regional carbon balance and sequestration capacity, and potential resurgence of agriculture across the region; (ii) Energy production capacity in light of water constraints on hydro- and thermoelectric facilities; and, (iii) Pollution management to support water quality standards and protect inland aquatic habitat.

The Northeast Regional Earth System Model (NE-RESM)

Final ID: OS12B-03

Intermittent ephemeral river-breaching

A. J. Reniers; [1, 2]; *J. H. MacMahan;* [3]; *E. L. Gallagher;* [4]; *A. Shanks;* [6]; *S. Morgan;* [5]; *M. Jarvis;* [5]; *E. B. Thornton;* [3]; *J. Brown;* [3]; *A. Fujimura;* [2];

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Body: In the summer of 2011 we performed a field experiment in Carmel River State Beach, CA, at a time when the intermittent natural breaching of the ephemeral Carmel River occurred due to an unusually rainy period prior to the experiment associated with El Nino. At this time the river would fill the lagoon over the period of a number of days after which a breach would occur. This allowed us to document a number of breaches with unique pre- and post-breach topographic surveys, accompanying ocean and lagoon water elevations as well as extremely high flow (4m/s) velocities in the river mouth during the breaching event. The topographic surveys were obtained with a GPS-equipped backpack mounted on a walking human and show the evolution of the river breaching with a gradually widening and deepening river channel that cuts through the pre-existing beach and berm. The beach face is qualified as a steep with an average beach slope of 1:10 with significant reflection of the incident waves (MacMahan et al., 2012). The wave directions are generally shore normal as the waves refract over the deep canyon that is located offshore of the beach. The tide is mixed semi-diurnal with a range on the order of one meter. Breaching typically occurred during the low-low tide. Grain size is highly variable along the beach with layers of alternating fine and coarse material that could clearly be observed as the river exit channel was cutting through the beach. Large rocky outcroppings buried under the beach sand are also present along certain stretches of the beach controlling the depth of the breaching channel. The changes in the water level measured within the lagoon and the ocean side allows for an estimate of the volume flux associated with the breach as function of morphology, tidal elevation and wave conditions as well as an assessment of the conditions and mechanisms of breach closure, which occurred on the time scale of O(0.5 days). Exploratory model simulations will be presented at the conference examining the processes responsible for the development of the river breaching from the initial stages to a wide-open river flow and subsequent closure.

Final ID: GC12B-05

Sharing Water Data to Encourage Sustainable Choices in Areas of the Marcellus Shale *(Invited)*

S. L. Brantley; [1]; *J. D. Abad;* [3]; *J. Vastine;* [2]; *D. Yoxtheimer;* [1]; *C. Wilderman;* [2]; *R. Vidic;* [3]; *R. P. Hooper;* [4]; *K. Brasier;* [1];

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Body: Natural gas sourced from shales but stored in more permeable formations has long been exploited as an energy resource. Now, however, gas is exploited directly from the low-porosity and low-permeability shale reservoirs through the use of hydrofracturing. Hydrofracturing is not a new technique: it has long been utilized in the energy industry to promote flow of oil and gas from traditional reservoirs. To exploit gas in reservoirs such as the Marcellus shale in PA, hydrofracturing is paired with directional drilling. Such hydrofracturing utilizes large volumes of water to increase porosity in the shale formations at depth. Small concentrations of chemicals are added to the water to improve the formation and maintenance of the fractures. Significant public controversy has developed in response to the use of hydrofracturing especially in the northeastern states underlain by the Marcellus shale where some citizens and scientists question whether shale gas recovery will contaminate local surface and ground waters. Researchers, government agencies, and citizen scientists in Pennsylvania are teaming up to run the ShaleNetwork (www.shalenetwork.org), an NSF-funded research collaboration network that is currently finding, collating, sharing, publishing, and exploring data related to water quality and quantity in areas that are exploiting shale gas. The effort, focussed initially on Pennsylvania, is now developing the ShaleNetwork database that can be accessed through HydroDesktop in the CUAHSI Hydrologic Information System. In the first year since inception, the ShaleNetwork ran a workshop and reached eight conclusions, largely focussed on issues related to the sources, entry, and use of data. First, the group discovered that extensive water data is available in areas of shale gas. Second, participants agreed that the Shale Network team should partner with state agencies and industry to move datasets online. Third, participants discovered that the database allows participants to assess data gaps. Fourth, the team was encouraged to search for data that plug gaps. Fifth, the database should be easily sustained by others long-term if the Shale Network team simplifies the process of uploading data and finds ways to create community buy-in or incentives for data uploads. Sixth, the database itself and the workshops for the database should drive future agreement about analytical protocols. Seventh, the database is already encouraging other groups to publish data online. Finally, a user interface is needed that is easier and more accessible for citizens to use. Overall, it is clear that sharing data is one way to build bridges among decision makers, scientists, and citizens to understand issues related to sustainable development of energy resources in the face of issues related to water quality and quantity.

Final ID: IN12A-04

From Particles and Point Clouds to Voxel Models: High Resolution Modeling of Dynamic Landscapes in Open Source GIS *(Invited)*

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Body: Multitemporal data acquired by modern mapping technologies provide unique insights into processes driving land surface dynamics. These high resolution data also offer an opportunity to improve the theoretical foundations and accuracy of process-based simulations of evolving landforms. We discuss development of new generation of visualization and analytics tools for GRASS GIS designed for 3D multitemporal data from repeated lidar surveys and from landscape process simulations. We focus on data and simulation methods that are based on point sampling of continuous fields and lead to representation of evolving surfaces as series of raster map layers or voxel models. For multitemporal lidar data we present workflows that combine open source point cloud processing tools with GRASS GIS and custom python scripts to model and analyze dynamics of coastal topography (Figure 1) and we outline development of coastal analysis toolbox. The simulations focus on particle sampling method for solving continuity equations and its application for geospatial modeling of landscape processes. In addition to water and sediment transport models, already implemented in GIS, the new capabilities under development combine OpenFOAM for wind shear stress simulation with a new module for aeolian sand transport and dune evolution simulations. Comparison of observed dynamics with the results of simulations is supported by a new, integrated 2D and 3D visualization interface that provides highly interactive and intuitive access to the redesigned and enhanced visualization tools. Several case studies will be used to illustrate the presented methods
and tools and demonstrate the power of workflows built with FOSS and highlight their interoperability.

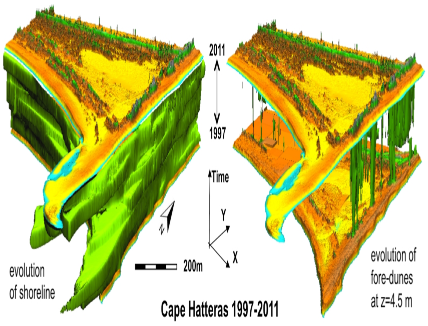

Figure 1. Isosurfaces representing evolution of shoreline and a z=4.5m contour between the years 1997-2011at Cape Hatteras, NC extracted from a voxel model derived from series of lidar-based DEMs.

Final ID: P12B-04

An upper limit on Early Mars atmospheric pressure from small ancient craters

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Body: Planetary atmospheres brake, ablate, and disrupt small asteroids and comets, filtering out small hypervelocity surface impacts and causing fireballs, airblasts, meteors, and meteorites. Hypervelocity craters <1 km diameter on Earth are typically caused by irons (because stones are more likely to break up), and the smallest hypervelocity craters near sea-level on Earth are ~20 m in diameter. 'Zap pits' as small as 30 microns are known from the airless moon, but the other airy worlds show the effects of progressively thicker atmospheres:- the modern Mars atmosphere is marginally capable of removing >90% of the kinetic energy of >240 kg iron impactors; Titan's paucity of small craters is consistent with a model predicting atmospheric filtering of craters smaller than 6-8km; and on Venus, craters below ~20 km diameter are substantially depleted.

Changes in atmospheric CO2 concentration are believed to be the single most important control on Mars climate evolution and habitability. Existing data requires an early epoch of massive atmospheric loss to space; suggests that the present-day rate of escape to space is small; and offers only limited evidence for carbonate formation. Existing evidence has not led to convergence of atmosphere-evolution models, which must balance poorly understood fluxes from volcanic degassing, surface weathering, and escape to space. More direct measurements are required in order to determine the history of CO2 concentrations. Wind erosion and tectonics exposes ancient surfaces on Mars, and the size-frequency distribution of impacts on these surfaces has been previously suggested as a proxy time series of Mars atmospheric thickness.

We will present a new upper limit on Early Mars atmospheric pressure using the size-frequency distribution of 20-100m diameter ancient craters in Aeolis Dorsa, validated using HiRISE DTMs, in combination with Monte Carlo simulations of the effect of paleo-atmospheres of varying thickness on the crater flux. These craters are interbedded with river deposits, and so the atmospheric state they record corresponds to an era when Mars was substantially wetter than the present, probably >3.7 Ga. An important caveat is that our technique cannot exclude atmospheric collapse-reinflation cycles on timescales much shorter than the sedimentary basin-filling time, so it sets an upper limit on the density of a thick stable paleoatmosphere. We will discuss our results in relation to previous estimates of ancient atmospheric pressure, and place new constraints on models of Early Mars climate.

Final ID: IN12A-05

A Modular GIS-Based Software Architecture for Model Parameter Estimation using the Method of Anchored Distributions (MAD)

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Body: The Method of Anchored Distributions (MAD) is an inverse modeling technique that is well-suited for estimation of spatially varying parameter fields using limited observations and Bayesian methods. This presentation will discuss the design, development, and testing of a free software implementation of the MAD technique using the open source DotSpatial geographic information system (GIS) framework, R statistical software, and the MODFLOW groundwater model. This new tool, dubbed MAD-GIS, is built using a modular architecture that supports the integration of external analytical tools and models for key computational processes including a forward model (e.g. MODFLOW, HYDRUS) and geostatistical analysis (e.g. R, GSLIB). The GIS-based graphical user interface provides a relatively simple way for new users of the technique to prepare the spatial domain, to identify observation and anchor points, to perform the MAD analysis using a selected forward model, and to view results. MAD-GIS uses the Managed Extensibility Framework (MEF) provided by the Microsoft .NET programming platform to support integration of different modeling and analytical tools at run-time through a custom “driver.” Each driver establishes a connection with external programs through a programming interface, which provides the elements for communicating with core MAD software. This presentation gives an example of adapting the MODFLOW to serve as the external forward model in MAD-GIS for inferring the distribution functions of key MODFLOW parameters. Additional drivers for other models are being developed and it is expected that the open source nature of the project will engender the development of additional model drivers by 3rd party scientists.

URL: http://mad.codeplex.com

Final ID: A13G-0269

A Model of Surface Energy Budget over Water, Snow and Ice Surfaces

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Body: The recently developed maximum entropy production (MEP) model of turbulent and conductive heat fluxes over land surfaces is generalized to water/snow/ice surfaces. Analogous to the case of land surfaces, an analytical solution of latent, sensible and surface water/snow/ice heat flux is derived as a function of surface temperature (e.g. sea surface temperature) and surface net short- and long wave radiation. Compared to the classical bulk transfer equations based models, the MEP model does not need wind speed, near-surface air temperature and roughness lengths as input. The model is parameter parsimonious. A test of the MEP model against observations from several field experiments has suggested its usefulness and potential for predicting conductive and turbulent fluxes over water/snow/ice surfaces. The model is a suitable tool for remote sensing of the surface energy balance over oceans, snow covered Antarctica and sea ice. The model can also be incorporated into regional and global atmospheric models as an alternative algorithm for surface energy/water balance.

Final ID: A13I-0302

Nanoscale ice measured through in-situ ellipsometry and ESEM.

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Body: Ellipsometery presents a unique way to measure the thicknesses of thin samples to the precision of nanometers; however, this technique has yet to be fully applied to a discipline of atmospheric science that requires utmost precision: the study of growing and ablating cloud ice crystals. We use a diffusion chamber to grow cirrus cloud ice crystals epitaxially and measure their evolving thicknesses and other nanoscale optical properties with a spectroscopic ellipsometer. The environment in which the ice crystals grow is controlled to mimic the conditions present in the atmosphere. Dynamic measurements of crystal thickening reveal a precision record of linear basal facet growth rates. These growth rate measurements are evaluated in the context of standard particle growth parameterizations. Much uncertainty exists in ice crystals' radiative scattering properties, something that may be improved by accounting for mesoscopic surface roughness. It is the goal of this study, in part, to see whether the measurements we make — attained by the reflection of a light beam on the ice crystals — can be corrected by using a model for surface roughness. Because of the difficulty in analyzing the mesoscopic surfaces of ice crystals, emphasis is also placed on development of a mechanism to transport ice crystals to the Princeton Imaging and Analysis Center's FEI-Quanta 200 environmental scanning electron microscope (ESEM) for examination and imaging. Once images are taken at the Princeton ESEM, the thicknesses of the ice crystals are measured by post-processing geometrical analysis. Our data from the ESEM are then compared to the readings made by our ellipsometer in order to assess the validity of our novel method to grow and investigate the nanoscale properties of ice crystals. Here we show the first results of a novel method to investigate the mesoscopic properties of ice at an unprecedented level of precision.

Final ID: C13A-0595

On Snowball Earth, were all inland-sea refugia created equal?

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Body: Evidence suggests that photosynthetic eukaryotic algae survived the so-called Snowball Earth events of the Neoproterozoic. How and where these organisms persisted is not clear, and this problem remains a key criticism of the existence of Snowball Earth events during the Neoproterozoic. With net accumulation of ice at polar regions, and net sublimation at the tropical regions, thick floating ice called sea glaciers flowed from the poles toward the equator, covering the global ocean, and prohibiting the transmission of light into the water below the ice.

We have recently shown that under some climatic conditions, sea glaciers may have been unable to fully penetrate long narrow embayments, or inland seas,in regions of net sublimation, so that refugia could exist at the landward ends of some idealized seas with uniform width.

Those earlier results, derived from analytical solutions to the equations governing ice flow, were restricted to idealized conditions and only allowed for ice-free conditions only under the most optimistic climates. We now show experiments with a numerical model in which width variations, including narrow restrictions representing an inlet strait, can impede sea-glacier penetration.

Final ID: C13D-0651

Modeling permafrost and hydrological cycle interactions in CESM

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Body: Permanently and seasonally frozen soils have a significant influence on energy, water, and carbon and nutrient cycling in high-latitude regions, and thus affect global climate as well. Observations of ground conditions in permafrost regions have shown rapid changes in some locations. Recent projections of permafrost extent made using the Community Earth System Model (CESM) indicate that if current emission levels are maintained, near-surface permafrost areas may be reduced to less than 30% of current values. Model development of CESM has resulted in steady improvements in its ability to reproduce observations of past and current frozen ground conditions. However, biases remain, most notably in the representation of the terrestrial hydrological cycle in high-latitude regions. Here we report on recent improvements to CESM cold-region hydrology, including the movement of water through frozen soils, active layer soil moisture, river discharge, wetlands, and flooding. We then examine the effects of these parameterization changes on projections of end-of-century permanently and seasonally frozen soils and provide a preliminary assessment of potential wetland distribution, river discharge, and soil moisture changes that could be anticipated if large-scale permafrost thaw occurs.

Final ID: EP13C-0859

Multi-resolution estimation of lidar-DTM surface flow metrics to identify characteristic topographic length scales

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Body: Characteristic length scales are present in topographic relief and provide insight into the scale ranges of processes governing catchment erosion. Despite the wide availability now of meter-resolution Digital Terrain Models (DTMs) that can in principle resolve such length scales, their objective measurement is still an unsolved problem. Here we explore how topographic length scales can be extracted from lidar DTMs by analyzing the resolution dependence of key surface drainage measures, and how such scales can be used to construct robust geomorphic feature extraction algorithms.

Inspired by the topographic index of TOPMODEL fame, we identify log(area/slope) and curvature as important metrics for the identification of length scales characteristic of landscape-forming processes. Further inspired by wavelet transform analysis, our key strategy is to smooth topography across a range of resolutions (smoothing kernel widths), then to map surface flow patterns at each resolution, and then to derive distributions of log(area/slope) and other metrics. This approach, first developed by Stark and Stark in 2001 and named Multi-Resolution Estimation (MRE), is based on the idea that the topographic effect of an erosion process dominant over a particular length scale range will vanish once smoothing (and thus resolution) exceeds that length scale range. Using the MRE approach we construct probability density functions and estimate modal values and inter-quartile ranges of topographic variables as a function of resolution and we are able to identify and extract characteristic scale breaks. We show that such scale breaks relate to characteristic topographic length scales in the landscape. We explore how such metrics can be used to aid algorithms designed for extraction of channel heads and other geomorphic features of interest from lidar DTMs, and we discuss the implications for assessing the processes that govern catchment evolution.

References:

Stark, C. P. and G. J. Stark. A channelization model of landscape evolution. Amer. Jour. Sci., 301:486-512, 2001

Final ID: GC13A-1050

Global wave climate change from a community ensemble of wind-wave projections

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2. Princeton University, Princeton, NJ, United States.
3. Escola Naval, Lisbon, Portugal.
4. Kyoto University, Kyoto, Japan.
5. Environment Canada, Toronto, ON, Canada.

Body: Until recently, coastal impacts of climate change studies have been preoccupied with the influence of sea-level rise. There is a need to determine how other driving forces in the coastal zone (e.g., waves and storm surges) will respond to a changing climate to aid these studies.

Several research groups have independently investigated projected changes in global wind-wave climate. These groups have applied different projection methods - both statistical and dynamical - to determine the projected wave climate change signal. The Coordinated Ocean Wave CLimate Project (COWCLIP) has carried out an intercomparison of this 'ensemble of opportunity' to establish the variance within available global wind-wave projections.

We find agreed projected change in wave climate over considerable portions of the global ocean. The multi-model ensemble is too limited to systematically sample the full range of uncertainty associated with wave climate projections. However, variance of wave climate projections associated with study methodology appears to dominate other sources of uncertainty (e.g., climate scenario and model uncertainties).

Final ID: GP13B-1129

Sherman Statistic Reveals Non-Random Behavior in the Phanerozoic Geomagnetic Polarity Time Scale

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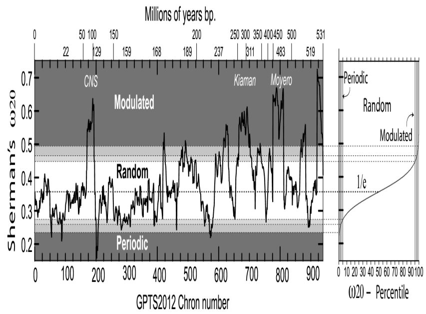
Body: The Phanerozoic geomagnetic polarity reversal record has fluctuated repeatedly through a variety of statistical states, including hyperchrons and superchrons, characterized by periodicity, randomness, and modulation. Transition from one state to another is typically rapid. Here we quantify this statistical evolution through application of Sherman's ω statistic to the 2012 edition of the Phanerozoic Geomagnetic Polarity Time Scale (GPTS2012). Sherman's ω evaluates the randomness of a sequence of events distributed in time. The probability distribution of ω is defined for small sample populations n, and approaches a normal distribution for n>20. The expected value of ω for a random sequence is 1/e; event sequences with ω significantly lower than 1/e are periodic, and those with ω significantly higher than 1/e are modulated. The 960 event-long GPTS2012 has an ω value of 0.5652, which is nearly 30 standard deviations higher than 1/e, implying a non-random modulation in reversal frequency, possibly of mantle origin. The superchrons, along with the poorly constrained and under-sampled pre-M-sequence of GPTS2012 contribute to this high statistic. Removing the effects of superchrons by considering only the most recent 170 chrons gives ω=0.3988, which is 1.73 standard deviations higher than 1/e, and not significantly different from a random sequence. The time evolution of ω can be examined with sliding windows of the GPTS defined by number of events n (variable time interval), or by constant time interval (variable n). For example, the evolution of ω for n=20, shown below, indicates that the GPTS evolves mainly in the random regime with occasional excursions into the modulated regime associated mainly with superchrons, and the periodic regime, at 12 Ma, 19.7 Ma, 129 Ma and 228 Ma. Geodynamo models also yield large ω associated with superchrons and small ω at some times when reversals are frequent, with a range that is similar to the GPTS.



Final ID: H13F-1425

An Intercomparison of RADARSAT-2, SMOS and Field Measured Soil Moisture in the Berambadi Watershed, South India

S. k. Tomer;[1, 2]; *A. Al Bitar;*[1]; *M. Sekhar;*[2]; *O. Merlin;*[1]; *S. Bandyopadhyay;*[3]; *Y. H. Kerr;*[1];
1. CESBIO, Toulouse, Haute-Garonne, France.
2. Civil Enginnering, Indian Institute of Science, Bangalore, KARNATAKA, India.
3. Indian Space Research Organization, Bangalore, KARNATAKA, India.

Body: This study presents an intercomparison of the RADARSAT-2 derived soil moisture, SMOS derived soil moisture and field measured soil moisture in the Berambadi watershed, South India. Seventeen images of RADARSAT-2, SMOS products, and field data collected in the 50 field plots during 2010-2011 were used. The data were collected from field campaigns in the framework of AMBHAS project. A non parametric algorithm was developed based on the CDF transformation to retrieve the soil moisture from RADARSAT-2 backscatter coefficient at a spatial resolution of 100 m based on the measured soil moisture. The developed algorithm to retrieve surface soil moisture from RADARSAT-2 provided a good estimate of the field plot soil moisture with a RMSE of 0.05 cm^3 cm^{-3}.

The average soil moisture from RADARSAT-2 and field measured soil moisture were compared to SMOS derived soil moisture at the watershed scale. Several averaging strategies were considered to take into account the surface heterogeneity and SMOS antenna patterns. Results were analysed by taking into consideration the soil texture heterogeneity, radio frequency interference effect and climatic effect. SMOS underestimated the soil moisture in compare to both RADARSAT-2 and field averaged soil moisture. A bias correction for the SMOS data is suggested using Clayton copula. SMOS showed a better correlation with the RADARSAT-2 watershed averaged soil moisture than directly averaged field soil moisture, as field campaign covered a smaller region of the watershed than RADARSAT-2 data. This shows the potential synergy between the use of active/passive microwave soil moisture for upscalling/downscalling soil moisture.

URL: http://www.ambhas.com/

Final ID: C13G-03

High Resolution Radar Measurements of Snow Avalanches

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Body: Geophysical mass flows, such as snow avalanches, are a major hazard in mountainous areas and have a significant impact on the infrastructure, economy and tourism of such regions. Obtaining a thorough understanding of the dynamics of snow avalanches is crucial for risk assessment and the design of defensive structures. However, because the underlying physics is poorly understood there are significant uncertainties concerning current models, which are poorly validated due to a lack of high resolution data. Direct observations of the denser core of a large avalanche are particularly difficult, since it is frequently obscured by the dilute powder cloud. We have developed and installed a phased array FMCW radar system that penetrates the powder cloud and directly images the dense core with a resolution of around 1 m at 50 Hz over the entire slope. We present data from recent avalanches at Vall\'ee de la Sionne that show a wealth of internal structure and allow the tracking of individual fronts, roll waves and surges down the slope for the first time. We also show good agreement between the radar results and existing measurement systems that record data at particular points on the avalanche track.

Final ID: V13G-03

How does a single precipitation event erode a landscape? Clues from meteoric 7Be and 10Be analysis of suspended sediments and soils

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Body: Stream sediment contains a history recorded in isotopes that cling to suspended particles. In this study we exploit this recorded history in order to understand how a single precipitation event erodes the landscape at two watershed sites (Bisley I and Mameyes) within the Luquillo Critical Zone Observatory, Puerto Rico. We use fallout cosmogenic radionuclides Beryllium-7 (7Be) and Beryllium-10 (10Be) to determine the provenance of suspended sediment at various stages of a hydrograph. Sediments from source areas within the watersheds, such as stable ridge crests and active landslide scars, were also sampled and analyzed. Exploiting the large difference in half-life, the 10Be/7Be ratio of suspended sediments coupled with the concentration and nature of organic material present show original depth of mobilized stream sediment in the hillslope.

The storm hydrographs of a one-month recurrence interval storm on June 7th, 2011 were sampled at both watersheds. In the small watershed (0.067 km2), storm discharge and total suspended solids (TSS) show short lag times between the initiation of precipitation and the initial rise of the hydrograph and no lag time between peak discharge and peak TSS. The larger site (17.8 km2) had a lag time of approximately 30 minutes between the initiation of precipitation and a rise in discharge and had a 15-minute lag between peak stage (which occurred first) and peak TSS, highlighting the longer travel distances that particles must take to reach the stream sampling point in the larger basin.

We compare fallout 7Be nuclide concentration in source sediments and assume a simple, two end-member model to mix these sources in the stream. Soil sediments collected from stable ridge crests (‘old’) have relatively high average 7Be concentrations of 2.7x106 atoms/g±10% and sediments collected from active landslide scars (‘new’) have relatively low 7Be concentrations of 4.0x104 atoms/g±15%. Suspended sediments had an average 7Be concentration of 7.2x105 atoms/g±8%, indicating a mixing of sediment pools.

Results from the two-component mixing-model indicate that, in the small watershed, new sediments accounted for 84% of newly mobilized total suspended sediments while old sediments only accounted for 16% as a discharge weighted mean over the entire hydrograph. The highest peak of old sediment (24% of TSS) at this site corresponds to the peak in stage, with old sediment percentages decreasing from peak stage to the end of sampling. Peak new sediment occurred at the rising limb (81% of TSS) and immediately after the receding limb (84% of TSS) of the hydrograph. These results are consistent with the fact that landslide scars mar the small watershed and expose bare, non-vegetated, deep-sourced material for transport off of the hillslopes during storm events. In the large watershed, the storm mobilized more stable soils (36%) and less new sediment (64%) than in the small watershed. Peak old sediment is witnessed after the peak stage within the larger watershed site, where it stabilizes around 50% for approximately an hour, then decreases with the receding limb of the hydrograph. Conversely, peak new sediment occurred during the rising limb, then decreased during peak flow, then began to increase during the later portion of the receding limb.

Final ID: A13Q-04

Increased Anthropogenic Sulfur Dioxide Negligibly Impacts Stratospheric Aerosol Compared to Moderate Volcanoes during the decade 2000-2010

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3. Atmospheric and Oceanic Sciences, University of Colorado, Boulder, CO, United States.
4. Laboratory for Atmospheric and Space Physics, Boulder, CO, United States.
5. Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Boston, MA, United States.
6. Earth System Laboratory, National Center for Atmospheric Research, Boulder, CO, United States.
7. Aerospace Engineering Sciences, University of Colorado, Boulder, CO, United States.

Body: Observations of stratospheric aerosol have shown increases of 4-7% per year since 2000. Unfortunately, observations alone have been unable to unambiguously partition the increase between its anthropogenic and natural sources. Here we use a global climate model coupled to a sectional aerosol microphysical model to attribute the source of the observed trend. Specifically, we compare model runs that include the increases in anthropogenic sources of sulfur dioxide near the Asian monsoon and the string of moderate volcanic injections of sulfur dioxide into the stratosphere observed from 2000 to 2010. Comparing model results to satellite observations reveals that volcanic eruptions are the primary reason for the observed increases in stratospheric aerosols over the past decade. During this time period, significant anthropogenic influences on stratospheric aerosol were not observed.

Final ID: OS13G-04

Detecting Suspended Sediments from Remote Sensed Data in the Northern Gulf of Mexico

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Body: The Sediment Analysis Network for Decision Support (SANDS) project utilized remotely sensed data from Landsat and MODIS, both prior and following landfall, to investigate suspended sediment and sediment redistribution. The satellite imagery was enhanced by applying a combination of cluster busting and classification techniques to color and infrared bands. Results from the process show patterns associated with sediment transport and deposition related to coastal processes, storm-related sediment transport, post-storm pollutant transport, and sediment-current interactions. Imagery prior to landfall and following landfall are shown to the left for Landsat and to the right for MODIS. Scientific analysis and production of enhanced imagery was conducted by the Geological Survey of Alabama. The Information Technology and Systems Center at the University of Alabama in Huntsville was responsible for data acquisition, development of the SANDS data portal and the archive and distribution through the Global Hydrology Resource Center, one of NASA's Earth Science Data Centers .

SANDs data may be obtained from the GHRC at ghrc.nsstc.nasa.gov and from the SANDS data portal at sands.itsc.uah.edu.

This project was funded by the NASA Applied Sciences Division

URL: http://sands.itsc.uah.edu/

Final ID: H13K-07

Estimating Riverine Water and Constiuent Fluxes in a Data Assimilation Framework

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Body: River systems are the primary means of transporting waters over the landscape from headwaters to basin mouth while carrying various constituents. Rivers give home to diverse aquatic habitats, while serving humans water needs. River discharge is the most accurately measured component of the hydrological cycle, when it is carried out on the ground using traditional in-situ measurements. While in-situ river monitoring is cost competitive to remote sensing alternatives, comprehensive water flux assessments need to combine in-situ and remote sensing observations with hydrological modeling. The capabilities of in-situ vs. remote sensing sensors are largely complementary that data assimilation frameworks built on top of hydrological models can utilize.
The Global Terrestrial Networks for Hydrology (GTN-H) effort of the World Meteorological Organization (WMO) was designed to implement such data assimilation on top of the data assets from its partner institutions. GTN-H seeks to hold a comprehensive repository of a wide range of hydrological information ranging from climate data (including various reanalysis and precipitation data products) that are available for near realtime hydrological simulations, in-situ discharge records collected by the Global Runoff Data Centre, Koblenz, Germany, complemented by key water quality variables from UNEP's Global Environmental Monitoring – Water (GEMS/Water) programme.

The modeling platform serving GTN-H is currently built on the Framework for Aquatic Modeling of the Earth System (FrAMES) developed by the CUNY Environmental CrossRoads Initiative with contributions from the University of New Hampshire and Colorado University. FrAMES offers high degree of flexibility in configuring large scale hydrological simulations coupled with the capability of tracking dissolved and suspended constituents.

This presentation will show the key components of the GTN-H data archive and the application of FrAMES to produce value added hydrological simulation and data assimilation products assessing riverine water and constituent fluxes.
URL: http://www.gth-h.net

Final ID: H14E-01

Impact Assessment of Large Scale Floods Using Imaging Spectroscopy

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5. River Studies, USGS-CERC, Columbia, MO, United States.
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Body: The Lower Mississippi River experienced an extreme flood event during April-May 2011 due to springtime snowmelt and excessive rainfall. In order to protect the city of Cairo the US Army Corps of Engineers breached a two mile long levee on the Birds Point New Madrid (BPNM) floodway inundating about 527 sq. kms of farmland. The entire operation was coordinated with a number of data collection activities in terms of stage and discharge measurements at inflow and outflow points and various other locations in the floodway. Subsequently LiDAR, Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) flights and soil sample were collected after the floodwaters receded. IKONOS and Worldview 2 images show large plumes of sediments originating in the O'Bryan's ridge of the BPNM floodway and extending to more than 20 km downstream. We postulate imaging spectroscopy will enable us to identify various surface constituents and help us in characterizing a flooding event of such a large spatial extent in extensive detail. This has not been explored before. In this study we have used AVIRIS remote sensing data to explore and quantify the landscape characteristics of the floodway using different indices and spectral signatures of materials. Atmospherically corrected surface reflectance values were obtained from the AVIRIS at sensor radiance values using ATCOR 4 incorporating the MODTRAN radiative transfer model. Normalized Difference Vegetation Index (NDVI) and moisture stress index values computed from the AVIRIS data shows strong signals of high moisture stress and very low NDVI values in the zones of heavy scouring such as O Bryan's ridge and it is possible to spatially map those locations even in absence of topographic data. This is further substantiated by the available post flood topographic LiDAR data. Laboratory physical and chemical characterization of soil samples and their GIS analyses indicate soils most vulnerable to erosion were along a straight flow path from the breach point to its discharge point at the southern end of the floodway. Physical and chemical analyses of soil are used in conjunction with imaging spectroscopy data for characterizing the soil cover of the landscape using statistical techniques. We have used the Spectral Angle Mapper (SAM) classifier algorithm on the AVIRIS data together with USGS spectral library and LOPEX (Leaf Optical Properties EXperiment) databases and obtained good classification results. The SAM classification algorithm was able to classify woody vegetation accurately and also pick up spectral signatures of cultivated crops such as corn and soy fairly accurately. The algorithm also helped to exactly map the spatial extent of some very typical soil spectra near O'Bryan's ridge obtained through endmember collection, possibly explaining the deposition in the floodway as floodwaters receded. Some of the historic meanders of Mississippi were also highlighted in different indices and classifications from the AVIRIS data showing evolutionary history between topography and vegetation dynamics.

Final ID: B14A-02

Hydrocarbon biodegradation following Deepwater Horizon: A compound specific point of view *(Invited)*

D. L. Valentine; [1]; *M. C. Redmond;* [1]; *S. D. Mendes;* [1]; *C. Aeppli;* [2]; *C. M. Reddy;* [2]; *T. B. Ryerson;* [3];
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Body: The sinking of the Deepwater Horizon drilling unit led to the uncontrolled release of petroleum into the Gulf of Mexico with significant impacts on the Gulf's ecosystem. The discharged petroleum contained thousands of distinct compounds each with different physical and chemical properties and thus different pathways of transport and different susceptibilities toward biodegradation. This molecular complexity contributes to uncertainties in defining the fate and impacts of the discharged petroleum. This presentation will consider the fate of abundant compounds and compounds classes highlighting what is known about their biodegradation, as well as the uncertainties in defining their fate.

Final ID: T14B-04

Linked uplift of the Central and Eastern Anatolian plateaus through slab break-off and upper mantle flow ***(Invited)***

T. Schildgen; [1]; *D. Cosentino;* [3]; *C. Yildirim;* [5, 1]; *M. R. Strecker;* [1]; *H. Echtler;* [2]; *B. Rojay;* [4];

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2. Helmholtz-Zentrum Potsdam, Deutsches GeoForschungsZentrum (GFZ), Potsdam, Germany.
3. Dipartimento di Scienze Geologiche, Università degli Studi Roma Tre, Rome, Italy.
4. Jeoloji Mühendisligi Bölümü, Middle East Technical University, Ankara, Turkey.
5. Dept. of Geological Engineering, Istanbul Technical University, Istanbul, Turkey.

Body: Assessing geodynamic mechanisms of topographic growth and plateau development requires integrated observations of surface deformation, crustal-scale faulting, and geophysical characteristics of the crust, lithosphere, and mantle. Next to Tibet in the India-Eurasia collision zone and the Altiplano-Puna of South America, the Central and Eastern Anatolian plateaus are integral parts of the world’s third largest orogenic plateau. In the past 10 years, a wealth of geophysical data has provided new insights into the crust, lithosphere, and mantle beneath Eastern Anatolia. Together with an expansion of high-resolution surveys into Central Anatolia and our biostratigraphic and geochronologic data on the timing and magnitude of uplift along the flanks of the Central Anatolian Plateau, the observations have helped to pinpoint probable mechanisms of orogenic plateau growth in an overall collisional setting. Furthermore, numerical and analogue modeling has brought forth a series of testable hypotheses concerning the effects of various geodynamic processes on surface uplift and plateau development. We combine constraints on surface uplift timing, magnitude, and patterns in the Central and Eastern Anatolian plateaus with structural observations and geophysical constraints to propose that lithospheric delamination and slab break-off occurred first beneath Eastern Anatolia, and propagated westward as far as Cyprus. Additional uplift was likely associated with mantle upwelling following slab break-off. In Central Anatolia, greatest uplift was focused along the southern plateau margin, which was predominantly related to slab break-off and slab tearing. In contrast, uplift and lateral growth along the northern plateau margin appears to result from crustal shortening along the restraining bend of the North Anatolian Fault. All of these uplift mechanisms may be linked, as mantle upwelling and westward mantle flow are predicted to occur after slab break-off, and both processes helped to form the North Anatolian Fault through accelerated westward escape of the Anatolian microplate.

Final ID: NG14B-03

Multiple stable states and pattern formation in tidal environments ***(Invited)***

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Body: Tidal environments display typical and widely occurring patterns on several scales. At the large scale, characteristic tidal morphological structures can be identified: subtidal areas, which are permanently flooded, tidal flats, usually non-vegetated expanses located between mean low water level and mean sea level, and tidal marshes, vegetated landforms located between mean sea level and mean high water level. At a smaller scale, marshes display zonation patterns, patches of nearly homogeneous vegetation species characterized by very sharp transitions in species composition and in the associated soil elevation. This contribution describes modelling and observational results which identify a common mechanism for the emergence of bio-geomorphic patterns in tidal environments. Our analyses show that the coupled dynamics of inorganic sediment transport and local biogenic soil formation leads to multiple stable states. Such states correspond to distinct geomorphic structures at the large scale (subtidal platforms, tidal flats, and marshes) and to zonation patterns at the marsh scale. In both cases the interaction between biotic and biotic processes turns out to be crucial for the emergence of the observed patterns.

Final ID: A21A-0013

FESEM Analysis showing evidence of aerosol Mixing over Indo-Gangetic Plains

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3. Max Planck Institute Chemistry, Mainz, Germany.
4. Sharda University, Greater Noida, India.
5. Applied Science, Vidya College of Engineering, Meerut, India.
6. Radio & Atmospheric Science, CSIR, National Physical Laboratory, New Delhi, India.
7. Geophysics, Banaras Hindu University, Varanasi, India.

Body: Kanpur AERONET deployed in January 2001 has provided a long-term dataset which has been used to understand the aerosol properties and aerosol long term trend in the Indo-Gangetic Plains (IGP). Recent studies have revealed higher black carbon (BC) mass concentrations in the IGP, home to 900 million people. We present analysis of black carbon mass concentrations obtained from several locations in the IGP - namely Varanasi, Lucknow, Kanpur, Greater Noida and Delhi. Measurements show significant diurnal variation with higher BC concentrations in the morning hours and low concentrations during afternoon and evening time. Seasonally, BC concentrations are generally found to be higher during winter months compared to spring and summer monsoon season showing high seasonal variability. The higher winter-time BC is associated with a stable and shallow boundary layer which favors accumulation of pollutants over the IGP, resulting in dense haze conditions. Filter-based analysis, obtained from samples used in Aethalometer and high vacuum sampler, were analyzed to study aerosol surface characteristics and size of particles. Additionally, FESEM (Field Emission Scanning Electron Microscope) analysis show many dust minerals (Na, Al, Si, K, Fe), biogenic substances, fly ash of varying sizes 15 nanometer to 5 micron. The SEM imagery also show heterogeneous aerosol particles, sometimes these mineral grains are seen separately and sometime coating of fly ash and mineral particles are clearly seen. Similarly, Kanpur AERONET data is analyzed during winter and pre-monsoon season, contrasting aerosol properties (SSA, Refractive index and Size distribution) are found that are associated with large aerosol mixing, also supported from the FESEM analysis.

Final ID: B21B-0348

Informing tree-ring reconstructions with automated dendrometer data: the case of single-leaf pinyon (Pinus monophylla) from Great Basin National Park, Nevada, USA

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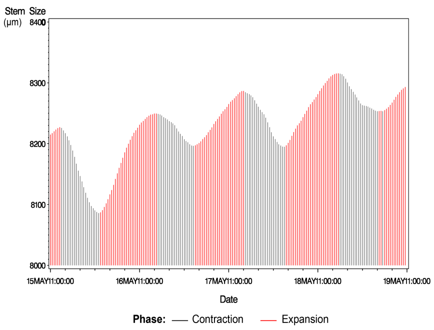
Body: One of the most pressing issues in modern tree-ring science is to reduce uncertainty of reconstructions while emphasizing that the composition and dynamics of modern ecosystems cannot be understood from the present alone. I present here the latest results from research on the environmental factors that control radial growth of single-leaf pinyon (Pinus monophylla) in the Great Basin of North America using dendrometer data collected at half-hour intervals during two full growing season, 2010 and 2011. Automated (solar-powered) sensors at the site consisted of 8 point dendrometers installed on 7 trees to measure stem size, together with environmental probes that recorded air temperature, soil temperature and soil moisture. Additional meteorological variables at hourly timesteps were available from the EPA-CASTNET station located within 100 m of the dendrometer site. Daily cycles of stem expansion and contraction were quantified using the approach of Deslauriers et al. 2011, and the amount of daily radial stem increment was regressed against environmental variables. Graphical and numerical results showed that tree growth is relatively insensitive to surface soil moisture during the growing season. This finding corroborates empirical dendroclimatic results that showed how tree-ring chronologies of single-leaf pinyon are mostly a proxy for the balance between winter-spring precipitation supply and growing season evapotranspiration demand, thereby making it an ideal species for drought reconstructions.

URL: http://dendrolab.org



Final ID: B21D-0391

The effects of forest fire on the frozen soil thermal state

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Body: The upper organic soil layer in high-latitude ecosystem acts as an insulating layer due to its low thermal properties. During summer it does not allow heat to penetrate deeper into the ground and keeps the ground cool. The amount of soil moisture available in the organic layer retards active layer thickening during thawing and increases soil conductivity during the winter when the soil is frozen. Forest fires are able to burn the upper organic layer of soil and disturb the permafrost thermal state stability. The ability of the organic layer to regrow after forest fire could slow active layer thickening rate and, eventually, enable permafrost to recover.

In this study we modeled post-fire permafrost thermal state recovery under different severity burn scenarios for wet (lowland) and dry (upland) boreal forest sites. In order to model this phenomenon we coupled DOSTEM (Dynamic Organic Soil Terrestrial Ecological Model) and GIPL (Geophysical Institute Permafrost Laboratory) model to assess post-fire active layer dynamics. Preliminary results indicate that recovery of the permafrost thermal state depends on the successional growth rate of the upper organic layer and on the amount of available soil moisture.

Final ID: C21C-0612

Validation and application of MODIS-derived clean snow albedo and dust radiative forcing

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Body: Snow albedo is an important control on snowmelt. Though albedo evolution of aging snow can be roughly modeled from grain growth, dust and other light absorbing impurities are extrinsic and therefore must be measured. Estimates of clean snow albedo and surface radiative forcing from impurities, which can be inferred from MODIS 500 m surface reflectance products, can provide this driving data for snowmelt models. Here we use MODSCAG (MODIS snow covered area and grain size) to estimate the clean snow albedo and MODDRFS (MODIS dust radiative forcing of snow) to estimate the additional absorbed solar radiation from dust and black carbon. With its finer spatial (20 m) and spectral (10 nm) resolutions, AVIRIS provides a way to estimate the accuracy of MODIS products and understand variability of snow albedo at a finer scale that we explore though a range of topography. The AVIRIS database includes images from late in the accumulation season through the melt season when we are most interested in changes in snow albedo.

In addition to the spatial validation, we employ the best estimate of albedo from MODIS in an energy balance reconstruction model to estimate the maximum snow water equivalent. MODDRFS calculates radiative forcing only in pixels that are completely snow-covered, so we spatially interpolate the product to estimate the forcing in all pixels where MODSCAG has given us estimates of clean snow albedo. Comparisons with snow pillows and courses show better agreement when the radiative forcing from absorbing impurities is included in the energy balance reconstruction.

Final ID: ED21C-0724

Collaborative Research: Bringing Problem Solving in the Field into the Classroom: Developing and Assessing Virtual Field Trips for Teaching Sedimentary and Introductory Geology

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2. Hillsborough Community College, Tampa, FL, United States.

Body: Coastal Florida offers a unique setting for the facilitation of learning about a variety of modern sedimentary environments. Despite the conflicting concept of “virtual” and “actual” field trip, and the uncertainties associated with the implementation and effectiveness, virtual trips provide likely the only way to reach a large diversified student population and eliminate travel time and expenses. In addition, with rapidly improving web and visualization technology, field trips can be simulated virtually. It is therefore essential to systematically develop and assess the educational effectiveness of virtual field trips. This project is developing, implementing, and assessing a series of virtual field trips for teaching undergraduate sedimentary geology at a large four-year research university and introductory geology at a large two-year community college. The virtual field trip is based on a four-day actual field trip for a senior level sedimentary geology class. Two versions of the virtual field trip, one for advanced class and one for introductory class, are being produced. The educational outcome of the virtual field trip will be compared to that from actual field trip. This presentation summarizes Year 1 achievements of the three-year project. The filming, editing, and initial production of the virtual field trip have been completed. Formative assessments were conducted by the Coalition for Science Literacy at the University of South Florida. Once tested and refined, the virtual field trips will be disseminated through broadly used web portals and workshops at regional and national meetings.

Final ID: GC21E-1012

The application of exergy to human-designed systems

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Body: Exergy is the portion of the total energy of a system that is available for conversion to useful work. Exergy takes into account both the quantity and quality of energy. Heat is the inevitable product of using any form of high-quality energy such as electricity. Modern commercial buildings and industrial facilities use large amounts of electricity and so produce huge amounts of heat. This heat energy typically is treated as a waste product and discharged to the environment and then high-quality energy sources are consumed to satisfy low-quality energy heating and cooling needs. Tens of thousands of buildings and even whole communities could meet much of their heating and cooling needs through the capture and reuse of heat energy. Yet the application of exergy principles often faces resistance because it challenges conventions about how we design, construct and operate human-engineered systems. This session will review several exergy case studies and conclude with an audience discussion of how exergy principles may be both applied and highlighted in formal and informal education settings.

Final ID: H21A-1158

CI-WATER HPC Model: Cyberinfrastructure to Advance High Performance Water Resources Modeling in the Intermountain Western U.S.

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Body: The CI-WATER project is a cooperative effort between the Utah and Wyoming EPSCoR jurisdictions, and is funded through a cooperative agreement with the U.S. National Science Foundation EPSCoR. The CI-WATER project is acquiring hardware and developing software cyberinfrastructure (CI) to enhance accessibility of High Performance Computing for water resources modeling in the Western U.S. One of the components of the project is development of a large-scale, high-resolution, physically-based, data-driven, integrated computational water resources model, which we call the CI-WATER HPC model. The objective of this model development is to enable evaluation of integrated system behavior to guide and support water system planning and management by individual users, cities, or states. The model is first being tested in the Green River basin of Wyoming, which is the largest tributary to the Colorado River. The model will ultimately be applied to simulate the entire Upper Colorado River basin for hydrological studies, watershed management, economic analysis, as well as evaluation of potential changes in environmental policy and law, population, land use, and climate.

In addition to hydrologically important processes simulated in many hydrological models, the CI-WATER HPC model will emphasize anthropogenic influences such as land use change, water resources infrastructure, irrigation practices, trans-basin diversions, and urban/suburban development. The model operates on an unstructured mesh, employing adaptive mesh at grid sizes as small as 10 m as needed- particularly in high elevation snow melt regions. Data for the model are derived from remote sensing sources, atmospheric models and geophysical techniques. Monte-Carlo techniques and ensemble Kalman filtering methodologies are employed for data assimilation. The model includes application programming interface (API) standards to allow easy substitution of alternative process-level simulation routines, and provide post-processing, visualization, and communication of massive amounts of output. The open-source CI-WATER model represents a significant advance in water resources modeling, and will be useful to water managers, planners, resource economists, and the hydrologic research community in general.

URL: http://www.ci-water.org

Final ID: H21C-1187

Risky Business: Development, Communication and Use of Hydroclimatic Forecasts *(Invited)*

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Body: Inter-seasonal and longer hydroclimatic forecasts have been made increasingly in the last two decades following the increase in ENSO activity since the early 1980s and the success in seasonal ENSO forecasting. Yet, the number of examples of systematic use of these forecasts and their incorporation into water systems operation continue to be few. This may be due in part to the limited skill in such forecasts over much of the world, but is also likely due to the limited evolution of methods and opportunities to "safely" use uncertain forecasts. There has been a trend to rely more on "physically based" rather than "physically informed" empirical forecasts, and this may in part explain the limited success in developing usable products in more locations. Given the limited skill, forecasters have tended to "dumb" down their forecasts – either formally or subjectively shrinking the forecasts towards climatology, or reducing them to tercile forecasts that serve to obscure the potential information in the forecast. Consequently, the potential utility of such forecasts for decision making is compromised. Water system operating rules are often designed to be robust in the face of historical climate variability, and consequently are adapted to the potential conditions that a forecast seeks to inform. In such situations, there is understandable reluctance by managers to use the forecasts as presented, except in special cases where an alternate course of action is pragmatically appealing in any case. In this talk, I review opportunities to present targeted forecasts for use with decision systems that directly address climate risk and the risk induced by unbiased yet uncertain forecasts, focusing especially on extreme events and water allocation in a competitive environment. Examples from Brazil and India covering surface and ground water conjunctive use strategies that could potentially be insured and lead to improvements over the traditional system operation and resource allocation are provided.

Final ID: NH21A-1579

Potential Effects of SLR and Land-Cover Changes on Hurricane Surge and Damage

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3. Civil Engineering, Texas A&M University, College Station, TX, United States.

Body: Hurricanes are one of the most costly natural disasters impacting US coastal areas. Recent studies point towards an increase in damages caused by hurricanes, resulting from sea-level rise (SLR), possible hurricane intensification due to a warmer climate and increasing coastal populations. The SLR is one of the most significant factors of climate change that will impact coastal areas. Besides geometrical changes in coastal bays (i.e., deeper water depth and larger surface area), SLR is also expected to have substantial impacts on the patterns and process of coastal wetlands, thereby affecting surge generation and propagation inside the bays. We analyzed the impacts of SLR on hurricane storm surges, structural building damage, and population and businesses affected for coastal bays located on the Texas central coast. To evaluate the effects of SLR on surges, we considered its impacts on changes in land cover and bay geometry caused by SLR. The analyses were conducted using the hydrodynamic model ADCIRC and a wind and pressure field model (PBL) representing the physical properties of historical hurricane Bret and hypothetical storms. The effects of land cover change were represented within ADCIRC by the changes in the frictional drag at the sea bottom and changes in momentum transfer from the wind to the water column caused by vegetation losses. Simulations were performed using a high-resolution unstructured numerical mesh to study surge response in communities along the coastal bays of Texas. First, we evaluated the impacts of land cover changes due to SLR on the surge response. Second, we evaluated the impacts of neglecting land cover changes due to SLR on the surge response. Finally, we evaluated the overall effect of SLR on the mean maximum surge and the consequent extent of the flooded areas.

Although the overall impacts of SLR on surge (water elevation above mean water level) are highly dependent on storm conditions and specific locations within the study area, we showed that the mean maximum surge (spatial average within each bay) increases with SLR. The overall mean maximum surge within the study area increased on average approximately 0.1 m (SLR of 0.5 m) and 0.7 m (SLR of 2.0 m). Simulations neglecting land cover changes due to SLR did significantly underestimate the expected structural damage for buildings. This difference increased with SLR and was affected by the storm meteorological conditions. Stronger and faster storms were associated with higher underestimation. Although considering land cover changes resulted in an overall damage increase, for SLR below 0.5 m, this increase was almost negligible. As a result, the land cover changes arising from SLR are important for damage estimation considering SLR scenarios over at least 0.5 m. For example, when considering a SLR of 0.6 m, based on the Intergovernmental Panel on Climate Change's (2007) high emission scenario, we demonstrated a 10% increase in building structural damage. The assimilation of land cover changes is especially important when calculating expected damages from high SLR scenarios. If a SLR of 2.0 m is assumed, a 35% increase in the expected structural damage to buildings is estimated. In summary, the changes in coastal bay geometry and land cover caused by SLR play an important role in the resulting surge response.

Final ID: OS21B-1691

Observations of Currents in Two Tidally Modulated Inlets

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Body: Observations of currents obtained in two tidally modulated inlets are used to examine the spatial evolution of the vertical structure in hourly averaged mean flow and at tidal frequencies. Field experiments of 30 day duration were conducted at Hampton/Seabrook Harbor, NH, in the Fall of 2011 and again at New River Inlet, NC, in the spring of 2012. The temporal variation and vertical structure of the currents were observed with 600 khz and 1200 khz RDI Acoustic Doppler Current Profilers (ADCP) deployed on low-profile bottom tripods just outside and within the inlet mouth, and with a Nortek Aquadopp Profiler mounted on a jetted pipe on the flank of the inlet channel. Across-inlet current profiles were obtained at each site at various tidal stages with a 1200 khz RDI vessel-mounted ADCP onboard the personal watercraft (the Coastal Bathymetry Survey System, or CBASS) that transited the inlet multiple times at various spatial locations. Flows within the inlet were dominated by semi-diurnal tides, ranging from 2.5 to 4 m in elevation at Hampton/Seabrook Harbor with velocities exceeding 3 m/s, and tides ranging from 1 to 1.5 m in elevation at New River Inlet with velocities exceeding 2 m/s. Flows sampled with the CBASS will be used to examine the horizontal and vertical variation in mean currents (averaged over about 20 – 40 min) at various tidal stages. Currents sampled with the fixed instruments will be used to examine the temporal variation in amplitude and direction of mean currents (averaged over 30 – 60 min) as a function of depth, as well as the amplitude, phase, and rotational structure at tidal frequencies. Observations from the two field sites will be compared and discussed in terms of the spatial and temporal evolution from outside the river mouth to the inner inlet channels over the fortnightly sampling period.

Final ID: OS21B-1733

Performance of a process-based hydrodynamic model in predicting shoreline change

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Body: Shoreline change is controlled by a complex combination of processes that include waves, currents, sediment characteristics and availability, geologic framework, human interventions, and sea level rise. A comprehensive data set of shoreline position (14 shorelines between 1978-2002) along the continuous and relatively non-interrupted North Carolina Coast from Oregon Inlet to Cape Hatteras (65 km) reveals a spatial pattern of alternating erosion and accretion, with an erosional average shoreline change rate of -1.6 m/yr and up to -8 m/yr in some locations. This data set gives a unique opportunity to study long-term shoreline change in an area hit by frequent storm events while relatively uninfluenced by human interventions and the effects of tidal inlets.

Accurate predictions of long-term shoreline change may require a model that accurately resolves surf zone processes and sediment transport patterns. Conventional methods for predicting shoreline change such as one-line models and regression of shoreline positions have been designed for computational efficiency. These methods, however, not only have several underlying restrictions (validity for small angle of wave approach, assuming bottom contours and shoreline to be parallel, depth of closure, etc.) but also their empirical estimates of sediment transport rates in the surf zone have been shown to vary greatly from the calculations of process-based hydrodynamic models. We focus on hind-casting long-term shoreline change using components of the process-based, three-dimensional coupled-ocean-atmosphere-wave-sediment transport modeling system (COAWST). COAWST is forced with historical predictions of atmospheric and oceanographic data from public-domain global models. Through a method of coupled concurrent grid-refinement approach in COAWST, the finest grid with resolution of O(10 m) that covers the surf zone along the section of interest is forced at its spatial boundaries with waves and currents computed on the grids that cover the U.S. East Coast with resolutions as low as O(1 km). The computed patterns of the gradients of surf-zone integrated longshore sediment transport rates are compared with the observed shoreline change.

Final ID: OS21B-1749

Computer Simulations of Self-Organized Bedforms in Tidal Inlets and River Mouths

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Body: Bedforms are ubiquitous in unconsolidated sediments. They range in size from small orbital ripples (lengths ~5-50 cm) to megaripples (lengths ~1-5 m) to large dunes (lengths ~10-100 m). Bedforms are important because they affect sediment transport, flow energy dissipation, and larger-scale hydro- and morpho-dynamics. Bedforms in different environments (eg, deserts, rivers and oceans) are thought to be dynamically similar, therefore modeling approaches from one environment can be used to predicted features in another (Gallagher 2011). Here, a self-organization model (similar to models for subaerial bedforms) is used to simulate the formation and development of bedforms in the combined flows of the surf zone, tidal inlets and river mouths. Sediment flux is determined from combined wave and current flows using a stream power (Bailard 1981) formulation, a bed shear stress (Ribberink 1998) formulations or a third formulation based on simple rules which represent sheet flow. Interestingly, the transport formulation has little effect on model results. Random bed irregularities, either imposed or resulting from small variations in transport representing turbulence, are seeds for bedform development. Feedback between the bed and the flow in the form of a shadow zone downstream of a bedform and increasing flow acceleration with elevation over the crests of bedforms alter the transport such that organized bedforms emerge. The modeled morphology of surf zone megaripples (including cross-sectional shape and plan view) and dynamics (including growth and migration) are similar to natural megaripples. The model can be used to extend the field observations of Clarke and Werner (2004) which suggest that, if conditions remain the same, megaripples will continue to grow. Contrary to many bedform models (e.g., Hulscher et al. 1996, Nielsen 1981, Clifton 1976, Wiberg and Harris 1994), this model supports the idea that bedform spacing is not fixed for a given flow condition. At this time the model is being extended to predict co-existing bedforms of multiple scales in the combined flows (including steady, tidal, wave, and wave driven currents) of river mouths and tidal inlets.

Final ID: PP21B-1975

Using ice sheet models simulations of the last glacial period for the reconstruction of late Holocene ground surface temperatures from borehole temperature profiles

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Body: Borehole temperature profiles (BTP) are not only the source for estimates of the background geothermal heat flow, but also allow the reconstruction of past surface temperature changes. Though shallow boreholes (e. g. less than 500 m) are available nearly everywhere, their use is inhibited by the necessity of extracting the paleoclimatic signal present in the borehole temperature at any depth. However, assuming a long-term ground surface temperature history (GSTH), a generalized reduced temperature may be used for the interpretation of the shallow observations. To derive or test the required assumptions, very deep boreholes (say, > 2000 m) are highly important also for the investigation of shallow measurements.

In areas which were influenced by the Last Glacial Period (LGP), the existence of the large scale ice sheets (e.g. the Laurentide or Weichselian), the spatial distribution of basal conditions, and the timing of their retreat have a major influence on the subsurface temperature regime. Though for parts of its history no longer directly related to atmospheric temperature, deep BTPs carry information on basal conditions and retreat histories, and can thus contribute to the confirmation/rejection, or even calibration of ice sheet models.

From this it follows that a meaningful interpretation of the paleoclimatic signal can only proceed with a reasonable understanding of the regional ice sheet behavior, and, in order to quantify the effects, a calibrated numerical ice sheet model. From such a model, synthetic long term GSTHs may be generated, which can subsequently be used to derive the generalized reduced temperatures for the shallow BTPs. This approach is challenging in several aspects: (1) high-resolution, high-order/hybrid ice sheet models are only now emerging, and the physics at the base (e.g. ice streams) needs improvement; (2) a calibration in the sense of a Bayesian inverse problem are rare, and (3) appropriate sets of borehole data (including the corresponding metadata) still have to be collected and need to undergo strict quality control before being used. A methodological concept for a regional interpretation is also missing. However, a substantial improvement in obtaining the post-glacial GSTH in areas formerly covered by ice sheets with a certain spatial differentiation makes such an effort worthwhile.

Final ID: PP21B-2012

Forest Composition and Biomass at Euroamerican Settlement in the Upper Great Lakes

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Body: The Paleoecological Observatory Network (PalEON) is a collaborative team of paleoecologists, ecological statisticians, and ecosystem modelers with the goals of a) reconstructing forest composition, fire regime, and climate variability in northeastern US forests for the past 2000 years, and b) applying this knowledge to develop more accurate simulations of forest dynamics for the 20th and 21st-century. A major on-going effort in PalEON is to develop high-quality gridded land-cover datasets for the last 2000 years, by combining Public Lands Survey (PLS) and fossil pollen data. Here we present 5-arcmin gridded reconstructions of forest composition, stem density, and basal area for Minnesota, Wisconsin, and upper Michigan, at the time of Euroamerican land surveying, ca. 1850AD. All PLS taxonomic names have been standardized and only tree identifications from the closest two trees at corner points were used. Forest composition and uncertainty was modeled using Bayesian hierarchical model with conditional autoregression and a Gibbs sampler. We are in the process of developing statistical models to characterize the spatial uncertainty in the stem density and biomass reconstructions. Work is underway to merge these reconstructions of forest composition with township data on forest composition for the New England States (Cogbill, 2002) and additional PLS data from lower Michigan, Ohio, Indiana, and Illinois. The PalEON reconstructions of settlement-era vegetation broadly agree with the potential vegetation maps of Ramankutty and Foley (1999); however, the PalEON reconstructions reveal a much higher spatial heterogeneity and more diffuse ecotones between major vegetation formations. These reconstructions will be applied to validate ecosystem model simulations in the PalEON model intercomparison project and set baselines for future simulations, and should improve regional-scale modeling of processes such as fire dynamics, vegetation-atmospheric feedbacks, and carbon cycling.

URL: www.paleonproject.org

Final ID: SH21A-2166

Measurements of Charge States of Solar Energetic Ions Observed by the STEREO Instruments

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Body: The measurements of the Time To Maximums (TTMs) of elemental particle rates in Solar Energetic Particle events employing near Earth instruments in space affords a method by which the charge states of ions, and in particular Fe, can indirectly measured for some SEP events. For some events the TTM is observed to vary strongly as some function of energy and charge to mass ratio (Q/M). When the observed TTMs are plotted as a function of rigidity, the TTMS are seen to vary inversely as a power law over a substantial energy range. The difference between the Q/M ratio of protons and heavier ions (generally near 2) allows the establishment of the spectral index alpha, when the TTMs are plotted not as a function of rigidity R, but instead as β R** α ,where. β is v/c, and α frequently near 1/2. The loci of all the TTMs should be the same for Q>1 ions that are fully stripped, and to the degree they are not, the charge state assumed can be reduced to bring the TTMs for these species into concert with the remainder. The results are clearest for Fe. Because the method depends only on TTMs, we can explore the possibility measuring ion charge states at the STEREO spacecraft as we have done with near Earth instruments.

Final ID: PP21C-02

The magnitude, timing and abruptness of changes in North African dust deposition over the last 20,000 years: Insights into regional atmospheric circulation and dust-related climate impacts

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6. MARUM-Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany.
7. Earth and Atmospheric Sciences, Cornell University, Ithaca, NY, United States.

Body: Reconstructions of eolian dust accumulation in West African margin sediments provide important continuous records of past changes in atmospheric circulation and aridity in the region. Existing records indicate dramatic changes in West African dust emissions over the last 20 ka, including high dust emissions during Heinrich Stadial 1 and the Younger Dryas and lower dust emissions during the African Humid Period, a period of enhanced monsoon precipitation from approximately 11.7-5 ka. The limited spatial extent of these records, as well as the lack of high-resolution flux data, do not allow us to determine whether changes in dust deposition occurred with similar timing, magnitude and abruptness throughout northwest Africa. Here we present new records from a meridional transect of cores stretching from 27°N to 19°N along the northwest African margin, as well as from cores in the western tropical Atlantic reflecting downwind deposition. By combining grain size endmember modeling with 230Th-normalized fluxes in these cores, we are able to document spatial and temporal changes in dust loads and grain size distributions within the North African dust plume throughout the last 20 ka. Our results provide quantitative estimates of the magnitude of dust flux changes associated with Heinrich Stadial 1, the Younger Dryas, and the AHP. Our data are consistent with abrupt, synchronous changes in dust fluxes in all cores at the beginning and end of the AHP. Using these new records to tune dust loadings in a fully coupled model of 6 ka climate, we find that low dust fluxes during the AHP may have had a substantial positive feedback on regional precipitation by amplifying the northward displacement of the Atlantic and West African ITCZ.

Final ID: V21C-02

Hot 'nough for ya?: Controls and Constraints on modeling flux melting in subduction zones *(Invited)*

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Body: The qualitative concept of flux-melting in subduction zones is well established. Progressive dehydration reactions in the down-going slab release fluids to the hot overlying mantle wedge, causing flux melting and the migration of melts to the volcanic front. However, the quantitative details of fluid release, migration, melt generation and transport in the wedge remain poorly understood. In particular, there are two fundamental observations that defy quantitative modeling. The first is the location of the volcanic front with respect to intermediate depth earthquake (e.g. $\sim 100\pm40$ km; England et al., 2004, Syracuse and Abers, 2006) which is remarkably robust yet insensitive to subduction parameters. This is particularly surprising given new estimates on the variability of fluid release in global subduction zones (e.g. van Keken et al. 2011) which show great sensitivity of fluid release to slab thermal conditions. Reconciling these results implies some robust mechanism for focusing fluids/melts toward the wedge corner. The second observation is the global existence of thermally hot erupted basalts and andesites that, if derived from flux melting of the mantle requires sub-arc mantle temperatures of $\sim 1300^\circ$ C over shallow pressures of 1-2 GPa which are not that different from mid-ocean ridge conditions. These thermodynamic constraints are also implicit in recent parameterizations of wet melting (e.g. Kelley et al, 2010) which tend to produce significant amounts of melt only near the dry solidus.

These observations impose significant challenges for geodynamic models of subduction zones, and in particular for those that don't include the explicit transport of fluids and melts. We present new high-resolution model results that suggest that a more complete description of coupled fluid/solid mechanics (allowing the fluid to interact with solid rheological variations) together with rheologically consistent solutions for temperature and solid flow, may provide the required ingredients that allow for robust focusing of both fluids and hot solids to the sub-arc regions. We demonstrate coupled fluid/solid flow models for simplified geometries to understand the basic processes, as well as for more geologically

relevant models from a range of observed arc geometries. We will also evaluate the efficacy of current wet melting parameterizations in these models.

All of these models have been built using new modeling software we have been developing that allows unprecedented flexibility in the composition and solution of coupled multi-physics problems. Dubbed TerraFERMA (the transparent Finite Element Rapid Model Assembler...no relation to the convection code TERRA), this new software leverages several advanced computational libraries (FEniCS/PETSc/Spud) to make it significantly easier to construct and explore a wide range of models of varying complexity. Subduction zones provide an ideal application area for understanding the role of different degrees of coupling of fluid and solid dynamics and their relation to observations.

Final ID: PP21D-03

Geochemistry and Cyclostratigraphy of Magnetic Susceptibility data from the Frasnian-Famennian event interval in western Canada: Insights in the pattern and timing of a biotic crisis

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Body: Cyclostratigraphic calibration of magnetic susceptibility data along with stable isotopic and geochemical proxy data for redox, productivity, and detrital input from western Canada provide insight into the pace and timing of the Late Devonian, Frasnian-Famennian (F-F) biotic crisis. Two organic-rich shales that, in much of the world, display geochemical anomalies indicating low oxygen conditions and carbon burial characterize the F-F event. These events, referred to as the Lower and Upper Kellwasser events (LKE & UKE), have been linked to the evolutionary expansion of deeply rooted terrestrial forests and the concomitant changes in soil development and chemical weathering and changes in Late Devonian climate. Our geochemical data record relatively high levels of redox sensitive trace metals (Mo, U, V), proxies for biological productivity (Ba, Cu, Ni, Zn), and detrital input (Al, Si, Ti, Zr) during both events. C stable isotopic data generated from organic matter records a 3-4‰ positive excursion during both events. Each event is recorded in lowstand and/or early transgressive facies. These data corroborate hypotheses about enhanced biological productivity, driven by heightened terrestrial detrital input, leading to low oxygen conditions and decreases in biotic diversity during during relatively low stands of Late Devonian sea level.
Age dating of such events in deep time is problematic due to insufficient biochronologic control. Each event is within one conodont biostratigraphic zone, with durations on the order of 0.5-1.0 Ma. Time series analysis of high-resolution magnetic susceptibility data identified 16 long eccentricity cycles (405 ky) during the Frasnian stage and one in the earliest Famennian stage. The geochemical anomalies associated with the LKE and UKE are recorded over 7 and 14 m of stratigraphic section respectively. These strata represent only a portion of a 405 ky long eccentricity cycle and astronomical tuning implies that the LKE likely occurred during a single short eccentricity cycle (100 ky) while the UKE was more protracted, lasting approximately two short eccentricity cycles (200 ky). This work demonstrates the utility of long time series of magnetic susceptibility data used in conjunction with other multi-proxy data to provide insight into events in geologic time. These results corroborate earlier studies that pointed out fundamental differences in the LKE and UKE wherein the LKE appears to be related to relatively rapid climate and sea level change whereas the UKE seems to be related to more protracted climatic cooling associated with the beginning of an icehouse climate.

Final ID: GC21G-04

Future sea level rise assessment by constrained extrapolation *(Invited)*

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Body: Process-based models project future sea level change primarily from modeled future atmospheric warming and secondary effects such as altered atmospheric circulation, precipitation, and ocean circulation and temperature - which in turn influence sea level through thermal expansion of ocean water, changes in land ice, changes in terrestrial hydrology, and other effects. In addition to these direct forcings, important internal processes occur in glaciers and ice sheets that may be to some degree modulated but not directly controlled by atmospheric or ocean temperature and are not well understood or represented in process-based models. Non-process-based models such as extrapolation models can be useful tools for investigating certain aspects of future sea level rise in situations where lack of physical understanding or constraining observations precludes full processed-based modeling.

We present the results of extrapolation models designed to estimate the magnitude of cryospheric components of sea level rise in the 21st century with special emphasis on evaluating uncertainty and characterizing the consequences of certain ice dynamics events in terms of the resulting sea level rise. The model combines all available ice loss data and projections along with their attendant errors to provide a robust multi-data combination estimate of sea level land the uncertainties. While extrapolation relies on a continuation of observed rates into the future (i.e. stationarity) and thus is not a reliable predictor for dynamic systems at long times into the future, it is an excellent tool for exploring “what if” questions: given a hypothetical set of circumstances, extrapolation provides a very straightforward and fairly robust way to evaluate the future outcome in terms of cumulative sea level change. Knowledge of the range of outcomes, even without knowledge of the exact future course of events, provides valuable information for planning and reduces overall uncertainty.

Final ID: OS21G-07

Transport dynamics of mass failures along weakly cohesive clinoform foresets

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Body: The initiation mechanisms of sediment gravity flows are poorly understood. Previous studies have created sediment gravity flows by releasing dense water-sediment mixtures into ambient water. One limitation to these studies is that the slurries are premixed and are injected into the water column such that the initial properties of the flow - density, composition and momentum flux - are predetermined. This precludes observation of the processes that initiate the flows and set these initial conditions. As a result, there is a gap in our understanding of how submarine gravity flows initiate and what sets their initial conditions. Here we use a new experimental method that allows a range of gravity flows to self-generate. Building a clinoform using a cohesive mixture of walnut-shell sand and kaolinte, allows the foreset to build up and fail episodically, generating spontaneous sediment gravity flows. Slopes undergo a series of morphological changes prior to failure. The slope develops a concave shape that becomes exaggerated as deposition continues. This morphology leaves the slope in a metastable state. Either of two mechanisms triggers destabilization of the slope: slumping or bed-load transport. Once the slope is destabilized, failure is initiated. We also investigated the influence of clinoform progradation rates on failure size and frequency. We conducted experiments over a range of water and sediment discharge rates (0.007 to 0.036 liters of water per second, 0.50 to 1.28 g/s sediment). Neither failure size nor failure frequency changes with discharge rate; instead, increases in sediment supply are taken up by changes in the partitioning of sediment between the steep upper foreset and the more gradual delta-front apron below. Sediment is delivered to the delta-front apron by a form of semi-continuous slow creep along the foreset. This slow creep is a failure mode that has been under-appreciated in the submarine mass-flow literature. The independence of failure size and frequency suggests that the presence of mass failure deposits does not provide insight on the rate of sediment delivery. If these relationships hold at field scales, this would imply that individual sediment gravity flows are relatively insensitive to changes in water and sediment supply. On the other hand, the flux associated with slow creep appears to be controlled directly by sediment supply.

Final ID: GC22C-03

Coupled Modeling of Geomorphology and Ecohydrology: Topographic feedbacks driven by solar radiation *(Invited)*

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Body: There is a two-way coupling between geomorphic processes and vegetation dynamics. To examine the role of vegetation on landform development, landscape evolution models (LEMs) have used relatively simple theory of erosion-vegetation interactions and vegetation dynamics based on field evidence and conjecture. Such modeling studies have described “with broad strokes” the control of vegetation on landscape relief, drainage density, and sediment yields in a range of model sensitivity studies, often without any direct field confirmation. For improved predictions of climate-landscape relations in real-world cases, and identify the need for future model development, there is strong need for field confirmations of ecohydrologic LEMs. In this talk, we first discuss some of the key findings of recent LEM studies that incorporate vegetation. Second, we introduce the role of solar radiation on ecohydrologic processes in the CHILD LEM, and confirm model predictions against observations. Using the model we examine how solar radiation control the spatio-temporal dynamics of soil moisture, vegetation biomass, and their feedback on landform development in a semi-arid climate across a latitude gradient. We identify that at the catchment scale while the initial greening usually takes places relatively uniformly in space, the growing season takes longer on north facing slopes leading to higher overall biomass on north aspects. Through eco-geomorphic feedbacks, this leads to steeper north facing slopes, and increased valley asymmetry in the modeled landscapes. These findings are important to improve the predictions of climate change impacts on the landscape system.

Final ID: SM22D-04

The Main Pillar: Assessment of Space Weather Observational Asset Performance Supporting Nowcasting, Forecasting and Research to Operations

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Body: Abstract

Sporadically, the Sun unleashes severe magnetic activity into the heliosphere. The specific solar/heliospheric phenomena and their effects on humans, technology and the wider geospace environment include a) high-intensity emissions from the Sun causing radio blackouts and (surface) charging, b) particle acceleration in the solar corona leading to high dose rates of ionizing radiation in exposed materials that can trigger single event upsets in electronic components of space hardware, or temporal/permanent damage in tissue, c) arrivals of fast-moving coronal mass ejections with embedded enhancements of magnetic fields that can cause strong ionospheric disturbances affecting radio communications and induce out-of-spec currents in power lines near the surface. Many of the effects could now be forecast with higher fidelity than ever before. However, forecasting critically depends upon availability of timely and reliable observational data. It is therefore crucial to understand how observational assets perform during periods of severe space weather. This paper analyzes and documents the status of the existing and upcoming observational capabilities for forecasting, and discusses how the findings may impact space weather research and its transition to operations.

Final ID: G22A-04

Space-Time Cube Analytics of Evolving Landforms Captured by Airborne and Terrestrial Lidar ***(Invited)***

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4. Topographic Engineering Center, US Army ERDC, Alexandria, VA, United States.

Body: A multidimensional framework for analysis of land surface dynamics from time series of lidar data is presented. The framework integrates the standard line feature extraction and raster-based statistics with novel volume representation of evolving terrain and defines metrics for quantification of observed change. Within the raster-based approach, the stable core and envelope surfaces are derived by applying per-cell statistics to time series of lidar-based digital elevation models (DEMs). The core and envelope are then used to map the contour displacement range and compute the relative volume intensity graphs that characterize the redistribution of mass in the study area. To fully capture the properties of evolving surfaces in both space and time, a discrete and a continuous space-time cube (STC) approach is introduced. Simple to implement, discrete STC stacks series of DEMs into a voxel model which is then used to derive isosurfaces representing a given contour evolution and to extract space-time crossections that represent evolution of elevation along a given profile. Raster maps representing DEM differences can also be stacked into a voxel model and evolution of change of a given magnitude is then extracted as an isosurface. Continuous STC represents the dynamic surface as a trivariate function where time is the third dimension and elevation is the modeled variable. To compute the continuous STC the time series of point cloud data is merged into a single point cloud that is then interpolated into a voxel model at a desired spatial and temporal resolution. Trivariate regularized smoothing spline with octree-based segmentation is used to compute voxel models of elevation evolution and its first and second order derivatives directly from time series of point cloud data. The resulting voxel models are then used to identify the locations and time of the fastest rate of change, possible acceleration or areas and time intervals of stability. The presented concepts and methods were applied to a 15 year time series of airborne lidar surveys of the North Carolina barrier islands. The analysis of coastal terrain dynamics includes sections of barrier island characterized by different types of landforms, including a beach-foredune system, active back island dune and a cape. Evolution of these landforms has been influenced by wind, wave and storm surge processes creating impacts that are reflected in specific STC-derived isosurface topologies. Terrestrial lidar application is illustrated by analysis of two year monitoring data acquired at a meander bend of an eroding stream in North Carolina Piedmont. The presented STC methodology is simple to implement yet powerful in its ability to condense surface evolution complexity into meaningful information. Furthermore, the methodology is general and can be used with any software that supports 2D and 3D raster data processing, trivariate interpolation, and volume visualization. Our implementation was based on open-source GRASS GIS.

Final ID: IN22A-05

Use of Persistent Identifiers to link Heterogeneous Data Systems in the Integrated Earth Data Applications (IEDA) Facility

L. Hsu; [1]; *K. A. Lehnert;* [1]; *S. M. Carbotte;* [1]; *R. A. Arko;* [1]; *V. Ferrini;* [1]; *S. H. O'hara;* [1]; *J. D. Walker;* [2];
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Body: The Integrated Earth Data Applications (IEDA) facility maintains multiple data systems with a wide range of solid earth data types from the marine, terrestrial, and polar environments. Examples of the different data types include syntheses of ultra-high resolution seafloor bathymetry collected on large collaborative cruises and analytical geochemistry measurements collected by single investigators in small, unique projects. These different data types have historically been channeled into separate, discipline-specific databases with search and retrieval tailored for the specific data type. However, a current major goal is to integrate data from different systems to allow interdisciplinary data discovery and scientific analysis.

To increase discovery and access across these heterogeneous systems, IEDA employs several unique IDs, including sample IDs (International Geo Sample Number, IGSN), person IDs (GeoPass ID), funding award IDs (NSF Award Number), cruise IDs (from the Marine Geoscience Data System Expedition Metadata Catalog), dataset IDs (DOIs), and publication IDs (DOIs). These IDs allow linking of a sample registry (System for Earth SAmple Registration), data libraries and repositories (e.g. Geochemical Research Library, Marine Geoscience Data System), integrated synthesis databases (e.g. EarthChem Portal, PetDB), and investigator services (IEDA Data Compliance Tool). The linked systems allow efficient discovery of related data across different levels of granularity.

In addition, IEDA data systems maintain links with several external data systems, including digital journal publishers. Links have been established between the EarthChem Portal and ScienceDirect through publication DOIs, returning sample-level objects and geochemical analyses for a particular publication. Linking IEDA-hosted data to digital publications with IGSNs at the sample level and with IEDA-allocated dataset DOIs are under development.

As an example, an individual investigator could sign up for a GeoPass account ID, write a proposal to NSF and create a data plan using the IEDA Data Management Plan Tool. Having received the grant, the investigator then collects rock samples on a scientific cruise from dredges and registers the samples with IGSNs. The investigator then performs analytical geochemistry on the samples, and submits the full dataset to the Geochemical Resource Library for a dataset DOI. Finally, the investigator writes an article that is published in Science Direct. Knowing any of the following IDs: Investigator GeoPass ID, NSF Award Number, Cruise ID, Sample IGSNs, dataset DOI, or publication DOI, a user would be able to navigate to all samples, datasets, and publications in IEDA and external systems. Use of persistent identifiers to link heterogeneous data systems in IEDA thus increases access, discovery, and proper citation of hard-earned investigator datasets.

URL: www.iedadata.org

Final ID: GC22C-06

Spatiotemporal characteristics of climatic forcing of erosion – examples from the southern Central Andes and the Himalaya *(Invited)*

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Body: The windward flanks of the southern Central Andes and the Himalaya are characterized by steep climatic, tectonic, and vegetation gradients. In these regions, orographic rainfall causes some of the wettest places on Earth that are closely linked with pronounced runoff and erosion. However, the higher-elevation flanks of both orogens become progressively drier, until arid conditions are attained in the orogen interiors (i.e., the Tibetan and Altiplano-Puna plateaus). Some of the world's largest rivers with high sediment loads emerge from these mountain belts, and understanding the relation between climate and erosion is key in predicting mass fluxes, assessing the effects of climate variability, and long-term climate forcing of erosion on landscape evolution in these tectonically active mountain belts. Here, we present the spatiotemporal effects of climatic gradients on erosion and mass fluxes. We rely on new sedimentary archives, digital topography, and cosmogenic nuclide basin-wide erosion rates from the Andes (n=50) and the western Himalaya (n=30).

We make three key observations that underscore the importance of climatic parameters on the voracity of surface processes in both areas. (1) First-order spatial erosion patterns can be explained by a simple specific stream power (SSP) approach. Importantly, we explicitly account for discharge by routing high-resolution, satellite-derived rainfall downstream. This is important as the steep climatic gradient of both orogens results in a highly nonlinear (and non-power law) relation between drainage area and discharge, one of the key assumptions for deriving energy expenditure in fluvial systems. This simple, but robust approach allows us to compare similarly steep catchments from the wet windward sectors along the flanks, with the dry internal parts of the orogens. (2) The derived relation between SSP and basin-wide erosion rates indicates that erosion (E) scales with $E \sim SSP^2$ on cosmogenic-nuclide time scales. (3) The use of late Pleistocene and Holocene sedimentary archives (lacustrine sediments related to landslide damming of river valleys) from both regions furnishes valuable information on the temporal variation of erosion rates. These records reveal that the high-relief arid sectors of both environments, which are characterized by low present-day and millennial-scale erosion rates, may have increased sediment flux by an order of magnitude during wetter periods on longer time scales in the past. Overall, these findings underscore (1) the fundamental importance of climate-driven processes in the long-term landscape evolution of tectonically active mountain belts; (2) the importance of climatic forcing on sediment production, mass transfer, and permanent vs. transient sediment storage in orogens; and (3) the importance of climate variability in intensifying erosion and sediment-flux rates on millennial time scales.

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Explaining the surprisingly poor correlation between turbulent surface wind and aeolian sand flux

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Body: Existing models of aeolian sand transport, derived theoretically and from wind-tunnel experiments, often disagree substantially with field observations. Despite advancements in anemometry and sediment flux detection technologies, even very high-resolution observations of aeolian sand transport show only weak correlation with concurrent surface wind speeds and model predictions. Unlike in experiments and numerical models, winds in natural environments exhibit turbulent fluctuations over a broad range of length scales extending from individual grains to the top of the atmospheric boundary layer and over a similarly large range of time scales. Here, we present simultaneous high-resolution (10 Hz) measurements of surface wind and saltation sand transport over a ~5 m tall barchan dune (median grain diameter = 0.35 mm) collected at White Sands Dune Field, New Mexico, USA. Studying aeolian transport in the field offered a natural experiment for understanding how the rate of aeolian saltation responds to turbulent changes in wind and frequent crossings of the threshold for particle motion. In agreement with past observations, our data indicate that: (1) saltation flux lags wind fluctuations by about 1 second, (2) the threshold for initiation of particle motion (“entrainment”) exceeds the threshold for cessation (“distrainment”) by about 20%, (3) concurrent instantaneous wind and sediment flux measurements are poorly correlated. Based on our data, we show how lagged transport and threshold hysteresis are related to inertia in the transport system arising from ballistic particle trajectories and non-instantaneous momentum transfers among grains and wind. We argue that this nonlinear and lagged response of saltation to turbulent wind fluctuations accounts for the poor correlation between wind and transport as well as the poor performance of existing saltation models.

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Riverine biophysical interactions in the form of channel-spanning logjams in the Colorado Front Range, USA

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Body: Channel-spanning logjams completely span the active channel and create longitudinal discontinuities of the water surface and stream bed across at least two-thirds of the channel width. These jams disproportionately affect channel process and form relative to smaller jams that do not span the entire channel width. We analyze a spatially extensive dataset of 859 channel-spanning jams distributed along 124 km of 16 distinct rivers on the eastern side of Rocky Mountain National Park, Colorado, USA with drainage areas spanning 2.6 to 258 sq km and diverse valley geometry and forest stand age. We categorize valley geometry in terms of lateral confinement, which correlates with gradient. Jams exhibit substantial downstream variability in spacing at channel lengths of hundreds to thousands of meters. The number of jams within a reach is explained by a statistical model that includes drainage area, valley type, and channel width. Longitudinal spacing of jams drops substantially at drainage areas greater than ~ 20 sq km, although jam spacing exhibits tremendous variability at smaller drainage areas. The lack of jams at larger drainage areas likely reflects increasing transport capacity for instream wood. Variability in jam spacing at small drainage areas likely reflects local controls of valley geometry and associated wood recruitment and fluvial transport capacity. Management of instream wood designed to facilitate the formation of channel-spanning jams can be most effectively focused on smaller drainage areas where these jams were historically most abundant. Unmanaged streams in the study region with drainage area < 60 sq km have ~ 1.1 channel-spanning jams per 100 m length of stream. The cumulative effects of these jams on physical and biotic components of streams are substantial. Numerous jams create nonlinear complex responses that facilitate formation of multi-thread channels, as well as enhancing storage of carbon and other nutrients in channel and floodplain environments, hyporheic exchange, diversity and abundance of instream habitat, and channel-floodplain connectivity.

Final ID: EP23C-0825

Can erosion control structures in large dryland arroyo channels lead to resilient riparian and cienega restoration? Observations from LiDAR, monitoring and modeling at Rancho San Bernardino, Sonora, MX

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Body: The use of erosion control structures to mitigate or even reverse erosion and to restore ecological function along dryland channels (arroyos and gullies) has led to a long list of both successful and failed restoration efforts. We propose that successful implementation of “engineering” approaches to fluvial restoration that include in-channel control structures require either a quantitative approach to design (by scientists and engineers), or intimate on-the-ground knowledge, local observation, and a commitment to adapt and maintain restoration efforts in response to landscape change (by local land managers), or both. We further propose that the biophysical interactions among engineering, sedimentation, flood hydrology and vegetation reestablishment are what determine resilience to destructive extreme events that commonly cause erosion control structure failure. Our insights come from comprehensive monitoring of a remarkable experiment underway at Ranch San Bernardino, Sonora, MX. At this site, private landowners are working to restore ecosystem function to riparian corridors and former cieñega wetlands using cessation of grazing; vegetation planting; upland grass restoration; large scale rock gabions (up to 100 m wide) to encourage local sediment deposition and water storage; and large earthen berms (up to 900 m wide) with cement spillways that form reservoirs that fill rapidly with water and sediment. Well-planned and managed erosion control structures have been used elsewhere successfully in smaller gully networks, but we are unaware of a comparable attempt to use gabions and berms for the sole purpose of ecological restoration along >10 km of arroyo channels draining watersheds on the order of ~400 km2 and larger. We present an approach to monitoring the efficacy of arroyo channel restoration using terrestrial and airborne LiDAR, remote sensing, streamflow monitoring, shallow groundwater monitoring, hydrological modeling and field observation. Our methods allow us to directly quantify the magnitude of sedimentation (and hence reversal of arroyo cutting) upstream of in-channel structures as a function of hydrology, and to quantify the dampening of flood energy caused by erosion control structures and by the restoration of riparian vegetation. We are also able to create a surface water budget that constrains water storage and infiltration by monitoring streamflow at several places above, within, and downstream of restoration efforts. We also speculate on the resilience of such efforts. Quantifying the effects of the restoration efforts at Rancho San Bernardino may prove useful in guiding similar large-scale ecological restoration efforts elsewhere in degraded dryland landscapes.

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Biophysical Controls on Carbon Cycling in Restored and Unrestored Urban Streams

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Body: Stream restoration is a multibillion dollar industry, yet how restoration impacts the ecological functioning of streams remains poorly understood. Because stream restoration may alter numerous biophysical controls, including light availability (through tree removal during bank regrading), hydraulics, sediment characteristics, and/or nutrient concentrations, it can be challenging to achieve a general understanding of how different aspects of stream restoration design influence ecosystem function (e.g., carbon cycling). In this study we combined strategies of continuously monitoring hydrology, turbidity, and dissolved oxygen at a station with spatially distributed but temporally sparse synoptic sampling to understand how restoration and land-use impact carbon fixation and respiration in urban streams. The study was performed over three years in three adjacent 3rd-4th order stream reaches in the urban Chesapeake Bay watershed, one of which was restored in 2002 using the ubiquitous Natural Channel Design method. By parsing the dissolved oxygen time series into contributions from respiration and gross primary production, we found the unrestored urban reach to be the most heterotrophic. It removed two times more carbon from the stream to the atmosphere than an unrestored suburban stream that was nutrient impacted and five times more carbon than the restored urban stream. The synoptic sampling revealed that nutrients, light, and hydrodynamic disturbance were the primary controls on carbon fixation and respiration, with fine sediment also exhibiting importance, likely as a vehicle for nutrient transport. Low rates of net carbon removal in the restored stream arose from high light availability resulting in high primary production, combined with low fine sediment availability restricting respiration. Thus, while restoration may have been effective for stream stabilization, it has decreased the functionality of the stream for net carbon removal to the atmosphere. Surprisingly, streambed potential respiration rates were indistinguishable between different geomorphic zones within the streams, suggesting that large-scale factors (i.e., nutrient and fine sediment supply) were more dominant controls than geomorphically controlled local variability.

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Toward a Rapid Synthesis of Field and Desktop Data for Classifying Streams in the Pacific Northwest: Guiding the Sampling and Management of Salmonid Habitat

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Body: River managers often seek to understand habitat availability and quality for riverine organisms within the physical template provided by their landscape. Yet the large amount of natural heterogeneity in landscapes gives rise to stream systems which are highly variable over small spatial scales, potentially complicating site selection for surveying aquatic habitat while simultaneously making a simple, wide-reaching management strategy elusive. This is particularly true in the rugged John Day River Basin of northern Oregon, where efforts as part of the Columbia Habitat Monitoring Program to conduct site-based surveys of physical habitat for endangered steelhead salmon (Oncorhynchus mykiss) are underway. As a complete understanding of the type and distribution of habitat available to these fish would require visits to all streams in the basin (impractical due to its large size), here we develop an approach for classifying channel types which combines remote desktop GIS analyses with rapid field-based stream and landscape surveys. At the core of this method, we build off of the River Styles Framework, an open-ended and process-based approach for classifying streams and informing management decisions. This framework is combined with on-the-ground fluvial audits, which aim to quickly and continuously map sediment dynamics and channel behavior along selected channels. Validation of this classification method is completed by on-the-ground stream surveys using a digital iPad platform and by rapid small aircraft overflights to confirm or refine predictions. We further compare this method with existing channel classification approaches for the region (e.g. Beechie, Montgomery and Buffington). The results of this study will help guide both the refinement of site stratification and selection for salmonid habitat monitoring within the basin, and will be vital in designing and prioritizing restoration and management strategies tailored to the distribution of river styles found across the region.

Final ID: EP23D-0847

A Grain Scale Non-Equilibrium Sediment Transport Model for Unsteady Flow

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Body: A one dimensional (1D) finite-volume model is developed for simulating non-equilibrium sediment transport in unsteady flow (Zhang and Duan, 2011; Zhang et al., in press). The governing equations are the 1D mass and momentum conservation equations for sediment-laden flow and the sediment continuity equation for both bed load and suspended-load transport. Suspended sediment concentration is determined by a modified Rouse-type distribution, which accounts for the effect of vertical sediment flux on sediment transport. The spatial lag between the instantaneous flow properties (e.g., velocity, bed shear stress) and the rate of bed load transport in unsteady flow is quantified by using an adaptation length, which is derived theoretically by applying the momentum principle in the bed load layer. The resulting model is tested with a series of laboratory experiments of dam break flow over mobile beds reported by Spinewine and Zech (2007) and Fraccarollo and Capart (2002). Simulated results of water surface profiles, bed profiles, bed elevation changes, and bed load layer thickness are compared with the measurements, and show not only results in agreement, but also the applicability of the proposed methods for the adaptation length and suspended sediment recovery coefficient for simulating non-equilibrium sediment transport in unsteady flow.

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A combined non-linear and non-local model for sediment transport in depositional systems

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Body: Two alternative models have been developed by geomorphologists in order to explain the observed landscape elevations in depositional systems: (i) a non-linear model which assumes that the sediment flux at a point on the surface is a non-linear function of the local slope; (ii) a non-local model which assumes a convolution integral flux, which expresses the flux as a weighted sum of surface slopes located away from the point of interest. Up to now the non-linear (i) and non-local (ii) models have been mutually exclusive and arbitrarily used to obtain optimal fits with experimental and field observations. The objective of this contribution is, in the context of depositional systems, to introduce and explore the potential utility of a physically-based single non-linear-non-local (NLNL) model that combines both non-linearity and non-locality. On comparing the NLNL sediment transport models for different subsidence settings with available experimental data we find that:

- The NLNL model provides a good fit to observed steady state fluvial profiles.
- Accounting for the non-locality in the system allows for the use of non-linear parameters within the range of those expected by theoretical sediment transport arguments.
- Comparing subsiding and non-subsiding steady-state systems provides a test by which non-local and non-linear effects can be disentangled.
- The dependence of the interactions between the non-local and non-linear components (competition versus amplification) due to the nature of the subsidence should allow for the construction of experiments that can clearly quantify the roles of non-linearity and non-locality in sediment transport.

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Paradigm for Subgrid Scale Closure Modeling in Multiphase Geophysical Flows

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Body: We present a new paradigm for modeling multiphase geophysical flows to produce highly accurate and highly efficient forecasting of the complexity of the natural environment across the full range of relevant length and time scales. The assumption that computing technology will never allow us to perform direct numerical simulations (DNS) of the natural environment often limits our ambition in forward thinking model development and produces only incremental improvements in the state-of-the-art technology. Regional and global forecasting models for earth, ocean, and atmospheric processes based on averaged equations (e.g. RANS) must advance beyond simple closures relations obtained for single-phase fluid turbulence (e.g., k-epsilon, k-omega, and Mellor-Yamada). We propose using a hierarchy of computationally intensive, high fidelity simulations to resolve subgrid processes across a range of cascading length and time scales in the model domain to generate numerical interpolations for the unresolved physical processes. Further, we believe that it is possible to use the cumulative results of these subgrid scale simulations to develop a Bayesian network, for example, which may eventually replace the computationally intensive simulations with a highly efficient probabilistic closure model for the unresolved physical processes. The success of our approach will be greatly enhanced through rigorous validation of our subgrid scale models using three-dimensional laboratory and field measurements of fluid-particle turbulence at the scales of interest. Recent advances in optical imaging techniques have made it possible to make highly resolved three-dimensional measurements of fluid-particle turbulent interactions in the laboratory with spatial and temporal resolutions at or near the Kolmogorov scales. Additional work must be done to transition these technologies for use in the field. As a pilot test case we introduce our new paradigm using a hierarchy of models we have developed for studying sediment transport at different scales. At subparticle scales we use DNS to explicitly model turbulent fluid-particle interactions; the DNS is limited to O(1000) particles. At particle scales we use the discrete element method (DEM) for the sediment phase coupled to a RANS fluid model. The DEM-RANS simulation includes closures for turbulence and hydrodynamic particle forces and is used to simulate intermediate scales with spatially uniform conditions such as in sheet flow transport. At bedform scales, a mixture model (SedMix3D), exploits closures for mixture viscosity, diffusivity, sedimentation rates and particle pressure. The mixture model is used to simulate the coupling of bedforms and coherent vortex structures in the turbulent boundary layer. Pathways for connecting simulations will be identified and explored. Discussion will focus on the role of Bayesian derived probability distributions in transferring key information between models of different scales.

Final ID: EP23D-0858

Simulation of Sediment Wave Generation and Maintenance

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Body: Deep-sea sediment waves are a common feature throughout the world, forming under the influence of turbidity currents, thermohaline currents, and/or deformational processes. Past efforts for modeling turbidity-current generated sediment waves have focused on 1D (depth-averaged) Navier-Strokes equations, whereas here we use the 2D equations, as implemented in TURBINS 2D. We employed two experimental setups: 1) Repeated flows in a lock-exchange configuration, in which deposition and erosion are observed to lead to waveforms developing on an initially linear ramp, and 2) single continuous inflow currents that are allowed to flow over a pre-existing sinusoidal geometry. Using these two setups, we examine both the initial generation of sediment waves over the course of many episodic events, as well as maintenance of sediment waves under the influence of a quasi-steady flow. In both setups, we examined a range of flow parameters, such as ramp length, sediment settling velocity, etc.

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Numerical simulation of turbulence and sediment transport of medium sand

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Body: Eleven numerical simulations, ranging from no transport to bedload to vigorous suspension transport, are presented of a combined large eddy simulation (LES) and distinct element model (DEM) of an initially flat bed of medium sand. The fluid and particles are fully coupled in momentum. The friction coefficient, defined here as the squared ratio of the friction velocity to the depth-averaged velocity, is in good agreement with well-known rough bed relations at no transport and increases with the intensity of bedload transport. The friction coefficient nearly doubles in value at the onset of sediment suspension owing to a rapid increase of the depth over which particles and fluid exchange momentum. The friction coefficient decreases with increasing suspension intensity because of increasingly stable stratification. Fluid Reynolds stress and time-averaged velocity profiles in the bedload regime agree well with previous experiments and simulations. Also consistent with previous studies of suspended sediment, there is an increase in slope of the lower portion of the velocity profile that has been modeled in the past using stably stratified eddy viscosity closures or an adjusted von Karman constant. Stokes numbers in the simulations, using an estimated lagrangian integral time scale, are less than unity. As such, particles faithfully follow the fluid, except for particle settling and grain-grain interactions near the bed. Fluid-particle velocity correlation coefficients approach one in portions of the flow where volumetric sediment concentrations are below about ten percent.
Bedload entrainment is critically connected to vertical velocity fluctuations. When a fluid packet approaches the bed from the interior of the flow (i.e. a sweep), fluid is forced into the bed, and at the edges of the sweep, fluid is forced out of the bed. Much of the particle entrainment occurs at these sweep edges. Fluid velocity statistics following the particles reveal that moving bedload particles are preferentially concentrated in zones of upward fluid velocity. This may explain previous observations noting a rapid vertical rise at the beginning of saltation trajectories. The simulations described here have no lift forces. Because of the short particle time scales relative to that of the turbulent structures, high transport stage bedload entrainment zones involve mutual interaction between turbulence structures and bed deformation. These deformation structures appear as depressed areas of the bed at the center of the sweep and raised areas of entraining particles at the edges of the sweep penetration.
Suspended sediment entrainment structures are similar to these bedload entrainment structures but have much larger scales. Preferential concentration of suspended grains in zones of upward moving fluid dampens turbulence intensities and momentum transport. Much of the suspended transport takes place within this highly concentrated near-bed zone of damped turbulence. Particle-fluid correlation coefficients are relatively low in the lower portion of this highly concentrated suspended sediment zone, owing to particle-particle interactions. As such, Rouse-like profiles utilizing eddy viscosity closures, adjusted according to flux Richardson numbers, do not adequately describe the physics of this zone.

Final ID: EP23E-0863

Liquidation sales: Land speculation and landscape change

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Body: Large-scale land-use transitions can occur with astonishing speed, and landscape stability can change with equal suddenness: for example, the catastrophic dustbowl that paralyzed the Midwestern US in the early 1930s came barely 40 years after the derby for homestead land in Oklahoma in 1889. Some human–landscape systems, like the large prehistoric settlements in the Brazilian Amazon, persisted for centuries without environmental collapse. Others quickly exhausted all of the environmental resources available, as occurred with phosphate mining on the Pacific Island of Nauru. Although abrupt shifts from resource plenty to resource scarcity are theoretically interesting for their complexity, the very real consequences of modern social and environmental boom-bust dynamics can catalyze humanitarian crises.

Drawing on historical examples and investigative reporting of current events, I explore the hypothesis that land speculation drives rapid transitions in physical landscapes at large spatial scales. "Land grabs" is one of four core environmental justice and equality issues Oxfam International is targeting in its GROW campaign, citing evidence that foreign investors are buying up vast tracts of land in developing countries, and as a consequence exacerbating food scarcity and marginalization of poor families. Al Jazeera has reported extensively on land-rights disputes in Honduras and investment deals involving foreign ownership of large areas of agricultural land in New Zealand, India, Africa, and South America. Overlapping coverage has also appeared in the New York Times, the Washington Post, the BBC News, the Guardian, and other outlets. Although land itself is only one kind of natural resource, land rights typically determine access to other natural resources (e.g. water, timber, minerals, fossil fuels). Consideration of land speculation therefore includes speculative bubbles in natural-resource markets more broadly.

There are categorical commonalities in agricultural change and deforestation around the world. Although the details differ at local scales, even disparate cases of land use and landscape changes may express similar patterns and structures. Records of sediment flux in salt marshes and fluvial deposits indicate rates of past landscape responses to human activities; the 1930s dustbowl event left a sedimentary signature in western North American lakes. Petrochemicals and fertilizers from agricultural runnoff are causing hypoxic dead zones in coastal waters to expand. In the Brazilian Amazon, regional-scale changes in weather and climate have been linked to deforestation, and deforestation has been linked to patterns of boom-bust development. But even when rampant land acquisition for agriculture or housing has been identified as problematic, the attendant environmental consequences are not necessarily obvious. The nonlinear attenuation of cause and effect is a function of the hierarchy of scales that typify these complex, human–landscape systems: the emergence of long-term, large-scale environmental dynamics lag behind the short-term, localized dynamics of a resource bubble. Insight into how these coupled systems behave may reveal the scales at which government, institutional, or self-organized social intervention may be most effective, and presents an opportunity to integrate evolving spheres of research from the behavioural sciences and Earth-surface processes.

Final ID: EP23E-0865

Can human activities alter the drowning fate of barrier islands?

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Body: Low-lying coastal barriers face an uncertain future over the coming century and beyond as sea levels rise, with many projections suggesting end-of-century rates of sea-level rise as high or higher than 1 cm/yr. Geologically, such rates of sea-level rise have been experienced several thousand years ago and we can use our understanding of geological processes and sedimentary evidence to help unravel the dynamics of natural barriers experiencing sea-level rise. Along many modern coastal barriers, however, anthropic change, such as beach nourishment, dune construction, and emplacement of hard structures, plays a dominant role in coastline dynamics. A fundamental question to be addressed is whether human activities intended to preserve infrastructure and beach recreation may make wholesale collapse, or 'drowning,' of barrier systems more likely. Here we present a numerical modeling tool that couples natural processes and the human responses to these changes (and the subsequent of human responses on natural processes).
Recent theoretical model development suggests that barriers are intrinsically morphodynamic features, responding to sea-level rise in complex ways through the interactions of marine processes and barrier overwash. Undeveloped coastal barriers would therefore respond to an accelerated sea-level rise in complex, less predictable manners than suggested by existing long-term models. We have developed a model that examines non-equilibrium cross-shore evolution of barrier systems at decadal to centennial temporal scales, focusing on the interactions between processes of shoreface evolution and overwash deposition. Model responses demonstrate two means of barrier collapse during sea-level rise: 'height drowning', which occurs when overwash fluxes are insufficient to maintain the landward migration rate required to keep in pace with sea-level rise, and 'width drowning', which occurs when the shoreface response is insufficient to maintain the barrier geometry during landward migration. The model also demonstrates the potential for discontinuous shoreline retreat, with alternating periods of barrier stability and rapid migration, even for constant rates of sea-level rise.
Anthropic activities can strongly interact with these behaviors. In particular, considering only cross-shore processes, beach nourishment activities widen the beach and can affect shoreface fluxes, and dune building, which curtails the overwash process, can potentially enhance barrier drowning by reducing overwash fluxes. Furthermore, coastal protection activities of adjacent communities or even individual property holders can be uncoordinated or coordinated, with their effects coupled along the coast through coastal reorientation and gradients in alongshore sediment transport. In the coordinated framework, owners act in concert to alter the barrier based upon community benefits, whereas in the non-coordinated framework owners alter only their own property. Another important role in management is the perception of future sea-level-rise-associated losses—communities manage their coast differently depending on their adopted forecast for sea-level rise. We find that coordinated behavior coupled with natural processes can substantially affect the drowning scenarios from the individual decision-making process.

Final ID: G23A-0887

Development of an Online Archive for Terrestrial Lidar Data

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Body: The UNAVCO Geodetic Imaging program provides terrestrial laser scanning (TLS) support to the Earth science community through TLS instrumentation, field engineering, data processing, and technical training. As part of this TLS support role, UNAVCO is responsible for generation of level one (L1) TLS data products and TLS data archive and access. A UNAVCO-organized TLS community workshop held October, 2011 in Boulder, Colorado defined many of the challenges and requirements a TLS data archive and access system must address. TLS data acquisition presents unique challenges for metadata, provenance capture, and data archive: datasets are often large (several Gb per day) and are stored in a variety of proprietary formats that require conversion and standardization for access and exchange. Due to the wide range of scientific and engineering objectives that motivate TLS data collection, field methods and collection techniques vary greatly and must be thoroughly documented in project metadata. These challenges make level zero (L0 – raw) data capture, metadata preservation, and data provenance important objectives for the TLS repository.

To address this set of challenges and related requirements, UNAVCO is developing a TLS repository based on the open source RAMADDA platform (http://ramadda.org). The UNAVCO TLS repository will provide online archive of L0 and L1 data products, capture field metadata, document data processing workflows for provenance, and store original georeferencing information. In addition, the TLS repository provides on-demand services for georeferencing, simple point cloud visualization, data sub-setting and thinning, and file format (e.g., LAS, ASCII, proprietary) data conversion. The RAMADDA-based system offers automation of RINEX processing of GPS data, OPUS and CSRS submission and solution ingestion, and generation of control point lists to streamline the georeferencing of TLS data. Georeferencing metadata and GPS file provenance are particularly important for scan reoccupations and repeat scanning for geodetic studies. Each RAMADDA service logs its processing workflow and related parameters to retain provenance and allow for constraints on error budgets and transparent reprocessing by future investigators. In addition to storing the L0 raw scan data in proprietary format, the TLS repository will also host UNAVCO's standard L1 data product, a merged, aligned point cloud in an open format (LAS or ASCII). This product is the most accessible and useful starting point for supported investigators conducting TLS-based science. While directly accessible to the UNAVCO community, the RAMADDA system also provides service-level access, enabling an external client such as the OpenTopography lidar data facility to display metadata and directly access data from the UNAVCO-based repository.

URL: http://unavco.org/tls

Final ID: H23E-1428

Hydrodynamic Heat Transport Measured at the Field Scale

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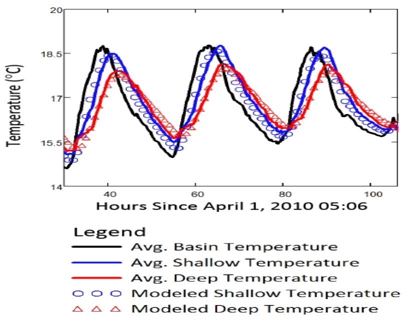
Body: Heat and solute transport in groundwater have long been considered analogous. Advection, hydrodynamic dispersion, and diffusion have very similar interpretations whether heat (as measured by temperature) or dissolved mass (as measured by concentration) is the primary parameter of interest. However, while there have been many field scale measurements of solute hydrodynamic dispersion reported in the literature, relatively few estimates of heat hydrodynamic dispersion are available. We report on a field scale experiment in which temperature was measured at two shallow (0.3 and 1 m) depths below an infiltration basin. The downward propagation of diurnal surface temperature oscillations in saturated groundwater was monitored across the basin and over several months, using Fiber Optic Distributed Temperature Sensing. The variation in basin water depth and heterogeneity of the basin sediments provided a range of advective velocity and sediment types to examine. Standard heat advection and dispersion equations were used to model the observed heat transport. Model fits of thermal breakthrough suggest a strong influence of hydrodynamic dispersion on heat transport. Thermal dispersivity appears to scale with distance, as is generally the case for solute dispersivity measured in field experiments. These results suggest that thermal dispersivity rather than thermal diffusivity may be in the important transport parameter for predicting thermal transport in strongly flowing groundwater systems.



Final ID: H23F-1446

Impacts and socio-ecological feedbacks associated with regionalization of water supply in a suburban New England watershed

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Body: Suburban watersheds often rely on locally derived ecosystem services such as water supply, even as these services are threatened by existing land use and land-use change patterns. At some point, the ability of the watershed to provide such services may become impaired. Socio-ecological feedbacks are likely to emerge, leading to more active management of locally derived water provisioning services, or replacement of services generated locally with those from more distant locations. We applied a spatially distributed hydrological model to explore the impact of multiple interacting and spatially varying human activities, including feedbacks, on the hydrology of a suburban watershed in the Boston, MA, metropolitan area, the Ipswich R. watershed. We accounted for the role of impervious surfaces, lawns and lawn watering, septic systems, and water use, as well as several socio-ecological feedbacks evident in the region (water bans, regional import). The result of human activities on the landscape is that most of the river system is wetter than a hypothetical pristine condition (predicted mean basin runoff during summers of 0.65 mm per day in contemporary vs. 0.10 mm per day in pristine). However, water withdrawals along the large main stem river remove some of this excess, resulting in a reduced net effect of human activities at the large watershed scale (predicted mean basin runoff of 0.54 mm per day). Recent feedbacks in response to low flows have resulted in increasing importance of imported water supplies, removing local constraint to further development. Because suburban watersheds continue to rely on local ecosystem services, suburban watersheds may be useful model systems within which to study socio-ecological feedbacks.

Final ID: SM23D-2334

An introduction to MIT mission

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Body: MIT is a Chinese mission proposed to lunch following Double Star and KuaFu project. The mission targets at the material coupling of the earth's magnetosphere, ionosphere and thermosphere. Implementing the mission will further our understanding of the sun-earth system, characterize the impact of solar activity on Earth's space environment, improve the security for man-made spacecraft. The mission's science objectives include the mechanism and the origin of outflow oxygen ions and other related outstanding scientific questions. The mission plans four satellites: two of them have polar circular orbit at the lower attitude of 500km*1000km; the other two have other two have elliptical orbit of 6400km*43000km with angle 75°. These altitudes are the key regions for the acceleration of the outflow oxygen ions. The proposed payloads are particles detectors, field detectors, aurora and neutral imaging system. These payloads will measure the plasma compositions and the electromagnetic waves, therefore determine the key factors for the oxygen ions to gain energy and flow upward. In this paper, we report the detailed orbit, payload and the current status for the MIT mission.

Final ID: T23D-2702

Bounds on fault strength based on simulation of "rider block" structures emerging from brittle lithosphere extension

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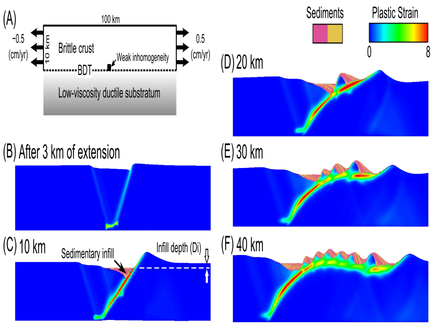
Body: Continental and oceanic core complexes are the most recently recognized major tectonic features on Earth. They represent extension focused on normal faults with tens of kilometers offset. In some core complexes, kilometer-scale “rider blocks” are cut off from the hanging wall and passively transported on top of the large offset normal fault. Previous numerical simulations of lithospheric extension produced the large offset, core complex-forming, normal faults only when the faults were weaker than a given threshold. We consider extensional faulting of Mohr-Coulomb layers in high-resolution simulations to refine the conditions that can lead to rider block formation and estimate the size of rider blocks formed. Presenting a guiding analytic theory based on Andersonian fault mechanics as well, we show that only a narrow range of fault weakening, relative to intact surrounding rock, allows for a consecutive series of rider blocks to emerge in a core complex-like geometry. Furthermore, rider blocks develop when the dominant form of weakening is by reduction of fault cohesion while faults that weaken primarily by friction reduction do not form distinct rider blocks.



Final ID: H23L-03

Putting the Hydrology Back in Water Resources: Recent Efforts to Improve Representation of Physical Hydrology in Water Resources Planning and Operations Models

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Body: Water resources planners and managers rely on a broad range of data analysis and modeling tools. Data analysis, statistical models, and physical hydrology models are used to estimate water supply, while systems-based planning and operations models are used to simulate system operation with respect to competing objectives—e.g., water supply vs. flood control vs. in-stream flows—under physical and regulatory constraints. In general, physical hydrology models neglect water operations, while planning and operations models lack physically-based representation hydrologic processes.

Accurate assessment of climate change impacts on water resources requires modeling tools that integrate physical hydrology and water resources operations. This presentation will discuss recent efforts to improve representation of physical hydrology in water resources planning and operations models, focusing on key challenges, trade-offs between various approaches, and implications for climate change risk assessment and adaptation studies. Discussion will focus on recent model development by the US Bureau of Reclamation, California Department of Water Resources, and collaborators for the Sacramento-San Joaquin watershed in California.

Final ID: OS23D-05

Simulating Sediment Transport Processes in San Francisco Bay Using Coupled Hydrodynamic, Wave, and Sediment Transport Models

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Body: Under the conceptual model of sediment transport in San Pablo Bay, a sub-embayment of San Francisco Bay, proposed by Krone (1979), sediment typically enters San Pablo Bay during large winter and spring flows and is redistributed during summer conditions through wind wave resuspension and transport by tidal currents. A detailed understanding of how the waves and tides redistribute sediment within San Francisco Bay is critical for predicting how future sea level rise and a reduction in the sediment supply to the Bay will impact existing marsh and mudflat habitat, tidal marsh restoration projects, and ongoing maintenance dredging of the navigation channels. The three-dimensional UnTRIM San Francisco Bay-Delta Model was coupled with the Simulating WAves Nearshore (SWAN) wave model and the SediMorph morphological model, to develop a three-dimensional hydrodynamic, wind wave, and sediment transport model of the San Francisco Bay and the Sacramento-San Joaquin Delta. Numerical simulations of sediment resuspension due to tidal currents and wind waves and the subsequent transport of this sediment by tidal currents are used to quantify the spatial and temporal variability of sediment fluxes on the extensive shoals in San Pablo Bay under a range of tidal and wind conditions. The results demonstrate that suspended sediment concentration and sediment fluxes within San Pablo Bay are a complex product of tides and waves interacting spatially throughout the Bay, with concentrations responding to local resuspension and sediment advection. Sediment fluxes between the San Pablo Bay shoals and the deeper channel are highest during spring tides, and are elevated for up to a week following wave events, even though the greatest influence of the wave event occurs abruptly.

Final ID: T24C-06

Deformation and incision of the western margin of the Central Andean Plateau, S. Peru and N. Chile ***(Invited)***

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Body: The western margin of the Central Andean Plateau in southern Peru and northern Chile hosts a rich geologic and geomorphic record of crustal deformation and river incision that developed during a period of regional plateau uplift. Significant growth of topography likely occurred in the western Central Andes starting at ca. 30 Ma, when the regionally extensive silts and sandstones of the Moquegua and Azapa Group sediments gave way to coarse sandstones and conglomerates. Apatite (U-Th)/He thermochronology, 3D thermal modeling, and infilling volcanic flows show that a subsequent major phase of canyon incision started in the middle reaches of Ocoña Canyon (southern Peru) between 11 and 8 Ma, with ca. 2-km of incision occurring between ca. 11 and 5 Ma. Surface uplift coeval with this incision has been documented in northern Chile, where rotated forearc basin deposits reveal 1 to 2 km of differential uplift between the Coastal Cordillera and the plateau margin that started after 11 to 10 Ma. In contrast with the 11 to 8 Ma onset of incision in the middle reaches of Ocoña Canyon, the currently 1-km-high coastal/piedmont region appears not to have been affected by incision until after 5 Ma, as documented by the 50-km-wide alluvial and colluvial plain that remained occupied by rivers until at least 5 Ma. Apatite (U-Th)/He thermochronology pointing to a final 1-km of incision in the middle reaches of Ocoña Canyon after ca. 5 Ma is supported by apatite 4He/3He thermochonometry, which documents the passage of a km-scale knickpoint through the same region between ca. 7 and 4 Ma.

Although river incision provides only a minimum time constraint for the start of surface uplift, the broadly coincident start of incision with the rotation of forearc basin deposits in northern Chile implies a close temporal coupling between the start of surface uplift and the onset of incision in Ocoña Canyon. Furthermore, the delayed incision of the coastal/piedmont region until after 5 Ma shows that the piedmont started to be uplifted well after uplift had started within interior regions, requiring two distinct phases of uplift. The first phase uplifted the plateau margin ca. 2 km relative to the piedmont along a broad monocline, while the second entailed 1-km of block uplift of both the piedmont and the plateau margin.

Final ID: OS24C-07

How sea level rise and storm climate impact the looming morpho-economic bubble in coastal property value. ***(Invited)***

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4. Ohio State University, Columbus, OH, United States.

Body: In the United States, the coastal region is now the most densely populated zone in the country and as a result has become a significant source of tax revenue and has some of the highest property values in the country. The loss of land at the coastline from erosion and damage to property from storms has always been a source of vulnerability to coastal economies. To manage this vulnerability, humans have long engaged in the act of nourishing the coastline – placing sand, typically from offshore sources, onto the beach to widen the beach and increase the height of dunes. As humans alter natural coastal dynamics by nourishing, the altered natural dynamics then influence future beach management decisions. In this way human-occupied coastlines are a strongly coupled dynamical system and because of this coupling, the act of nourishment has become an intrinsic part of the economic value of a coastline. Predictions of increased rates of sea level rise and changing storminess suggest that coastal vulnerability is likely to increase. The evolving vulnerability of the coast has already caused changes to occur in the way humans manage the coastline. For example, the federal government has recently reduced subsidies to help coastal communities nourish their beaches. With a future of changing environmental forcing from sea level and storms, the prospect of changes in nourishment cost could have profound consequences on coastal value and sustainability. We utilize two modeling approaches to investigate how disappearing nourishment subsidies reduce coastal property value and to explore the potential for a bubble and subsequent crash in coastal property value as subsidies dwindle and vulnerability rises. The first model is an optimal control model that couples a cost benefit analysis to coastline dynamics. In the second model, we couple a numerical coastline model with an agent-based model for real estate markets. Results from both models suggest the total present value of coastal property is significantly reduced with the removal of nourishment subsidies, creating a temporary bubble in coastal property value. In both models, results show the extent to which rising sea level and changing storminess impact the size of the property value bubble. The utility of the optimal control model is that it provides an empirically grounded parameterization of the coupled human coastal system. The coupled agent-based physical coastline model is more difficult to constrain with current data, however the model provides insight into the dynamics of subjective beliefs about coastal risk, which depend on the weight agents place on scientific predictions and on the way they process signals from previous climate events. Results from this model illustrate how the dynamics of the property bubble burst depend on agent beliefs about their changing environment.

Final ID: A31A-0016

Surface measurements of upper tropospheric water vapor isotopic composition from the Chajnantor Plateau, Chile: First results from a long-term measurement program

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Body: A 2010 pilot study showed that water vapor isotopic measurements on the arid 5km high Chajnantor Plateau of northern Chile are consistent with previous measurements from the base of the tropical tropopause layer, with water vapor concentrations as low as 215 ppmv and water vapor dD values as low as -540 per mil. In July 2012, we deployed a water vapor isotopic analyzer and an ozone monitor at the Atacama Large Millimeter Array (ALMA) astronomical observatory on the Chajnantor Plateau for a four-year long monitoring program. We present joint measurements of water vapor concentration, water vapor isotopic composition, and ozone concentration from the first four months of the monitoring program, spanning the SH winter and spring seasons. The last-saturation framework has proven effective for interpreting the driest measurements at Chajnantor, but the processes governing the moistening of air parcels reaching Chajnantor are less well understood. Furthermore, the seasonal variability of water vapor isotopic composition at Chajnantor and its relationship to upper tropospheric humidity variability are not known. In addition to the new data from Chajnantor, we will present new diagnostic analyses of the isotopic data, focusing on seasonal variability in last-saturation conditions, the potential for stratospheric air incursions into the SH subtropical mid-troposphere, and on the processes that moisten the air reaching Chajnantor to specific humidities above those encountered in the upper troposphere.

Final ID: B31A-0401

Landscape Vulnerability Analysis from Historic Lower Mississippi River Flood in 2011

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4. U.S. Geological Survey, Rolla, MO, United States.

Body: This study presents the results of a landscape vulnerability analysis of the Birds Point New Madrid Floodway in southeastern Missouri. The U.S. Army Corps of Engineers intentionally inundated 500 square kilometers of agricultural floodplain in May of 2011 as an emergency flood control measure. We use pre-flood (2005) and post-flood (2011) high resolution Lidar data to establish the landscape impact of the levee breach on the floodplain. The Lidar DEMs were corrected for flight line errors using a Fourier filtering technique, and then subtracted to obtain a differential DEM of erosion and deposition patterns. We use soil erosion characteristics, AVIRIS remote sensing data, and 2D floodplain modeling to analyze the three components of vulnerability: sensitivity, exposure, and adaptive capacity. HydroSed2D (Liu, Landry and García 2008), a 2D flow model, is implemented to simulate flow depths and speeds, or flood exposure, over the entire floodway, as well as smaller sections at increased resolution using a nested grid. We classify woody vegetation based on AVIRIS remote sensing data, and represent vegetated regions in the model as varied values of the Manning's n coefficient. Soil erodibility, vegetation, topography, and flow characteristics are compared to observed landscape changes within the floodplain. Overall, the floodway showed a remarkable resilience to an extreme flood event. When compared to levee breaches on similar rivers in other floods, the lack of newly deposited sediment is noticeable and likely attributable to the presence of a substantial riparian corridor between the main channel of the Mississippi River and the floodway. Although many meander scars indicating former channels of the Mississippi River are apparent in the topography, only one, known as O'Bryan Ridge, experienced high volumes of erosion and deposition due to the flooding. The vulnerability analysis supports the hypothesis this high impact is due to a combination of vulnerability factors such as high flow speed, few localized patches of vegetation, and high soil erodibility at this ridge compared to other similar meander scars. The methodology of this analysis can be used to locate regions of high vulnerability in future floodplain management and flood control, and mitigate potentially catastrophic landscape change.

Final ID: C31A-0577

High Heat-Flow Beneath the Central Portion of the West Antarctic Ice Sheet

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Body: Based on the tectonic setting and slow seismic velocities in the upper mantle, the geothermal heat flow beneath the West Antarctic Ice Sheet is expected to be both relatively high and spatially variable. Unfortunately, very few heat flow measurements have been made in West Antarctica to confirm or refute this expectation. During December 2011, high-precision temperature measurements were made in the 3405-m deep borehole recently completed at the WAIS Divide ice core site (79° 28.059'S, 112° 05.137'W) in the central portion of the West Antarctic Ice Sheet. Interpretation of the temperature measurements indicates the ice sheet is melted at the bed at this location and that the basal melting rate is extraordinarily high, 1.5~cm a^{-1} (the borehole does not penetrate all the way to the bed to protect the underlying environment). The associated geothermal heat flux is estimated to be about 240 mW m^{-2}, 4--5 times the continental average. Given the absence of a surface depression at the WAIS Divide site, this high heat flow is likely to be the regional value (horizontal scale $\ge$ 30~km), rather than simply a local anomaly.

Final ID: EP31A-0795

Plunge location of sediment driven hyperpycnal river discharges considering bottom friction, lateral entrainment, and particle settling

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Body: River discharges with very high sediment loads have the potential to develop into plunging hyperpycnal flows that transition from a river jet to a turbidity current at some location basinward of the river mouth due to the density difference between the turbid river and the receiving water body. However, even if the bulk density of the turbid river is greater than that of the receiving lake or ocean, some distance is needed for the forward inertia of the river to dissipate so that the downward gravitational pull can cause the system to collapse into a subaqueous turbidity current. This collapsing at the plunge point has been found to occur when the densimetric Froude number decreases to a value between 0.3 < Frd < 0.7 (Fang and Stefan 2000, Parker and Toniolo 2007, Dai and Garcia 2010, Lamb et al. 2010). In 2D channel flow analysis at the plunge point, this has led to the concept of a two-fold criterion for plunging. The first is simply for the need of high enough suspended sediment concentration to overcome the density difference between the river fluid and the fluid of the receiving water. The second is the need for sufficiently deep water to reduce the densimetric Froude below the critical value for plunging, which leads to dependence of plunging on the receiving water basin topography (Lamb et al. 2010). In this analysis, we expand on past work by solving a system of ODE river jet equations to account for bottom friction, lateral entrainment of ambient fluid, and particle settling between the river mouth and the plunge location. Typical entrainment and bottom friction coefficients are used and the model is tested against the laboratory density current data of Fang and Stefan (1991). A suite of conditions is solved with variable river discharge velocity, aspect ratio, suspended sediment concentration, and particle size; a range of salinity values and bottom slopes are used for the receiving water body. The plunge location is then expressed as a function of the boundary conditions at the river mouth and those of the receiving water. The relationships can be used for modern systems, but can also help to put reasonable bounds on paleo-hydraulic setting.

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Final ID: EP31A-0800

Effects of lateral momentum transfer on the predication of river flow and flood inundation

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Body: Previous studies on 2D modelling of flood inundation have predominately linked the river flow with floodplain inundation through mass exchange at the common boundary, but excluded the lateral momentum transfer. This study describes the coupling of a 1D river flow model and 2D inertial-based flood inundation model (FloodMap) that accounts for both the mass and momentum exchange between the two sub-systems. Simulations were undertaken to evaluate the effect of excluding momentum exchange on river flow prediction and flood inundation.
Two sets of simulations were undertaken: (i) within an artificial floodplain where the effects of longitudinal channel slope, transverse hillslope and flow magnitude are evaluated; and (ii) in a real-world setting where benchmarking data are available from previous studies carried out by the UK Environment Agency. Results demonstrate the spatial and temporal difference of both the river flow and floodplain inundation between the simulation with both mass and momentum exchange considered and its counterpart which excludes the lateral momentum exchange between the river and floodplain flow. In the artificial setting, when the lateral momentum flux is excluded, the overall pattern of response in the river channel is the overestimation of water depth during the rising limb and underestimation during the recession limb. The magnitude of over/underestimation is proportionate to that of the flood event and channel longitudinal slope. Compared to a horizontal transverse floodplain slope, the magnitude of depth overestimation when flow rises is smaller when there is an inward transverse slope from the floodplain to the river channel. On the other hand, the depth underestimation is higher when flow recedes, resulting in a larger overall underestimation magnitude. In the real-world simulation, the magnitude and timing of the over-/underestimation demonstrate a much more complex pattern due to the non-linear flow exchange occurring at the river and floodplain boundary. There is significant difference in the predicted peak floodplain depths between the two model formulations. The observed effect of excluding lateral momentum transfer on flow parameters in the river channel agrees well with previous studies undertaken with regard to compound channels and river junctions, and could be explained by the expected response of in/excluding individual terms in the governing equations. The over-/underestimation of water depth is associated with the increase/decrease of convective term in the momentum equation which essentially compensates the otherwise would-be less/more amount of momentum when influx to or efflux from the river is considered. Such effects are transferred to the floodplain flow routing, resulting in corresponding over-/underestimation of floodplain water depth. This study demonstrates the importance of including the lateral momentum transfer in the coupled modelling of 1D river flow and 2D floodplain inundation. This may have significant implications for assessing the standard of flood defence protection and estimating flood damages.

Final ID: EP31A-0802

Empirical estimates of the dominant environmental forcings on the relative sea level change of river delta systems

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Body: A global, empirically derived projection of river delta systems at risk of future relative sea level rise is presented based on a set of global environmental risk indicators. Indicators are drawn from upstream basin, coastal zone, and oceanic domains. They include human dimension variables such as population density, urban development, and water engineering, as well as biogeophysical variables such as the local wave environment and cyclone risk. All indicators are hypothesized to have a significant level of direct or indirect control on the local rate of relative sea level rise, commonly through changes in sediment delivery and deposition on the delta plain.
Indicators are statistically weighted based on observed rates of relative sea level rise in the literature. These weightings, applied to time series of risk indicators from river network and ocean models and the satellite record, enable identification of regions at greatest risk as a function of time and space. We find regional differences in the dominant sources of sea level rise risk, with higher latitude sites along the Arctic Ocean and in southern Africa and Australia dominated by oceanic risks. In Southeast Asia, the coastal zones with large deltaic megacities dominate ocean and basin source risks, while broadly developed river basins in East Asia and parts of Europe contribute strongly to sea level rise risk in those regions. Future work that will enable rigorous testing of alternative weighting schemes from which overall risk is determined will be discussed.

Final ID: EP31A-0806

Capacity of river networks to buffer thermal impacts of power plants in the northeastern US

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Body: Water temperature is a fundamental variable that influences an array of ecosystem processes including nutrient uptake, leaf breakdown, biological production, and habitat. Water temperatures can be altered by warm effluent flows from thermoelectric power plants but these impacts are often mitigated over distances downstream due to temperature re-equilibration with atmospheric conditions. We assessed the mitigation capacity of rivers in the northeastern U.S, a region with a high density of power plants, using a water temperature model developed within the Framework for Aquatic Modeling in the Earth System (FrAMES) coupled with the Thermoelectric Power Plant Model (TPPM). The spatially distributed river network model predicts average daily water temperatures at a 3-minute river grid resolution, accounting for the mixing of terrestrial runoff, power plant withdrawals, heat loading, and re-equilibration of temperatures in rivers based on solar radiation, air temperature, and hydraulic dimensions. Average predicted water temperatures match daily observations well with an average Index of Agreement (d) of 0.81 for 68 stations (2000 – 2010). Model results suggest power plants increase the total length of rivers exceeding a threshold temperature of 20 degrees Celsius by less than 1% when the re-equilibration in rivers is considered. Without the natural capacity of river temperature re-equilibration with atmospheric conditions power plants increase the total annual length of warm habitats by 15%. This highlights the buffering capacity of river networks to mitigate anthropogenic impacts to the system, representing an important ecosystem service performed by rivers in the northeast.

Final ID: EP31A-0807

Using numerical models to place constraints on fluvial input into glacial lakes, Southern Alps, New Zealand

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Body: Located east of the main divide in the central Southern Alps, the Mackenzie Lakes; Ohau, Pukaki and Tekapo, occupy fault controlled glacial valleys and contain a high resolution sedimentary record of the last ~17 ka. These sediments potentially contain a record of climatic events and transitions, earthquakes along the Alpine Fault to the northwest, landscape response during and following deglaciation and recent human-influenced land use changes. Our study focuses on Lake Ohau, the smallest and deepest of the three lakes.

We use HydroTrend, a climate-driven hydrological model, to calculate water and sediment discharge into Lake Ohau using daily timesteps over the last 60 years. The model is constrained by measured climate parameters and compared to observations from Ohau and the nearby Ahuriri catchment. Using a simple conceptual model of lake dynamics, we produced a series of simulations to examine sediment accumulation at different positions across the lake basin. We then compared these modelled accumulation records to a 5 m core collected from the distal end of the lake with compelling results.

Having calibrated the models against modern fluvial and climatological data and recent sedimentary record, we ran a transient simulation from the Last Glacial Maximum (LGM). High precision ^{10}Be surface exposure dating (Putnam et al. 2012) indicates that the Ohau glacier had retreated to a position ~11 km upstream of the present day head of the lake by ~17.4 ka. Basin geometry is constrained by 35 km of single channel seismic lines. Climatological boundary conditions were derived from nearby climate records including Boundary Stream and Okarito Lagoon. We explore the rate of filling the lake basin from ~17.4 ka to present. Results suggest sedimentation rates must have been higher than present day during the post-glacial retreat, pointing to higher erosion rates in the catchment prior to the Holocene. We aim to further test model results against a long core that we hope to recover from the lake basin in the next several years.

Final ID: EP31B-0808

The interaction between vegetation and channel dynamics based on experimental findings

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Body: Strong feedbacks exist between river channel dynamics, floodplain development and riparian vegetation. Several experimental studies showed how uniformly sown vegetation causes a shift from a braided river to a single-thread and sometimes meandering river. The objective of this study is to test what the effect of fluvially distributed seeds and vegetation settling is on channel pattern change and channel dynamics.

The experiments were carried out in a flume of 3 m wide and 10 m long. We tested where the vegetation deposited in a braided and meandering river and how the morphology changed. We used a simple hydrograph of 0.25 hour high flow and 3.75 hour low flow, where alfalfa seeds were added during high flow. The bed sediment consisted of a poorly sorted sediment mixture ranging from fine sand to fine gravel. The evolution was recorded by a high-resolution laser-line scanner and a Digital Single Lens Reflex (DSLR) camera used for channel floodplain segmentation, water depth approximation and vegetation distribution.

In an initially braided river, vegetation settled on the higher banks and stabilized the banks. In an initially meandering river, vegetation settled in the inner scrolls, and also on the outer banks when water level exceeded bankfull conditions. In agreement with earlier work, the outer bank was stabilized; erosion rate decreased and bends became sharper. The inner bend vegetation stabilized a part of the point bar and hydraulic resistance of the vegetation steered water in the channel and to the non-vegetated part of the inner bend. As result the meander bend became braided as water flows along the vegetation. Vegetation formed patches that grew over time and reduced channel dynamics. We conclude that self-settling vegetation decreased local bank erosion and that vegetated islands leads to a multi-thread system instead of single-threaded.

Final ID: EP31B-0811

The Signature of Life in Stabilized Dune Topography

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Body: Life dramatically affects aeolian dunes on Earth by modifying dune morphology and immobilizing sediment. Complete immobilization (stabilization) occurs when vegetation growth shelters the surface and eliminates sediment transport (and the capacity of the dune to clear vegetation). In unidirectional dune forms stabilization is usually preceded by a period of transition dominated by pronounced morphological change (e.g., parabolic dunes). Here, we hypothesize that stabilized topography holds previously unidentified clues detailing the kinematics and behavior of vegetation during stabilization (a 'signature'). During stabilization dune ridges advance downwind and 'bulldoze' vegetation in their path. We split dune ridges into a series of wind-parallel 'dune slices' and outline how slipface vegetation could prove to be a 'tipping point' in stabilization for each dune slice. Slipface vegetation sets off a self-reinforcing stabilization feedback, simplifying our treatment and yielding two predictable behaviors: slipfaces either clear vegetation (deposition rate > vegetation deposition tolerance), or succumb to vegetation and become immobilized (deposition rate < vegetation deposition tolerance). We model slipface deposition rates through slipface geometry and show how predictable variations in classical dune forms (i) could be responsible for incipient transformation of barchan to parabolic dunes, (ii) result in a progressive stabilization feedback fundamentally inconsistent with widely used dune activity indices, and (iii) record a quantitative signature of the relative kinematics of sediment flux and vegetation growth in stabilized slipface geometries. To explore the idea in real dune fields, we extract slipface deposition rates through slipface geometry recorded in digital terrain data for three dune fields: (i) Bigstick Sand Hills, SK, Canada, (ii) White Sands, NM, USA, and (iii) Cape Cod, MA, USA. With independent estimates of sediment flux and vegetation deposition tolerance we show how all three dune fields show consistent results with characteristic deposition rates approximately 60% of vegetation deposition tolerance. These results open the possibility that a consistent and identifiable 'signature of life' could be coded into all stabilized dune topography worldwide.

Final ID: EP31B-0812

Alluvial deposits and plant distribution in an Amazonian lowland megafan

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Body: A large volume of sandy alluvial deposits (> 1000 km2) characterizes a flat wetland in northern Amazonia. These have been recently described as the sedimentary record of a megafan system, which have a distinct triangular shape produced by highly migratory distributary rivers. The vegetation map suggests that this megafan is dominated by open vegetation in sharp contact with the surround rainforest. Understanding the relationship between geomorphological processes and vegetation distribution is crucial to decipher and conserve the biodiversity in this Amazonian ecosystem. In this study we interpret plant dynamics over time, and investigate its potential control by sedimentary processes during landscape evolution. The study area is located in the Viruá National Park. Two field campaigns were undertaken in the dry seasons of 2010 and 2011 and the sampling sites were selected by combining accessibility and representativeness. Vegetation contrasts were recorded along a transect in the medial section of the Viruá megafan. Due to the absence of outcrops, samples were extracted using a core device, which allowed sampling up to a depth of 7.5 m. All cores were opened and described in the field, with 5 cm3 samples collected at 20 cm intervals. The δ13C of organic matter was used as a proxy to distinguish between C3 and C4 plant communities. The chronology was established based on radiocarbon dating. The results suggest that the cores from forested areas show the most depleted values of δ13C, ranging from -32.16 to -27.28‰. The δ13C curve in these areas displays typical C3 land plant values for the entire record, which covers most of the Holocene. This finding indicates that either the vegetation remained stable over time or the sites were dominated by aquatic environments with freshwater plants before forest establishment. The cores from the open vegetation areas show a progressive upward enrichment in δ13C values, which range from -28.50 to -19.59‰. This trend is more pronounced after de mid-Holocene, suggesting that the open vegetation, represented mostly by C4 land plants, evolved only more recently. Based on our isotope data, a model is proposed taking into account the influence of sedimentary dynamics on the modern pattern of plan distribution. The establishment of open vegetation occurred at different times depending on location over the megafan area, varying from around 3,000 to 6,400 cal yrs BP. As sedimentation took place, areas located far from the surrounding rainforest were prone to inputs of organic matter derived from open vegetation, whereas the contribution of organic matter derived from arboreous vegetation increases toward the areas located closer to the rainforest. In general, open vegetation is constrained to depositional sites that remained active until relatively recent Holocene times, while surrounding areas with a relatively older geological history are covered by dense forest. The results presented here consist in a striking example of the influence of sedimentary processes during the Late Pleistocene-Holocene on the development of modern plants of this Amazonian lowland.

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Does Moss Grow on a Rolling Stone? The Influence of Precipitation Phase on Streamflow Characteristics, Bed Particle Transport and Periphyton Development in 18 Mountain Channels, Central Idaho

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Body: It has been suggested that linked ecological and geomorphological systems exhibit complex and non-linear response to disturbance. However, quantifying the response of these systems is complicated by identifying the relevant linkages between system components and by variability in time scale adjustments. To help elucidate some of these complexities we characterized the influence of streamflow and bed-substrate mobility on periphyton assemblage development. Study catchments are subdivided into 3 categories based on the fraction of precipitation that fell as rain vs. snow. The categories are rain-dominated (RD), mixed rain-snow (MRS) and snow-dominated (SD). Three water years of streamflow data demonstrate that RD catchments experienced the largest inter-regime and inter-annual variability in streamflow conditions. RD sites were characterized by flashy responses to frequent precipitation events during wet winter and spring months and experienced channel drying during the summer. Runoff in MRS and SD catchments was characterized by much higher magnitude, longer duration flow events in early and mid-summer. Hydrologic results suggest that RD watersheds limit periphyton mass because of drought conditions and that MRS and SD channels control the temporal scale of periphyton development via long duration, high magnitude flood events that transport bed sediments and disrupt primary production. Results from our rock-tracing experiment indicate that assessments of biological disturbance based on hydrologic metrics alone miss important details of the characteristics of physical disturbance within channels. Channels within RD catchments appear to be in disequilibrium because of variability in the frequency and consistency of hydrologic events capable of mobilizing bed particles. Wet winters resulted in frequent and flashy streamflow events that likely caused bedload transport, whereas drier winters caused few streamflow events and subsequently little to no bedload transport. Inter-annual flow variability in RD channels resulted in a lack of bed armor development and an absence of mature, well-sorted bedforms. In contrast, the more consistent, long duration, high magnitude flow events experienced by MRS and SD channels resulted in less inter-regime and inter-annual hydrologic and bedload transport variation. MRS and SD channels exhibited mature, well-sorted bedforms and bed-armor development. Although streamflow and transport characteristics were more consistent in MRS and SD watersheds, it is important to note that some of the MRS channels experienced rain-on-snow events that pushed channel bed characteristics towards RD style channels. Periphyton analysis suggests that the time of sampling from peak flows exerts a strong control on the observed level of periphyton development and that greater variability in flow and particle transport distances in RD systems results in greater variability in periphyton mass. Importantly, these results highlight the need for considering channel substrate mobility and not hydrologic regime alone in assessing basal food resource production and suggest that transitions from MRS to RD conditions will result in more extreme and more variable biotic and abiotic disturbances.

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Geomorphic Change Detection and Quantification Using LiDAR, SONAR and RTK-GPS of Sandbars along the Snake River in Hells Canyon

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Body: Sediment depletion downstream of large dams causes long-term geomorphic change along a river reach. Short- and long-term, natural and human-altered discharge patterns cause additional geomorphic change. Annual high-resolution, topobathymetry data are being collected on sandbars to track patterns of geomorphic and volumetric change through time. The sandbars are located along the Hells Canyon reach of the Snake River on the Oregon/Idaho border. The bars are downstream of a number of dams that have cut off the upstream source of sand to the Hells Canyon reach. We are combining LiDAR data for above water areas, multibeam SONAR data for below water areas and RTK-GPS data for the water/land interface and densely vegetated areas. Idaho Power has installed and surveyed a control point network to allow accurate positioning of the data and aligning of the various data sets. Data densities are a few points per square meter with the RTK-GPS, tens of points per square meter with the SONAR, and up to hundreds of points per square meter with the ground-based LiDAR. Automated and manual methods are being used to clean the point cloud data. A number of techniques are being used to convert the point clouds to grids, typically utilizing a unique technique for each data type (GPS, LiDAR, and SONAR). Surface roughness data are being used to determine the edges of the sand region, especially in the underwater area where we do not have visual confirmation of the boundary. After the different data types are gridded, they are combined to create seamless surfaces which are then analyzed. The morphologies of the central crest and the back channel of the sandbars are changing between years. In years with higher than average spring flows, the central crest of the sandbars increases in elevation and the back channels deepen. In years with moderate and low spring flows, the height of the crests decline and the back channels fill in. The flattening of the sandbars is attributed to natural redistribution processes and anthropogenic use. The cut-banks behind the sandbars have typically not retreated during the study period (8 years). Volumetric differences show that the cut/fill patterns are consistent over large areas of each bar. The annual morphologic changes are consistent among the sampled bars. The time series is just starting to be long enough to assess long-term trends in bar volume and morphology as opposed to inter-annual variability. The increased availability of high-density SONAR and LiDAR data has substantially aided our efforts to detect and quantify geomorphic change along the Snake River. The data editing and analysis techniques for these high-density data sets are advancing rapidly. Improvements in error analysis and within grid cell data proprieties are being developed to document the accuracy of the results and determine other morphological properties.

Final ID: EP31C-0823

Dynamic Feedbacks Between Flow, Erosion and Evolving River Bank Roughness Revealed Through Repeat High-Resolution Topographic Surveys

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Body: Bank erosion is a key process in fluvial dynamics, with significant fractions of the total sediment load being sourced from river banks. Studies have shown that hydraulic erosion of the bank toe is a driving factor of long term rates of bank retreat. Fluvial bank erosion rates are often quantified using an excess shear stress model where the erosion rate is a function of the boundary shear stress applied by the flow above a critical threshold. Research has shown that the form roughness induced by natural topographic bank features such as slumps, spurs and embayments, is a major component of the spatially-averaged total shear stress. The skin friction component of this shear stress is typically an order of magnitude less than the total, meaning that the form roughness provides an important control on bank erosion rates. However, measuring the relative components of the total shear stress for a natural system is not straightforward. In this research we apply the method of Kean and Smith [2006, J. Geophys. Res., 111(4), F04009, doi:10.1029/2006JF000467] to partition the form and skin drag components of river bank roughness for an eroding bank of the Cecina River in central Italy. This method approximates the form drag component of the roughness along a longitudinal bank profile as a series of user defined Gaussian curves, with the skin friction component estimated through analysis of the deviations of the data from the fitted curves. For our site, a temporal sequence (2003 – 2011) of high-resolution topographic surveys has been collected through a combination of photogrammetry and Terrestrial Laser Scanning. For each survey five vertically equidistant profiles are extracted and analysed alongside DEMs of difference and associated flow data modelled using the distributed hydrological model MOBIDIC. The data are used to explore the dynamic feedbacks that exist between river discharge, bank erosion processes and bank form roughness, revealing insights into the self-limiting nature of erosion rates.

Final ID: EP31C-0832

Quantifying post-wildfire erosion patterns using terrestrial LiDAR

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Body: Wildfires are becoming increasingly frequent in the western United States. In burned landscapes, geomorphic change can take place rapidly during rainstorms following a wildfire. Rainfall over a burned area tends to mobilize more sediment than in unburned basins because the wildfire changes soil properties, creating more overland flow. A dearth of ground debris allows for deeper and faster flow that can entrain sediment. We apply terrestrial LiDAR to post-wildfire geomorphic change analysis to determine the pattern and magnitude of erosion following rain storms. By differencing digital elevation models created from terrestrial LiDAR surveys, we can measure post-wildfire geomorphic change. Topographic analysis with LiDAR allows us to monitor landscape recovery and evolution following a wildfire.

Traditional methods of post-wildfire erosion analysis have focused on measurements such as erosion pins and silt fences. These capture erosion or deposition at a point or cumulative deposition of the sediment from some unknown contributing area upstream of the silt fence. This requires researchers to integrate measurements over a large area to determine basin-wide erosion. By contrast, successive terrestrial LiDAR surveys allow us to map changes in topography over an entire basin or hillslope to determine the spatial distribution of erosion within a basin or on a hillslope and to correlate the erosion with the hydrologic processes between surveys.

Our study site is a high-severity burn hillslope, burned by the 2010 Fourmile Canyon fire about 15 km west of Boulder, CO. The wildfire was contained on 16 September 2010 and the first LiDAR survey was on 7 October 2010 prior to any significant rain storms. Following this baseline survey, we have used terrestrial LiDAR to capture the landscape state before and after unique hydrologic events such as: low-intensity rain storms, winter snowmelt, and summer convective thunderstorms. Comparing the landscape topography before and after these hydrologic events allows us to quantify the topographic change due to specific hydrologic processes.

The results of our LiDAR survey reveal that at the hillslope scale, erosion is not uniform across the burned hillslope. The maximum erosion on a hillslope area of 1900 m2 showed detectable change on only 4% of the total area, but 4 m3 of erosion. The centimeter scale LiDAR topography reveals that most of the erosion is concentrated in concave portions of the hillslope where water concentrates, and relatively little inter-rill erosion was observed. Moreover, the majority of erosion occurs during high-intensity short duration summer convective thunderstorms. We saw a mean depth of erosion of 7 cm in a hillslope swale following storms with rainfall intensities greater than 30 mm/hr. However, in the same swale there was a mean erosion depth of 9 mm after a storm with only 10 mm/hr of precipitation. In general, low-intensity long duration rain storms and snowmelt events have had very little effect on our burned hillslope. The change in erosion with changing rainfall intensity is likely linked to switching between saturation-excess overland flow to infiltration-excess overland flow with increasing rainfall intensity.

Final ID: EP31D-0841

On the influence of varying stream discharge on bed topography and tracer migration in gravel bedded channels

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Body: A series of controlled experiments were conducted in a large experimental flume at the St. Anthony Falls Laboratory to study the effect of varying discharge on bed topography and tracer dispersal. Instantaneous, high-resolution bed elevations and sediment transport rates along with travel distances of tracer particles of size representative of the grain size distribution of bed material were measured, for a range of discharges. It is shown that bedform geometry directly depends on discharge with increasing height, decreasing length, and decreasing variability in bedform aspect ratio as the discharge increases. For the case of higher discharges where the bed topography is more pronounced, it is demonstrated that the length of the bed forms acts as a first order control on tracer travel distances. Based on a multi-scale analysis of bed elevation increment series, we demonstrate that the spectral slope and the degree of non-linear dependence of higher order structure functions on moment order control the distribution of travel distances, with larger particles traveling further at low discharge and smaller particles not significantly affected by the discharge rate. Results also show that the mean travel distance of smaller particles does not get much affected by the bed topography as the dynamics of smaller particles are mainly dominated by the particle hiding effect. Our results also confirm, for the first time, the heavy-tailed distribution (truncated power-law tail) in the statistics of tracer travel distances for a mixture of grain sizes and discharges as recently hypothesized in theoretical studies and as expected in natural rivers characterized by a wide grain size distribution and extreme flood events. The implications of these results for predictive modeling of sediment transport are discussed.

Final ID: EP31E-01

Feedbacks between roughness and boundary-layer aerodynamics control desert dune field evolution *(Invited)*

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Body: Spatial variations in sand flux across a desert dune field control dune migrations rates, the viability and density of vegetation, and deposition rates. Many dune fields begin abruptly with a line source of sediment, with either a deflation basin or body of water upstream of them. We hypothesize that this sharp increase in roughness trips the development of an internal boundary layer (IBL), which thickens downwind and causes a spatial decrease in the surface wind stress and hence sediment flux. Although such boundary layers are well-studied at sea-land transitions, there is almost no research conducted in deserts, and the implications for sediment transport have not been explored. We employ classic flat-plate boundary layer theory to compute the expected boundary stress profile downwind of a roughness transition at the desert dunes of White Sands, New Mexico. The required assumptions are severe: a neutrally-buoyant atmospheric boundary layer (ABL), quasi-steady and two-dimensional flow, uniform downstream roughness, etc. Lacking direct observations of the wind stress profile, we used repeat aerial topography surveys to directly measure the sand flux profile over several years. The agreement between the theoretical sand flux profile from IBL theory and that determined from topography data is remarkable, but raises deeper questions about near-bed atmospheric flows and sediment transport. We demonstrate for White Sands that sand-transporting winds are always associated with neutrally-buoyant ABL profiles; is it always the case that winds strong enough to move sand also produce a well-mixed ABL? The separation of scales between intermittency in winds and the migration rate of dunes appears to justify the quasi-steady assumption, but is this the rule for dune fields? Finally, the IBL model predicts that the upwind margins of dune fields should be zones of scour – which is broadly supported at White Sands – however some local accumulation of sand is necessary to spawn the dunes that emerge from these regions. Does this last point contradict the IBL theory, or is there more subtlety involved in the stress profile across the roughness transition that cannot be resolved with an analytic approach? One interesting outcome of IBL theory is that the feedback between boundary roughness and boundary stress acts to preserve – rather then diffuse – the abrupt roughness transition. We outline exciting avenues for future research at the interface of atmospheric dynamics and landscape evolution.

Final ID: GC31A-0966

A decision-tree-based method for reconstructing disturbance history in the Russia boreal forests over 30 years

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Body: The boreal forest is one of the largest biomes on Earth and carries crucial significance in numerous aspects. Located in the high latitude region of the Northern Hemisphere, it is predicted that the boreal forest is subject to the highest level of influence under the changing climate, which may impose profound impacts on the global carbon and energy budget. Of the entire boreal biome, approximately two thirds consists of the Russian boreal forest, which is also the largest forested zone in the world. Fire and logging have been the predominant disturbance types in the Russian boreal forest, which accelerate the speed of carbon release into the atmosphere. To better understand these processes, records of past disturbance are in great need. However, there has been no comprehensive and unbiased multi-decadal record of forest disturbance in this region. This paper illustrates a method for reconstructing disturbance history in the Russia boreal forests over 30 years. This method takes advantage of data from both Landsat, which has a long data record but limited spatial coverage, and the Moderate Resolution Spectroradiometer (MODIS), which has wall-to-wall spatial coverage but limited period of observations. We developed a standardized and semi-automated approach to extract training and validation data samples from Landsat imagery. Landsat data, dating back to 1984, were used to generate maps of forest disturbance using temporal shifts in Disturbance Index through the multi-temporal stack of imagery in selected locations. The disturbed forests are attributed to logging or burning causes by means of visual examination. The Landsat-based disturbance maps are then used as reference data to train a decision tree classifier on 2003 MODIS data. This classifier utilizes multiple direct MODIS products including the BRDF-adjusted surface reflectance, a suite of vegetation indices, and land surface temperature. The algorithm also capitalizes on seasonal variability in class characteristics by including metrics from different times of year. The resultant classification maps are validated using the remaining samples of Landsat-based disturbance map and the accuracy of classification is assessed. The result of this set of procedures is a geographical database of mature forest with identified disturbance types and ages (by decade) for the entire Russian boreal forest spanning more than three decades. The presented method has been applied experimentally in a previous study on a forest region in the Russian Far East where disturbed and mature forests in RFE were successfully differentiated with an overall accuracy of 88% (Kappa 0.73), and the overall accuracy of identification of individual disturbances was 70% (Kappa 0.64).

Final ID: GC31B-0989

Historical Snow Cover and Water Resources Change in central Asia

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Body: Seasonal snow cover is a vital source of river runoff in arid and semi-arid regions of central Asia. Decrease of seasonal snow cover is one of the major consequences of climate change in central Asia. To quantify the historical snow cover change, its relationship to global and regional atmospheric processes, and its impact on water resources, a new database for cryospheric research in central Asia has been created in Asiacryoweb.org. It serves a data portal for snow cover, glacier, meteorology, hydrology and ice core data in central Asia, as well as a platform for further research collaborations.

We analyze the historical snow cover change using data derived from AVHRR and MODIS images in 1986 - 2008. The results suggest that the snow cover extent in central Asia has declined significantly in general. We found significant decrease of seasonal snow cover in alpine regions surrounding major mountains (Tienshan, Pamir and Altai-Sayan) in summer; while in winter, northern part of Kazakhstan Steppe, mountains in Altai-Sayan and peripheral regions of Tienshan and Pamir mountains have seen significant strong increase of snow cover. Analysis of the relationship between snow cover extent and climate pattern indices shows a significant negative relationship between snow cover in Pamir mountains and Altai-Sayan mountains with Eastern Atlantic Pattern, and a significant negative relationship between snow cover in northern Aral-Caspian desert, Tienshan and the East Atlantic / West Russia pattern. And the Polar / Euraisa Pattern has a positive relationship with snow in Kazakhstan Steppe, Pamir, and Tienshan. The changing snow cover regime will affect not only the amount but also the timing of available water melting from snow.

Final ID: GC31B-0995

Bayesian Multimodel Projection of Temperature Change in Eurasia

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Body: Global coupled Atmospheric-Ocean General Circulation Models (coupled GCMs) are the modelling tools traditionally used for theoretical investigations of the mechanisms of climatic changes. With the help of GCMs, we can not only simulate the present-day and project future climatic changes, but also separate natural climate variability from anthropogenic effects. It is generally believed that multi-model ensembles are superior to single models, and that the ensemble may even outperform the best single participating model. This study uses the Bayesian multimodel approach developed by Duan and Phillips (2010, JGR) to study the trend in temperature change in Eurasia using climate simulations from the Climate Model Intercomparison Projection Phase 5 (CMIP5). Observed data from 1901-2005 are used for this study. The trend is estimated based on change in decadal scale. Bayesian weights are computed for each 10-year period. The change in Bayesian weights is analyzed. The suitability of using the weights computed from the past data to predict temperature in the future is evaluated.

Final ID: GC31D-01

Water Cycle Change and the Human Fingerprint on the Water Landscape of the 21st Century: Observations from a Decade of GRACE ***(Invited)***

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Body: Over the last decade, satellite observations of Earth's water cycle from NASA's GRACE (Gravity Recovery and Climate Experiment) mission, have provided an unprecedented view of global hydrological change and freshwater availability. Since its launch, the mission has helped to confirm that precipitation, evaporation and continental discharge rates are increasing, that the mid-latitudes are drying while the high and low latitudes are moistening, and that the hydrologic extremes of flooding and drought are becoming even more extreme. Importantly, GRACE has exposed the human fingerprint of water management practices such as groundwater use and reservoir storage, which raises many important issues for climate, water, food and economic security. Moreover, the GRACE mission has enabled us to peer beneath Earth's surface and characterize the worldwide depletion of groundwater aquifers, raising significant concerns about the potential for heightened conflict over transboundary water resources. In this talk I review the basics of how the GRACE mission observes terrestrial and global hydrology, what new information the mission has provided since its launch in 2002, and the implications for the future of water availability and sustainable water resources management.

URL : http://ucchm.org

Final ID: H31C-1124

Development of climate projections for water resources planning

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Body: To make use of climate model data in any hydrologic prediction system, it is necessary to first translate those data into a product that is statistically realistic in space and time. Such translation is typically performed by statistical or dynamical downscaling, with the former being far more common than the latter. While statistical downscaling has advanced substantially in the past 20 years, these methods remain dependent on a major assumption which may be questionable under a changing climate: statistical methods assume stationarity of both the higher resolution spatial weather patterns and in the relationship between climate model output, e.g. precipitation, and local weather. We examine this assumption through multiple statistical downscaling experiments using the Bias Corrected Spatial Disaggregation (BCSD), Bias Corrected Constructed Analogues (BCCA), Statistical Asynchronous Regression (SAR), a new hybrid statistical-dynamical downscaling methodology, and a fully dynamical Weather Research and Forecasting (WRF) model simulation. The various statistical methods were each performed three times using training datasets designed to mimic 1) how they are traditionally validated, 2) how they perform in a best case scenario, and 3) how they would perform under climate change. The hybrid method avoids many of the issues that constrain statistical methods by using some of the same physics that drive the WRF model to make a first estimate of local weather patterns based off the large scale atmospheric forcing. It then utilizes an Asynchronous Regression correction to remove any bias in the simulation. While the hybrid method increases the computational cost over a purely statistical method, it remains a small fraction of the cost of a fully dynamic WRF run. Importantly, both the hybrid method and the WRF simulation provide more than just the precipitation and temperature estimates provided by most statistical methods. They also provide surface radiation, humidity, wind, and pressure data at an hourly time step. As a result, these techniques can be used to drive more advanced, physically based hydrologic models. In addition, the fully dynamical and hybrid methods do not rely on ground-based observations, as such they can be used in remote regions of the world where no such observations are available.

Final ID: H31C-1129

Evaluating the influence of summer monsoon intensity on the runoff of the middle Yellow River Basin

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Body: Continental monsoon climate controls the runoff in Central and Southeastern China, especially the drainage between Lanzhou and Huanyuankou, i.e. the middle Yellow River Basin. To analyze the influence of summer monsoon intensity on the runoff of the region, this paper evaluates the temporal variation and power spectrum of summer monsoon indices (Ism) of 139 years (1873-2011) and natural runoff of the middle Yellow River Basin of 93 years (1919-2011) by using continuous wavelet transform (CWT). The CWT of Ism indicates that ~80a and ~40a periodicities persist over the whole period, while the higher frequency oscillation (i.e. 2-8a) decreases after 1970 during which both the ENSO influence and continental monsoon intensity are being weak. The attenuating of 2-8a oscillation is also found in the CWT of natural runoff in the drainage area between Hekouzhen and Longmen, which might lead to a good correlation between Ism and natural runoff in the region. However, the 2-8a oscillation in the CWT of natural runoff is more consistent over the whole period of 1919-2000 in downstream areas, i.e. drainage area between Longmen and Huangyuankou, which indicates strong influence from other climatic factors such as ENSO.

Final ID: H31N-01

Progress and opportunities in Earth System model coupling with emphasis on hydrological model components *(Invited)*

D. J. Gochis; [1]; *S. D. Peckham;* [2]; *J. S. Arrigo;* [3]; *J. S. Famiglietti;* [4]; *C. M. Ammann;* [1]; *J. T. Reager;* [4]; *J. Edman;* [4];

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Body: The need for improved assessments and predictions of many key environmental variables is driving a multitude of model development efforts in the geosciences. Increasingly, the aggregation of these various modeling components is referred to as 'Earth Systems Modeling' although, traditionally, 'Earth Systems Modeling' referred to a set of physics components that controlled the behavior of the Earth's climate and were used primarily in a global circulation modeling context. However, the proliferation of climate impacts research is driving a host of new Earth System Model development efforts as society seeks to understand how climate does and will impact key societal activities and resources and, in turn, how human activities influence climate and the environment. This surge in model development has highlighted the role of model coupling as a fundamental activity itself and, at times, a significant bottleneck in Earth Systems and climate impacts research. This talk explores some of the recent activities and progress that has been made in assessing the attributes of various approaches to the coupling of Earth Systems models. A roadmap on Earth System Model coupling, developed as part of the National Science Foundation's EarthCube effort will be discussed as will some initial results of a related pilot study that aims to provide a standardized framework for assessing model coupling activities. The goal of this effort is strategize optimal pathways forward in model coupling and to engage or enable a broader swath of geoscientists in Earth System model development. As such, the framework and roadmap presented stress the needs for open, standards-based approaches for code development, model interoperability and data and metadata structures as well as the need for multi-scale and multi-physics model structures.

Final ID: SH31A-2200

The role of streamers in the deflection of coronal mass ejections: comparison between STEREO 3D reconstructions and numerical simulations

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Body: On 2009 September 21, a filament eruption and the associated Coronal Mass Ejection (CME) was observed by the %coronographs on board of the
STEREO spacecraft. The CME originated from the southern hemisphere and showed a deflection of about 15° towards the heliospheric current sheet (HCS) during the propagation in the COR1 field-of-view (FOV). The CME source region was near the central meridian, but no on-disk CME signatures could be seen from the Earth.
The aim of this paper is to provide a physical explanation for the strong deflection of the CME observed on 2009 September 21.
The two-sided view of the STEREO spacecraft allows us to reconstruct the three dimensional (3D) travel path of the CME and the evolution of the CME source region. The observations are combined with a magnetohydrodynamic (MHD) simulation, starting from a magnetic field configuration closely resembling the extrapolated potential field for that date. %The amount of helicity injected in the coronal volume is similar in both the observation and the simulation. By applying localized shearing motions, a CME is initiated in the simulation, showing a similar non-radial evolution, structure, and velocity as the observed event. The CME gets deflected towards the current sheet of the larger northern helmet streamer, due to an imbalance in the magnetic pressure and tension forces and finally it gets into the streamer. This study shows that during solar minima, even CMEs originating from high latitude can be easily deflected towards the heliospheric current sheet, eventually resulting in geoeffective events. How rapidly they undergo this latitudinal migration depends on the strength of both the large scale coronal magnetic field and the magnetic flux of the erupting filament.

Final ID: EP31E-02

The role of dune interactions and wind fluctuations in the selection of dune sizes within barchan fields *(Invited)*

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Body: Sand dunes dominate desert morphology. They naturally emerge under strong winds and sufficient sand supply from the interaction between sand transport, topography and hydrodynamics. The fact that dunes are mobile landforms gives a dynamical character to desert geomorphology with potential implications for the surrounding ecosystems. As dune mobility is closely related to dune morphology, in particular its size, the study of the long-term evolution of desert areas requires a better understanding of (1) the factors behind dune size selection and (2) the multi-scale nature of dune morphology. Recently it has been shown that dune size is bounded both at small and large scales by sand transport and hydrodynamics, respectively. The smallest dune size is limited to several meters in length by the existence of the so called “saturation length”, i.e. the characteristic length of transport transients. The maximum dune size, in the order of hundreds of meters, is in turn limited by the stabilizing effect of the upper limit of the atmospheric boundary layer. Dune dynamics at both scales is also qualitatively different as elementary dunes emerge from a linear instability, and are thus ubiquitous, while giant dunes seem to result from the coalescence of smaller ones. In consequence, a typical dune field should consist in a roughly continuous hierarchy of dune sizes, with many elementary dunes and very few giant dunes. However, in several cases this is not the correct picture as dune sizes are quite uniform and seems to cluster around an intermediate value that is well above the minimum but much smaller than the maximum one. This points to an alternative selection mechanism different from the simple dune merging.

Here, we argue that the combination of dune collisions and wind fluctuations, at least within barchan fields, is able to stop the continuous merging process and select a characteristic dune size in function of local conditions. To that end we use a morphodynamic dune model capable of reproducing the evolution of dune fields for different wind regimes. We find that colliding dunes of very different sizes tend to merge and thus increase the average dune size within the field. In contrast, colliding dunes of comparable sizes tend to redistribute the volume such that both dunes become more equal afterwards, which limits dune growth. In accordance with previous results, we find that dune growth is also limited by wind fluctuations, both in intensity and direction, which lead to the formation of elementary barchans from dune calving. As a result, the balance between those processes contributing to dune growth and those limiting it is able to select a specific, non-trivial dune size. In addition, simulations also suggest that this balance can be unstable in certain conditions and start a positive feedback for dune growth. As collisions with very large dunes have a higher probability of leading to the merging of both dunes, dune growth may continue until it is eventually limited by the size of the atmospheric boundary layer.

Final ID: ED31C-03

The potential roles of science centers in climate change adaptation

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Body: The overwhelming consensus amongst climatologists is that anthropogenic climate change is underway, but leading climate scientists also anticipate that over the next 20 years research may only modestly reduce the uncertainty about where, when and by how much climate will change. Uncertainty presents not only scientific challenges but social, political and economic quandaries as well.

Both scientific and educational communities understand that climate change will test the resilience of societies especially because of the uncertainties regarding the timing, nature and severity of climate change. Thus the need is great for civic conversations regarding climate change adaptation. What roles might science centers play in helping their audiences and communities make decisions about climate change adaptation despite less-than-perfect knowledge? And how might informal and formal education work together on this task?

This session will begin with a review of some initial efforts by selected science centers and their partners to engage their audiences in and help their communities grapple with climate change adaptation. It then will conclude with an audience discussion about potential future efforts by science centers both individually and in collaboration with formal education institutions to elevate public and policymaker awareness and appreciation of the need for climate change adaptation.

Final ID: G31C-05

Contributions to Terrestrial and Global Hydrology from a Decade of GRACE Measurements

J. S. Famiglietti; [1, 2]; *H. Kim;* [1]; *M. Rodell;* [3]; *J. T. Reager;* [1, 2]; *T. H. Syed;* [4]; *M. Lo;* [1, 5]; *D. P. Chambers;* [6]; *S. C. Swenson;* [7];

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7. Climate and Global Dynamics, NCAR, Boulder, CO, United States.

Body: A decade of GRACE time-variable gravity measurements has provided unprecedented insights into the dynamics of the terrestrial and global water cycles. In this presentation we review pre-launch expectations and compare them to what hydrologic information GRACE has actually provided. Examples include estimating unknown fluxes such as evapotranspiration and discharge from large river basins, remote sensing of groundwater storage changes from large aquifer systems, and tracking emerging trends in freshwater availability around the globe. Impacts on drought and flood monitoring will also be highlighted. Implications for water management, water security and water cycle change will be discussed.

URL: http://ucchm.org

Final ID: GC31D-05

Advancing global hydro-climatological data archives to support climate change impact assessments on water resources

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Body: Climate variations and changing climate will very likely alter the rate and nature of hydrological processes and consequently affect water resources in many regions. Current General Circulation Models and downscaling methods that are increasingly used to assess changes in the water cycle and water resource vulnerabilities introduce a cascade of uncertainties that cannot realistically be dealt with at the moment and are too inaccurate to support improved decision-making for water management and for future water systems design. Therefore, water managers need not only improved hydrological and climate modelling and downscaling methods but also access to adequate hydro-meteorological monitoring networks.

The Global Terrestrial Network for Hydrology (GTN-H), a joint effort by the World Meteorological Organization (WMO) and several global observing systems, aims at integrating in-situ and remote sensing hydrological observations with hydrological model results held by its partner institutions to support a wide range of hydrological applications including research of global and regional climate change.

Adhering to the different needs of all data users (scientists, policy makes and other stakeholders) and bridging the gap between the distributed datasets, currently a new information system is being developed to enable web-based discovery, access and analysis of observation data and derived products served through GTN-H. This system is built on international standards published by the Open Geospatial Consortium (OGC) using open standardized web services, namely (1) Catalogue Services for data discovery, (2) Web Map Services for data visualization and (3) Web Feature Services, Web Coverage Services and Sensor Observation Services for data access.

This presentation will give an overview about the GTN-H data archive and the design of the new information system including an outlook of its potential use for water related climate change impact assessments.

URL: http://www.gtn-h.net

Final ID: H31N-05

Service-Oriented Approach to Coupling Earth System Models and Modeling Frameworks *(Invited)*

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;
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Body: Modeling water systems often requires coupling models across traditional Earth science disciplinary boundaries. While there has been significant effort within various Earth science disciplines (e.g., atmospheric science, hydrology, and Earth surface dynamics) to create models and, more recently, modeling frameworks, there has been less work on methods for coupling across disciplinary-specific models and modeling frameworks. We present work investigating one possible method for coupling across disciplinary-specific Earth system models and modeling frameworks: service-oriented architectures. In a service-oriented architecture, models act as distinct units or components within a system and are designed to pass well defined messages to consumers of the service. While the approach offers the potential to couple heterogeneous computational models by allowing a high degree of autonomy across models of the Earth system, there are significant scientific and technical challenges to be addressed when coupling models designed for different communities and built for different modeling frameworks. We have addressed some of these challenges through a case study where we coupled a hydrologic model compliant with the OpenMI standard with an atmospheric model compliant with the EMSF standard. In this case study, the two models were coupled through data exchanges of boundary conditions enabled by exposing the atmospheric model as a web service. A discussion of the technical and scientific challenges, some that we have addressed and others that remain open, will be presented including differences in computer architectures, data semantics, and spatial scales between the coupled models.

Final ID: H31N-08

The Essential Terrestrial Variables (ETV's) in Support of a National Framework for Numerical Watershed Prediction *(Invited)*

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Body: There is a clear national need to provide geoscience researchers with seamless and fast access to essential geo-spatial/geo-temporal data to support physics-based numerical models necessary to understand, predict and manage the nations surface and groundwater resources. Fundamental advances in science such as the evaluation of ecosystem and watershed services, the detection and attribution of the impact of climatic change, represent examples that will require high resolution spatially explicit assessments. In this paper we propose the concept of Essential Terrestrial Variables (ETV's), which we define as those variables that are nominally required to support watershed/catchment numerical prediction anywhere in the continental US and ultimately at the global scale. ETV's would represent a fundamental community resource necessary to build the products/parameters/forcings commonly used in distributed, fully-coupled watershed and river basin models. We argue that there are at last 3 fundamental issues that must be resolved before implementation of ETV's in support of a national water model: 1) data access and accessibility, 2) data scale and scalability, 3) community provenance and data sustainability.

At the present time, there is no unified data infrastructure for supporting watershed models, and the data resource itself (weather/climate reanalysis products, stream flow, groundwater, soils, land cover, satellite data products, etc.) resides on many federal servers with limited or poorly organized access, with many data formats and without common geo-referencing. Beyond the problem of access to national data, the scale and scalability of computation for both data processing and model computational represents a major hurdle. This predicament is especially true since a full-scale national strategy for numerical watershed prediction will require data resources to reside very close to numerical model computation. Finally model/data provenance should be sufficient to allow reproducible results and scientific workflows that support continuous data and model tracking, geo-referencing, and general support for model/data reproducibility, data analytics and visualization. Furthermore, these workflows should be readily publishable and discoverable by the broader community with provisions for community comment on workflow utility, effectiveness, and improvement.

US policy on access to basic data is generally enlightened in that most national geospatial data can be acquired. However, it is clear that fast and efficient access to all the data and models is not yet available to the scientific community for systems that support integrated watershed modeling. Adoption of ETV's and the concomitant supporting cyber infrastructure would be an important step towards a national framework for numerical watershed prediction.

Final ID: GC32B-01

Shining India?: Assessing and addressing the risks from an unsustainable trajectory of climate, water, food, energy and income inequity ***(Invited)***

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Body: Climate and demographics are primary drivers of regional resource sustainability. In today's global economy, increasing trade has provided a mechanism to alleviate regional stresses. However, increasing regional income promotes consumption, aggravating regional and global resource pressures. South Asia, has the highest population density at a sub-continent scale. Given its monsoonal climate, and high intensity of agriculture it faces perhaps the most severe population weighted water stress in the world. Rapidly declining groundwater tables and the associated high energy use for pumping for irrigated agriculture translate into unsustainable energy imports and expenditure that contributed to the two largest blackouts in global history in summer 2012. Access to water has been progressively declining for both rural and urban populations for the last 3 decades. The increasing energy imports and poor grid reliability translate into limits to the growth of manufacturing and exports of goods and services. The growing income inequity within the population and across national borders, and the impacts of floods and droughts on access to water, food and energy collectively suggest a very high risk for social unrest and a conflict flashpoint. I present a scenario analysis that establishes this case for the emergence of internal and external strife in the region as an outcome of the current resource and natural disaster management policies in the region. Prospects for strategic policy changes for water and energy management and the design of a food procurement and distribution system that could lead to a better future are discussed.

Final ID: OS32A-01

Combined Flow Bedforms: Descriptions and Implications for Understanding Ancient Storms Deposits

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Body: Bedforms generated by the combination of unidirectional and wave-induced oscillatory flow are ubiquitous in coastal and lacustrine environments. Yet, despite the extensive progress made in past research, there remain a wide range of unexplored flow conditions where the bedform geometry, and hence consequent stratigraphy, have not been explored, especially for high energy flow conditions present in storms. To address this issue, experiments were conducted using the Large Oscillatory Water-Sediment Tunnel (LOWST) at the University of Illinois. A uniform 250 μm diameter sand was investigated where the oscillatory flow velocity was changed from 0 to 1 m/s, and the superimposed unidirectional velocities were varied between 0 and 0.50 m/s. We detail the geometries and stratification produced by the range of combined flow bedforms present under these conditions, and show that even if the full bedform geometry is preserved there is no unique stratigraphic characteristic to fully reconstruct the original formative flow. Therefore, based on the preserved geometries of the sedimentary structures, a probabilistic model is proposed to reconstruct the most likely flow type (i.e., unidirectional, oscillatory or combined). In addition, the stratigraphy generated by individual bedforms allows testing of the theoretical model proposed by Myrow and Southard (1991) for the vertical stratification found in ancient storm deposits.

Myrow, P.M. and J.B. Southard (1991). Combined-flow model for vertical stratification sequences in shallow marine storm-deposited beds. Journal of Sedimentary Petrology, 61(2):202-210

Final ID: C32B-03

Evaluation of spatially distributed snow models for streamflow forecasting *(Invited)*

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Body: Water supply forecasts in the Sierra Nevada using ground-based measurements of snow water equivalent are uncertain because neither point measurements nor transects adequately explain spatial or temporal variability in mountainous terrain. The statistical relationships between the snow observations and streamflow do not perform well in extreme years or in basins with ephemeral snow and may prove less reliable in the future with a changing climate. Since 1990, forecast errors in the Sacramento, San Joaquin, Tulare and Lahontan drainages have had median errors of 10% to 30% and an error in every 1 out of 5 years of 25% to 70%. To address this problem, we combine satellite-based retrievals of fractional snow cover for a 12-year period starting in 2000 with spatially distributed energy balance calculations to reconstruct the snow water equivalent (SWE) values throughout each melt season. The 12-year period of study captures an average of 70% of the streamflow range of the last 80 years in the 18 basins with such estimates available. Reconstructed SWE is validated with: (i) snow pillows (ii) snow courses that show the model can accurately predict maximum SWE at the regularly sampled locations for a range of wet, mean and dry years. Validation from snow surveys in 2010 on slopes of up to 21° at the highest elevations in the American River basin show the model also performs well in a variety of topography. The relationship of SWE with elevation is significantly different for wet, mean and dry years as well as between drainages. Certain latitudes receive proportionally less water in dry years and more water in wet years than other latitudes. At the scale at which water is managed the relationship between SWE and SCA becomes increasingly correlated from March 1st to July 1st, such that real-time SCA observations may be sufficient for SWE prediction. We compare spatially integrated volumes of snow water equivalent from the retrospective model and 2 near real time models with full natural flow estimates in all 18 Sierra Nevada basins. The near real time models consist of an interpolation constrained by remotely sensed maps of snow-covered area and the Snow Data and Assimilation System (SNODAS). April 1 SWE is compared with unimpaired streamflow using the absolute magnitudes, the Spearman rank correlation coefficient, and linear regressions. The results show that the reconstruction performs the best at estimating the unimpaired streamflow, followed by the interpolation and then SNODAS. The implication is that the real-time models can be evaluated with the retrospective one. Moreover, the reconstruction provides a historical perspective to put the real-time estimates into context.

Final ID: B32D-08

Subcanopy Solar Radiation Model: an irradiation model for predicting light in heavily vegetated landscapes

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Body: Solar radiation flux, irradiance, affects many biological (e.g. photosynthesis, germination, metabolism) and hydrological (e.g. snow melt, water cycling) processes. Models of these processes often require data at the watershed scale. GIS based solar models that predict irradiation at the watershed scale take topographic shading into account, but do not account for vegetative shading. Methods that quantify subcanopy irradiation do so only at a single point. Further, calibrating the subcanopy models require significant field effort and knowledge of individual species characteristics (leaf area index, mean leaf angle, clumping factor, etc.). Upscaling from point values to watersheds is a significant source of uncertainty.

We propose an approach to modeling irradiation that uses airborne LiDAR to estimate canopy openness as a Light Penetration Index (LPI). We coupled LPI with the GRASS GIS r.sun solar model to produce the Subcanopy Solar Radiation model (SSR). SSR accounts for both topographic shading and vegetative shading at the watershed scale. Output is 52 raster maps (one per week) of 24 hours of irradiation (watt-hours/m2).

We calibrated the r.sun model to a weather station at our field site and to field measurements of direct and diffuse solar radiation taken for 24 hours at the weather station site. We validate predictions of the SSR by comparing modeled output to field measurements and to a standard method for point estimation of subcanopy radiation, hemispherical photographs processed with Gap Light Analyzer 2.0 (GLA). Based on ANCOVA analysis, SSR and GLA models exhibit a similar linear relationship with field data, and the models predict similar total solar radiation flux across the range of canopy openness. With similar quality to a standard point method, but with greatly expanded spatial coverage, SSR should become a useful tool in watershed analysis.

Final ID: C32A-07

Glacier surge triggered by massive rock avalanche:

Teleseismic and satellite image study of long-runout landslide onto RGO Glacier, Pamirs

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Body: Glacier surges are thought to result from changes in resistance to sliding at the base of the ice mass. The reasons for such changes in basal conditions are not entirely understood, and this is in part because empirical constraints are severely limited. Recent work in the Karakoram and Pamir mountains, home to the majority of Earth's surging mountain glaciers, has boosted observational data, but has led to diametrically opposed interpretations of their glacier surging mechanics, ranging from thermal to hydrological switching. In this context we describe a surge of the RGO (Russian Geographical Society) Glacier in the Pamirs triggered by a massive rock avalanche off Mt Garmo in 2001.

Initial reports pegged the RGO Glacier landslide as having been triggered in 2002 by strong ground motion originating from a nearby tectonic earthquake. We used multitemporal satellite imagery to establish failure must have struck in August-September 2001. This revised date was confirmed by reexamining teleseismic data recorded at stations in central Asia: it became clear that a landslide seismic source of magnitude Msw$\approx$5.4 on 2001/09/02 had been misinterpreted as two tectonic sources located within kilometers of Mt Garmo. Exploiting a new technique we have developed for inverting long-period seismic waveforms, we show that a mass of rock and ice around $2.8\times{}10^{11}\,$kg collapsed to the SSE from an elevation of around 5800m, accelerated to a peak speed of about 60m/s, collided with the valley wall $\sim 2\,$km to the south and turned east to run out a further 6km over significant fractions of the accumulation and ablation zones of the RGO Glacier. Based on this estimate of landslide mass, we deduce that the supraglacial debris blanket generated by this rock avalanches averaged about 20m in thickness. By this reckoning, the Mt Garmo landslide is one of the largest in the last 33 years.

Next we mapped the velocity field of the RGO Glacier over time using multitemporal satellite imagery. We performed image correlation velocimetry (sometimes known as feature tracking or optical flow velocimetry) using around 120 Landsat 7 ETM+ scenes spanning 1999 through 2012. Reliable velocity fields were generated even after the loss of scan-line correction (SLC-off scenes) in 2003. Our preliminary results reveal two phases of glacier surge. The first began within a few months of the rock avalanche during the winter of 2001, with ice flow speeds rising by more than an order of magnitude to nearly 1000m/y mid-glacier at the landslide toe, and propagating as a wave down-glacier in less than a year. This phase ended in 2002-3. The second, milder surge phase began in 2005 and ended in 2007. Each phase led to an advance of the terminus over several 100m. We interpret surge initiation as being the direct consequence of rock avalanche deposition on the glacier.

To explore the apparent link between rock avalanching and glacier surging, we have developed a 2D thermomechanical, higher-order, flowline model coupled to a basal hydrology scheme. We conclude with a discussion of the behavior of this model when heavily perturbed by abrupt debris deposition, and we explore whether the occurrence of landslide-triggered surging can in any way advance our understanding of glacier surge mechanics in general.

Final ID: H32E-08

Improving wind energy forecasts using an Ensemble Kalman Filter data assimilation technique in a fully coupled hydrologic and atmospheric model

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Body: Wind power is rapidly gaining prominence as a major source of renewable energy. Harnessing this promising energy source is challenging because of the chaotic nature of wind and its propensity to change speed and direction over short time scales. Accurate forecasting tools are critical to support the integration of wind energy into power grids and to maximize its impact on renewable energy portfolios. Numerous studies have shown that soil moisture distribution and land surface vegetative processes profoundly influence atmospheric boundary layer development and weather processes on local and regional scales. Using the PF.WRF model, a fully-coupled hydrologic and atmospheric model employing the ParFlow hydrologic model with the Weather Research and Forecasting model coupled via mass and energy fluxes across the land surface, we have explored the connections between the land surface and the atmosphere in terms of land surface energy flux partitioning and coupled variable fields including hydraulic conductivity, soil moisture and wind speed, and demonstrated that reductions in uncertainty in these coupled fields propagate through the hydrologic and atmospheric system. We have adapted the Data Assimilation Research Testbed (DART), an implementation of the robust Ensemble Kalman Filter data assimilation algorithm, to expand our capability to nudge forecasts produced with the PF.WRF model using observational data. Using a semi-idealized simulation domain, we examine the effects of assimilating observations of variables such as wind speed and temperature collected in the atmosphere, and land surface and subsurface observations such as soil moisture on the quality of forecast outputs. The sensitivities we find in this study will enable further studies to optimize observation collection to maximize the utility of the PF.WRF-DART forecasting system.

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A regression-based approach for blending remotely sensed and in-situ snow water equivalent estimates in the Colorado River Basin.

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Body: Snowmelt is the primary source of water supply in many parts of the world so it is important to understand the spatial and inter-year variability of snow accumulation and ablation. Several studies have analyzed the effect of physiographic variables on snow distribution so as to improve the basin-wide interpolations of point measurements. Concurrently, efforts exist to estimate snow water equivalent (SWE) distribution via hind-cast energy balance modeling (i.e. reconstruction) without the need for in-situ measurements. We developed a method that merges these two approaches by treating hind-cast energy balance snow distribution estimates as independent variables used to interpolate in-situ measurements. In this regard, we used a multiple linear regression to model SWE distribution based on physiography and reconstructed SWE estimates (independent variables) and observed SNOTEL SWE (dependent variable). Through this approach we were able to improve the explained variability of the model when including both reconstructed SWE and physiography as an independent variables. For the years 2001 to 2010, the r-squared value improved an average of 0.23 for April 1st SWE predictions. R-squared values are statistically significant (>0.05) for all years for the months Mar-Jun and the increase in R-squared ranged from 0.04 to 0.59 (mean = 0.25). These preliminary results support the hypothesis that past patterns of snow cover depletion used in the reconstruction estimates may be useful for estimating the spatial distribution of SWE in real time.

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Relationship between environmental conditions and rates of coastal erosion in Arctic Alaska

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Body: Rates of coastal cliff erosion are a function of the geometry and substrate of the coast; storm frequency, duration, magnitude, and wave field; and regional sediment sources. In the Arctic, the duration of sea ice-free conditions limits the time over which coastal erosion can occur, and sea water temperature modulates erosion rates where ice content of coastal bluffs is high. Predicting how coastal erosion rates in this environment will respond to future climate change requires that we first understand modern coastal erosion rates.

Arctic coastlines are responding rapidly to climate change. Remotely sensed observations of coastline position indicate that the mean annual erosion rate along a 60-km reach of Alaska's Beaufort Sea coast, characterized by high ice content and small grain size, doubled from 7 m yr-1 for the period 1955-1979 to 14 m yr-1 for 2002-2007. Over the last 30 years the duration of the open water season expanded from ~45 days to ~95 days, increasing exposure of permafrost bluffs to seawater by a factor of 2.5. Time-lapse photography indicates that coastal erosion in this environment is a halting process: most significant erosion occurs during storm events in which local water level is elevated by surge, during which instantaneous submarine erosion rates can reach 1-2 m/day. In contrast, at times of low water, or when sea ice is present, erosion rates are negligible.

We employ a 1D coastal cross-section numerical model of the erosion of ice-rich permafrost bluffs to explore the sensitivity of the system to environmental drivers. Our model captures the geometry and style of coastal erosion observed near Drew Point, Alaska, including insertion of a melt-notch, topple of ice-wedge-bounded blocks, and subsequent degradation of these blocks. Using consistent rules, we test our model against the temporal pattern of coastal erosion over two periods: the recent past (~30 years), and a short (~2 week) period in summer 2010. Environmental conditions used to drive model runs for the summer of 2010 include ground-based measurements of meteorological conditions (air temperature, wind speed, wind direction) and coastal waters (water level, wave field, water temperature), supplemented by high temporal frequency (4 frames/hour) time-lapse photography of the coast. Reconstruction of the 30-year coastal erosion history is accomplished by assembling published observations and records of meteorology and sea ice conditions, including both ground and satellite-based records, to construct histories of coastline position and environmental conditions. We model wind-driven water level set-up, the local wave field, and water temperature, and find a good match against the short-term erosion record. We then evaluate which environmental drivers are most significant in controlling the rates of coastal erosion, and which melt-erosion rule best captures the coastal history, with a series of sensitivity analyses. The understanding gained from these analyses provides a foundation for evaluating how continuing climate change may influence future coastal erosion rates in the Arctic.

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Quantifying the transition from fluvial- to wave-dominance for river deltas with multiple active channels

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Body: The plan-view morphologies of fluvial- and wave-dominated deltas are clearly distinctive, but transitional forms are numerous. A quantitative, process-based description of this transition remains unexplored, particularly for river deltas with multiple active channels. Previous studies focused on general attributes of the fluvial and marine environment, such as the balance between wave energy and river discharge.

Here, we propose that the transition between fluvial and wave dominance is directly related to the magnitude of the fluvial bedload flux to the nearshore region versus the alongshore sediment transport capacity of waves removing sediment away from the mouth. In the case of a single-channel delta, this balance can be computed for a given distribution of waves approaching shore. Fluvial dominance occurs when fluvial sediment input exceeds the wave-sustained maximum alongshore sediment transport for all potential shoreline orientations both up- and downdrift of the river mouth.

However, deltaic channels have the tendency to bifurcate with increasing fluvial strength. Initial bifurcation splits the fluvial sediment flux among individual channels, while the potential sediment transport by waves remains constant for both river mouths. At higher bifurcation orders, multiple channels interact with each other alongshore, a situation more complicated than the single channel case and one that cannot be simple addressed analytically. We apply a model of plan-view shoreline evolution to simulate the evolution of a deltaic environment with multiple active channels. A highly simplified fluvial domain is represented by deposition of sediment where channels meet the coast.

We investigate two scenarios of fluvial delivery. The first scenario deposits fluvial sediment alongshore on a self-similar predefined network of channels. We analyze the effects of different network geometrical parameters, such as bifurcation length, bifurcation angle, and sediment partitioning. In the second scenario, local conditions help determine where channels form, distribute sediment and bifurcate, therefore allowing feedbacks between the marine and fluvial domains. With increasing fluvial sediment flux, the delta transitions from a classic cuspate morphology to a space-filling, radial fluvial delta. This simplified model allows us to quantify the transition from fluvial to wave dominance and enables comparisons with natural examples near this transition, such as the Tinajones lobe of the Sinu River Delta, Colombia, and the Po Delta, Italy.

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On a Neck, On a Spit

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Body: Recurved barrier spits occur in a wide variety of environments, from active delta complexes to rocky coasts, where spits extend depositionally from a shore that is otherwise eroding. Although controls on spit orientation are often presented in the literature a posteriori (i.e. after the spit has been observed), there surprisingly remains a lack of a general model that can predict spit shape and orientation in terms of external variables, such as wave climate, sediment supply, and embayment depth. Here, we study spit shape controls using a numerical model that evolves the plan-view coast based upon the processes of alongshore sediment transport and barrier overwash maintaining a minimum critical width. Model results demonstrate that the directional distribution of approaching waves serves as a first-order control on spit shape, with waves from multiple directions playing a vital role in spit extension and reshaping. Accordingly, changes in wave angle distribution, such as those that could be caused by climate changes, can have a rapid and profound effect on spit orientation and growth. Surprisingly, we find that boundary effects, namely the rate of change of the updrift coast location, play a similarly important role in spit shape. Rapid shoreline retreat sponsors the growth of elongate, linear, rapidly overwashing spits, whereas slow retreat sponsors the growth of smoothly curving and slowly extending spits. The depth of the platform upon which a spit grows plays another important role, with deeper platforms tending to accommodate more curved spits. We analyze our model results in terms of trends in alongshore sediment transport and shoreline stability, finding similar trends along natural examples. Summaries of ensemble model runs provide a template for predicting spit shape and evolution based upon wave forcing, sediment supply, and local geometry.

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Influence of Climate Change on Wave Dissipation over Coral Reefs: Effects on Beach Morphology

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Body: Coral reefs play a critical role in protecting coastlines by dissipating wave energy as it approaches shore. However, anthropogenic alterations to reef systems, such as changes in species composition, growth rates, and reef morphology, in combination with sea-level rise, have the potential to significantly alter wave dissipation across reefs. Changes in wave dissipation may lead to shifts in alongshore sediment transport gradients, thereby altering patterns of erosion and accretion on tropical coastlines. To simulate the effects of reef degradation on sediment transport rates, we used Delft3D to consider two schematized profile model domains based on a stretch of coast from Molokai, Hawaii. We created two representative end-member reef flat widths and simulated the incremental degradation, represented by an increase in overall depth, of the fore reef and reef crest structure (-0.10, -0.25, -0.50, and -1.00 m), as well as potential sea-level rise scenarios (+0.10, +0.25, +0.50, and +1.00 m). Resulting significant wave heights and alongshore sediment transport rates during storm conditions were compared across simulations for the two domains. Preliminary findings indicate that over a wide reef flat, sea-level rise has a greater relative effect than reef degradation on wave energy and alongshore sediment transport rates. In contrast, on narrow reef flats, the effects of reef degradation and sea-level rise are of the same order of magnitude. Further, because narrow reef flats are likely more sensitive to changes in coral reef degradation, our results suggest that reefs having alongshore-variable widths are most likely to experience changes in alongshore sediment transport gradients, and therefore shifts in patterns of erosion and accretion, than more linear fringing reef systems.

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The Role of Ecomorphodynamics in Barrier Island Response to Climate Change

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Body: Coastal dune morphology is the most important factor determining barrier island vulnerability to storms—low relief, sparse dunes are prone to frequent overwash and inundation during storms whereas high relief, continuous dunes are more likely to minimize storm impacts. The evolution of island relief, then, is a function of two competing processes: (i) dune formation/recovery, driven by the coupling of biological and geomorphic processes, and (ii) dune destruction due to storm-induced overwash. These two processes are not independent, as the degree of dune erosion during a given storm depends on dune size and morphology. In addition, changes in grass species composition and resilience, following an overwash event may negatively impact dune recovery thus increasing island vulnerability to subsequent storms. Climate-change induced sea level rise, increases in storm intensity and shifts in species composition have the potential to amplify these eco-geomorphic feedbacks.

In a first attempt to analyze quantitatively the effects of climate change on barrier island relief, we have developed an "ecomorphodynamic" model of island evolution. Consistent with observations, we find that the dune morphology primarily depends on grass species, with some grasses building long dune ridges and others creating sparse hummocky dunes, while some grasses may even prevent dune formation. In a next step, we added the effect of storms to study the evolution of island relief under a series of storm impacts. By changing average storm intensity and impact frequency, it is then possible to mimic some of the potential effects of climate change. For a sufficiently low storm frequency, and constant, moderate storm intensity, we find that dunes are able (on average) to recover from an impact before the next storm occurs. In this case, dunes are only partially eroded during a storm, allowing them to eventually re-attain their potential maximum size for a given set of external conditions. Under such a scenario, the island reaches a relatively stable "high elevation" state having minimum vulnerability to storms. In contrast, for a sufficiently high storm frequency, the island enters a feedback of ever more-widespread overwash and increasing dune erosion, leading to an ever weaker dune recovery. Hence, the island ends up in a "low elevation" state having maximum vulnerability to storms. Therefore, by increasing storm frequency from one run to another as an initial proxy for different climate change scenarios, the island transits from a "high" to "low" state nonlinearly, such that a small increase in frequency leads to an abrupt change in vulnerability.

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Salt marsh equilibrium states and transient dynamics in response to changing rates of sea level rise and sediment supply.

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Body: Understanding and predicting the response of salt-marsh bio-geomorphic systems to changes in the rate of sea level rise and sediment supply is an issue of paramount importance due to the crucial role exerted by salt marshes within the tidal landscape. Salt-marsh platforms, in fact, buffer coastlines against storms, filter nutrients and pollutants from tidal waters, provide nursery areas for coastal biota, and serve as a sink for organic carbon.
Observations of marsh degradation worldwide and the acceleration in the rate of global sea level rise highlight the importance of improving our understanding of the chief processes which control salt-marsh response to current natural climate changes and to the effects of variations in sediment supply. The results of our analytical model of salt-marsh bio-morphodynamic evolution in the vertical plane, accounting for two-way interactions between ecological and geomorphological processes, show that marshes are more resilient to a step decrease in the rate of relative sea level rise rather than to a step increase of the same magnitude. Interestingly, marshes respond more rapidly to an increase in sediment load or vegetation productivity, rather than to a decrease (of the same amount) in sediment load or vegetation productivity. Model results also suggest that marsh stability is positively correlated with tidal range: marshes with high tidal ranges respond more slowly to changes in the environmental forcings and therefore are less likely to be affected by perturbations than their counterparts in low tidal ranges. Finally, the model suggests that, in the case of a oscillating rate of sea level rise, marsh stratigraphy will be unable to fully record short term fluctuations in relative mean sea level, whereas it will be able to capture long term fluctuations particularly in sediment rich, microtidal settings.

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Modeling rates of bank erosion in sinuous tidal channel derived from event-based terrestrial lidar surveys in the Mont Saint Michel Bay

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Body: The Mont-Saint-Michel (MSM) bay is characterized by a semi-diurnal regime with a tidal range of 14 meter. Understanding river bank migration of tidal channels in such mega tidal salt marshes requires a precise quantification of the relative contribution of frequent and infrequent bank erosion events to the longer term dynamics.
We use terrestrial lidar scanner (TLS) which overcomes the limitations of traditional bank measurement approaches (e.g. aerial photography, GPS measurements) with high resolution and high precision topographic data. We use 30 TLS measurements and traditional data sources to quantify the annual and daily dynamics of bank erosion for a sinuous salt marsh channel near the island of the MSM.
We present the results of a 2 years study that begun in September 2010. We compare annual bank retreat with daily surveys focused on spring tides in order to calculate “event-based” volume of bank erosion. For active steep banks, the volume of sediment eroded is computed between 2 set of point cloud that are classified by the CANUPO algorithm to remove vegetation (Brodu and Lague, 2012). A new algorithm allows a direct comparison of point clouds in 3D based on surface normal computation and measurement of mean surface change along the normal direction. On a 5 centimeter resolution grid, the changes between 2 banks point cloud is computed and used to calculate volume of eroded bank. Measured rates of bank retreat varied between no detectable change to 2 m/tide, which correspond roughly to 100 cubic meters/tide. We also document a non-homothetic pattern of bank erosion during spring tides : erosion is focused in narrow zones of the meander and shifts spatially at daily timescales.
To relate bank erosion to hydraulic characteristics of the channel, an ADCP was used to measure flow velocity during tides. The measurements highlights two main points that only occurs when tides overcomes the salt marsh: (i) the ebb flow is stronger than flood flow with velocities up to 2.2 m/s and (ii) the maximum ebb velocity (MEV) increase linearly with the maximum tide height. The dominant role of the ebb was also noted during field observations : during the ebb, the flow is focused on a narrow zone of the bank due to rapid bathymetric modifications at daily timescales. This could explain the non-homothetic behavior of bank erosion.
The daily volume of eroded bank is only significant when the tide overcome the salt marsh which occurs 10 % of time. From the linear relationship between tide height and MEV, we can relate bank erosion to flow velocity. We show that the eroded volume increases exponentially with the MEV. This new physical model of bank erosion is applied on daily tides records. From Sept 2010 to June 2012, the model succeeds to estimate the volume of bank eroded. However, the model fails to reproduce the dynamics before Sept 2010, which can be explained by a significant change in channel curvature and morphology.
The study shows that the combination of TLS and hydrosedimentary measurements can be used to construct 'field' models of tidal channel dynamics. Our data highlights a strong non-linearity between bank erosion, tidal amplitude and ebb flow velocity that results in spring tide events representing 95.7 % of the total erosion for a duration of 10 % of time.

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Tree-like Representation of Hydrologic Time Series

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Body: The representation of a time series as a tree graph and the use of tree topological measures for concise parameterization is a new way of studying hydrologic time series. It is especially relevant for the analysis of processes mediated by transport on river networks, such as streamflow, sediment, and other environmental fluxes and offers the possibility for understanding the scaling of these fluxes in terms of the scaling of the river network. In this study, we analyze 15-minute streamflow data recorded for 4 years at 10 stream gauges within the Eel river basin (CA). The so-called level-set trees for the analyzed time-series were compared to point out similarities as well as differences between their topological structures. It was established that these trees exhibit Horton and Tokunaga self-similarity, with a range of Tokunaga parameters a and c. It was noticed that the parameter c, which characterizes the “monotonicity” of hydrologic peaks is strongly related to the basin drainage area, although it was not found to relate to the Tokunaga parameter c of the underlying river network. Based on the tree representation of streamflow, each runoff peak can be characterized by a Horton-Strahler (HS) order. It is observed that, according to this characterization, the mean runoff peaks obey the Horton law with the Horton exponent ranging between 0.45 and 0.74. At the same time, we observed that, after dividing the peaks by their respective HS order, the mean runoff peak scales with the catchment drainage area. This observation evokes the well-established power law dependence between mean annual flood and drainage area. However, the present study shows that not only do the larger runoff peaks (higher HS orders) scale with drainage area but also the smaller runoff peaks (lower HS orders), and their scaling parameters vary within a narrow range (i.e., 0.81-0.86). These preliminary results are promising and suggest that the analysis of tree-like representations of time-series might give further insights into the scaling behavior of hydrologic extremes.

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Comparing and Contrasting Water Use Pattern in the Colorado River Basin Using Landsat and MODIS-based Analyses

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Body: Information on spatial and temporal water use patterns is very important for sustainable management of water resources, particularly in arid and semiarid regions. The Colorado River Basin (CRB), with an area of about 630,000 km2 in the western United States, is one of the highest priority basins under the Department of the Interior's WaterSMART (Sustain and Manage America's Resources for Tomorrow) initiative. The CRB is vulnerable to climate and land cover changes due to the sensitivity of its discharge to changes in precipitation, temperature, and water demand from various sectors. In recent years, remotely sensed data have been increasingly used for estimating water use based on various models, including energy balance models. We used an operational Simplified Surface Energy Balance (SSEBop) model for estimating water use in the CRB using Landsat (30 m) and the Moderate Resolution Imaging Spectroradiometer (MODIS) (1 km) images. The use of multi-scale remotely sensed images has provided us an opportunity on scaling issues to compare and contrast the water use pattern in the CRB. Our results showed that there was good agreement (R2 > 0.70) between the Landsat- and the MODIS-based water use estimates. However, the spatial distribution of water use indicated that MODIS-based estimates are good at the regional scale, while Landsat-based estimates can also be used at the field scale. This study has great significance for carrying out water census studies at different Hydrologic Unit Code (HUC) levels.

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Estimation of regional hydrogeological properties for use in a hydrologic model of the Chesapeake Bay watershed

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Body: Characterization of subsurface hydrogeologic properties in three dimensions and at large scales for use in groundwater flow models can remain a challenge owing to the lack of regional data sets and scatter in coverage, type, and format of existing small-scale data sets. This is the case for the Chesapeake Bay watershed, where numerous studies have been carried out to quantify groundwater processes at small scales but limited information is available on subsurface characteristics and groundwater fluxes at regional scales. One goal of this work is to synthesize disparate information on subsurface properties for the Chesapeake Bay watershed for use in a 3D integrated ParFlow model over an area of 400,000 km2 with a horizontal resolution of 1 km and a vertical resolution of 5 m. We combined different types of data at various scales to characterize hydrostratigraphy and hydrogeological properties. The conceptual hydrogeologic model of the study area is composed of two major regions. One region extends from the Valley and Ridge physiographic province south of New York to the Piedmont physiographic province in Maryland and Virginia. This region is generally characterized by fractured rock overlain by a mantle of regolith. Soil thickness and hydraulic conductivity values were obtained from the U.S. General Soil Map (STATSGO2). Saprolite thickness was evaluated using casing depth information from well completion reports from four state agencies. Geostatistical methods were used to generalize point data to the model extent and resolution. A three-dimensional hydraulic conductivity field for fractured bedrock was estimated using a published national map of permeability and depth-varying functions from literature. The Coastal Plain of Maryland, Virginia, Delaware and New Jersey constitutes the second region and is characterized by layered sediments. In this region, the geometry of 20 aquifers and confining units was constructed using interpolation of published contour maps of aquifer altitudes and confining unit thicknesses. Areas of outcrop of the aquifers and confining units were corrected using the USGS HydroSHEDS land surface topography dataset. Ongoing work includes the use of this constructed dataset in the hydrologic model to determine regional groundwater flow paths and travel times.

Final ID: OS33B-1820

Sedimentary Record and Morphological Effects of a Landslide-Generated Tsunami in a Polar Region: The 2000 AD Tsunami in Vaigat Strait, West Greenland

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Body: To date, the effects of tsunami erosion and deposition have mainly been reported from tropical and temperate climatic zones yet tsunamis are also frequent in polar zones, particularly in fjord settings where they can be generated by landslides. Here we report the geological effects of a landslide-triggered tsunami that occurred on 21st November 2000 in Vaigat, northern Disko Bugt in west Greenland. To characterise the typical features of this tsunami we completed twelve detailed coastal transects in a range of depositional settings: cliff coasts, narrow to moderate width coastal plains, lagoons and a coastal lake. At each setting we completed a detailed map using a laser scanner and DGPS survey. The tsunami deposits were described from closely spaced trenches and, from the lake, by a series of sediment cores . At each setting we examined the sedimentological properties of the deposits, as well as their bulk geochemistry and diatom content. Selected specimens of arctic willow from inundated and non-inundated areas were collected to assess the impact of the event in their growth ring records. Samples of sediments beneath the AD 2000 deposit were studied for 137Cs to confirm the age of the tsunami and to assess the extent of erosion. Offshore sediment samples, modern beach and soils/sediments underlying the AD 2000 tsunami deposits were sampled to determine tsunami deposit sources.

The observed tsunami run-up exceeded 20 m next to the tsunami trigger – a rock avalanche at Paatuut - and up to 10 m on the opposite coast of the fjord. The inland inundation distance ranged from several tens of meters to over 300 m. The wave was recorded as far as 180 km away from the source. The tsunami inundated the coast obliquely to the shoreline in all locations studied. The tsunami frequently caused erosion of existing beach ridges whilst erosional niches were formed inland. The tsunami deposits mainly comprise gravels and very coarse sand. They are over 30 cm thick close to the coast and in front of inland scarps. In the most inland parts of the inundation they are often marked only by patches of coarse sand left on the pre-tsunami soil. At several sites we observed boulder deposits, although in many cases they were likely transported as boulders in icebergs. A characteristic feature related to tsunami deposits were "mud pats" - up to 1 m in diameter and about 20 cm thick silty deposits with occasional gravels - which cover the tsunami deposit. They are interpreted as the result of melting of icebergs washed inland by the tsunami. They often occur close to the inundation limit. The mud pats are a characteristic feature for the tsunami deposits in iceberg dominated settings and are unlikely to be left by storms. The results of this study will serve as a guide for further studies of palaeotsunami in the Vaigat region and elsewhere in polar regions.

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Denudation Gradient Across the Eastern Margin of the Tibetan Plateau

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Body: Understanding the spatial distribution of denudation in active mountain ranges is important to unravel their dynamics, as it allows both to determine the existence of actively uplifting areas or to assess the influence of precipitation on landscape evolution. The Eastern margin of the Tibetan Plateau, along the Longmen Shan range, is characterized by one of the steepest topographic escarpment on Earth and a high seismogenic potential as demonstrated by the 2008 Wenchuan Earthquake, but also a low convergence rate, such that the present dynamics of this area is still not clearly elucidated.

For these reasons, a better knowledge of the rates and patterns of denudation across the margin can deliver important clues on the tectonic and geomorphic processes affecting the Earth surface and help to decipher the larger-scale processes acting in this active domain. This is of major interest as, over the last decade, Eastern Tibet in general and the Longmen Shan in particular has been one of the hotspots of the still ongoing debates about the actual modes of deformation of the Tibetan Plateau.

We present a new dataset for denudation rates, derived from 10Be concentration in detrital sediments, that allows to complement existing isolated data and provides the first near-continuous cross-range transect in this area. Denudation rates rises abruptly from ~0.2 mm/yr in the frontal foothills to ~0.5 mm/yr at the topographic maximum of the Longmen Shan range, and then progressively fall down to <0.1 mm/yr when reaching the low relief parts of the Plateau. Under the assumption that the distribution of denudation can be used as a proxy for tectonic uplift, this pattern confirms the existence of a relatively narrow band of active uplift at the range front as proposed by Kirby et al. [2003].

Final ID: T33C-2679

Decadal deformation rates from SAR interferometry in the eastern Pamir-Tian Shan collision zone and implication for the growth and erosion of detachment folds.

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Body: The Cenozoic Indo-Asian collision caused the impingement of the north-verging Pamir orogen with the south-verging Tian Shan. Rapid convergence rates of 8-12 mm/y across the Pamir-Tian Shan boundary are suggested by GPS measurements and broadly match Holocene and Quaternary shortening rates. The shortening is dominantly accommodated by a series of oppositely verging thrust faults that interfere to form a complex pattern of temporal and spatial variation in deformation style and rate. Cosmogenic radionuclide (CRN) dating and optically stimulated luminescence (OSL) dating suggest late Quaternary shortening rates of 3-7 mm/y on individual structures. To the east, the rigid Tarim basin is translated northward alongside the Pamir and subducted beneath the Tian Shan. Since ~16 Ma deformation has stepped southward into the Tarim basin from the Tian Shan range-bounding fault. Most recently a series of detachment folds with inferred shortening rates of 1-5 mm/y and lateral propagation rates of up to 50-80 mm/y formed and continue to be active today.

We present (1) new decadal deformation rates in the Pamir – Tian Shan and Tarim – Tian Shan collision zone in westernmost China inferred from Interferometric Synthetic Aperture Radar (InSAR) and (2) digital topography and fluvial network analysis to constrain deformation on longer timescales. These data are integrated with (3), published GPS data, (4) published Quaternary shortening rates, and (5) geologic mapping in order to identify spatial patterns of modern deformation, investigate temporal variations in deformation rate and show the response of the river network to active deformation. Preliminary InSAR results reveal interseismic deformation of 1-6 mm/y that is concentrated on thrust faults and detachment folds. However, current deformation appears localized on particular segments of the structures, a pattern that is likely to change with time.

We speculate that rapid Quaternary growth of detachment folds in the Kashi foreland and their high structural relief (3-4 km) is counteracted by rapid erosion, leaving a subdued topography of generally less than 0-1.5 km. Widespread beveling of the folds is favored by, easily eroded lithologies, high discharge, high aggradation, and an oblique angle between the regional topographic gradient and the fold axes. When rates of lateral and vertical erosion by impinging rivers (perhaps assisted by aggradation and/or high discharge) keep pace with rock uplift rates, beveling of the fold becomes possible. However, during drier times, regional base-level lowering, and/or where rivers flow perpendicular to the fold axis, rock uplift tends to lead to incision and “trapping” of the river, thus localizing erosion, creating water gaps, and allowing topographic emergence of the fold. On the Atushi and Mutule anticlines, 2-3 episodes of widespread beveling of the fold can be identified. The temporal and spatial variation of uplift across a single fold are likely to interact with transitions between wet and dry periods, as well as stream reorganization events, to modulate the complex modern topography.

Final ID: EP33C-03

The role of vegetation in shaping dune morphology ***(Invited)***

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Body: Aeolian dunes naturally emerge under strong winds and sufficient sand supply. They represent the most dynamical feature of the arid and/or coastal landscape and their evolution has the potential to either increase desertification or reduce coastal vulnerability to storms. Although large-scale dune morphology mainly depends on the wind regime and sand availability, vegetation plays an important role in semiarid and/or coastal areas. It is well known that under certain conditions vegetation is able to stabilize dunes, driving a morphological transformation from un-vegetated mobile crescent dunes to static vegetated "parabolic" dunes, de facto paralyzing desertification and initiating land recovery. Furthermore, vegetation is also the primary ingredient in the formation of coastal foredunes, which determine vulnerability to storms, as low dunes are prone to storm-induced erosion and overwash. In both cases, the coupling of biological and geomorphic (physical) processes, in particular vegetation growth and sand transport, governs the evolution of morphology.

These processes were implemented in a computational model as part of a previous effort. It was shown that, for a migrating dune, this coupling leads to a negative feedback for dune motion, where an ever denser vegetation implies ever lesser sand transport. The model also predicted the existence of a “mobility index”, defined by the vegetation growth rate to sand erosion rate ratio, that fully characterizes the morphological outcome: for indices above a certain threshold biological processes are dominant and dune motion slows after being covered by plants; for lower indices, the physical processes are the dominant ones and the dune remains mobile while vegetation is buried or rooted out.

Here, we extend this model to better understand the formation of coastal dunes. We include new physical elements such as the shoreline and water table, as well as different grass species and potential competition among them. Consistent with field observations, we find that basic dune morphology is primarily determined by grass species, with linear or hummocky dunes being built by some species, while others may prevent dune formation. We also find that the evolution of coastal dune morphology is controlled by at least two bio-geomorphic couplings: (1) between vegetation growth and sand transport, which leads to a positive feedback for dune growth, as certain beach grasses maximize growth under sand accretion, which means that an ever denser vegetation implies an ever higher accretion rate; and (2) between vegetation growth and shoreline position through the sand influx. While the first coupling is responsible for dune formation, the second one determines when dunes stop growing and thus controls final dune size. This is particularly relevant for accreting/eroding coastlines where we find that dune size, and thus coastal protection, is maximized for relatively small accretion rates while larger accretion rates lead to formation of a new, smaller dune ridge at the beach.

Final ID: H33P-02

DFL-MaP: A Global Real-time Hydrological Modeling System for Drought-Flood-Landslide Monitoring and Prediction *(Invited)*

Y. Hong; [1, 2]; *X. Xue;* [1, 2]; *J. J. Gourley;* [3, 2]; *R. F. Adler;* [4];
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3. NOAA National Severe Storm Laboratory, Norman, OK, United States.
4. University of Maryland/NASA GSFC, College Park, MD, United States.

Body: This talk will review a Global Hydrologic Modeling Framework, jointly developed by NASA and the OU-HyDROS lab, that assimilates real-time, multi-satellite observations and potential ET to monitor and forecast streamflow, actual ET, and soil moisture at 3-hour, 1/8th degree resolution using the distributed, computationally-efficient CREST model (Wang et al. 2011). The initial system has been recently developed into a real-time global hydrological extreme monitoring system called DFL-MaP (Drought-Flood-Landslide Mapping and Prediction System), displayed at http://eos.ou.edu. On the water excess side, the system detects storm-triggered floods and landslides, and on the water deficit side, it maps precipitation-based meteorological drought (SPI), streamflow-based hydrological drought (SRI), and plant-available, soil-moisture-based agricultural drought (Soil Moisture). The DFL-MaP system directly addresses the first objective of Global Earth Observation System of Systems (GEOSS): Enabling the use of Earth observations and predictive models for timely disaster decision making to benefit society. Challenges and opportunities will also be discussed in this talk.

URL : http://hydro.ou.edu
http://eos.ou.edu
DFL-MaP Simulated Global Discharge
DFL-MaP detected global drought

Final ID: EP33E-05

The Statistical Mechanics of the Bed Load Sediment Velocity Distribution *(Invited)*

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Body: Particles transported as bed load within a specified streambed area possess a distribution of velocities. This distribution figures prominently in describing the rate of sediment transport and the rate of dispersal of particles during transport. We provide a probabilistic derivation of the distributions of streamwise and cross-stream particle velocities under uniform, quasi-steady transport conditions. The formulation centers on defining the ensemble of microstates of particle momenta (the set of possible ways to partition a fixed number of particles into momentum states) subject to the constraint that the sum of the particle momenta in each microstate is fixed, a constraint that is imposed by conditions of equilibrium transport. From this we obtain the most probable distribution of momentum states assuming each microstate within the ensemble is equally probable. The analysis suggests that for small particle numbers the distribution of velocities is exponential-like but decays faster then an exponential function. For large particle numbers the distribution is exponential. These distributions are consistent with experimental results from high-speed imaging of sand particles transported as bed load over a planar bed, which reveal that the probability distributions of streamwise and cross-stream particle velocities are exponential-like. These particle velocity distributions also emerge from numerical analyses involving large eddy simulations (LES) of turbulent fluid motions and a discrete element method (DEM) describing particle motions, wherein the LES and DEM models are fully coupled in momentum.

Final ID: SH33E-02

Numerical modeling of the initiation of coronal mass ejections in active region NOAA 9415 ***(Invited)***

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2. Catania University, Catania, Italy.
3. Observatoire de Paris, LUTh, Meudon, France.

Body: Coronal mass ejections (CMEs) and solar flares are the main drivers of the space weather. Understanding how these events can occur and what conditions might lead to eruptive events is of crucial relevance for up to date and reliable space weather forecasting.
The aim of the present paper is to present a numerical magnetohydrodynamic (MHD) data-driven model suitable for the simulation of the CME initiation and their early evolution.
Starting from a potential magnetic field extrapolation of the active region (AR) NOAA 9415, we solve the full set of ideal MHD equations in a non-zero plasma-β environment. We investigate the response of the solar corona when photospheric motions, resembling the ones observed for AR 9415, are applied at the inner boundary.
As a consequence of the applied twisting motions a force-free magnetic field configuration, having the same chirality as the investigated active region, is obtained. As a response to the converging shearing motions a flux rope is formed that quickly propagates outwards, carrying away, against the gravitational attraction by the Sun, the plasma confined inside the flux rope. Moreover, a compressed leading edge propagating at a speed of about 550 km$\,$s^{-1} and preceding the CME is formed.
The presented simulation shows that both the initial magnetic field configuration and the plasma-magnetic field interaction are relevant for a more comprehensive understanding of the CME initiation and early evolution phenomenon.

Final ID: EP33C-08

Ecogeomorphology: Impressions of organisms in critical zone evolution *(Invited)*

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Body: Organisms pervade Earth's critical zone, and shape it through their impact on geochemical, hydrological and geomorphological processes. Examples from Gordon Gulch in the Boulder Creek Critical Zone Observatory illustrate the involvement of organisms in weathering, mobile regolith transport, and hydrologic function of the critical zone, all processes that are at the core of critical zone evolution and function. We examine *i)* evidence of involvement of microorganisms in chemical weathering of rock, *ii)* the role of trees in physical weathering and downslope transport of mobile regolith, and *iii)* the effect of vegetation on runoff, which can influence both weathering and erosion.

Microorganisms are present throughout soil profiles. Although microbial biomass declines roughly exponentially and diversity diminishes with depth, populations do not vanish even in saprolite at depths > 1m in a critical zone developed within Proterozoic gneiss. Fluorescence of leached organic matter from the same profiles shows that organic matter at the top of saprolite is derived from microbial biomass to a much greater extent than in upper layers of the soil. Deep organic matter is more oxidized, consistent with humic substances being used by microbes as electron shuttles, a process likely coupled to incipient bedrock weathering.

While it is well known that trees transport soil when they are blown down, generating pit and mound microtopography, only a small fraction of trees die in this fashion. As a large proportion of a tree's biomass is underground, it is inevitable that the growth of roots displace soil. Those roots that penetrate the saprolite can also damage rock, and can play a role in releasing blocks of rock into the mobile regolith column. We find that growth of roots of ponderosa pines displaces mobile regolith in a characteristic pattern surrounding a trunk. Fresh rock emerges in an annulus around tree trunks. Mobile regolith is demonstrably inflated by up to 0.1 m adjacent to trunks, and declines with characteristic length scales of order 1 m. Inflation patterns are asymmetric, likely reflecting the locations of large roots. We therefore argue that the growth and decay of roots serve as displacement events that promote downslope creep of mobile regolith. Translating this into transport rate requires knowledge of tree spacing and demographics. Root growth below soil can open fractures in the saprolite, generating damage that is similarly paced by tree spacing, growth and decay rates.

Vegetation modulates water movement on its path between precipitation and runoff. In most years, maximum water table rise and runoff occurs during sustained snowmelt, when evapotranspiration demands are low and water inputs are high. In summer 2012, however, heavy mid-summer rains produced water table and discharge responses more commonly seen during snowmelt, demonstrating that it is not the precipitation phase that controls runoff. Instead, water inputs must exceed vegetation demands or must incite preferential flow through the vadose zone.

These examples point to the fundamental roles of organisms in controlling the delivery of water to rock, mediating

incipient mineral weathering, and opening rock fractures and moving mobile regolith.

Final ID: EP33D-07

Using TLS to measure braided river bar movement in the Pasig-Potrero River on Mt. Pinatubo

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Body: Terrestrial Laser Scanning (TLS) offers the ability to detect centimeter scale change and observe processes at otherwise un-measureable scales. Using TLS on the Pasig-Potrero River on Mt. Pinatubo in the Philippines, we tracked the motion of in-channel bars over hourly to weekly time scales. During the rainy season the Pasig-Potrero is highly braided with super-critical flow and active sediment transport. TLS data are being used to better understand how bars respond to changes in flow and how the response by vegetated and unvegetated bars differs. Over a three week field campaign over 500 mm of rain fell and bar movements of over 30 meters were recorded. These data will be paired with concurrent discharge measurements and sediment load samples to determine how channel bars were changing over these short time scales. Further comparisons will be made with longer term channel evolution data collected over the past 21 years since Mt. Pinatubo erupted in 1991.

Final ID: NS33A-07

Free online seismic data from a sand tank experiment

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2. Dept. Petroleum Engineering, Louisiana State Univ, Baton Rouge, LA, United States.

Body: Theoretical fluid flow models are used regularly to predict and analyze porous media flow but require verification against natural systems. Seismic monitoring in a controlled laboratory setting at a nominal scale of 1:1000 in the acoustic frequency range can help improve fluid flow models as well as elasto-granular models for uncompacted, saturated-unsaturated soils.

A mid-scale sand tank allows for many highly repeatable, yet flexible, experimental configurations with different material compositions and pump rates while still capturing phenomena such as patchy saturation, flow fingering, or layering. The tank (~6 x 9 x 0.44 m) contains a heterogeneous sand pack (1.52-1.7 phi). In a set of eight experiments the water table is raised inside the sand body at increments of ~0.05 m. Seismic events (vertical component) are recorded by a pseudo-walkaway 64-channel accelerometer array (20 Hz-20 kHz), at 78 kS/s, in 100- scan stacks so as to optimize signal-to-noise. Three screened well sites monitor water depth (+/- 3 mm) inside the sand body. Data sets comprise SEG-Y formatted files (seismic) and are publicly downloadable from the internet (http://github.com/cageo/Lorenzo-2012), in order to allow comparisons of different seismic and fluid flow analyses.

The capillary fringe does not appear to completely saturate, as expected, because the interpreted compressional-wave velocity values remain so low (< 210 m/s). Even the highest water levels there is no large seismic impedance contrast across the top of the water table to generate a clear reflector.

Preliminary results indicate an immediate need for several additional experiments whose data sets will be added to the online database. Future benchmark data sets will grow with a control data set to show conditions in the sand body before water levels rise, and a surface 3D data set. In later experiments, buried sensors will help reduce seismic attenuation effects and in-situ saturation sensors will provide calibration values.

Final ID: B33H-08

Multi-Scale Synthesis and Terrestrial Model Intercomparison Project – A Systematic Approach for Evaluating Land-Atmosphere Flux Estimates

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5. 5.Cooperative Institute for Research in the Environmental Sciences, University of Colorado, Boulder, CO, United States.
6. 6.Earth System Research Lab, National Oceanic and Atmospheric Administration, Boulder, CO, United States.

Body: Terrestrial biosphere models (TBMs) have become an integral tool for extrapolating local observations and understanding of land-atmosphere carbon exchange to larger regions. Although models vary in their specific goals and approaches, their central role within carbon cycle research is to provide a better understanding of the mechanisms controlling the spatial and temporal variability in uptake and release across a range of spatial scales (regionally to globally). The Multi-scale synthesis and Terrestrial Model Intercomparison Project (MsTMIP) is a formal model intercomparison effort focused on improving the diagnosis and attribution of carbon exchange at regional and global scales. MsTMIP builds upon current and past synthesis activities, but has a unique framework designed to isolate, interpret, and help inform understanding of how differences in process parameterizations among current TBMs impact estimates of carbon uptake and release. By prescribing standard spin-up procedures and forcing data sets, we isolate any biases and uncertainties in TBM estimates of regional and global carbon budgets resulting from differences in model formulation and parameterization. More specifically, this activity allows for the isolation and quantification of the inter-model variance in estimates of land-atmosphere carbon exchange due to differences in model structure. Model structure refers to the types of processes considered in the model (e.g., nutrient cycling, disturbance, lateral transport of carbon), and how these processes are represented (e.g., photosynthetic formulation, temperature sensitivity, respiration parameterization) within the model. The impact of model structural differences on estimates is represented using hierarchical cluster diagrams or dendrograms, allowing us to test whether models with similar structural attributes produce similar land-atmosphere carbon exchange estimates. Model results are then quantitatively evaluated in the context of these structural model differences, against available observations (e.g., inventory-based estimates, eddy-covariance measurements) and model-data products (e.g., up-scaled gross primary productivity estimates, evapotranspiration). Here we present the initial results from the MsTMIP activity, linking the model-model and model-reference differences we see back to model formulation and parameterization.

Final ID: EP34A-01

Modeling Floodplain Depositional Patterns under Variable Flood Regimes ***(Invited)***

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Body: One of the more difficult aspects of predicting riverine fluxes to the ocean is intermediate storage in lowland floodplains. This storage is significant: floodplain deposition maintains and builds up low-lying lands along rivers and on deltas. Especially in deltas it is one of the processes that counteracts sea-level rise and maintains stability of the deltaic coast.

AquaTellUs is a 3D floodplain architecture model that uses a nested model approach; a 2D longitudinal profile, embedded as a dynamical flow path in a 3D grid-based space. We model the main channel belt as a 2D longitudinal profile that responds dynamically to changes in channel profile geometry, water discharge, sediment load, grain-size distribution and sea level based on first-order, physics-based principles. Sediment flux is described with a modified Exner equation by separate erosion and sedimentation components. Erosion flux along the main flowpath depends on river discharge and channel slope, and is independent of grain-size. Depositional flux along the channel path as well as in the lateral direction into the floodplain depends on the local stream velocity, and on grain-dependent settling rates. Lateral depositional patterns are informed by analysis of remote-sensing imagery of recent flood deposits and by comparison to SRTM and ASTER GDEM2 elevation data of floodplain topography. Floodplain deposition is an event-driven system — only peak discharge events cause overbank flow, crevasse-splays, and potential channel avulsion. The computational architecture of AquaTellUs preserves stratigraphy by event, allowing for preservation of flood layers of variable thickness and composition.

We here present depositional cross-sections and pseudo-wells resulting from numerical experiments that show the pronounced effect of different probability density functions for river discharge and sediment load, i.e. flooding recurrence times on the resulting floodplain aggradation. AquaTelllUs distinctly shows a more exponential geometry of elevated channel belts under highly variable flood regimes, with potential implications for breach dynamics. In addition, the model predicts that natural levee complexes are distinctly higher near the apex of delta plains and the levee heights taper off towards the coastal plain.

Final ID: H34A-01

The intricate relationship between sediment dispersion and channel dynamics in straight and braider rivers: insights from numerical simulations *(Invited)*

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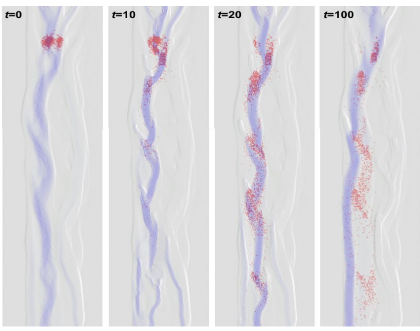
Body: Sediment grain dynamics (erosion, transport, deposition) is the key process controlling both the morphodynamics of rivers (alluvial or bedrock), and the dispersion of sediment transport along drainage network. Despite the large gap between grain and landscape scales, most of the upscaled erosion equations are justified by, and consistent with, processes that operate at the grain scale. Einstein H. [1947] was one of the first to link the movements of grains, with successive resting periods and motions, and the resulting sediment fluxes. He showed that the bedload flux is proportional to the ratio of the grains step (transport) length to the average resting period.

From numerical simulations based on a stochastic cellular model, we illustrate how river dynamics and sediment dispersion are basically linked. We show that fluvial processes at various scales can be lumped into two basic functions: the sediment transport length, and the bed erosion rate. The sediment transport length plays a critical role in controlling the partitioning between bedload and suspended load, the transport capacity of rivers, and even the instabilities of fluvial regimes. We show in particular how the formation of sediment bars, which in turn controls the braiding instability, can be related to the sediment transport length. The erosion-rate variability is the main control of the volume of the immobile, although active (i.e. exchanging with stream), sediment grain layer, which in turn control the average resting time of sediments.

With these simulations, we discuss the way sediments are trapped into through various processes (e.g. river aggradation/erosion, bar or channel mobility). All these trapping processes generate a wide distribution of grain resting time that fixes both the average velocity of particles and their dispersion. At last, we discuss how the observed sediment transport can fit, or not, into the existing theories of anomalous transport. The multi-rate mass transfer model, which basically describes the exchange between immobile and mobile zones, is naturally a good candidate for describing observed sediment breakthrough curves. Although it can be applied to simple channel dynamics, it does not render the asymmetry of the bed-to-stream exchanges induced by the lateral migration of channels. Other models of anomalous transport, such as CTRW, are also envisioned and discussed.



Final ID: T34D-03

Topographic controls on stress state, thermal structure and fluid flow adjacent to the central Alpine Fault near DFDP-1 boreholes, New Zealand *(Invited)*

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Body: Downhole fluid-pressure gradients, pressure decline rates after drilling perturbations, and laboratory tests on rock samples indicate a six-orders-of-magnitude reduction in permeability from $>10^{-14}$ m^2 in the hanging wall to $<10^{-20}$ m^2 at the Alpine Fault in boreholes DFDP-1A (Alpine Fault at 91 m depth) and DFDP-1B (Alpine Fault at 128 m depth). We consider the hydrological and thermal implications of this permeability structure using a 3D finite-difference approach that takes into account rapid exhumation and realistic topography. Specifically, we aim to fit the geothermal gradient that was precisely measured in the DFDP-1B borehole of 62.6 ± 2.1 °C/km. We present results and also make predictions about the influence of exhumation and topography on the thermal structure, fluid pressures and stress state in the upper crust in the vicinity of DFDP-1 boreholes and the proposed DFDP-2 site in the Whataroa River valley.

Final ID: PP34B-04

Quantitative estimates of past changes in ITCZ position and cross-equatorial atmospheric heat transport ***(Invited)***

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Body: The mean position and seasonal migration of the Intertropical Convergence Zone (ITCZ) govern the intensity, spatial distribution and seasonality of precipitation throughout the tropics as well as the magnitude and direction of interhemispheric atmospheric heat transport (AHT). As a result of these links to global tropical precipitation and hemispheric heat budgets, paleoclimate studies have commonly sought to use reconstructions of local precipitation and surface winds to identify past shifts in the ITCZ's mean position or seasonal extent. Records indicate close ties between ITCZ position and interhemispheric surface temperature gradients in past climates, with the ITCZ shifting toward the warmer hemisphere. This shift would increase AHT into the cooler hemisphere to at least partially compensate for cooling there.

Despite widespread qualitative evidence consistent with ITCZ shifts, few proxy records offer quantitative estimates of the distance of these shifts or of the associated changes in AHT. Here we present a strategy for placing quantitative limits on past changes in mean annual ITCZ position and interhemispheric AHT based on explorations of the modern seasonal cycle and models of present and past climates. We use reconstructions of tropical sea surface temperature gradients to place bounds on globally averaged ITCZ position and interhemispheric AHT during the Last Glacial Maximum, Heinrich Stadial 1, and the Mid-Holocene (6 ka). Though limited by the small number of SST records available, our results suggest that past shifts in the global mean ITCZ were small, typically less than 1 degree of latitude. Past changes in interhemispheric AHT may have been substantial, with anomalies approximately equal to the magnitude of modern interhemispheric AHT. Using constraints on the invariance of the total (ocean+atmosphere) heat transport we suggest possible bounds on fluctuations of the OHT and AMOC during Heinrich Stadial 1. We also explore ITCZ shifts in models and observations to determine whether shifts of mean ITCZ position occur because of shifts in seasonal extreme positions, changes in the amount of time spent by the ITCZ near one seasonal extreme, or combinations of the two.

Final ID: EP34A-07

Numerical model of the lowermost Mississippi River as an alluvial-bedrock reach: preliminary results

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Body: Recent field studies reveal that the river bed of the Lower Mississippi River is characterized by a transition from alluvium (upstream) to bedrock (downstream). In particular, in the downstream 250 km of the river, fields of actively migrating bedforms alternate with deep zones where a consolidated substratum is exposed. Here we present a first version of a one-dimensional numerical model able to capture the alluvial-bedrock transition in the lowermost Mississippi River, defined herein as the 500-km reach between the Old River Control Structure and the Gulf of Mexico. The flow is assumed to be steady, and the cross-section is divided in two regions, the river channel and the floodplain. The streamwise variation of channel and floodplain geometry is described with synthetic relations derived from field observations. Flow resistance in the river channel is computed with the formulation for low-slope, large sand bed rivers due to Wright and Parker, while a Chezy-type formulation is implemented on the floodplain. Sediment is modeled in terms of bed material and wash load. Suspended load is computed with the Wright-Parker formulation. This treatment allows either uniform sediment or a mixture of different grain sizes, and accounts for stratification effects. Bedload transport rates are estimated with the relation for sediment mixtures of Ashida and Michiue. Previous work documents reasonable agreement between these load relations and field measurements. Washload is routed through the system solving the equation of mass conservation of sediment in suspension in the water column. The gradual transition from the alluvial reach to the bedrock reach is modeled in terms of a “mushy” layer of specified thickness overlying the non-erodible substrate. In the case of a fully alluvial reach, the channel bed elevation is above this mushy layer, while in the case of partial alluvial cover of the substratum, the channel bed elevation is within the mushy layer. Variations in base level are accounted for in terms of a specified rate of sea level rise. In addition, the model allows a subsidence rate that varies in space and time. The time rate of change of channel bed elevation is computed solving the equation of mass conservation of the bed material. Validation of the model against field data is currently in progress in a relatively simplified setting, in which the bed material is characterized in terms of a single grain size. In addition, due to the lack of information on the geometry and the grain size characteristics of the floodplain, the modeling effort is restricted to the channel bed, and the procedure to route the washload through the system is not implemented. Having clearly in mind that the present Lowermost Mississippi River is not in equilibrium, validation runs are performed in two steps. The model is first run under pre-1930 conditions, under the assumption that the natural Mississippi River was not too far from long-term steady-state. The model is then run from the 1930s to the 2010s with the prevailing inputs of water and sediment and the model results are compared against field data. In the near future we plan to test the model with non-uniform bed material, and extend it to include inundation of the floodplain, and deposition of washload on it.

Final ID: EP34A-08

Modeling the Effect of Changing Sediment Load on the Flow Regime of the Lower Mississippi River *(Invited)*

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Body: The effect of hundreds of dams on the lower Mississippi River system has been to reduce sediment supply to about half its pre-settlement value. This decline appears to be continuing today. The lower Mississippi River undergoes a transition from a purely alluvial river to a mixed alluvial-bedrock river at a point upstream of Baton Rouge. Here attention is focused upon the alluvial reach. A model that treats a) both bedload and suspended load transport of mixed sizes of sand and mud, b) the effect of flow self-stratification due to suspended sediment and c) the effect of flow-dependent bedform resistance is used to study the long-term effect of varying sediment supply on river depth and slope under a variety of scenarios.

Final ID: B41C-0311

Modeling net ecosystem exchange of carbon dioxide in a beetle-attacked subalpine forest using a data-constrained ecosystem model

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Body: The mountain pine and spruce bark beetles and associated blue-stain fungi have caused widespread mortality in the forests of the western U.S. during the past decade, impacting over 1.6 Mha in Northern Colorado and Southeast Wyoming alone. Both the beetles and fungi they carry block tree xylem and eventually cause mortality due to hydraulic failure. Previous studies of bark beetle mortality in Canadian forests have suggested a net loss of carbon following beetle attack. This study aimed to determine if forests in the southern Rocky Mountains showed a similar response. We simulated carbon fluxes over a time period of six years (2005-2010) at the Glacier Lakes Ecosystem Experiment sites (GLEES) Ameriflux site using the Terrestrial Regional Ecosystem Exchange Simulator (TREES) model. This time period included a beetle infestation during the last three years that resulted in mortality of 51% of the spruce trees that accounted for 90% of the spruce basal area. Model estimates of net ecosystem exchange of CO2 (NEE) were compared to eddy-covariance measurements before, during, and after beetle attack. Model predictions of NEE were generated two ways, 1) using the standard set of maintenance respiration coefficients, and 2) constraining modeled respiration using equations derived from field measurements of stem, leaf, and soil respiration at GLEES, and were compared to NEE observations before, during, and after the presence of bark beetles. Model changes included both simple modification of the exponential temperature response curve (Q10) and adding new equations based on both temperature and live tissue nitrogen content. Pre-beetle observed growing season mean NEE averaged -1.49 μmol C m-2 s-1 and simulation means ranged from -4.10 to 0.64 μmol C m-2 s-1. Changing the model's computation of maintenance respiration to incorporate site-specific temperature response (Q10) resulted in an over-prediction of nighttime NEE by up to 100%, but a 10-30% improvement during the day. Generally, error in NEE prediction was non-linear and correlated to time of day, with the greatest magnitude error occurring around midday. These results suggest model estimates of NEE could be improved by 1) partitioning maintenance respiration into night and daytime fluxes by adding unique functionality for each , 2) incorporating effects of xylem occlusion by blue-stain fungi on plant hydraulic conductance (and subsequent effects on CO2 fluxes), 3) testing whether the increase in complexity of the model is justified by the chamber and tower based flux data, and 4) evaluating all model changes before, during, and after beetle attack. Further improvements of mechanistic ecosystem models like these, constrained by field measurements taken during a major forest disturbance, will improve estimates of C cycling at regional to global scales.

Final ID: B41E-0359

Study the Linkage of Allometric Scaling and Resource Limitation Model of Vegetation Structure with Stochastic Radiative Transfer Theory

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Body: Vegetation structure is one of the key variables of the terrestrial biosphere, affecting its biogeochemical and biophysical functioning. Information on vegetation structure has traditionally come from ground-based inventories that provide detailed information on the overall size and species-specific characteristics within small plots, but do not provide a comprehensive, spatially-consistent, measure of the current state of the above ground ecosystem. Recently, remote sensing based estimates of vegetation structure are becoming available – mapping biomass from spectral data; mapping forest height from Lidar; mapping various vegetation structure from both active and passive remote sensing data; amongst others. However, many retrieval approaches for vegetation structure depend on empirical data and statistical analysis. It should be noted that a stable statistical relationship could only be built if all the variations across species, geographical locations, and environmental factors were taken into account. Our study using physically based approach therefore tries to address the difficulties encountered in the empirical approaches. Based upon the fact that the return signals received by remote sensors are the reflections of the underneath canopy structure, reconstruction of the three dimensional canopy is possible through the use of stochastic radiative transfer model and appropriate allometric relationships if the information is sufficient. To obtain the desired structural parameters of vegetation, we investigate the following: (a) the correlations and independent information existing in active (Lidar) and passive (spectral and multi-angle) remote sensing data; (b) the development of a synergistic algorithm based on stochastic geometry to retrieve frequency distributions of tree height and crown size besides retrieval of mean characteristics of vegetation structure (i.e., stem density, tree height, crown shape and size, within-crown foliage density or leaf area index) by exploiting synergistically the information content of lidar, multiangle and hyperspectral remote sensing data; (c) the extension of pair correlation function in forms of allometric scaling to represent dispersion in vegetation canopies, and therefore imbuing retrievals with explanatory power and building direct linkages to dynamics of resource allocation within canopy; (d) calculation of biomass information from knowledge of frequency distribution of individual size in a canopy from allometric relationships and linking structural variables to biomass; (e) inversion of the allometric scaling and resource limitations model with knowledge of vegetation structure retrievals to predict environmental limiting factors for vegetation growth and identifying potential changes due to natural or anthropogenic disturbances.

Final ID: C41B-0561

Arctic radiative processes and the influences of clouds and aerosol using CAM5

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Body: Many climate models have biases in arctic shortwave and longwave radiative fluxes due in part to biases in cloud processes. Simulations using CAM5 with 2-moment liquid and ice cloud microphysics at 1 degree horizontal resolution find relatively good agreement to observations of cloud fraction, shortwave TOA fluxes, and albedo, with some biases in longwave TOA fluxes, surface temperature, and cloud water phase. Observational gaps are also highlighted. Sensitivity studies are completed to understand the impacts of aerosol number concentration on arctic clouds and radiation.

Final ID: EP41A-0759

Predicting friction factor in herbaceous emergent wetlands

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Body: Over 53% of all wetlands in the US have been lost since the mid-1780s; to counteract wetland losses, wetland land area is being replaced through wetland restoration and mitigation. Development of the target wetland hydroperiod is critical to restoration success. For wetlands in which outflow is a component of the water budget, such as in riparian wetlands, surface water stage is controlled all or in part by the hydraulic resistance within the wetland, requiring accurate simulation of hydraulic resistance due to vegetation. Hydraulic models that consider vegetation rely on an accurate determination of a resistance parameter such as a friction factor or drag coefficient. At low Reynolds numbers typical of flows in wetlands, hydraulic resistance is orders of magnitude higher than fully turbulent flows and resistance parameters are functions of the flow regime as well as the vegetation density and structure. The exact relationship between hydraulic resistance, flow regime, and vegetation properties at the low-Reynolds number flows remains unclear. Prior research has typically involved laboratory studies of flow through idealized, individual stems. However, emergent wetland vegetation frequently grows as clumps. The goals of this research were to investigate the effect of clumping vegetation on flow resistance and to develop a prediction equation for use in wetland design. A 6-m by 1-m by 0.4-m recirculating flume was planted with mature common rush, Juncus effusus, a common emergent wetland plant. Three different flow rates (3, 4, and 5 L/s) and three different tailgate heights (0, 2.5, and 5 cm) were used to simulate a range of flow conditions. Plant spacing and clump diameter were varied (20 and 25 cm, 8 and 12 cm, respectively). Friction factors ranged from 9 to 40 and decreased with increasing plant density. Non-dimensional parameters determined through Buckingham Pi analysis were used in a regression analysis to develop a prediction model. Results of the regression analysis showed that the fraction of vegetated occupied area was most significant factor in determining friction factor.

Final ID: EP41B-0777

Definition of mass-balance frameworks for interacting fluvial systems with application to Bangladesh

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Body: Sediment extraction is a powerful concept for analyzing proximal-to-distal geomorphic and stratal trends within fluvial systems. A useful starting point for understanding this process in fluvial systems is the mass-balance framework, a conversion from length scales to sediment-extraction scales within a depositional basin. We attempt to isolate the mass-balance frameworks of fluvial systems which are near enough to one another to potentially interact as tributary systems. To do so, we must define the boundaries between the depositional provinces of each individual fluvial system. The depositional province is the domain within a larger basin within which only a single fluvial system may deposit sediments, as determined by the subsidence pattern within the basin and the sediment discharges of the fluvial system and its neighboring fluvial systems.

Numerical modeling is applied to track the local sediment discharge of point-sourced fluvial systems within a subsiding model basin. The point-sourced fluvial systems create radial fans within the basin which are analogous to the cumulative floodplain extent of an avulsing river. The extent of these fans is determined by the balance between the amount of sediment available to each system and the amount of space created by subsidence near the point sources. The boundary between depositional provinces of adjacent fluvial systems is initially determined by the point on the line between point sources at which the local sediment discharges of each system are equal. A new radiating fluvial fan is then developed from the sediment available at this point, and the positions of equal sediment discharge between this new fan and the original fans are calculated. In this way, depositional provinces are created for each adjacent point-sourced fluvial system, as well as a domain between the provinces within which the systems become tributary. Mass-balance frameworks can then be constrained for each fluvial system, and depositional signals can be isolated for individual rivers.

The Ganges-Jamuna-Meghna river system in Bangladesh provides an example of three interacting fluvial systems which are currently tributary, but which may have not had confluence at times during the Holocene. This modeling effort is in support of core-transect drilling in Bangladesh aimed at understanding how these rivers have responded to tectonic forcing in the Holocene. Definition of depositional provinces for each river could aid in the recognition and distinction of stratal patterns caused by tributary input from those caused by tectonism.

Final ID: EP41B-0787

Antecedent morphology and active tectonics in the upper Bengal Delta: Multi-temporal controls on river mobility and sediment preservation

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Body: The upper Bengal delta is a tectonically active depositional environment composed of unconsolidated muds and sands constructed by channel migration, avulsion, and overbank processes. These riverine sediments define the channels, floodplains, and terraces that make up the surface morphology of the upper delta plain. Until recently, the stratigraphic architecture underlying this surface morphology was poorly defined, and at present, both the origin of the upland terraces and the nature of the river avulsions continue to be debated. However, stratigraphic results from a 41-well drilling transect and a corresponding high-resolution multichannel seismic expedition in 2011 in north-central Bangladesh have begun to reveal the subsurface distribution of sediments in this dynamic environment. Two adjacent sand-dominated Holocene channel systems, presently occupied by the Jamuna and Old Brahmaputra Rivers, are each bounded by mud-capped morphological features. Pleistocene-aged terraces (Barind and Madhupur Terraces) bound the modern Jamuna River valley on either side. These terraces are composed of fining-upward fluviodeltaic deposits capped by 5-10 m of mud. The Madhupur Terrace also forms the southwestern boundary of the alternate channel course along the Old Brahmaputra, and the northeastern boundary of this valley is formed by a tectonically influenced wedge of Pleistocene mud (Sylhet Basin). This wedge is capped by a thin veneer of Holocene mud interfingered with ephemeral channel sands derived from the overthrusting 2-km high Shillong Anticline. Each of these mud-capped morphological deposits represents an area of the delta that has persisted throughout the Pleistocene; thus we focus on these fine-grained sediments in an effort to understand the long-term transition from surface morphology to preserved stratigraphy. We suggest that these Pleistocene features are an important control on river course mobility, and subsequently, on sediment deposition and preservation, at least over timescales of 10^{2-3} years; whereas the long-term (>10^{3-4} years) deltaic architecture, including the Pleistocene upland terraces, is dominated by deformation associated with active convergence along the Dauki Fault and Shillong Anticline. Understanding the subsurface distribution of sediments and the dominant controls on fluvial processes in this delta offers insight into both the nature of sediment erosion and reworking and the influence of tectonics on these fluvial processes.

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Kinematic Controls On The Geometrical Structure Of The Preserved Cross-Sets

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Body: The architecture of stratigraphy records the associated characteristics of Earth-surface dynamics and holds the potential to unlock paleoclimate information. Cross-stratified units are one of the most common features preserved in the stratigraphic record formed by migrating ripples and dunes. Their geometry has been understood to depend on the movement, change in shape, and direction of travel of the bed forms. In this study, we provide theoretical relationships that map the statistics of surface kinematics of bed form evolution into the 2-D geometrical structure of the preserved stratigraphy. The surface kinematics of bed form evolution is characterized by the migration (translation of the waveforms) and deformation (change in shape of the waveforms) of the bed forms. We show that the local slope and curvature of the preserved stratigraphic boundaries depend on the competition between migration and deformation of the evolving bed forms. Further, we show that deformation is the sole cause for the formation of curved boundaries in cross-stratified units and, for the first time, provide quantitative relationship between curvature of the bounding surfaces of the preserved cross-sets and the deformation rate of the bed forms. The results presented in this study are validated using experimental data of bed form evolution collected under equilibrium, steady-state conditions with no net deposition.

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Modes of Late Pleistocene Fine-Grain Sediment Dispersal in Canterbury Basin, South Island New Zealand

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Body: Decades of process-based studies of sediment dispersal on continental margins have identified key mechanisms that create muddy marine lithofacies, such as along- and across-shelf transport by surface plumes and in the benthic boundary layer. However, few examples exist of how these muddy shelf environments evolve over late Pleistocene changes in relative sea level and sediment supply. IODP Expedition 317 to Canterbury Basin New Zealand provides an opportunity to identify the processes forming sedimentary sequences where temporally evolving across- and along-margin sediment sources interact with both eustasy and tectonics to generate margin stratigraphy. We use X-ray diffraction bulk sediment mineralogy, grain size distributions, and downhole well-logs at mid-outer shelf and upper slope sites to evaluate the correlation of lithofacies with relative sea level and sediment sources during late Pleistocene glacioeustatic cycles. Results from principal component analysis of the three data types are compared to the core lithostratigraphy and seismic reflection profiles. Lithofacies correlate to changes in mineralogy and grain size, and are characterized by several cyclic transitions from coarser, more carbonate-rich sediment to muddy, terrigenous-rich material. The cycles are also indentified in natural gamma-ray logs. Sediment provenance changes are revealed by the second principle component of the mineralogy and grain-size data, which shows that terrigenous material grades to fine carbonate and mica-rich sediment, pointing to a Haast Schist (along-shelf dispersal) signature in muddier intervals, which is not apparent in coarser, more carbonate-rich intervals. These results suggest that changes in relative sea level influence the mode of fine-grain sediment dispersal, favoring along-shelf transport during highstands and more across-shelf transport during regressive or falling stages of sea-level. An overall upward trend of increased muddy terrigenous material with a Torlesse Terrane signature suggests increased importance of across-shelf sediment transport with time and corresponds to substantial Pleistocene shelf edge progradation seen in seismic reflection profiles.

Final ID: EP41C-0805

Tracing the Geomorphic Signature of Lateral Faulting

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Body: Active strike-slip faults are among the most dangerous geologic features on Earth. Unfortunately, it is challenging to estimate their slip rates, seismic hazard, and evolution over a range of timescales. An under-exploited tool in strike-slip fault characterization is quantitative analysis of the geomorphic response to lateral fault motion to extract tectonic information directly from the landscape. Past geomorphic work of this kind has focused almost exclusively on vertical motion, despite the ubiquity of horizontal motion in crustal deformation and mountain building. We seek to address this problem by investigating the landscape response to strike-slip faulting in two ways: 1) examining the geomorphology of the Marlborough Fault System (MFS), a suite of parallel strike-slip faults within the actively deforming South Island of New Zealand, and 2) conducting controlled experiments in strike-slip landscape evolution using the CHILD landscape evolution model. The MFS offers an excellent natural experiment site because fault initiation ages and cumulative displacements decrease from north to south, whereas slip rates increase over four fold across a region underlain by a single bedrock unit (Torlesse Greywacke). Comparison of planform and longitudinal profiles of rivers draining the MFS reveals strong disequilibrium within tributaries that drain to active fault strands, and suggests that river capture related to fault activity may be a regular process in strike-slip fault zones. Simple model experiments support this view. Model calculations that include horizontal motion as well as vertical uplift demonstrate river lengthening and shortening due to stream capture in response to shutter ridges sliding in front of stream outlets. These results suggest that systematic variability in fluvial knickpoint location, drainage area, and incision rates along different faults or fault segments may be expected in catchments upstream of strike-slip faults and could act as useful indicators of fault activity.

Final ID: EP41C-0806

The influence of tectonic strain on geomorphic metrics

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Body: The influence of tectonic strain on geomorphic metrics becomes apparent by coupling landscape evolution models with a 3D mechanical Earth model that is capable of strain-associated localized crustal weakening. Strain in the frictional-brittle crust produces predictable anisotropic cohesion and grain size distribution fabrics that influence spatial strain induced (SI) erodibility patterns where exposed at the surface. Cohesion reductions can be as great as 3 orders of magnitude and the finest grain size volume fraction can increase up to 2 orders of magnitude in zones of localized strain. Model results suggest SI erodibility exerts an anisotropic, first order influence on the geomorphic metrics of landscape evolution for active orogens, including stream network geometry, channel width and depth, knickpoint conditions, and topographic evolution. Two dominant wavelengths of tortuosity arise, with the SI erodibility influence apparent at a wavelength comparable to the spacing between fault zones and the hydraulic influence apparent at shorter wavelengths. Rapid vertical incision occurs wherever SI erodibility is exposed but incision slows once the channel incises into underlying unstrained bedrock. Shallowly dipping faults produced in a dip-slip regime are largely protected from vertical incision by unstrained overburden while a steeply dipping fault produced in a strike-slip regime exposes a greater volume of SI erodibility with depth. Transverse gorges often connect fracture sets at their shortest separation distance because 1) the separating ridge is skinny with relatively low relief and 2) the fault intersection is located relatively closer to the surface, providing exposed SI erodibility that increases in area with greater incision. Coupling tectonic and erosion processes can influence knickpoint conditions by introducing 1) erodibility transitions and 2) differential uplift along a stream profile. Erodibility has a nonlinear influence on knickpoint migration that becomes apparent with erodibility transitions along the stream profile. Channel width and depth are limited by the lateral and vertical extents of the SI erodibility zone and therefore are functions characteristic of predictable strain fields. The strain field also controls hydraulic geometry by influencing 1) the spatial distribution of discharge by establishing anisotropic erodibility fabrics and 2) the slope changes at erodibility transitions and differential uplift in a watershed. In addition to its influence on detachment, permanent strain leads to fragmentation and grain size reduction that can influence the transportability of detached bedrock.

Final ID: EP41C-0810

Granular Mechanics of Debris-Flow Incision: Measuring and Modeling Grain-Scale Impact Forces

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Body: Although steep valleys are ubiquitous in mountainous terrain and there is evidence that episodic scour by debris flows is an important erosional process in these valleys, there is no agreed upon mechanical framework to describe debris flow incision into bedrock. In this work, we take steps towards a defensible stochastic debris flow incision rule. We first characterize frequency-magnitude distributions of basal force using measurements made with a force plate that was overridden during natural debris-flow events that incised bedrock. With these measurements in mind, we use grain-scale numerical experiments (discrete element method simulations) of free-surface, gravity-driven granular flows to quantify how changes in field measureable channel and flow properties (channel slope, flow depth, and grain size) influence the erosive potential of a flow.

The basal force during five monitored natural debris-flow events had a large-magnitude, high-frequency fluctuating component. Variability in force magnitude that resulted from the fluctuating component increased linearly with the time-averaged mean basal force. Probability density functions of basal normal forces greater than the mean force were best fit by generalized Pareto distributions with well-defined means and variances. In contrast, probability density of basal normal force from simulated monodispersed flows decayed much more rapidly and in an exponential manner with increasing force magnitude. Only when monodispersed flows were replaced by broad grain size distributions, characteristic of natural debris flows, did the distributions of simulated impact forces have a similar form to those measured beneath the natural flows. These results highlight the important role flow grain size can have on basal impact force.

As either bed inclination or flow depth was increased in the simulated flows, the mean and the spread of the impact force and impact energy distribution increased as well and in a nonlinear fashion. Bed impact flux was largely decoupled from the downstream flux of particles and was a linearly decreasing function of slope once slope increased beyond a threshold value.   Incision rate, which should scale as the product of impact energy and impact flux, increased as a nonlinear function of slope. Steep landscapes in which millennial scale erosion rates have been quantified display a similar nonlinear relationship between erosion rate and channel gradient. This suggests that the grain-scale mechanics quantified here could place strong controls on steepland morphology that evolves over thousands to millions of years.

Final ID: EP41C-0811

The emergence of topographic steady-state in perpetually dynamic topography.

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Body: We report here the results of a series of analog experiments of landscape evolution in which the evolving topography and sediment flux is observed as a function of the rate of base-level fall (equivalent to rock uplift) under a constant model-climate. The experimental apparatus comprises a 50 cm x 50 cm box that contains up to 30 cm of ~20 micron silicon paste. Climate is simulated as a constant and spatially uniform rate of precipitation derived from an overhead suite of fine misters. Topography was measured via a laser scanner to a precision of less than 1mm and imaged digitally at 5 min intervals. Base-level fall is achieved through the slow sliding of two opposing sides of the box at rates between 9 to 60 mm/hr. Erosion occurs as both hillslope (mass movements) and channel processes; our slope-area data show that we are simulating reasonably realistic landscapes.

Our results show that in a flux-steady-state landscape, the non-linear highly dynamic behavior of ridge-valley topography leads to the emergence of stable catchment geometries. We further demonstrate that this stability is a fundamental characteristic of internal system dynamics, is independent of climate and uplift rate and is instead linked to the exhumation of mountain relief: both scale-dependence and scale-invariance in topographic dynamics emerges after 1.2 relief-depths of erosion.

We also show that the temporal evolution of sediment flux follows a classic growth curve in which flux decreases as a reflection of limited resources as propagating headwaters run out of new uneroded landscape. In response to changes in uplift rate, sediment flux also provides a measure of an intrinsic time-response within the system, which could be used to transform model time to real time.

Final ID: EP41C-0814

Does rift lateral propagation depend on climate and surface processes?

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Body: Initiation and linkage of rift segments is a fundamental aspect of tectonics in extensional settings. Despite that, the factors controlling the structural and topographic expression of individual rift segments are still not well resolved. Here, we investigate the impact of surface processes, including both erosion and deposition, on the lateral dynamic propagation of individual rift segments. We use a fully-coupled 3D model which is based on the landscape evolution model CASCADE and the 3D tectonics code FANTOM. We present results of numerical simulations designed to study the response of viscous-plastic crustal materials subjected to extension and to surface processes. In particular, we focus on the evolution in time and space of both the tectonic structures and of the surface morphology of the rift segments, under different climatic conditions. At first order, we show that the dynamic lateral propagation of a single rift segment, composed of two conjugate shear zones, is dictated not only by its rheological properties but also by the efficiency of erosion and sedimentation
acting on its surface, which in turn depends on climate and precipitation. Especially, we demonstrate that increasing the efficiency of fluvial erosion or decreasing the viscosity of the lower crust, increase the velocity of rift lateral propagation and also tend to localize strain on only one of the shear zones, resulting in a half-graben like structure. This illustrates the strong coupling between tectonic, surface processes and climate, and demonstrates that surface processes, by enhancing localization of deformation, act as a positive forcing to rift lateral propagation. We suggest that our results may have important consequences for understanding the propagation of rift structures for varying climatic conditions in space and time.

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Basin Wide Erosion and Soil Production Rates of a High Altitude Plateau in the Korean Peninsula Considered as an Uplifted Paleo Erosional Surface: Implications for Its Development Process and the Tectonics

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Body: The development process of High Altitude Plateaus (HAPs) has been a controversial issue in geomorphology. HAPs have been interpreted as uplifted erosional surfaces mainly controlled by fluvial processes. Recent studies, however, argued that the definition of the Paleo Erosional Surfaces (PESs) is ambiguous and HAPs, considered as the uplifted PESs, could be formed under various local lithologic, tectonic and climatic conditions. But these suggestions were severely limited by the lack of quantitative data in the field.

Here, we investigate this issue of the development process of HAPs through estimating both basin wide erosion rates and soil production rates of the Daegwanryeong area in the Korean Peninsula (KP), where a HAP with low-relief hilly landscape is found. Study area has been known as a typical one of PESs in the KP, which have been uplifted since the early Miocene. Particularly deeply weathered saprolites, easily found in the study area, have also been believed to be resulted from the Tertiary deep weathering under higher temperature at the paleo sea level.

First, analysis of ^{10}Be in saprolite from the base of the soil column, except one under no soil mantle, shows that soil production rates decline linearly with increasing soil depth. These data provide a soil production function with a maximum soil production rate of 70.6m/m.y. under 24cm of soil and a minimum of 22m/m.y. under 75cm of soil. Accordingly it means that the interface between soil and saprolite have gone down maximum 141.2 m since the Quaternary. Thus it suggests that the saprolites are the results under current local climatic and geomorphic conditions rather than the relict of the Tertiary deep weathering.

Second, measurements of ^{10}Be in alluvial sediments show that the average erosion rate (70.7m/m.y.) of the study area is close to the maximum soil production rate, thus basin wide erosion rates of the study area are controlled by the current soil production rates. It means that about 1,400m has been eroded off since the early Miocene, when uplift of the KP seems to begin. Consequently it is difficult to think the HAP of the study area as the PES as well as one, which has been eroded keeping the original form of the PES. Furthermore, the erosion rates are lower than the uplift rates during the late Quaternary (about 300m/m.y.), but similar to the uplift rates before the early Miocene (about 100m/m.y.). Therefore, it suggests that the HAP of the study area has been uplifted since the early Miocene, but has not approached the steady state with the neotectonics of the KP.

In summary, we suggest that the HAP of the study area is the result of the geomorphic process under current climatic and geomorphic condition rather than the relict of the PES.

Final ID: EP41D-0832

Weathering the deep Critical Zone, understanding the controls on carbon-mineral association in a first-order watershed

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Body: The process of chemical weathering converts bedrock into saprolite and eventually to soil and in doing so releases rock-derived nutrients, converts primary minerals to secondary phyllosilicates (clay minerals), and increases the specific surface area (SSA) of the materials. Soil carbon is found to be more stable when sorbed onto mineral surfaces, and certain phyllosilicates have orders of magnitude larger SSA than the minerals from which they are derived; yet organic-rich zones are often physically separated from zones of mineral SSA production. We assess the carbon content, mineralogy, and geochemical mass balance in a 9-hectare, first-order watershed with relatively uniform greenschist bedrock. The watershed is located in a nature preserve and has a 250 meter long spring-fed stream. Up gradient from the stream is a 150-meter long, 1-meter deep gully that contains at least ½-meter thick soil through the extent of the gully. The catchment contains steep hillslopes and we sampled four soil pits along a hillslope transect at the summit, shoulder, backslope (36% grade), and gully. We are assessing the extent of chemical weathering and the limiting factors for carbon-mineral association under natural erosion and soil mixing conditions. In this study, the limiting factors for carbon-mineral association include mineral supply, carbon supply, and the opportunity for contact between carbon and mineral surfaces. These limitations are expected to vary based on landscape position in this single land-use watershed. Within the first two meters from the ground surface, our preliminary data reveal that clay (<2 micrometer) content did not show significant depth variation and averages between 5-6% of bulk soil composition, which is consistent throughout the sampled transect. This result suggests that chemical weathering extends deeper. Sampling of two 21-meter long rotosonic drill cores at the summit and near the gully reveal several aspects of this rarely measured deep zone of chemical weathering and its influence on production of mineral surface area. Drilling also provided an exceptionally deep weathering profile for quantifying elemental and mineralogical changes from in-situ parent material. This work is one component in a multidisciplinary study of the Christina River Basin Critical Zone observatory in the Piedmont coastal plain of southeastern Pennsylvania, which seeks to quantitatively examine the role of mineral erosion on carbon cycle from upland soils to the sea.

Final ID: EP41E-0843

WHY ARE CHANNELS SINUOUS?

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Body: Sinuosity is a ubiquitous property of channelized flow patterns on Earth and other planetary bodies. Sinuosity is typically discussed as an emergent consequence of migration processes in meandering rivers, but meandering rivers are only one type of sinuous channel: there are many examples that show little or no indication of meandering, such as bedrock river canyons, drainage channels in tidal mudflats, and volcanic rilles. In some of these patterns, sinuosity is described as "inherited" from a preexisting morphology, which elides an explanation for how the inherited sinuosity originated. Even in river meandering theory there is ongoing debate regarding how initial channel sinuosity arises.

Comparing the results of a generalized flow-routing model to observations of natural flow patterns, we find that the ratio of floodplain resistance (R, representing topographic roughness, substrate erodibility, or vegetation density) relative to floodplain slope (m) produces a range of sinuous planforms with natural analogs. We offer a unifying theory for channel sinuosity in which this ratio of resistance to slope (R:m) exerts the primary landscape control on planform shape and predicts the range of sinuosity a floodplain may express. Resistance-dominated floodplains produce channels with higher sinuosity than those of slope-dominated floodplains because increased resistance impedes down-slope flow.

Measurement of "relative resistance" (R:m) could inform how riparian restoration projects evaluate the floodplains of artificially straightened rivers. Our analysis suggests that if the sinuosity of a formerly natural channel derived from a high R:m, then even a channel redesigned to be sinuous will straighten if the relative resistance of its floodplain is suppressed or inherently low. (Alternatively, increasing floodplain resistance might foster a higher sinuosity than hydraulic geometry would forecast.) The explanation for sinuosity that we propose is universal enough to account for a wide variety of channel types in nature, and can serve as an analytical tool for determining the sinuosity a landscape might support.

Final ID: H41G-1256

Sharp landscape features and their role in predictive hydrology and geomorphology

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Body: Sharp topographic features often represent critical boundaries, or discontinuities, in hydrologic and geomorphic processes. Many such features are found in the proximity of actively evolving river channels (e.g., small knickpoints, steep channel banks, natural levees, scroll bars, and floodplain microtopography). While these features are often overlooked in hydro-geomorphic modeling, they can be used as indicators of channel dynamics. The increasing availability and quality of high-resolution topography data provides new opportunities to utilize these sharp features to interpret geomorphic processes and identify critical process-boundaries. However, sophisticated and automated techniques are needed for delineation and measurement of these sharp features over spatially extensive areas (i.e., entire channel-floodplain networks). Further, these features occur at scales much smaller than the grid scale of predictive hydrologic and morphodynamic models, raising the need for sub-grid scale parameterizations, or closures. In this work we present such techniques and use the Minnesota River Basin (MRB) as a prototype system to investigate the distinct assemblages of sharp features that exist in different geomorphic environments, connect them to the processes responsible for their formation, and propose ways for incorporating them in hydro-geomorphologic modeling. The MRB is a predominantly agricultural watershed with pervasive human modifications, an accelerating hydrologic cycle, a uniquely dynamic geologic history, and severe impairments for sediment and eutrophication. The MRB channel-floodplain network exhibits an exceptionally broad range of geomorphic environments, including rapidly meandering, incising, and aggrading reaches, making it an ideal location to study the linkages between form and process. Specific challenges are discussed in deriving sub-grid scale closures that implicitly account for these sharp features and developments needed for increased prediction accuracy at the macro-scale.

Final ID: H41I-1290

US-Pakistan Cooperation on End-to-End Hydrometeorological Disaster Risk Assessment: Satellite Sensors, Super Computing and Sustainable communities (S3)

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Body: An extensive research program in hydrometeorological disasters risk reduction is undergoing between U.S and Pakistan. The overarching goal of this collaborative project is to develop an end-to-end framework which incorporates multiple satellite remote-sensing products (e.g., TRMM, MODIS, ASTER, SRTM) into a rainfall-runoff model in an effort to investigate the adequacy of such products for improving hydrologic monitoring and prediction, especially during floods. First, evaluation of three high-resolution satellite precipitation products was performed in the context of flood monitoring. Furthermore, the spatial and temporal characteristics of the latest TRMM product (3b42V7) were evaluated for the Asian monsoon over Pakistan for the catastrophic floods in 2010. Second, a hydrologic model will be calibrated and implemented with an understanding of how satellite remote-sensing products simulate floods in sparsely and un-gauged basins. In order to reduce the risks from hydrometeorological disasters, this research project aims to conduct research, enact training programs, and initiate information-networking activities at the local and national levels. The broader impact of such techniques is to provide cost-effective tools to progressively build capacity for disaster prediction and risk reductions in Pakistan.

Final ID: IN41A-1474

Arctic Research Mapping Application (ARMAP): 2D Maps and 3D Globes Support Arctic Science

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Body: The Arctic Research Mapping Application (ARMAP) is a suite of online applications and data services that support Arctic science by providing project tracking information (who's doing what, when and where in the region) for United States Government funded projects. With ARMAP's 2D mapping application, 3D globes, and data services (http://armap.org), users can search for research projects by location, year, funding program, keyword, investigator, and discipline, among other variables. Key information about each project is displayed within the application with links to web pages that provide additional information. The ARMAP 2D mapping application has been significantly enhanced to include support for multiple projections, improved base maps, additional reference data layers, and optimization for better performance. The additional functionality of this tool will increase awareness of projects funded by numerous entities in the Arctic, enhance coordination for logistics support, help identify geographic gaps in research efforts and potentially foster more collaboration amongst researchers working in the region. Additionally, ARMAP can be used to demonstrate the effects of the International Polar Year (IPY) on funding of different research disciplines by the U.S. Government.

URL: http://armap.org

Final ID: NH41C-01

Sediment Sources, Sedimentation Processes and Post-Depositional Changes of the 2011 Tohoku-Oki Tsunami Deposits on the Sendai Plain, Japan ***(Invited)***

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Body: The 11th March 2011 Tohoku-oki tsunami inundated the low-lying Sendai Plain (Japan) more than 5 km inland leaving sand and mud deposits over most of the area. In order to establish the sources of the tsunami deposits and interpret processes of their sedimentation, samples were collected from the deposits, underlying soils and the beach along a shore-perpendicular transect and analysed for grain size, heavy minerals, diatom assemblages and nannoliths. Surveys were undertaken 2, 5 and 7 months after the tsunami to assess the importance of post-depositional changes in tsunami deposits. The last survey took place shortly after a major typhoon.

The fining-inland tsunami deposits consisted of poorly to moderately sorted medium to coarse sand within 2 km of the coastline and very poorly to poorly sorted mud farther inland. The tsunami deposits also exhibited vertical changes including fining upward and coupled coarsening-fining upward trends. Heavy minerals comprised on average 35% of the tsunami deposit in the 0.125 – 0.25 mm grain size fraction. Heavy mineral concentrations and assemblages were similar in the tsunami deposits, beach and underlying soils. Diatoms were rare in beach sediments, soils and tsunami deposits within 1 km of the coastline, while they were more abundant farther inland. Diatom assemblages in the soil and tsunami deposits were similar and dominated by species typical of freshwater-brackish habitats, while no typically marine species were encountered. Nannoliths were generally absent in the studied sediments, except for few specimens.

Our data indicate that there was probably no or only a very minor component of marine sediments transported onland by the tsunami. The sandy tsunami deposits within ~1 km of the coastline were mostly derived from beach and dune erosion. From 1 to 2 km landward the contribution of these sources decreased, while sources comprising local soil and inland canal sediments increased. Farther inland, mud deposits were mostly derived from local soil erosion. The tsunami deposits were most likely deposited during at least two inundations, mostly from suspension resulting in an upward grain size fining trend. However, bed load deposition was also important in the sandy deposits.

The tsunami deposits were generally well preserved after 2 months but sandy sediments in exposed areas were redeposited by wind action. After 7 months, preservation was still good. On the coastal dune slopes there was limited redeposition of sediment by flowing water. Plant recolonisation was slow. The surface of the tsunami deposits was commonly stabilised by an algal mat cover. In places where the deposits were thinner than 1 cm their visual discrimination from the underlying soil was problematic, however, the deposits were still relatively well preserved for

about 80% of their original extent.
The study reveals that even very large tsunamis may not transport marine sediments onland and thus many commonly applied indicators of tsunami deposits based on the assumption of their offshore origin may be of limited use. Preservation of tsunami deposits in a coastal plain setting primarily depends on their thickness and land topography. Most erosion and redeposition of the deposits take place shortly after tsunami inundation and depend on climate (wind, rain) and topography.

Final ID: GC41E-04

Current status of North American Monsoon Research ***(Invited)***

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Body: This talk provides a synthesis overview of the current state of understanding and predictions of the North American Monsoon climate system. Over the past few decades significant progress has been made in characterizing numerous climatological attributes of the North American Monsoon system. Targeted observational campaigns as well as retrospective data analyses have documented key North American monsoon processes occurring at a wide range of spatial and temporal scales. Particular advances have been made in understanding and modeling the diurnal cycle of monsoon convection and its modulation by propagating synoptic scale disturbances such as tropical easterly waves, inverted troughs, tropical storms and mid-latitude waves. New conceptual models have emerged which integrate many of these features into a cross-scale depiction of controls on monsoon rainfall activity. However, despite the progress that has been made, intra-seasonal prediction skill (i.e. beyond 2-3 weeks) and seasonal prediction skill, in particular, from dynamic prediction models remains critically low. The reasons for this remain somewhat uncertain but appear to be related to difficulties in representing many large-scale controls on monsoon behavior in coupled global circulation models. As a conclusion to this summary talk a set of scientific priorities will be proposed which seek to close the gap in North American Monsoon prediction skill.

Final ID: EP41G-05

Intermittency in bedload transport: the importance of coherent flow structures and grain to grain interactions

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Body: Accurate measurements and predictions of bedload transport rates require an understanding of the spatial and temporal variability in sediment fluxes. Bedload transport at large spatial scales can be multifractal (similar to turbulent velocity fluctuations) and highly intermittent but the explicit influence of turbulence on bedload transport scaling is not well understood, particularly at small temporal and spatial scales. To better understand the coupling between turbulence, grain to grain interactions, and bedload fluxes we conducted a series of flume experiments in which we measured the movement of individual grains using a high speed, high resolution video camera (250 fps). In the first experiment, uniform sand was transported through an array of vertical cylinders and bedload transport rates were measured at 5 locations (each 1 cm wide in the cross-stream direction) with different downstream distances from a cylinder. In the second experiment, a bimodal distribution of gravel was transported on a bed without any large roughness. We analyzed bedload transport rates in each of these experiments using spectral and multifractal (to obtain Holder exponents, singularly spectrum and fractal dimensions) analyses. In the sand experiments, the fractal dimension, downstream bedload fluxes, and Holder exponents (range and peak values) decreased with greater downstream distance from a cylinder. Physically this means that with greater distance from the cylinder, bedload fluxes became more irregular and discontinuous, and included a narrower range of signal strengths. We hypothesize that such changes occurred because the strength and scale of eddies, from the horseshoe vortices and von Karman vortex streets generated by the cylinder, changed downstream. Therefore, the scaling and intermittency of bedload fluxes can be highly spatially variable and depend not only on the mean flow conditions but on the local turbulence. However, although bedload and turbulence were coupled, other processes were also significant. For example, none of the bedload data displayed the scaling regimes commonly observed in the turbulence energy cascade (e.g. Kolmogorov scaling). This suggests that although bedload transport fluctuations are largely influenced by turbulence scales, they are not identical and cannot be modeled as such. Other processes that we observed in our experiments such as grain cluster disintegration, grain collisions and upstream sediment pulse integration also significantly impacted bedload transport scaling and need to be better understood.

Final ID: EP41H-05

Effects of Riparian Vegetation on Topographic Change During a Large Flood Event, Rio Puerco, New Mexico

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Body: The nature and pattern of vegetation on floodplains strongly affect the morphological changes that result from large floods by increasing drag and steering the flow through the landscape. Quantifying those changes is only possible through the use of high-resolution, multi-temporal topographic datasets. In 2003, herbicides were sprayed on a section of the Rio Puerco, New Mexico, killing the tamarisk and sandbar willow on the floodplain and banks. A large flood in 2006 caused extensive erosion along the devegetated zone, widening the channel and eroding the floodplain. We use lidar differencing to quantify the topographic change that occurred along a 12-km reach of the arroyo immediately downstream of the sprayed section. We show that the pattern of deposition on the floodplain can be explained as the sum of two signals: the sediment concentration (which depends on the distance downstream of the sprayed reach), and local vegetation density. The presence of dense vegetation on the landscape, regardless of size or species, increases deposition by imparting a drag on the flow and reducing the boundary shear stress on the sediment surface. The spatial variability of sediment depth correlates with the size and spacing of stems: thick, widely spaced tamarisk trunks are associated with high variability in the depth of sedimentation, while dense but thin tamarisk and sandbar willow stems correlate with sheet-like deposits. Away from the influence of the sediment source, the erosion of the arroyo walls balances the deposition rate on the floodplain, resulting in widespread, uniform aggradation of the arroyo bottom.

Final ID: EP41G-08

Size matters. History too. The rest is detail.

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Body: It is long established that grain size - both absolute and relative - strongly influences sediment transport. For mixtures of sizes, the history of flow and sediment supply determine the size of grains available on the bed surface for continued transport. Despite advances in understanding the interaction between the flow, bed, and transport, we have little ability to predict sediment transport rates. God is evidently in the detail. This detail can be external (detail that must be specified) or internal (detail that might be predictable). Although the elementary mechanics of grain entrainment, motion, and distrainment can be solved, our inability to specify the full system of flow and grains inevitably leads to assumptions and averaging that obscure detail, hide nonlinear interactions, and lead to predictive error. Here, we use inverse application of a surface-based transport model (flow and bed grain size predicted as a function of the rate and grain size of sediment supply) to explore the variability in transport conditions as a function of uncertainty in sediment supply. This helps define the effect of unexplained variation in external detail, providing a framework for investigating the effect of internal details related to sorting, grain structures, and biogeochemical processes.

Final ID: EP41I-08

The Influence of the Deep Critical Zone under Hillslopes on Hydrologic, Geomorphic, and Ecological Processes *(Invited)*

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Body: In actively uplifting terrain, channels cut through bedrock, hillslopes emerge and steepen, and a soil mantle drapes across the bedrock if erosion rates are not too high. Beneath the soil down to fresh bedrock extends the invisible part of the critical zone where stresses associated with emergence towards the surface and drainage of the bedrock leads to joint opening, fracture development and the generation of a hydrologically dynamic zone that stores and transmits water. Chemical erosion may further increase the saturated conductivity of this zone. Studies from many regions increasingly point to a prominent role of flow in this deeper part of the critical zone in surface processes. Here we describe observations from three intensive field campaigns (two past and one current) conducted over a 25 year period that explore how this deep part of the critical zone works hydrologically and connects to surface processes. All three sites are developed in turbidite sequences with varying mixtures of sandstone and mudstone, and consist of hillslopes draining to unchanneled valleys. Rates of uplift and erosion are sufficient that chemical weathering plays a secondary role to the breakdown of the rock. In the lowest gradient site in the grasslands just north of San Francisco, saturated conductivity decreased with depth in the critical zone, but was locally highly variable. Areas of lower saturated conductivity caused local exfiltration of water back to the surface and pore pressures well above hydrostatic. Saturation overland flow, channel initiation and possibly landslide initiation are associated with these exfiltration gradients. At our steepest site in the Oregon Coast Range, an upslope thickening critical zone lies underneath the 43 degree slope. All of the rainfall enters the fractured, weathered bedrock, but local exfiltration during intense rain can lead to shallow landsliding, especially after forest clear-cut removal (as happened at our site). In response to storm events, local pore pressures in the fractured bedrock differ greatly across the landscape. Our current research site in Northern California is developed primarily on argillite under a mixed canopy of mature evergreen forest. The critical zone systematically thickens toward the divide, and despite erosion rates of 0.2 to 0.4 mm/yr, the depth to fresh bedrock at the hilltop exceeds 20 m. No overland flow or lateral flow through the soil occurs; instead all runoff is from groundwater perched on the very low permeability fresh bedrock at the base on the critical zone. Twelve wells record the spatial pattern of this perched water table, and reveal widely varying response to storm inputs. The groundwater runoff sustains ecologically significant low flow during the nearly 6 months of no precipitation in adjacent creeks. The forest, despite being within meters of the perched groundwater, does not rely as the primary source of water, even at the end of summer. Instead, rock moisture in the unsaturated part of the critical zone is exploited by trees. Rare storms may cause the perched water table to reach the soil and destabilize it, while the transition from weathered to fresh bedrock at the base of the critical zone may eventually define the plane of failure for deep-seated earthflows which are common in the area.

Final ID: EP42D-01

The co-evolution and spatial organisation of soils, landforms, vegetation, and hydrology

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Body: Soils are the intermediary for many important environmental processes, and in many cases may be a significant driver of the response of these processes. Moreover the soils themselves are a response (over pedogenic timescales) to these same environmental processes. Soil timescales range from decades (for some fractions of soils carbon, and microbiological processes) through millennia (for vegetation and other fractions of soil carbon) to millions of years (for soil response to landforms). Thus that if we are to model pedogenesis in an attempt to understand the spatial distribution of soils (hillslope, catchment, or landscape scales) and their dynamic response (as for instance drivers of sediment load for basin subsidence analysis) we will need to quantify timescale of response and spatial and temporal links of the process dynamics of pedogenesis, landform evolution, vegetation and hydrology. This presentation summarises progress in our group in this coupling of processes across disparate time and space scales. We will show data that we have collected for pedogenesis, soil carbon and landforms that identify timescales for different components of the processes, and computer simulations where we have inferred other timescales from process response. We will present a framework which we believe will allow us to simplify the complexity of the spatial and temporal coupling by using spatial and temporal scale breaks in the processes.

Final ID: T42A-02

Structure and Evolution of Northwest Corner of South China Sea: implications for Cenozoic tectonics in Southeast Asia

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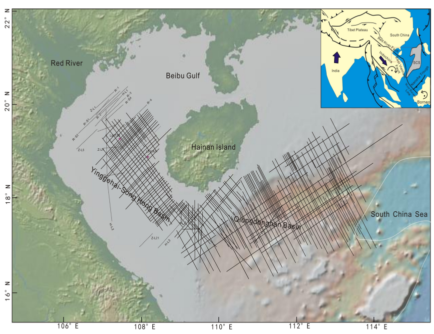
Body: The Yinggehai-Song Hong Basin (YGHB) and Qiongdongnan Basin (QDNB) are in the northwest corner of the South China Sea, which positioned at a juncture between a strike-slipping zone and an extensional zone. The basins lie at the southern termination of the largest Tibetan strike-slip zones, the Red River Fault, and are the principal repository of materials eroded from the Red River drainage. The basins are flanked to the East by an oceanic ridge and border the Nansha area to the South, which is being subducted underneath the Borneo Block. Hainan Island, located between the YGHB and QGNB, is composed primarily of granites and basalts. A combination of regional, high-quality reflection seismic and well data was used to unravel the basin history in greater detail than previously possible, which will enrich our knowledge about structure and evolution in Southeast Asia. After ca. 55 Ma the basins started to subside and grabens bounded by small-scale and NE-SW trending faults developed across wide areas. However, the evolution of YGHB and QDNB was shown different after 32 Ma. Strike-slip deformation of the YGHB took place after 32 Ma in response to the left-lateral movement of the Red River Fault. After the Middle Miocene the YGHB was inverted and generated prominent folds in the Lingao Uplift and Hanoi Basin. Inversion ceased at different times in different parts of the basin, indicating that the transition from compression to extension moved northward during the period 15.5-5.5 Ma. In contrast, to the west of YGHB, the QDNB displays a very different basin structure and evolution since 32 Ma. Larger-scale, partly fault-controlled depressions are superimposed clearly over underlying, faulted-bounding grabens on seismic profiles. The evolution of QDNB was controlled by extension, which is strongly influenced by the initiation of ridge spreading in the South China Sea. We also reconstructed the sedimentary flux from the Red River drainage constrained by higher resolution age data and a seismic stratigraphic framework. High rates of sediment accumulation since 5.5 Ma suggest climatic changes that increased erosion rates, even as tectonic processes appear to have slowed. This accelerating sedimentation also promoted large-scale fluid-shale diapirs formation in the YGHB.



Final ID: EP42A-03

Cheap and Cheerful Stream Restoration – An Example of System Wide Woody Addition Treatment

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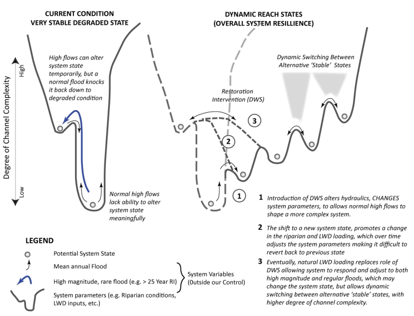
Body: Stream restoration has been plagued with high price tags, limited spatial extents, and questionable effectiveness in light of largely absent monitoring efforts. One prominent example is the placement of large woody debris (LWD) structures and engineered log jams that are frequently employed to promote heterogeneity of instream habitat. Ironically, many of these treatments attempt to lock in place and over-engineer the woody structures as opposed to allowing them to adjust and rearrange themselves as natural LWD would have. We are in the midst of a large scale restoration experiment using LWD to recover ESA-listed steelhead trout (Oncorhynchus mykiss) populations in the Asotin Creek Watershed of Southeast Washington. The project is an Intensively Monitored Watershed (IMW) where the restoration treatment and monitoring use a hierarchal staircase design maximizing the power to detect a population level response in steelhead. We are treating over 12 km of stream with enough LWD input (> 200 pieces per km) to mimic the historic background wood loading and encourage the stream to reshape and regularly rework itself leaving. We are using hundreds of structures we call DWS (dynamic woody structures), which generally consist of a series of wooden fence posts driven into the stream bed and complex LWD anchored between them to invoke a specific hydrogeomorphic response. The real advantage of these DWS are their cost. They can be installed quickly (15-30 minutes each) and cheaply (< $100/DWS); even in remote settings with a 2-3 person crew, hydraulic post pounder, very cheap materials, and avoiding impacts associated with operating heavy equipment. This allows us to install lots of the structures at high density (every 5-15 channel widths) over an entire stream system. We call this overall approach System Wide Woody Addition Treatment (SWWAT). In the long term, we hypothesize that the SWWAT will provide an intial input LWD that will become a part of study creeks which are more dynamic, resilient, and exhibit the capacity to regularly adjust. This dynamic switching between alternative stable states, we postulate will maintain a diversity of habitat types, and support increased steelhead production. In the short-term, we have a host of explicit design hypotheses about the physical and biotic response and a multi-scalar monitoring program geared to test each of these. We will present findings from a preliminary pilot project on three of the study creeks, which was subjected to a major flood, and tests many of these hypotheses.

URL: http://etal.usu.edu/Asotin/AsotinRestorationPlan_v1.pdf



Conceptual model of current and envisioned conditions.

Final ID: H42D-03

Novel or natural variation in ecohydrology-an example of smoldering combustion in the boreal forest.

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Body: Ecologists often implicitly assume that the physical environment has a potential for certain species composition unless dispersal is limited i.e. that species and their environment are in some sense co-evolved. Novel ecosystems imply that ecosystems are not generally novel in species composition. H.A Gleason in 1926 argued that vegetation was spatially and temporally variable in composition due to the differing contributions of the biotic and abiotic environments and thus all vegetation was in this sense novel. In the 1970's W.A. Watt and M.B. Davis show from pollen studies that vegetation composition changed often and quickly in the Pleistocene with no composition enduring for long periods. That is, there seem to be no modern analogues of past vegetation composition. Certainly ecosystems and their geophysical environments have recurrent patterns but also have major variations. To understand these patterns one must understand the processes that give rise to them. In this talk we will use the effect of the wildfire process of smoldering combustion on the vegetation of boreal and subalpine forests. We will accent the geophysical processes that affect the moisture content of the forest floor. Boreal forests consist mostly of coniferous trees which have relatively small branches to support individual needles and bundles of needles. This and the conical arrangement of branches make a transition from surface fires to crown fires relatively easy. This in part explains the predominance of crown fires (fire intensities > 4000 kWm-1). Boreal forests also have deeper organic layers (F &H soil layers) on the forest floor caused by slower decomposition. The loss of volatiles during decomposition explains the predominance of smoldering combustion in this layer during wildfires. The smoldering loss of the F layer and much of the H layer creates a habitat of more reliable water budget for survival of germinating tree seeds. Thus the amount of the F and H layers removed by smoldering combustion determines the number and composition of seedlings after fire. Smoldering combustion is controlled primarily by the organic layers' moisture and next by their density and depth. The forest floor's moisture budget is determined by the time since last precipitation, the hillslope geomorphology and hydrology, and tree interception. This coupling of weather (precipitation & evaporation), organic layer decomposition, hillslope hydrology, and tree canopies is one cause of variation in vegetation composition.

Final ID: GC42A-03

Potential Climate Change Impacts on the Built Environment in the United States and Implications for Sustainability *(Invited)*

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Body: The built environment consists of components that have been made by humans at a range of scales from small (e.g., houses, shopping malls) to large (e.g., transportation networks) to highly modified landscapes such as cities. The impacts of climate change on the built environment, therefore, may have a multitude of effects on humans and the land. The impact of climate change may be exacerbated by the interaction of different events that singly may be minor, but together may have a synergistic set of impacts that are significant. Also, there may be feedback mechanisms wherein the built environment, particularly in the form of cities, may affect weather and the climate on local and regional scales. Besides having a host of such interactions, the impacts of climate change on urban areas will likely have thresholds, below which effects are incidental or of mild consequence, but beyond which the effects quickly become major. Hence, a city may be able to cope with prolonged heat waves, but if this is combined with severe drought, the overall result could be significant or even catastrophic, as accelerating demand for energy to cooling taxes water supplies needed both for energy supply and municipal water needs. Moreover, urban areas may be affected by changes in daily and seasonal high or low temperatures or precipitation, which may have a much more prolonged impact than the direct effect of these events. Thus, the cumulative impacts of multiple events may be more severe than those of any single event. Primary hazards include sea level rise and coastal storms, heat waves, intense precipitation, drought, extreme wind events, urban heat islands, and secondary air pollutants, and cold air events including frozen precipitation.

Indicators need to be developed to provide a consistent, objective, and transparent overview of major variations in climate impacts, vulnerabilities, adaptation, and mitigation activities. Overall, indicators of climate change on the built environment should:
1) provide meaningful, authoritative climate-relevant measures about the status, rates, and trends of key physical, ecological, and societal variables and values to inform decisions on management, research, and education at regional to national scales;
2) identify climate-related conditions and impacts to help develop effective mitigation and adaptation measures and reduce costs of management; and
3) document and communicate the climate-driven dynamic nature and condition of Earth’s systems and societies, and provide a coordinated.

This presentation will provide an overview of possible climate impacts on the built environment. Also, given that spatial analysis and remote sensing techniques will be of paramount importance in assessing these impacts and in preparing adaptation strategies, the presentation will provide examples of how these techniques can be used to identify potential impacts of climate change on the built environment.

Final ID: H42D-06

Water Presence in an Arid and Semi-arid River: Pattern, causes, mechanisms and change *(Invited)*

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Body: The presence or absence of water in a stream is among the most fundamental hydrologic variables, particularly for arid and semi-arid rivers. The perennial or intermittent nature of a specific stream location is strongly tied to the biotic diversity and ecosystem services provided by a specific stream reach. Wet dry mapping has been conducted on several Arizona rivers over the last several years. The mapping has been most extensive in time and space along the San Pedro River where the effort has been led by the Bureau of Land Management and the Nature Conservancy. Analysis of the available 13 years of data reveals a number of critical aspects about how a river's wetness changes with climatic and geomorphic conditions. First, the pattern displays power law scaling across space for all completed surveys. Second, using a logistic regression approach the following variables were found to be important in predicting the wet/dry status of a given stream location: surface topography , depth to bedrock, mean daily streamflow in May, change in depth to bedrock, channel sinuosity, and flood plain width. The model is able to correctly predict 80.1 to 86.7% of the wet/dry locations in the river when 52.8% (31.5% wet and 21.3% dry) of its wet/dry status was constant during calibration. Importantly but unsurprisingly the logistic model indicates that hydrologic state combined with subsurface capacity to transmit flow and fluvial structure are important variables in determining the wet/dry status of specific river locations. Using groundwater models as well as climate scenarios for future conditions we are able to estimate how both the extent and the spatial pattern of stream wetness will change under future climate scenarios.

URL : http://tmeixner.faculty.arizona.edu/

Final ID: EP42C-02

Dynamic Flocculation of Muds in Fluvial to Marine Transitions

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Body: Rivers are the primary conduits for delivery of sediment and organic matter to the sea. The sediments from river plumes may deposit and be preserved in estuarine and deltaic zones, or may be carried and mixed by ocean currents to deposit elsewhere on the shelf or basin. The sediment settling velocity is the most important parameter in terms of controlling and predicting depositional patterns in river mouths and coastal shelves. Settling velocity greatly impacts the distribution of muds in deltas and turbidity currents, and is largely controlled by grain size and density. The flocculation process yields mud aggregates of variable size and density as a function of turbulent energy and salt levels. Since turbulent energy and salinity both change during the fluvial to marine transition, dynamic flocculation processes may have a significant control to the eventual distribution of sediment through these zones. The purpose of this study is to quantify the evolution of floc size distribution and fractal dimension of suspended flocs with time as a function of time and space as turbulent shear and salinity levels vary in the fluvial to marine transition (river jet/plume and turbidity currents). To do this, experiments are carried out in a laboratory chamber where turbulent shear and salinity levels are varied to mimic a fixed volume of fluid being advected through the transition zone, and floc size distribution properties are measured within the mixing chamber using a specially designed floc imaging system and a set of image processing routines that allows us to measure floc size distributions of suspended flocs. Results demonstrate that floc properties and floc settling velocity change due to the dynamic flocculation and are dependent on the turbulent time history the mud suspension was exposed to under constant concentration. Results from the study are then used to frame a discussion on the relative importance of accounting for these dynamic effects in numerical models of deltas and turbidity currents.

Final ID: EP42B-08

Numerical modeling of the morphodynamic evolution of long tidally-dominated river estuaries.

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Body: In this work a one-dimensional numerical model coupling hydrodynamics and morphodynamics is used to analyze the long term evolution of long tidally dominated estuaries. The model is shock capturing, in the sense that is able to correctly describe height and celerity of water surface discontinuities (tidal bores) arising from channel convergence and frictional effect. Model results indicate that the system moves toward a dynamic equilibrium configuration in which the amount of sediment entering upstream is flushed seaward. For high values of riverine sediment discharge, the estuary is infilled at a point that the tidal wave is dissipated within a short distance from the mouth and the bed slope is high enough to flush the sediments entering upstream. For low values of riverine sediment discharge, however, the equilibrium configuration may not be reached and the estuary would deepen indefinitely. For intermediate values, an equilibrium condition with a tidal wave that propagates upstream for large distances is computed.

Final ID: B43F-0477

Influence of aerosol chemical composition on N_2O_5 uptake: Airborne regional measurements in North-Western Europe

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3. CETEMPS - Dipartimento di Fisica, Universita di L'Aquila, L'Aquila, Italy.
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Body: Aerosol particles play an important role in night-time atmospheric chemistry as they provide an effective sink for reactive oxidised nitrogen. The heterogeneous uptake rate of dinitrogen pentoxide, N$_{2}$O$_{5}$, to atmospheric aerosols is known to be highly modulated by their chemical composition. Consequently, aerosols may significantly impact the cycling of reactive nitrogen during the night-time, which can also have consequences for day-time atmospheric chemistry. Previous ambient airborne measurements in the North-Eastern USA have shown that uptake rates are enhanced in the presence of acidified sulphate aerosols. While sulphate aerosol is still an important component of the aerosol burden in North-Western Europe, its contribution is often outweighed by that of ammonium nitrate and organic matter. Furthermore, sulphate is often present in its neutralised form due to the abundance of ammonia sources in the region. North-Western Europe therefore provides a contrasting chemical environment to compare with previous studies.

This paper presents analysis of the role played by aerosol chemical composition in determining the composition of the troposphere. In-situ measurements of aerosol properties made onboard the UK Facility for Airborne Atmospheric Measurements (FAAM) BAe-146 aircraft will be presented. An Aerodyne Aerosol Mass Spectrometer (AMS) measured the size resolved chemical composition of non-refractory particulate matter. These measurements were complemented by a suite of gas phase instrumentation, which measured inorganic and organic acids, reactive nitrogen species and volatile organic compounds.

The measurements were conducted as part of the RONOCO (ROle of Night-time chemistry in controlling the Oxidising Capacity of the atmOsphere) project. Science flights were conducted in the UK region during summer 2010 and winter 2011. Daytime measurements were also conducted in order to contrast with the night-time missions during the study periods.

A large range of pollution environments were studied, including relatively clean conditions and several major pollution episodes. Uptake of N$_{2}$O$_{5}$ to aerosol particles appeared to be modulated by the ambient size distribution, which is a confluence of the physical, chemical and hygroscopic properties of the particles. The role of ammonium nitrate in this system was particularly complex, as it increases particle size via water uptake, which will increase N$_{2}$O$_{5}$ uptake but ammonium nitrate itself will suppress N$_{2}$O$_{5}$ uptake. These competing effects driven by the aerosol chemical composition have significant ramifications for the cycling of reactive nitrogen in the night-time atmosphere.

Such cycling has implications for local ecosystems via the perturbation of the nitrogen cycle, regional air quality and climate change.

Final ID: C43C-0613

The role of melt, storage and tapping of supra glacial lakes in runoff from the Greenland Ice Sheet

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4. Institute for Marine and Atmospheric Research, Utrecht University, Utrecht, Netherlands.

Body: The linkage between melt, storage and runoff for the Greenland Ice Sheet (GrIS) has been of great interest in recent years given the number of record warm years recorded within the last decade. In the period 2007 to 2012, discharge data have been collected at the outlet of Watson River, Kangerlussuaq, west Greenland. This is combined with robust melt calculations based on six weather stations within the catchment and remotely-sensed estimates of the volume and drainage dates of water stored in supraglacial lakes. The melt calculations are from a surface energy balance model. Lake volume estimates (±20%) are derived from atmospherically corrected Moderate Resolution Imaging Spectroradiometer (MODIS) images using a depth-reflectance calibrated relationship based on bathymetry measurements made in the field. As an example we examine the period around July 8th to July 12th 2012 where record-warm weather over the Kangerlussuaq region, as well as the entire ice sheet, caused a high amount of melt. Within this well-studied region some supra glacial lakes drained coincident with the warm weather. On July 11th this resulted in severe damage to the bridge crossing the Watson River in the town of Kangerlussuaq, where a discharge of ~2500 m^3 sec^{-1} was measured – the highest ever recorded.

We investigate the linkage between surface melt, supraglacial storage and runoff by combining these three datasets. Firstly, we see whether we can identify the signal these lake drainages produce in the proglacial discharge record. By quantifying this and comparing it to the melt record for the catchment, we can assess whether the large flooding event on July 11th 2012 was caused by high melt over the ice sheet or by the drainage of supra glacial lakes, or a combination of the two and how much water the lakes contribute to the proglacial discharge.

Final ID: ED43C-0742

PROVIDING INTERNATIONAL RESEARCH EXPERIENCES IN WATER RESOURCES THROUGH A DISTRIBUTED REU PROGRAM

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Body: Research experiences for undergraduates offer training in problem solving and critical thinking via hands-on projects. The goal of the distributed Research Experience for Undergraduates (REU) Program in the Agricultural and Biological Engineering Department (ABE) at the University of Florida (UF) is to provide undergraduate students a unique opportunity to conduct research in water resources using interdisciplinary approaches, integrating research and extension, while the cohort is not co-located. The eight-week REU Program utilizes the extensive infrastructure of UF – Institute of Food and Agricultural Sciences (IFAS) through the Research and Education Centers (RECs). To provide international research and extension experience, two students were located at the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), in India. Prior to the beginning of the Program, the students worked closely with their research mentors at University of Florida and ICRISAT to develop a project plan for understanding the water quality issues in two watersheds. The students were co-located during the Orientation week at the University of Florida. During the Program, they achieved an enriching cohort experience through social networking, daily blogs, and weekly video conferences to share their research and other REU experiences. The group meetings and guest lectures are conducted via synchronously through video conferencing. The students who were distributed across Florida benefited from the research experiences of the students who were located in India, as their project progressed. They described their challenges and achievements during the group meetings and in the blogs. This model of providing integrated research and extension opportunities in hydrology where not all the REU participants are physically co-located, is unique and can be extended to other disciplines.

Final ID: EP43A-0865

Sensitivity Analysis for Assessing Effects of Tree Population Dynamics on Soil Bioturbation

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Body: Bioturbation due to tree root throw is thought to be an important process in soil production and soil mixing. Despite progress in our understanding of root throw processes, the tree population dynamics affecting the occurrence and timing of root throw events remain much less well explained. Unfortunately, research about forest dynamics is not always undertaken from the perspective of those interested in tree death, tree topple and associated root throw. As a result, the necessary field data about tree population dynamics is often unavailable for many locations. The acquisition of such data would allow for improved interpretation of root throw observations and for incorporation within numerical models of tree root throw occurrence. The present study uses our earlier tree population dynamics model calibrated for subalpine forests in the Canadian Rockies to test the sensitivity of forest parameters within the model that determine tree death, tree topple, root throw and soil bioturbation. Crown wildfire disturbance is the primary driver of tree population dynamics, with wind throw being mainly of local importance. The recruitment and mortality of trees during multiple generations of forest determine the number of live trees on the landscape at any given time. Tree death may occur due to competition/thinning of trees between wildfire events or as a result of the wildfire itself. Unless trees die due to sudden wind throw events (as mentioned above, this is only of local significance in our study area), they remain standing for some time period after tree death and before tree topple; these trees are referred to as standing dead trees. The duration of this time window and several other factors influence if a tree breaks at its base or upheaves a relatively intact root plate with attached sediment. Our field research has also suggested that a minimum dbh is required before a root plate is large enough to upheave notable amounts of sediment. Modelling results in this study demonstrate that wildfire return intervals, recruitment rates and mortality rates are all critical in determining patterns in the number of live trees over time. Further field research is required in a variety of forest settings to better define and understand recruitment and mortality rates as required in tree population dynamics models. Other factors that are important in determining root throw occurrence are topple rates of standing dead trees (consisting of trees that die during competition/thinning or that are killed by the wildfire), and whether or not the standing dead tree snaps at the bole or upheaves a root plate as it topples; once again, additional research is required in different forest settings to better understand this model parameter. When the factors outlined above are integrated together in our tree population dynamics model and sensitivity analysis is conducted, distinct temporal patterns and pulses of root throw and associated soil bioturbation emerge as the model cycles through generations of forest.

Final ID: EP43B-0868

Rock strength reductions during incipient weathering

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Body:

Patrick Kelly, Suzanne Anderson, Alex Blum

In rock below the surface, temperature swings are damped, water flow is limited, and biota are few. Yet rock weathers, presumably driven by these environmental parameters. We use rock strength as an indicator of rock weathering in Gordon Gulch in the Boulder Creek Critical Zone Observatory, a watershed at 2500 m underlain by Proterozoic gneiss intruded by the Boulder Creek granodiorite. Fresh rock is found at depths of 8-30 m in this area, and the thickness of the weathered rock zone imaged with shallow seismic refraction is greater on N-facing slopes than S-facing slopes (Befus et al., 2011, Vadose Zone J.). We use the Brazilian splitting test to determine tensile strength of cores collected with a portable drilling rig. Spatial variations in rock strength that we measure in the top 2 m of the weathered rock mantle can be connected to two specific environmental variables: slope aspect and the presence of a soil mantle. We find weaker rock on N-facing slopes and under soil. There is no clear correlation between rock strength and the degree of chemical alteration in these minimally weathered rocks. Denudation rates of 20-30 microns/yr imply residence times of 105-106 years within the weathered rock layers of the critical zone. Given these timescales, rock weathering is more likely to have occurred under glacial climate conditions, when periglacial processes prevailed in this non-glaciated watershed. Incipient weathering of rock appears to be controlled by water and frost cracking in Gordon Gulch. Water is more effectively delivered to the subsurface on N-facing slopes, and is more likely held against rock surfaces under soil than on outcrops. These moisture conditions, and the lower surface temperatures that prevail on N-facing slopes also favor frost cracking as an important weathering process.

Final ID: GP43B-1142

Developments for 3D gravity and magnetic modeling in spherical coordinates

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Body: Geoscience Australia (GA) is Australia's Commonwealth Government geoscientific agency. GA performs gravity and magnetic modeling at a range of scales, from broad regional crustal studies with thousands of kilometer lateral extent and tens of kilometer vertical extent, to detailed local studies with kilometer or less lateral extent and meters to hundreds of meters vertical extent. To achieve greater integration and coherence, and to better understand the geological significance of this work, GA are investing in a number of development projects;

* Spherical coordinate gravity and magnetic modeling,
* Modeling using High Performance Computing facilities,
* Utilizing rock property data as an input into the modeling and interpretation of gravity and magnetic data,
* Better management of geoscience data and models, and
* Visualisation of spatial data in a Virtual Globe format.

In collaboration with the Colorado School of Mines (CSM) and the China University of Geosciences (CUG), a capability to model gravity and magnetic data in a spherical coordinate framework is being developed. This will provide more accurate calculations and permit the results to be integrated into a single framework that more realistically reflects the shape of the Earth.

Modeling gravity and magnetic data in a spherical coordinate framework is far more computationally intensive than in a Cartesian (rectangular) coordinate framework. To reduce the time required to perform the calculations in a spherical coordinate framework, the modeling software will be deployed by GA on the National Computational Infrastructure (NCI) High Performance Computing (HPC) facility at the Australian National University (ANU). This will also streamline the management of these software relative to the other main option of establishing and maintaining HPC facilities in-house.

GA is a participant in the Deep Exploration Technologies Cooperative Research Centre (DET CRC). In combination with this involvement, there is support for improved management of rock property data and to develop methods to better understand how these data can be used to provide constraints for geophysical modeling. GA are also using the opportunities afforded through the DET CRC to improve documentation and standardization of data and model storage and transfer formats so that the tasks of management, discovery and delivery of modeling inputs and results to various users can be simplified and made more efficient.

To provide the foundations of integration and analysis of information in a 3D spatial context, GA are utilizing and customizing 3D visualization software using a Virtual Globe application, NASA World Wind. This will permit us to view the spherical coordinate models and other information at global to local scales in a realistic coordinate framework.

The various development activities will together play an important role in the on-going effort by GA to add value to

large stores of potential field, rock property, and geological information. This will lead to a better understanding of the geology of the Australian region which will be used in a range of applications, including mineral and energy exploration, natural hazard mitigation, and groundwater management.

Final ID: H43B-1321

Transparency and Refutability: Why and How Demonstrated using a Synthetic, Highly Nonlinear Groundwater Transport Problem

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Body: A synthetic test case illustrates the importance of a transparency (revealed importance) and refutability (tested hypotheses) in model development. The test case represents transport of an environmental tracer (cfc) and contaminant (pce) in a heterogeneous groundwater system. A locally refined grid is used to represent selected features and the dynamics of pumping. Observations include hydraulic heads for which simulated values are obtained with MODFLOW, and four types of observations for which simulated values are produced with particle tracking using the new program MODPATH-OBS. These include (1) proximity observations that measure whether particles arrive at expected locations, (2) time-of-travel observations that measure whether particles arrive when they are expected, (3) concentration observations of cfc and pce where the simulated values are obtained by assigning each particle a concentration that is allowed to decay during transport, and (4) source water type observations that measure the dominance of sources of water that reach a given destination. There are eight transmissivity and porosity parameters. One model run requires 20 minutes; computationally frugal model analysis methods that required 10s to 100s of model runs enabled rapid access to the insights obtained. Three sets of parameter values are considered: (a) starting parameter values for which the sum-of-squared weighted residuals (SOSWR) exceeds 11,000, (b) estimated parameter values for which SOSWR equals 326, and (c) true parameter values that are known for this synthetic problem and for which SOSWR equals 457. SOSWR is not zero for the true parameter values because most of the locally refined model grid used in these simulations is coarser than the globally refined model grid used to generate the observations in this synthetic problem. SOSWR is smaller for the estimated parameter values than the true values because of fitting typical of model calibration, regardless of how calibrated results are achieved. Estimated values were all reasonable. Results suggest that with two exceptions the parameters have the same relative importance to the observations for all three sets of parameter values, although the observations contribute differently. At the starting values, many particles do not reach expected destinations so the time cannot be simulated and many time-of-travel observations are omitted from the calculations. Thus, at the starting parameters the time-of-travel observations play a small role compared to their contribution at the estimated and true parameter values. Two porosity parameters that are not important at the starting values become distinctly more important as model fit improves, and uncertainty intervals calculated using local methods become much smaller. Individual observations ranked as most important to the parameters also change as the parameter values change. These insights demonstrate how computationally frugal methods that support model transparency and refutability can be used to explore model nonlinearity.

URL: http://wwwbrr.cr.usgs.gov/projects/GW_ModUncert/

Final ID: H43F-1429

Improving flash flood forecasting through coupling of a distributed hydrologic rainfall-runoff model (HL-RDHM) with a hydraulic model (BreZo)

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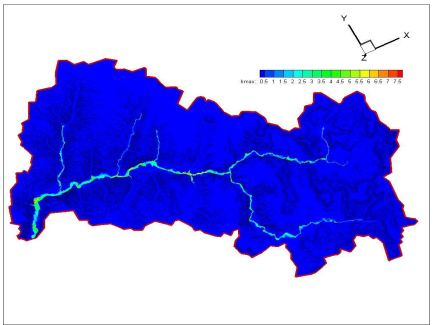
Body: Flash floods can be the most devastating events causing heavy life and economic losses. Improving flash flood warning in regions prone to hydrologic extremes is one highest priority of watershed managers. In this study, a distributed flash flood modeling system is presented. This system consists of advantages of a distributed hydrologic model (HL-RDHM) and the appropriate level of physical representation of channel flow through a high-resolution hydraulic model (BreZo). HL-RDHM is employed as a rainfall-runoff generator for runoff flow simulation, while the output from HL-RDHM is then used as input for the BreZo model, which simulates fine resolution flow in the river/channel system. The surface runoff generated from HL-RDHM is zoned to sub-catchment outlets and each outlet is considered as a point source to the channels. Multiple point sources are then simulated within BreZo to produce flash flood simulations in spatial and temporal distribution for the particular river/channel system and/or floodplain.

A case study was carried out for ELDO2 catchment in Oklahoma. ArcGIS Terrain Processing tools were used to divide ELDO2 (10m resolution) into sub-catchments with outlets. The surface flow from HL-RDHM was re-gridded to 10m resolution, then zoned to the 57 sub-catchments. The results obtained are very promising not only for better simulating the total discharge at the watershed outlet, but also for capturing the spatial distribution of flooded area in the floodplains.



Flooded map of ELDO2 (in meters) during the extreme event starting at 06/21/2000 10:00:00

Final ID: NG43B-1578

Diffusive evolution of experimental braided rivers

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Body: Braided rivers are complex systems in which a network of ephemeral, interacting channels continually migrate to create a rapidly changing landscape, with activity on a range of scales from channel to network organization. A previously proposed formulation in the literature has described the macroscopic behavior of braided rivers with a relationship between sediment flux and system slope that has the form of diffusion. This deterministic relationship has yet to be shown to be a true expression of stastistical diffusion on the macroscopic scale that results from stochastic behavior at the unit scale. We present results of a set of ~1m-scale experiments of braided rivers forming over a bed of monodisperse glass beads, designed to quantify both the characteristics of individual channels and the statistics of the system, and to test the extent to which statistical diffusion is applicable to braided rivers. Our data consist of repeat high-resolution topography scans, which provide data on both topographic relief and water depth values. The experiments evolve from an initial flat bed, allowing us to study the approach of the system to a steady state. We find that, although channels migrate rapidly, they have stable, self-similar geometries organized to a critical Shields stress criterion, which suggests that the timescale of channel geometry organization is small compared to dynamic channel timescales. Analysis of the channel network through time shows a decorrelation that is random and memoryless, and which occurs over time and space scales that yield a diffusivity estimate consistent with the deterministic theoretical prediction. Further investigation shows that many aspects of the system dynamics can be directly described with this diffusional framework. The timescale to equilibrium slope and topographic steady state, the rate at which correlation lengthscales increase through time, and the dependence of the equilibrium slope on sediment flux can all be described with diffusivities that are consistent with the theoretical prediction. Additionally, we demonstrate that the rate at which channels move to cover the landscape is both analytically soluble and the same as the rate at which the slope is adjusted to its equilibrium value, thus providing a mechanism and rate for the diffusive signal propagation between the unit and system scales. The emergent picture of our braided river system is one in which sediment transport drives the interaction of dynamic but equilibrium channels, which in turn act as the elements of randomness that effect diffusive behavior at the system scale.

Final ID: T43A-2638

Investigating the strain accumulation of upper plate faults at the N-Chilean convergent plate boundary at different spatial and temporal scales

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Body: According to recent paleoseismological investigations (Cortés et al., 2012), upper plate faults located at the N-Chilean convergent plate boundary well above the coupling zone of the subduction interface are capable of generating large earthquakes of up to Mw=7. We have chosen four active upper plate faults characterized by surface ruptures to investigate their activity and the processes responsible for strain accumulation. In this study, we use a combination of creepmeter time series and high-resolution topography data to assess fault deformation on spatial scales ranging from microns to meters and on temporal scales ranging from seconds to the geomorphological timescale (10^2-10^4 yrs).

To investigate the short-term deformation signals, we monitor the target faults with an array of creepmeters at a sampling rate of 30 seconds and a resolution of 1 µm. Despite the fact that long-term displacement rates range between 0.2-0.3 mm/yr for the 10^3-10^5 year timescale, displacement rates measured since 2008 are of the order of only a few µm/yr to approx. 80 µm/yr. There is no pronounced steady-state creep on the monitored faults. Time series analysis shows a few creep events, and numerous Sudden Displacement Events (SDEs) ranging from 1-59 µm. The sum of SDEs accounts for a significant part of the cumulative displacement (e.g. Salar del Carmen Fault: 50-60 %, Cerro Fortuna Fault: >90 %), but is an order of magnitude less than the long-term displacement rates.

To assess the long-term behavior of the monitored fault segments, high-resolution topography data has been acquired with Differential-GPS by measuring profiles perpendicular to the fault scarps and along incised gullies. The data show clear differences between individual segments of the target faults concerning the total fault scarp height, which is used as a proxy for cumulative displacement. The profiles enable us to distinguish single, composite and multiple scarps; allowing us to capture the number of seismic events that contributed to the creation of the fault scarp. Profiles measured inside gullies allow us to detect knickpoints used as proxy for seismic faulting and thus to quantify the number of events as well as the individual displacement per event. Fault scarp heights and styles/shapes as well as the amount and the height of knickpoints vary predominantly near step-overs, bends and between fault segments. This suggests individual deformation histories of the studied fault segments, possibly depending on their orientations and the local stress conditions both influencing the time dependent strain accumulation pattern. Displacements measured at knickpoints account for approx. 5-40 % of the cumulative displacement. This leaves a significant fraction of displacement probably accumulated by alternative processes, e.g. creep.

Comparing the instrumental record with the long-term deformation of the studied fault segments, we note that, according to the instrumental observation, no pronounced steady-state creep could be observed in the recent past of the target faults. In contrast, the topographic data suggest that a significant part of strain was accumulated by aseismic processes. We propose that strain accumulation of the studied faults is highly variable in time, possibly driven or influenced by the stage of the megathrust seismic cycle.

Final ID: NS43A-02

Coupled chemical alteration and mechanical deformation in fractures: Insights from laboratory-scale imaging ***(Invited)***

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Body: Perturbations from mechanical and chemical equilibrium can lead to significant alterations in fracture permeability and corresponding changes in fracture mechanical properties. Under conditions favoring mineral dissolution, alterations caused by chemical disequilibrium depend on the dimensionless Damkohler number (Da=kL/Vb, where k is an effective reaction rate, L is the length scale of the fracture, V is a mean flow velocity and b is the mean fracture aperture). At small values of Da, dissolution is relatively uniform throughout the fracture, whereas at high values of Da, instabilities in the reaction front lead to the formation of dissolution channels, and increased permeability at all values of Da. However, the addition of mechanical stresses can lead to contrasting behavior (i.e., either permeability increase or permeability decrease) due to the alteration of contact regions between the fracture surfaces. Quantifying the rates and relative impacts of different mechanisms in such experiments is necessary, particularly if we wish to use results to support predictions of field-scale behavior under different conditions. However, laboratory-scale experiments aimed at understanding coupled chemical and mechanical disequilibrium typically rely upon core-scale observations that provide insufficient details about the evolution of contacting asperities and the resulting stress induced deformation.

We present results from a set of experiments in fractured cores through which we flowed reactive fluids. The cores were reservoir- and cap-rock (limestone and anhydrite, respectively) from the Weyburn CO2 sequestration project in Saskatchewan. In addition to differential pore pressures and effluent chemistry we measured the surface topography (+/- 1 μm) of each sample before and after each experiment at high spatial resolution (20 x 20 μm). We fabricated a jig for accurately aligning the halves of the core on the profilometer stage and developed and tested numerical routines for reconstructing fracture apertures from the measured surfaces. All cores were subjected to an effective confining stress of 14 MPa and reactive fluids (CO2-equilibrated brine or DI water) were flowed through the cores at different values of Da. The limestone cores showed increased fracture apertures at all values of Da. At the lowest value of Da, the core diameter decreased during the experiment, which was consistent with the measured erosion of contacting asperities contact. Thus, in these experiments, the rate of deformation was slower than the rate of chemical dissolution of the fracture surfaces. In the anhydrite cores, at the lowest value of Da, the permeability decreased by approximately two orders of magnitude to near the value of the intact core. This was consistent with the observed formation of a zone of gypsum adjacent to the fracture plane that deformed due to the confining stress. Results from these experiments are extended via numerical simulations of dissolution that consider the influence of stress-induced deformation of contacts and provide a means for studying the influence of the competing processes of mechanical deformation and mineral dissolution at much larger scales.

Final ID: EP43D-04

Topographic Surface-Based Modeling: Building Complex Stratigraphy with Geomorphic Surfaces

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Body: Most three-dimensional geological models built using geostatistical techniques honor well data without difficulty, but fail to achieve geological realism. More often than not, model grids do not capture the stratigraphic complexity present in many depositional settings, and do not follow the actual layering in the sedimentary record, in particular where there are local volumes of steeper dips in channelized environments.

Adding to the variety of surface-based modeling techniques that have been developed during the last decade, here we discuss 'topographic surface-based modeling': modeling approaches that build stratigraphy through reproducing the evolution of topographic surfaces over time. The topographies are derived from a variety of sources, including numerical forward modeling, present-day topography and bathymetry, outcrop data, and three-dimensional seismic reflection data. Whenever deposition and erosion occur at the same time, in a spatially predictable pattern (as it is often the case with instability-related morphodynamics, e.g., bedforms, meandering rivers, submarine channels), erosional surfaces are time-transgressive and can have complicated 3D geometries. These complexities are difficult to represent in object-based or voxel-based stochastic models but are easily captured in topographic surface-based models. As locations of deposition, nondeposition, and erosion are recorded for each time step, it is possible to build 3D Wheeler diagrams that show the space-time distribution of preserved and eroded sediment and the time-transgressive nature of erosional surfaces.

3D grids generated this way preserve significant stratigraphic detail without the need for a large number of grid cells. In addition, the topographic surfaces serve as inputs for realistic distribution of properties such as grain size, porosity, and permeability. For example, elevation above channel thalweg can be a proxy for property distribution in channelized settings.

The methodology is applicable in modeling different depositional environments, especially in ones dominated by single-thread patterns of deposition and erosion. Examples include sinuous submarine slope channels, submarine lobe deposits, incised river valleys, and tidal inlets. These examples of topographic surface-based models show how the idea of translating geomorphology into stratigraphy has a number of useful applications.

Final ID: EP43D-05

Computer simulations of channel meandering and the formation of point bars: Linking channel dynamics to the preserved stratigraphy

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Body: Meandering rivers are probably one of the most recognizable geomorphic features on earth. As they meander across alluvial and delta plains, channels migrate laterally and develop point bars, splays, levees and other geomorphic and sedimentary features that compose substantial portions of the fill within many sedimentary basins. These basins can include hydrocarbon producing fields. Therefore, a good understanding of the processes of meandering channels and their associated deposits is critical for exploiting these reservoirs in the subsurface.

In the past couple of decades, significant progress has been made in our understanding of the morphodynamics of channel meandering. Basic fluid dynamics and sediment transport (Ikeda and Parker, 1981; Howard, 1992) has shown that many characteristic features of meandering rivers, such as the meandering wavelength, growth rate and downstream migration rate, can be predicted quantitatively. As a result, a number of variations and improvement of the theory have emerged (e.g., Blondeaux and Seminara, 1985; Parker and Andrews, 1985, 1986; and Sun et al., 2001a, b).The main improvements include the recognition of so called “bar-bend” interactions, where the development of bars on the channel bed and their interactions with the channel bend is recognized as a primary cause for meandering channels to develop greater complexity than the classic goose-neck meander bend shapes, such as compound bend. Recently, Sun and others have shown that the spatial patterns of width variations in meandering channels can be explained by an extrinsic periodic flow variations coupled with the intrinsic bend instability dynamics.

In contrast to the significant improvement of our understanding of channel meandering, little work has been done to link the geomorphic features of meandering channels to the geometry and heterogeneity of the deposits they form and ultimately preserves. A computer simulation model based on the work of Sun and others (1996, 2001a,b) is used to investigate the formation and preservation of point bars with meandering rivers. Rather than consisting of a single set of concentric scroll bar like feature as one would expect from the pattern of meandering channels, observations of point bar deposits in map view reveal the previously mentioned complexity in their internal organization. A preserved point bar deposit is often found to be composed of multiple sets of remnant scroll bar like features, each with different orientations. Each set is bounded by the unconformity resulting from one set of the scroll bar like feature truncated by the other set. This study links the channel dynamics to the preserved point bar architectures, and delineates the key controls that affect the point bar internal organization.

Final ID: EP43D-06

Significance of Quaternary and Experimental Fluvial Systems to Interpretation of the Stratigraphic Record ***(Invited)***

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Body: Studies of Quaternary and experimental fluvial systems provide significant insight for interpretation of fluvial deposits in the stratigraphic record, ranging from measurement of processes and relevant scales of key architectural elements, to process-based understanding of fluvial systems in sequence stratigraphic models. One key advantage for Quaternary and experimental systems is they commonly provide the ability to test, in a classical verification or falsification sense, interpretations, models and their alternatives that were developed from the stratigraphic record alone.

First, scaling relationships developed from Quaternary fluvial deposits can be utilized to constrain interpretations of ancient strata, as well as predict the scale of channel fills, channel-belt sand bodies, and incised valleys. Scaling relationships are defined by power laws, with absolute dimensions that scale to drainage area, water flux, and sediment flux. Width-to-thickness ratios for channel fills range from 10-20:1, whereas channel-belt sand bodies upstream from backwater effects commonly range from 70-300:1, and 20-40:1within the backwater zone, where channel migration is limited. Quaternary incised valleys range from 25-150 m in thickness, and ~5-100 km in width, with width-to-thickness ratios of ~500-800. Scales of Quaternary channel fills and channel-belt sand bodies overlap are consistent with compilations from the ancient record. However, even the smallest Quaternary incised valleys reside in the uppermost part of the domain of published ancient valleys, with ancient examples overlapping significantly with modern channel fills and channel belts. We suggest that many ancient examples have been overinterpreted because of a lack of objective criteria for differentiating channel fills, channel belts, and incised valleys.

Second, incised valleys have long played a key role in sequence-stratigraphic interpretations. For incised valleys in the stratigraphic record, either in outcrop or subsurface data, the sequence boundary is most commonly defined by the base of fluvial incision, which demarcates a significant basinward shift of facies, and is assumed to be an unconformity that everywhere separates younger strata above from older strata below. This classical interpretation is derived from a model for fluvial incision and sediment bypass during relative sea-level fall: fluvial deposits that rest on the sequence boundary are commonly assumed to represent filling of an empty container during late lowstand or early transgression. However, the model of fluvial incision and sediment bypass during relative sea-level fall has never been verified and does not stand up to scrutiny in Quaternary systems or experiments. Moreover, sediment bypass and deposition within incised valleys are not mutually exclusive: a large proportion of fluvial sediment is in transit over the duration of a base-level cycle, even though erosion and channel-belt deposition continuously redefines the valley shape, and at any one point the basal valley-fill surface is the same age as fluvial deposits that rest on top of it. Last, extension of valleys across a newly emergent shelf is accompanied by linked channel-belt deposition and delta progradation, such that the base of fluvial incision does not qualify as an unconformity or meet traditional criteria for a sequence boundary.

Final ID: EP43E-06

Climate-dependent sediment production: numerical modeling and field observations of variable grain size distributions from heterogeneous hillslope weathering of fractured basalt flows, Kohala Peninsula, Hawaii

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Body: We present a numerical model for hillslope sediment production that includes climate-dependent chemical weathering rates and bedrock fracture spacings, and predicts how grain size distributions vary with climate and hillslope erosion rate. Understanding sediment preparation, or the in situ reduction of fractured bedrock to coarse sediment by heterogeneous weathering on hillslopes, is critical to understanding the evolution of mountainous landscapes, as sediment supply rates and size distributions can strongly influence river incision rates. The majority of soil production models assume a homogenous substrate and uniform weathering front, and therefore do not track the size of rock fragments and corestones, which become the sediment supplied to channels by hillslope erosion. Our model is inspired by the Kohala Peninsula on the big island of Hawaii, which has a gradient of mean annual precipitation (MAP) spanning over an order of magnitude that has been shown to influence the weathering rates of the basalt. Previous geochemical studies have constrained climate-dependent weathering rates for local soil production. Using these inputs, we developed a kinetics-based numerical model for the chemical weathering of initially fractured basalt into soil and coarse sediment over 150ky. Following first-order reaction kinetics, chemical weathering in the model decreases exponentially with both depth below the surface and time. The model starts with a column of repeating basalt flows (typically 1 m thick), each with fracture spacing distributions consistent with thermal-mechanical cooling characteristics. Each individual fracture-bound block is assumed to weather from the surface inwards, similar in form to a weathering rind. Since the model is constructed of discrete blocks, larger blocks remain as unweathered corestones (the “sediment”), surrounded by weathered material. In addition to a MAP-dependent initial surface weathering rate and rate constant, climate is also reflected in the length scale for the reduction in chemical weathering below the surface, or the flushing depth. The flushing depth is assumed to scale linearly with MAP, but decreases exponentially with increasing soil depth, as soil capillarity will imbibe infiltration. Modeling six MAP regimes between 500 and 3000 mm produces a non-linear increase in soil depths from 0.59 m soil to 5.15 m, which is broadly consistent with field observations from Kohala Peninsula. The median corestone grain size (D50) was calculated at model completion for the 20 blocks below the soil-rock interface. In the driest regime the D50 was 98% of that for the initial column, while the D50 for the wettest regime was 56% of the initial. This sediment preparation model predicts soil depths and tracks particle size reduction with variable climate-dependent weathering rates. Incorporating this type of model into sediment-transport dependent landscape evolution models may be the key to understanding the systematic differences in topography across spatially variable climate gradients, such as Kohala Peninsula.

Final ID: EP43C-07

Experimental investigation of sediment transport through vegetated flow

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Body: Morphology evolves as the sediment fluxes constantly adjust to the flow transport capacity by scour or deposition. Natural flows in rivers or wetlands often interact with vegetation, and their transport capacity may be modified by these interactions. While the effect of aquatic plants on water flow has long been acknowledged, little quantitative data is available on their influence on sediment transport. Vegetation can not only modify the bottom roughness but also the whole flow structure. It is therefore expected to affect both bedload and suspended load fluxes. The purpose of the experiments presented here is therefore to quantify the influence of bottom vegetation (like grass) on the sediment transport capacity of a flow.

We performed a series of experiments in a 12m-long, 1-m wide flume. Half of the flume length was covered with plastic blades representing submerged flexible vegetation, like coastal eelgrass. Two plant densities were used. A range of flows was used to study different sediment transport stages: just above the entrainment threshold, bedload-dominated and suspension-dominated. Each flow was run until morphodynamic equilibrium was reached.

With the lower plant density, the velocity is slightly decreased close to the bottom but the velocity profiles do not present an inflection point. Ripples are observed along the flume both in the vegetated and unvegetated region, although they tend to be smaller in the vegetated region. The equilibrium sediment flux is similar to what is predicted without vegetation. The plants effective height decreases with the higher flows as the plants bend more. With the higher plant density, the velocity is much decreased in the vegetated region, i.e. below the plant effective height. Suspended load and bedload are both reduced in the vegetated area. The equilibrium fluxes are lower than in the low density case, which means that a higher slope is needed to transport the same amount of material.

In a hydraulic point of view, while the total friction increases with the plants, the skin friction, which is the fraction of the friction that is responsible for sediment transport, is reduced. The ratio of the skin friction to the total friction in a vegetated flow, which is a critical parameter for morphodynamic modeling, is therefore very different from this of an unvegetated flow. A future application of these experiments will be to propose a method to quantify this ratio in vegetated flows that will help to improve morphological models.

Final ID: EP43D-07

Building the coastline: Linking study of the modern and ancient depositional environments to predict the response of Mississippi River delta to environmental change

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Body: We combine data from the modern Mississippi River delta with industry-grade subsurface data from Breton Sound and Barataria Bay to define the Late Miocene to Recent behavior of this constructional coastline. Data from a seismic volume covering over 1000 square km of the delta and multiple subsurface wells are joined with measurements from the modern Mississippi system to highlight three properties of the coastal system that are particularly relevant to predicting maintenance of the delta surface: (1) the long-term composition of Mississippi River delta (i.e., the fraction of deposited sand versus mud); (2) variation in measured subsidence rate as a function of the time window; and (3) sedimentation patterns connected to channels and overbank surfaces. Examination of 10 km of well logs in latest Pliocene to latest Miocene deposits reveals that roughly 50 percent of the delta is composed of sand, a value similar to the reported composition of modern sub-deltas within the system. This sand fraction building the delta is roughly double the fraction of sand versus mud transported down the Mississippi River on an annual basis, indicating that sand not total sediment load controls aggradation of the dynamic delta top. We will discuss the shortcoming in using measured reductions in total suspended-sediment load for the Mississippi River system to estimate change in delta surface area under the condition of relative sea-level rise. The primary component of this relative sea-level rise is land-surface subsidence. Using the seismic data and well control we have quantified the dependence of measured subsidence rate on duration of the observation interval. In our study area the measured rates of local subsidence range from roughly 0.01 mm/yr to 100 mm/yr as the measurement window varies from 100,000 to 1 year. This wide range in rates highlights the challenge associated with tying land loss to overall subsidence. The highest rates of measured subsidence in the field area are connected to recent slip on growth faults that have been active for greater than 20 million years. Using geophysical data we identify the degree to which spatial variations in basin subsidence by growth faulting has affected the positioning of river channels and their deposits on the delta since the Late Miocene.

Final ID: EP43C-08

Turbulent and Mean Velocity Near Rigid and Flexible Plants, and Implications for Deposition

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2. Marine Geology & Geophysics, Woods Hole Oceanographic Institution, Falmouth, MA, United States.

Body: This study describes the mean and turbulent flow field near circular patches of model vegetation, and connects these to the spatial distribution of sediment deposition in the wake of the patch. Both a rigid, emergent and a flexible, submerged model of vegetation are considered, with two different stem densities for each model. The flow response to the emergent patch is essentially two-dimension, with flow diversion only in the horizontal plane. The horizontal shear layers in the wake produce a von Karman vortex street, but the presence of flow through the patch delays the onset these wake-scale structures, so that directly behind the patch there is a region of low velocity and decreased turbulence, which we term the steady wake. The spatial location of enhanced deposition correlated with the steady wake zone, which has length, L1. In contrast, the flow response to the flexible submerged vegetation is three-dimensional, with shear layers forming in both the vertical and horizontal planes. However, for the depth of submergence considered, the vertical shear and associated coherent structures dominate. Because of the strong vertical circulation in the wake of the patch, a steady wake zone does not occur behind the submerged patches. Considering all four patch configurations, enhanced deposition occurred only when both turbulence and mean velocity was below the upstream, initial values. These conditions primarily occurred within the steady wake behind the emergent patches. For the submerged patches, no regions of enhanced deposition were observed. When the total deposition is extrapolated for the reach of the flume, there appears to be no net enhanced deposition relative to the control experiments. These cases highlight the importance of turbulence, as well as mean flow, in setting the condition that enhance deposition.

Final ID: EP44B-01

First-order control of surface roughness at three scales: boundary layer dynamics, tracer dispersion and pebble abrasion *(Invited)*

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Body: In many situations it may be appropriate to treat surfaces as smooth and particles as spherical, however here we focus on scenarios in which the roughness of the surface exerts a first-order control on flow and transport dynamics. We describe three vignettes at three different scales: (1) roughness transitions and resulting sediment transport dynamics over ~10-km distance in a desert dune field; (2) reach-scale river bed roughness and its influence on dispersion of tracer particles in bed load; and (3) the control of particle surface roughness on the nature and rate of pebble abrasion. For (1), we show how the abrupt transition from a flat surface to a dune field may be treated as a step increase in the aerodynamic roughness parameter – so long as the spatial scale considered is significantly larger than that of an individual dune. This increase causes a spatial decline in the boundary stress downwind that may be understood using simple boundary layer theory, resulting in a factor of three decrease in the sand flux over a distance of kilometers. For (2), laboratory and field studies of tracer particles in bed load indicate that they undergo short flights separated by long rest periods having a power-law tail – even in steady flows. We hypothesize that for near-threshold transport – which predominates is coarse-grained rivers – particles become trapped in 'wells' produced by surface roughness, and their rest time is controlled by the time for the surface to scour down and release them. Laboratory observations support this hypothesis, while comparison to non-geophysical 'flows' indicates that these dynamics are generic to transport in disordered systems. Finally, for (3) we report laboratory experiments by our group and others showing how abrasion rate decreases with decreasing particle roughness. Geometric models quantitatively support the intuition that locations of high positive curvature on pebble surfaces are more susceptible to abrasion; as they are preferentially removed, abrasion rates slow down accordingly.

Final ID: H44E-03

A Global Hydrological Ensemble Forecasting System: Uncertainty Quantification and Data Assimilation ***(Invited)***

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2. School of Meteorology, University of Oklahoma, Norman, OK, United States.
3. NOAA/NSSL, Norman, OK, United States.

Body: A Global Hydrological Ensemble Forecasting System (GHEFS) driven by TRMM Multi-satellite Prediction Analysis (TMPA) precipitation ensembles and Global Ensemble Forecast System (GEFS) Quantitative Precipitation Forecast (QPF) ensembles, via the Coupled Routing and Excess STorage (CREST) distributed hydrological model, provides deterministic and probabilistic (e.g. 95% confidence boundaries) simulations of streamflow. The TMPA inputs enable flood monitoring and short-term forecasts while the GEFS ensembles provide for forecasts up to a seven-day lead time.

This talk will focus on a quantification of the system's uncertainty and streamflow ensemble prediction generation using the following three techniques:

1) an error model that first quantifies and then perturbs both temporal and spatial variability of the real-time, TMPA precipitation estimates by considering the version-7 research product as the reference rainfall product;

2) in forecast mode, utilization of the Ensemble Transform method to account for the uncertainty of GEFS forecasts from its initial condition errors;

3) a sequential data assimilation approach – the Ensemble Square Root Kalman Filter (EnSRF) applied to update the CREST model's internal states whenever observations (e.g. streamflow, soil moisture, and actual ET etc.) are available.

The GHEFS is validated in several basins in the U.S. and other continents in terms of flood detection capability (e.g. CSI, NSCE, Peak, Timing), showing improved prognostic capability by offering more time for responding agencies and yielding unique uncertainty information about the magnitude of the forecast impacts.

URL : http://eos.ou.edu   and http://hydro.ou.edu

Final ID: EP44B-04

Density Current over Rough and Uneven Bottoms

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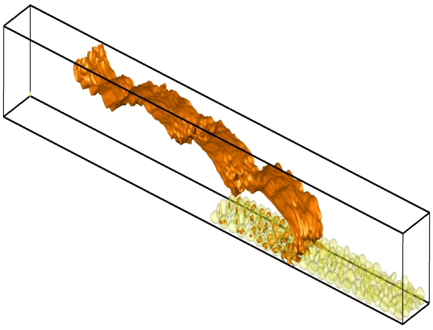
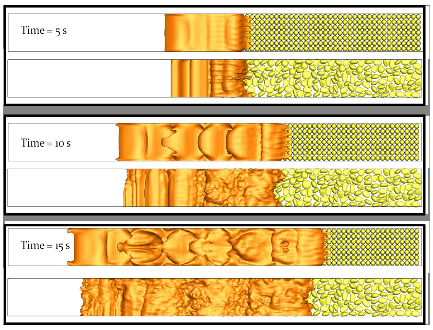
Body: The dynamics of density currents over rough and uneven bottoms are investigated by numerical simulations and laboratory experiments. Numerical methods are developed to represent the surface geometry of regularly arranged shaped bottom and irregularly shaped rough bottom. Large eddy simulations (LES) are conducted to calculate the dynamics of density currents over various types of rough bottoms. Numerical methods were developed to deal with the bottom shapes. Four types of rough bottoms are simulated, namely flat bottom, sine-shaped, half ping-pong balls, and gravel bottoms. To simulate the effect of randomly packed gravel bottom, a novel method combining computer collision detection and rigid body dynamics was used to generate the physically correct arrangement of these gravels. A new immersed boundary method was developed and used to simulate the flow field around the gravels. The results of density current front positions and velocities obtained from numerical simulations are compared with laboratory experiments. Satisfactory agreement has been observed. The methodology developed in this research can be used in much broad areas whenever discrete elements need to be resolved, for examples pore-scale modeling and detailed flow simulations in gravel bed rivers. More simulation examples will be shown.



Density current over gravel bed



Comparison between ping-pong ball bottom and gravel bed

Final ID: EP44A-05

Influence of variable lithology on landscape evolution

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Body: Landscapes evolve as a result of drivers (e.g. tectonics and climate) that provide the energy for geomorphic work and the resistance of the Earth's surface to that work. Lithology, a major factor in resisting erosion, is spatially variable on many scales across the Earth's surface. Even in relatively 'homogeneous' landscapes, variability in mineral content and joint spacing give rise to spatial variation in rock erodibility. In this study we quantify the significance of lithologic variability in the evolution of mountain topography using a well-constrained geologic setting and numerical modeling. To address this problem, we focus on the eastern Jura Mountains in northern Switzerland. Intense geologic study has produced detailed 3D lithologic maps from a combination of surface mapping at a 1:25000 scale and hundreds of boreholes in a region of only a few 10's of km2. Lithologies range from relatively soft shale to hard calcite-dolomites units providing a strong spatial contrast in erodibility. This well documented lithologic heterogeneity makes this region a viable natural experiment to explore the implications of lithologic variability on landscape evolution.

The CHILD landscape evolution model is used after modification to allow for spatially variable rock erodibility. We choose a minimum and maximum fluvial erodibility that scales linearly with rock tensile strength to assign each mapped unit a value. Modern topography is scaled to have a total relief of 5 m. This scaled-down DEM is used as the initial topographic condition. Simulations assume that the beds extend vertically from the mapped geometry. We explore the sensitivity of modeled results to the assumed minimum and maximum erodibility values. The range (difference between maximum and minimum values) is varied from ½ to 2 orders of magnitude but mean erodibility is held constant. Next, the sensitivity of these different scenarios is explored for different tectonic and climate environments to quantify the relative roles of tectonics, climate, and lithology on the evolved landscape. Results are quantified in terms of changes in hillslope angle, river steepness indices, relief, drainage density, and time to steady-state. All results are compared with a baseline scenario of uniform lithology as well as modern topography.

We find that spatial variations in modern topography are strongly correlated with lithology. Reproducing such variations in the modeled landscape requires an ~1 order of magnitude variation in rock erodibility between stratigraphic units. Both bed thickness and the range of erodibilities are important parameters in controlling the impacts of lithologic heterogeneity on landscape evolution. The model results are useful in understanding the spatial and temporal variations in landscape processes in lithologically complex terrain.

Final ID: EP44B-05

Effects of Small-scale Vegetation-related Roughness on Overland Flow and Infiltration in Semi-arid Grassland and Shrublands

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Body: We studied the effects of small-scale roughness on overland flow/runoff and the spatial pattern of infiltration. Our semi-arid sites include a grassland and shrubland in Central New Mexico and a shrubland in the Eastern Mojave Desert. Vegetation exerts strong controls on small-scale surface roughness in the form of plant mounds and other microtopography such as depressions and rills. We quantified the effects of densely measured soil surface heterogeneity using model simulations of runoff and infiltration. Microtopographic roughness associated with vegetation patterns, on the scale of mm-cm's in height, has a larger effect on runoff and infiltration than spatially correlated saturated conductivity. The magnitude and pattern of the effect of roughness largely depends on the vegetation and landform type, and rainfall depth and intensity. In all cases, runoff and infiltration amount and patterns were most strongly affected by depression storage. In the grassland we studied in central New Mexico, soil surface roughness had a large effect on runoff and infiltration where vegetation mounds coalesced, forming large storage volumes that require filling and overtopping in order for overland flow to concentrate into runoff. Total discharge over rough surfaces was reduced 100-200% compared to simulations in which no surface roughness was accounted for. For shrublands, total discharge was reduced 30-40% by microtopography on gently sloping alluvial fans and only 10-20% on steep hillslopes. This difference is largely due to the lack of storage elements on steep slopes. For our sites, we found that overland flow can increase infiltration by up to 2.5 times the total rainfall by filling depressions. The redistribution of water via overland flow can affect up to 20% of an area but varies with vegetation type and landform. This infiltration augmentation by overland flow tends to occur near the edges of vegetation canopies where overland flow depths are deep and infiltration rates are moderate. Infiltration augmentation is greatest in microtopographic depressions and flow threads. These results show that some vegetation-landform settings are efficient at trapping and concentrating the primary limiting resource, and demonstrate the importance of micro-scale soil characteristics for the ecohydrologic function of semi-arid environments. Since other essential attributes for plant ecosystems, such as nutrients, likely co-vary with water availability, further research is needed to elucidate ecosystem dynamics that may lead to self-organized behavior and determine thresholds for ecosystem stability.

Final ID: A51A-0010

Aerosol Optical Properties Over the High Altitude Station Hanle in the Western Himalayas

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Body: As a part of an astronomical site characterization program, studies of atmospheric aerosols were carried-out at the Indian Astronomical Observatory (IAO) Hanle (32047' N and 78058' E, 4500 m amsl), Ladakh region in the Western Himalayas, using Skyradiometer (Prede, Japan) from direct solar and diffuse sky irradiance measurements at 400, 500, 675, 870, and 1020 nm. Aerosol optical properties are retrieved using Skyrad.pack to calculate the aerosol optical depth (AOD), single scattering albedo (SSA), volume size distribution, and phase function. The AOD at 500 nm was found to be between 0.02 and 0.10, which is consistent with reported values for high altitude stations across the globe. Value of the Angstrom exponent (α), which relates to size particles, fluctuates between 0.5 and 1.5. The SSA is close to 1.0 for each wavelength, indicating the dominance of scattered light in the observed spectral region. The estimated daily mean aerosol asymmetry parameter (g) from the retrieved phase function varies in between 0.68 and 0.72 for the different wavelengths, indicating predominantly forward scattering than the backward scattering. The value of g decreases at the visible region and slightly increases in the near-infrared region. The retrieved g parameter strongly depends on both the wavelength and the Angstrom parameter. We find that the AOD value peaks during the spring season, and this is likely to be due to aerosol transport from the deserts to the west. The HYSPLIT back Trajectory analysis indicates the passage of air mass transported predominantly from Sahara in the African region towards the observing station. There is a bimodal as well as tri-modal volume size distribution with particle population sizes in the range 0.15 to 10 microns. The bi-modal features are more common during winter and autumn seasons, while the tri-modal features are seen in all the seasons with a marginal predominance during spring and summer. The temporal response of the two populations of particles is clearly different and due to wind lifting of near surface aerosols. We compared our Skyradiometer data with satellite data, specifically CALIPSO and MODIS, for validation. The satellites have trouble retrieving AOD at pristine locations such as the Himalayas where the AOD is usually less than 0.1. However, we find that the satellite data, when present, is generally consistent with the radiometer results in both the AOD magnitude and the seasonal cycle.

Final ID: EP51A-0974

Topography along the Smith River, OR provides insight into the process of bedrock river meandering and it's influence on adjacent hillslope lowering rates.

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Body:

Although active meandering in bedrock channels is widely recognized, the process of meandering in bedrock is not well understood. Our observations of active bedrock meanders in the Coast Ranges of California suggest that clay-rich lithologies, which erode easily when wetted and dried and therefore also do not persist as bedload in channels, may provide conditions in which bedrock meandering can develop in an analogous way to meandering alluvial streams.

To test this idea further, here we construct a relationship between bedrock bend migration rate and curvature, for comparison with the curvature-migration rate relationship characteristic of meandering alluvial rivers. Although we acknowledge that curvature alone cannot fully describe the variation in observed bend migration rates, we nevertheless argue that, because of their apparent universality in alluvial rivers, empirical curvature-migration rate relationships are indicative of some of the driving physics behind alluvial and, we propose, bedrock meandering.

In order to measure migration rates in a meandering bedrock channel, we use unpaired strath terraces mapped from LiDAR elevation data along the Smith River (OR) to construct a record of past river location. Vertical incision rates in this region are well-constrained (Personius et al., 1993) allowing for calculation of lateral channel migration rates from the ratio of vertical to lateral change in river location. Preliminary data imply that meandering in bedrock rivers is not unlike alluvial meandering, although the optimal width-normalized radius of curvature for lateral erosion may be slightly larger in bedrock rivers (~4-7 channel widths as compared to ~ 2.5 channel widths in alluvial channels). This work enables exploration of meandering in systems that are otherwise too slow to study over the timescales of meander bend growth, and provides a means of comparing bedrock rivers to meandering alluvial rivers, about which more is known.

These data also highlight how active meandering affects hillslope lowering rates in bedrock systems. As meander bends grow, lateral channel migration erodes outside-bend hillslope toes and hence increases hillslope lowering there. This same lateral channel migration moves erosion away from inside-bend hillslopes slowing or stopping lowering there. This subwatershed-scale heterogeneity is also evident in debris flow channels on outside-bend hillslopes that apparently nucleate at the apex of actively growing bends, a stark contrast to undisected inside-bend hillslopes. These data and observations show meandering to be a source of large autogenic changes in subwatershed-scale hillslope lowering rates.

Final ID: EP51E-01

Ice Age Geomorphology of North America

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Body: The Last Glacial Cycle in North America dramatically modified drainage patterns and geomorphology on a continental scale. As a consequence, the evolution of river systems holds information on the patterns of glaciation and isostatic response. This information can, in principle, be used to reconstruct the volumes of ice sheet sectors and eroded material by connecting the upstream ice sheets with stable isotope and other sedimentary records in offshore basins. Here we integrate this coupled geomorphic–hydrologic–glacial–sedimentary–paleoceanographic system to solve both the forward problem, how rivers evolve in response to Ice Age forcing, as well as the inverse problem, how fluvial systems record Quaternary history. The connections that define this system provide a link between climate and geomorphology that extends beyond the traditionally considered watershed-to-landscape scale by incorporating solid Earth deformations, large-scale shoreline migration, and the high amplitude changes in climate that drive the growth and decay of major ice sheets and water delivery to the bounding river systems.

We address this continental scale problem using a valley-resolving drainage reconstruction that incorporates a realistic ice sheet history, a gravitationally self-consistent treatment of ice-age sea-level changes that includes shoreline migration, and precipitation and evapotranspiration retrodicted using general circulation model (GCM) runs. Drainage divides over the flat-lying North American interior migrate hundreds to thousands of kilometers in response to dynamic interactions between ice sheets and solid Earth response, and these changes coupled with post last glacial maximum (LGM) ice sheet melting drive high-amplitude variability in water and sediment discharge to the oceans. The Mackenzie River Delta records a sedimentary record produced by a highly non-eustatic sea level history and massive glacial sediment inputs routed along the axis that divided the Cordilleran and Laurentide Ice sheets. The upper Missouri River was re-routed northward during multiple deglacial periods due to isostatic depression of the Canadian interior; this re-routing is in addition to its known pre-Illinoian bedrock course to the Northeast. The Missouri River and many of its northerly tributaries hug the Laurentide ice margin, a sign that they were trapped between the ice sheet and its forebulge on the eastward-sloping High Plains. In contrast, the Upper Mississippi flows due south and contains a broad bedrock overdeepening along the Illinois border that records where this river must have sliced through one or more forebulges associated with Laurentide Ice Sheets. Offshore, sedimentary records coupled with these drainage reconstructions can be used as an independent geologic constraint on ice sheet volumes. Our drainage reconstructions provide a new paleogeographic backdrop to understand the North America's glacial past and a framework for tackling new problems at the interface of geomorphology, ice age geodynamics, and paleoclimate.

Final ID: H51E-1405

Comparing Hydrologic Response Times Between a Forested and Mountaintop Mined Catchment

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Body: Mountaintop removal mining (MTR) represents the largest land cover/landuse change in the Central Appalachian region. By 2012, the U.S. EPA estimates that MTR will have impacted approximately 6.8% of the predominately forested Appalachian Coalfield region of West Virginia, Kentucky, Tennessee, and Virginia with nearly 4,000 miles of headwater streams buried under valley fills. In spite of the scale and extent of MTR, its hydrologic impacts are poorly understood. While MTR has a well-established pattern of downstream water quality degradation, its effect on the quantity and timing of catchment runoff is less clear. Several devastating floods in the region have been attributed to MTR, but there is little evidence to either confirm or refute this belief. Existing research has focused on statistical analysis of catchment outlet responses, but results from these studies only offer evidence of differences in hydrologic behavior, not process understanding of how the system is changing. This study begins to address that research gap by exploring differences in hydrologic response times, a fundamental hydraulic parameter that controls the conversion of rainfall to runoff. A simple rainfall-runoff model was used to quantify differences in response times for storm events in a mined and predominantly forested catchment. Results showed that the mountaintop mined catchment responded more quickly to storm events than the forested catchment. The mined catchment also showed more variability in response time than the forested catchment. These patterns repeated using multiple model structures. The more rapid response of the mined catchment is likely attributed to increased impervious surface, preferential flow paths within valley fills that rapidly route water to the stream, or rapid displacement of water stored in valley fills upon the onset of rain. However, further research using tools such as isotope tracers is needed to offer insight about the processes responsible for streamflow generation. Future research on the hydrologic impacts of MTR should focus on the process level to elucidate changes within catchment hydrology that can be used to explain changes at larger scales.

Final ID: H51F-1418

Operational Displays for Short Term Reservoir Operations

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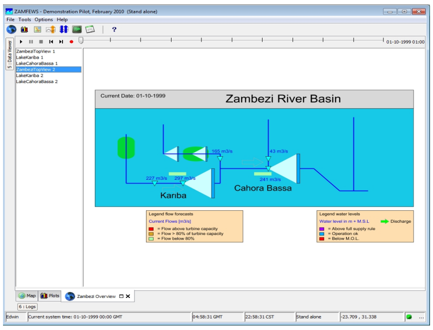
Body: In addition to computational techniques, it is important that data be displayed in an informative manner so that those using the resulting computations can make effective regulatory decisions. Displays of information must be embedded in a system that will allow the operators to execute models, conduct what-if scenarios, and drill down into more detailed information to help them understand the algorithmic results. We will present a software system used around the world for operational forecasting and regulations. The Delft Flood Early Warning System (Delft-FEWS) grew up as a platform to support flood forecasting. Since its inception, it has been implemented for purposes well beyond flood forecasting. The popularity of the Delft-FEWS platform is derived from the very simple and flexible architecture it implements. Models are linked synchronously through time series, where a time series can be a scalar or a grid. Parameter storage, model connectivity, basin descriptions, operational work flows and predefined display configurations are all stored by FEWS. Any model that runs off a combination of states, parameters and time series can be linked to FEWS thus permitting forecasters to integrate favorite legacy models and newer experimental models side by side. In addition, Delft-FEWS supports uncertainty estimates via ensemble model runs and then calculations of probabilities from those ensembles. Data can displayed in standard x-y plots, as profiles along a river, within a schematization of a system and in space as grids or basin averages with looping through time. Because there is a broad variety of users, the FEWS application supports a wide range of display functions.



A schematic display of the way reservoirs are linked.

Final ID: H51I-1464

Assessment of differences in physical watershed characteristics between gaged and ungaged portions of the Great Lakes basin

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Body: Prediction of hydrologic response in ungaged basins often relies on regression relationships between physical watershed characteristics in gaged basins and either calibrated rainfall-runoff model parameters or model-independent hydrologic response indices (e.g. runoff, runoff ratio, baseflow index, etc.). Predictive skill using these types of modeling approaches may be compromised when watershed characteristics in the ungaged areas are substantially different from those in the gaged areas used to establish the regression relationships. In the case of the Great Lakes basin, regionalization may be complicated by characteristics unique to coastal regions. For example, coastal regions of the Great Lakes contain eight large urbanized metro areas (Milwaukee, Chicago, Detroit, Toledo, Cleveland, Windsor, Toronto, and Buffalo), unique coastal wetland areas, and distinctive meteorological conditions (e.g. lake effect snow). This research investigates the extent to which a set of physical watershed characteristics may vary between gaged (inland) and ungaged (coastal) portions of the Great Lakes basin and therefore complicate regionalization schemes. The work is conducted alongside development of a new regionalization scheme for simulating discharge to the Great Lakes.

Final ID: H51J-1490

Watershed Hydrologic Response and Drainage Network Topology Across a Spectrum of Urban Development Patterns

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Body: The Gwynns Falls is the primary study watershed of the Baltimore Ecosystem Study LTER and is the site of a nested set of 15 current and formerly active stream gages at drainage areas ranging from <1 km2 to 171 km2. The gaged watersheds span a range of development patterns and ages: from 19th and early 20th century sewersheds and urban parks; to 1950’s-60’s inner-ring suburbs with >40% impervious area, buried headwater tributaries, channelized streams and no stormwater management; to 1990’s-2000’s suburban development with forested riparian zones, limited impervious area and extensive stormwater management. Spatial data sets used to characterize these watersheds include aerial photography and LiDAR topography at ~1 m horizontal resolution, as well as surface hydrography, land cover, buildings, roads, storm drains, stormwater management facilities, soil types, and bedrock geology. Hydrologic analysis, including storm-period mass balance, is supported by the availability of a HydroNEXRAD gridded precipitation data set with 1 km2 spatial and 15-minute temporal resolution covering the period from 2000-2011, as well as a set of 8 pairs of tipping-bucket rain gages.

The goal of this study is to compare watershed storm response across the spectrum of development ages and patterns. In order to assess characteristic response signatures we have developed a library of quickflow hydrographs, and we have extracted unit hydrographs for short-duration rainfall pulses and for simple storms of longer duration that activate a larger fraction of the available contributing area. We present analyses of hydrograph shape and precipitation-runoff mass balance. Potential controls include watershed size and shape, impervious cover, natural and artificial drainage density, dominant soil types, spatial distribution of saturated surfaces, and percent of drainage area controlled by stormwater management. We employ simplifying assumptions to investigate the extent to which comparative patterns of storm response can be explained by the topology of the augmented urban drainage network before invoking other controlling factors.

In order to assess the role of watershed size, shape and urban drainage network properties, we have developed binary hydrography layers that incorporate storm drains and paved surfaces as part of the channel network. We use the augmented drainage network in order to derive width functions, or probability density functions for flowpath distance upstream of the watershed outlet. The width functions provide idealized representations of hydrologic response for watersheds of similar size and different development pattern by using ratios of channel to hillslope velocity similar to those used by Rinaldo et al. (1995), D’Odorico and Rigon (2002) and Smith et al. (2005). These are compared with the empirically derived hydrologic response signatures. Initial results suggest that the width function is able to mimic differences in hydrograph shape across a set of watersheds with distinctive patterns of hydrologic response. Additional work will include simplified approaches to account for the effect of stormwater management.

Final ID: IN51D-1707

CSDMS2.0: Computational Infrastructure for Community Surface Dynamics Modeling

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Body: The Community Surface Dynamic Modeling System (CSDMS) is an NSF-supported, international and community-driven program that seeks to transform the science and practice of earth-surface dynamics modeling. CSDMS integrates a diverse community of more than 850 geoscientists representing 360 international institutions (academic, government, industry) from 60 countries and is supported by a CSDMS Interagency Committee (22 Federal agencies), and a CSDMS Industrial Consortia (18 companies). CSDMS presently distributes more 200 Open Source models and modeling tools, access to high performance computing clusters in support of developing and running models, and a suite of products for education and knowledge transfer. CSDMS software architecture employs frameworks and services that convert stand-alone models into flexible "plug-and-play" components to be assembled into larger applications. CSDMS2.0 will support model applications within a web browser, on a wider variety of computational platforms, and on other high performance computing clusters to ensure robustness and sustainability of the framework. Conversion of stand-alone models into “plug-and-play” components will employ automated wrapping tools. Methods for quantifying model uncertainty are being adapted as part of the modeling framework. Benchmarking data is being incorporated into the CSDMS modeling framework to support model inter-comparison. Finally, a robust mechanism for ingesting and utilizing semantic mediation databases is being developed within the Modeling Framework. Six new community initiatives are being pursued: 1) an earth - ecosystem modeling initiative to capture ecosystem dynamics and ensuing interactions with landscapes, 2) a geodynamics initiative to investigate the interplay among climate, geomorphology, and tectonic processes, 3) an Anthropocene modeling initiative, to incorporate mechanistic models of human influences, 4) a coastal vulnerability modeling initiative, with emphasis on deltas and their multiple threats and stressors, 5) a continental margin modeling initiative, to capture extreme oceanic and atmospheric events generating turbidity currents in the Gulf of Mexico, and 6) a CZO Focus Research Group, to develop compatibility between CSDMS architecture and protocols and Critical Zone Observatory-developed models and data.

URL: http://csdms.colorado.edu/wiki/Main_Page

Final ID: NS51A-1823

Developing Age Models to Utilize High Arctic Coastal Sediments for Paleoclimate Research: Results from the Colville Delta and Simpson Lagoon, Alaska

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Body: Sediment cores collected from Simpson Lagoon on the inner Beaufort Sea shelf adjacent to the Colville River delta, AK are being utilized to develop new, high-resolution (sub-decadal scale) archives of the 0-3,000 year Arctic paleoclimate record necessary to assess natural and anthropogenic climate variability. An imperative first step for developing a new paleoclimate archive is to establish methodologies for constraining the age-depth relationship. Naturally occurring and bomb-produced radioisotopes have been utilized in sediments to constrain downcore variability of accumulation rates on 10^0-10^3 y timescales, but this methodology is complicated by low activities of many of these tracers at high latitudes. The present study utilizes the combination of a (1) multi-tracer approach and a (2) tailored measurement strategy to overcome this limitation. ^{210}Pb and ^{137}Cs analyses were conducted on the fine (<32μm) sediment fraction to maximize measurable activity and to minimize radioisotope activity variability resulting from changes in grain size: ^{137}Cs geochronologies proved more reliable in this setting and revealed mm/y sediment accumulation in the lagoon. To corroborate the ^{137}Cs results, ^{239,240}Pu activities were analyzed for selected sites using ICP-MS which has ultra-low detection limits, and yielded accumulation rates that matched the Cs geochronology. Age model development for the remainder of the core lengths (>~100 y in age) were completed using radiocarbon dating of benthic foraminifera tests, which proved the only datable in situ carbon available in this sediment archive. These dates have been used to constrain the ages of acoustic reflectors in CHIRP subbottom seismic records collected from the lagoon. Using this age control, spatial patterns of lagoonal sediment accumulation over the last ~3 ky were derived from the CHIRP data. Two depocenters are identified and validate combining age-dated coring with high-resolution seismic profiling to identify areas of the highest temporal resolution for Arctic paleoclimate research in coastal sediments.

Final ID: OS51B-1870

Effect of topography on contour currents and contourite drifts off italian promontories (Mediterranean Sea)

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Body: The complex relationship between currents flowing around capes and related contourite deposits is an interesting topic to confront, both from a sedimentologic and oceanographic perspective. We analyze here the relationship between the spatial distribution of contourite drifts, observed at intermediate depths off promontories in the southern Tyrrhenian Sea and in the southern Adriatic Sea (Italy) and contour currents flowing around the offshore projection of the capes. These contourites are located slightly upstream from the tip of the cape (e.g. Cape Vaticano and Cilento Promontory) while they occur both upstream and downstream, in the lee wave region, of the Gargano Promontory and slightly downstream of Cape Suvero. We therefore analyze tank and numerical simulations of contour-following flows, with particular attention to turbulent phenomena that may occur in the lee region. Moreover, we provide physical justification for some aspects we recognized in the study experiments, discussing the stream-tube model (i.e., a thin vein of dense water flowing around a cape). The comparison between morphological characteristic of capes and numerical, tank and analytic results, provides new insights on the influence of cape morpho-structures on the position of contourite drifts. We found that the presence of turbulence, and thus of erosive condition in the lee of a cape, can be generally envisaged by using dimensionless numbers (Ref, Ek and Bu) related to large-scale morphology of the cape and ocean current features. For Cape Suvero the analyses is more complex since contourites are buried deposits, infilling a topographic depression (i.e. a slide scar). However it indicates that at the time of contourite formation a wider paleocape morpho-structure should have existed. Moreover, the classical hydrodynamic conservation of marine water potential vorticity suggests the occurrence of a anticlockwise eddy, trapped by the scar.

Final ID: T51F-2667

GPS Velocities and Structure Across the Burma Accretionary Prism and Shillong Anticline in Bangladesh

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Body: We installed a suite of 25 GPS receivers between 2003 and 2012 covering the deltaic country of Bangladesh, which lies near the junction of the Indian Shield, the Himayalan collision belt and the Indo-Burman Wedge. The crust of the Indian Shield thins southeastward in the Bengal Basin across the hinge zone of an Early Cretaceous continental margin. The thin continental and/or oceanic crust of the Bengal Basin beyond the hinge zone is overlain by the southward prograding Ganges-Brahmaputra Delta (GBD) creating a total sediment thickness of ≥16 km. This heavily-sedimented basin is being overthrust from the north by the Shillong Massif, a 2-km high basement-cored anticlinorium exposing Indian Shield, and from the east by the accretionary prism of the Indo-Burma Wedge. The soft, oblique collision of Burma with the Bengal Basin and Ganges-Brahmaputra Delta (GBD) has built a large accretionary prism that widens northwards to 250-300 km. The prism reaches as much as half way across the deep Bengal Basin. The outer folds and the thrust front are blind and buried by the rapid sedimentation of the GBD. The GPS data in Bangladesh cover the frontal region of this unusual subaerial accretionary prism, while observations from India and Myanmar provide velocities for more internal parts of the system. The convergence across this belt is oblique and partitioned. The velocity gradients across the accretionary prism indicate E-W shortening at ~13 mm/y and N-S dextral shear at ~25 mm/y. The shortening appears to be more concentrated farther west, towards the thrust front, while the shear is more distributed and does not extend to the frontal folds. How this motion is further partitioned into elastic earthquake-cycle loading and permanent inelastic deformation remains unclear. The north-dipping Dauki thrust fault raises the Shillong Massif lowers the rapidly subsiding Surma Basin foredeep. This crustal scale convergent boundary could represent the beginning of a forward jump of the Himalayan front. The surface expression of this boundary is the steep front limb of the south-verging Shillong anticline with secondary folding of the syn-tectonic Quaternary sediment of its foredeep. This suggests that the Dauki Fault is blind and extends well south of the topographic break. In support of this conclusion, receiver function analysis images a NNE-dipping velocity inversion corresponding to basement overthrusting sediment at ~6 km depth just south of the Plateau. Our GPS data, in combination with velocity data from northeast India suggests ~7 mm/y of shortening across the Dauki Fault, with the velocity gradient associated with the fault concentrated within Bangladesh, south of the Shillong anticline.

URL: http://www.BanglaPIRE.org

Final ID: T51F-2668

Weak middle crust beneath central Tibet: constraints from shoreline deformation around Siling Co

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Body: Whether the deep crust beneath the Tibetan Plateau is weak enough to flow on geologic timescales remains a central point of debate. Here we attempt to constrain the effective elastic thickness (Te) by exploiting the flexural deformation of highstand shorelines around the Siling Co, central Tibet, in response to climatically-induced lake recession. Extensive flights of well-preserved paleo-shorelines are distributed around the lake, and extend up to 60 m above present day lake level. In this study, we examined the highstand shoreline (~4594 m a.s.l.) in an effort to ascertain whether it is deflected. This highstand shoreline is characterized by obvious constructional features (beach ridges, benches, spits, bars and cuspates) that continuously connect to wave-cut scarps which define a clear geomorphic boundary between an older landscape characterized by dissected alluvial channels/gullies and a lower one characterized by younger, recessional shorelines. The age of relict shorelines was determined by OSL (optically stimulated luminescence) and of cosmogenic 36Cl depth profiles. The OSL ages for four samples from the highstand complex range from 9.3 ka to 4.3 ka, suggesting a relatively stable lake level during this time and the timescale of the lake unloading of the Siling Co, ~ 10 ka. Flights of shorelines below this highstand show ages younger than 3.3 ka, while degraded, relict shorelines highstand are significantly older; OSL ages range from ~ 18 – 43 ka and two 36Cl depth profile yield ages of 113 ka and 178 ka.

Comparing observed shoreline deflections with models of elastic deformation in response to removal of a 3D load, we find that the effective elastic thickness of central Tibetan crust is relatively thin (Te = 10 – 15 km), suggesting that most of the mechanical strength of the crust resides in the upper crust. The timescale of lake recession (~ 10 ka) implies strain rates on the order of ~ 1e-16 1/s, which, when combined with existing constraints on the thermal and seismic velocity structure of the crust in central Tibet, allow us to place bounds on the range of probable viscosity beneath central Tibet. Assuming a simple, two-layer model with a viscous layer beneath the elastic upper crust implies viscosity on the order of ~ 1e19 Pa s. A more comprehensive consideration of possible strength profiles consistent with available seismic and thermal data is consistent with a significant reduction in effective viscosity below depths of ~ 20 – 40 km. In this treatment, viscosities above this level range from 1e20 – 1e22 Pa s, while viscosities at depth range from 1e18 – 1e21 Pa s. Collectively, our findings of thin elastic upper crust and a reduction in viscosity at depth suggests that the middle and lower crust beneath central Tibet is likely relatively weak at timescales of 10 – 100 ka. However, a more definitive determination awaits a refined understanding of lake loading history.

Final ID: GC51F-02

The geography of forest drought vulnerability: Integrating modeling and measurements *(Invited)*

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Body: Forests are a key provider of ecosystems services throughout the globe. Understanding and ultimately predicting how forest are likely to respond to a changing climate is an active area of interest and research. While some model and empirical studies show increased in forest growth, particularly in temperature limited environments, there are also many studies that show declines in productivity and increased rates of forest mortality in response to greater or more frequent drought stress. Given the importance of water-limitation and drought stress as a control on how forests will respond to a changing climate, models that explicitly link forest productivity with hydrology are essential tools. I will provide an overview of RHESSys, a coupled model of ecosystem biogeochemical cycling and spatially distributed hydrology. RHESSys is an open-source tool that integrates state-of-the art science based understanding of forest structure and function with observational data from multiple sources, including point measures such as streamflow and carbon flux tower data and spatial data from remote sensing products. I will present a number of case studies that use this model to examine the geography of forest drought stress vulnerability. These case studies focus explicitly on eco-hydrologic interactions and demonstrate critical linkages among forest water use, carbon cycling, species-disturbance interactions, local micro-climate patterns and geomorphology. Use of the model provides an integrated systems-oriented perspective on forest drought stress and mortality and allows us to disentangle to relative importance of multiple controls on forest vulnerability. Our case studies also evaluate what management strategies may be most effective at mitigating forest drought stress at stand to watershed scales.

Final ID: EP51F-03

Glaciation in a tectonically active environment: Preliminary observations from the Inylchek and Sary-Dzaz Valleys, Kyrgyz Tian Shan

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Body: The Tian Shan comprises a series of generally east-northeast trending mountain ranges and intermontane basins in Central Asia, formed in response to northward propagation of stresses associated with the India-Asia collision and focused between the Tarim Basin and the Kazakh Shield. These ranges are typically bounded by seismically active reverse or oblique-slip faults occupying reactivated zones of crustal weakness formed during prior deformational episodes. Neogene deformation distributed across the Tian Shan has resulted in some of the world's highest peaks outside the Himalaya, particularly in eastern Kyrgyzstan along the border with China and Kazakhstan. Major glaciers drain these peaks – one of the largest is the glacier that occupies the Inylchek Valley. This glacier is currently the focus of an intensive monitoring effort by Kyrgyz, German and Austrian groups to understand its mass balance in response to climate change, yet not much is known about its response to previous glaciations.

Much of the Inylchek Valley lies along the Atbashi-Inylchek fault (also known as the South Tian Shan Suture), a major left-oblique slip fault that forms the southern boundary of the Sary-Dzaz range. Recent thermochronologic work has shown this range to be uplifting rapidly since ca. 2-3 Ma. This portion of the Inylchek Valley is linear but transitions to a southward-trending releasing bend at its western end, forming what has been mapped as a pull-apart basin. This end of the Inylchek Valley contains a moraine complex that we sampled for surface exposure dating by 10Be and 26Al in 2011. Results for both nuclides from two large boulders on this moraine indicate a preliminary age of approximately 20 ka (Lal/Stone scaling). The southern slope of the Sary-Dzaz range is characterized by a series of ridges and terraces spanning ca. 800 m in altitude from the present valley bottom, yet glaciers within the range and their associated deposits are restricted to the uppermost sections of the slope. In contrast, the northern slope of this range, draining to the Sary-Dzaz Valley, is characterized by less pronounced relief, yet it exhibits significantly more abundant and pronounced glacial features. Another major left-oblique-slip fault zone, the Nikolaev Line, is thought to intersect the Atbashi-Inylchek fault in the eastern sector of this valley. We are investigating the nature of the asymmetric glacial record on both the north and south faces of this range, with particular interest in the interactions of glaciation and tectonics in the area, and will present preliminary results of our 2012 field investigations.

Final ID: GC51F-03

Opportunities and challenges to conserve water on the landscape in snow-dominated forests: The quest for the radiative minima and more... *(Invited)*

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Body: In mountainous, forested environments, vegetation exerts a strong control on snowcover dynamics that affect ecohydrological processes, streamflow regimes, and riparian health. Snowcover deposition and ablation patterns in forests are controlled by a complex combination of canopy interception processes coupled with radiative and turbulent heat flux patterns related to topographic and canopy cover variations. In seasonal snow environments, snowcover ablation dynamics in forests are dominated by net radiation. Recent research indicates that in small canopy gaps a net radiation minima relative to both open and forested environments can occur, but depends strongly on solar angle, gap size, slope, canopy height and stem density. The optimal gap size to minimize radiation to snow was estimated to have a diameter between 1 and 2 times the surrounding vegetation height. Physically-based snowmelt simulations indicate that gaps may increase SWE and desynchronize snowmelt by approximately 3 weeks between north and south facing slopes, relative to undisturbed forests. On east and west facing slopes, small gaps cause melt to be slightly delayed relative to intact forests, and have a minimal effect on melt synchronicity between slopes. Recent research focused on canopy thinning also indicates that a net radiation minima occurs in canopies of intermediate densities. Physically-based radiative transfer simulations using a discrete tree-based model indicate that in mid-latitude level forests, the annually-integrated radiative minima occurs at a tree spacing of 2.65 relative to the canopy height. The radiative minima was found to occur in denser forests on south-facing slopes and sparser forests on north-facing slopes. The radiative minimums in thinned forests are controlled by solar angle, crown geometry and density, tree spacing, slope, and aspect. These results indicate that both gap and homogeneous forest thinning may be used to reduce snowmelt rates or alter melt synchronicity, but the exact configuration will be highly spatially variable. Development of management strategies to conserve water on the landscape to enhance forest and riparian health in a changing climate must also rigorously evaluate the effects of canopy thinning and specific hydrometeorological conditions on net radiation, turbulent fluxes, and snow interception processes.

Final ID: EP51F-04

Impacts of alpine glacial erosion on the shapes of glacial valleys, heights of mountains, and sediment delivery to the foreland *(Invited)*

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Body: Glacial erosion not only generates characteristic landforms at a variety of spatial scales, but also drastically influences the rate of sediment delivery to the foreland landscape. Prior glacial erosion models have explored the transition from V to U shaped valley cross sections, the flattening of along-valley profiles, and the steepening of headwalls. In tectonically inactive landscapes, repeated glacial erosion lowers the elevation of the valley, resulting in a long-term decline in glacier surface mass balance. As a consequence, earlier glacial periods often produce terminal moraines well beyond the moraines of more recent glaciations. In valleys with resistant rock, oversteepening of head and sidewalls leads to avalanching, which protects ridges from erosion. If rock uplift is significant, this feedback and the potential that higher elevations promote reduced erosion associated with cold basal glacial conditions, can promote the emergence of very tall mountains.

While many first order features of glacial erosional landscapes have been replicated by coarse-resolution glacial erosion models, few models explicitly assess the role of rock type and fracture density in modulating local subglacial erosion. We explore the potential influence of rock properties on landscape evolution using a new finer-resolution numerical model of glacial erosion in which quarrying and abrasion are explicitly treated over a bed that is discretized into fracture-bounded blocks. Time varying subglacial cavity geometry at the ice-bed interface results from a prescribed sliding history. The quarrying of blocks from upvalley edges of subglacial cavities allows sharp edges to migrate upvalley, while abrasion operates on all portions of the bed that are in intimate contact with glacier. The model suggests that roche moutonées emerge as the characteristic landform, and migrate upvalley. As the discretization interval of the model approximates the length scale of fracture-bounded blocks, we can assess how the roughness of a glacier bed evolves, and track the generation of both coarse (quarried) and fine (abraded) subglacial sediment. The coarse sediment eroded from cavity corners at the bed serves as tools for downstream abrasion, thereby linking the quarrying and abrasion processes. The evolving micro-topography influences both the basal drag experienced by overlying ice, and the generation of basal niches in which interglacial sediment can be stored. The basal micro-topography, combined with reduced stream power due to a flattened valley profile, leads to low interglacial sedimentation rates in the foreland. During glacials, however, the same valley becomes a strong source of sediment for the foreland. This results in a nearly binary response of the sediment system to glacial cycles, with the strongest sediment delivery occurring during the onset of a glaciation. This strong temporal pattern of sediment export from the glacial landscape is likely responsible for fluvial terrace sequences in the foreland.

Final ID: EP51D-05

Experiments Under Shallow-water Conditions in Meandering and Anabranching Channels ***(Invited)***

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Body: Meandering (e.g. Ucayali, Itaya, Nanay) and anabranching (e.g. Amazon, Maranon, Parana) rivers display complex planform configurations at different temporal and spatial scales. Experiments carried out for these planform configurations describe that laboratory flumes could be successfully used for describing basic physical processes. This study discusses comparison of hydrodynamic and bed morphodynamic laboratory measurements with field measurements carried out at the Ucayali and Amazon Rivers

URL : http://www.pitt.edu/~jabad

Final ID: B51H-06

Biological-Physical Feedbacks Determine Coastal Environmental Response to Climate Change *(Invited)*

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4. now at National Science Foundation, Arlington, VA, United States.

Body: As low-lying coastal landforms, transitional between marine and terrestrial realms, barrier islands are especially sensitive to changing environmental conditions. Interactions among biological and physical processes appear to play a critical role in determining how these landscapes will evolve in the future as sea level rises, storm intensity increases and plant species composition changes. Within a new conceptual framework, barrier islands tend to exist in one of two primary states. “Low” islands have little relief above sea level and are dominated by external processes, responding quickly on short time scales to changes in forcing (e.g., storms, sea level rise, etc.), migrating rapidly and generally being low in ecological diversity and productivity. In contrast, “high” islands are less vulnerable to storms, tend to be dominated by internal processes (e.g., sand trapping by vegetation), require long time periods to respond to changes in forcing, migrate slowly (if at all) and host a range of plant species and morphological environments including shrubs, small trees and vegetated secondary and tertiary dunes with intervening swales. The continued existence of barrier island landforms will depend on the degree to which islands can maintain elevation above sea level while also responding to changes in forcing by migrating landward.

A long-term morphological-behavior model exploring coupled barrier-marsh evolution and a new ecomorphodynamic model representing the formation/recovery of dunes as a function of storms, shed light on the role of interactions among biological and physical processes on barrier island response to climate change. Results suggest that connections between the marsh and barrier realms, which are mediated by biological processes in the marsh environment, are highly sensitive to factors such as sea level rise rate, antecedent morphology and marsh composition. Results also suggest that feedbacks between sediment transport and vegetation involved in dune building may allow small, gradual changes in storms to cause abrupt, nonlinear transitions from the high to low island state.

Final ID: EP51D-07

The hills are alive: Earth surface dynamics in the University of Arizona Landscape Evolution Observatory *(Invited)*

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Body: To meet the challenge of predicting landscape-scale changes in Earth system behavior, the University of Arizona has designed and constructed a new large-scale and community-oriented scientific facility – the Landscape Evolution Observatory (LEO). The primary scientific objectives are to quantify interactions among hydrologic partitioning, geochemical weathering, ecology, microbiology, atmospheric processes, and geomorphic change associated with incipient hillslope development. LEO consists of three identical, sloping, 333 m2 convergent landscapes inside a 5,000 m2 environmentally controlled facility. These engineered landscapes contain 1 meter of basaltic tephra ground to homogenous loamy sand and contains a spatially dense sensor and sampler network capable of resolving meter-scale lateral heterogeneity and sub-meter scale vertical heterogeneity in moisture, energy and carbon states and fluxes. Each ~1000 metric ton landscape has load cells embedded into the structure to measure changes in total system mass with 0.05% full-scale repeatability (equivalent to less than 1 cm of precipitation), to facilitate better quantification of evapotraspiration. Each landscape has an engineered rain system that allows application of precipitation at rates between3 and 45 mm/hr.

These landscapes are being studied in replicate as “bare soil” for an initial period of several years. After this initial phase, heat- and drought-tolerant vascular plant communities will be introduced. Introduction of vascular plants is expected to change how water, carbon, and energy cycle through the landscapes, with potentially dramatic effects on co-evolution of the physical and biological systems.

LEO also provides a physical comparison to computer models that are designed to predict interactions among hydrological, geochemical, atmospheric, ecological and geomorphic processes in changing climates. These computer models will be improved by comparing their predictions to physical measurements made in LEO. The main focus of our iterative modeling and measurement discovery cycle is to use rapid data assimilation to facilitate validation of newly coupled open-source Earth systems models.

LEO will be a community resource for Earth system science research, education, and outreach. The LEO project operational philosophy includes 1) open and real-time availability of sensor network data, 2) a framework for community collaboration and facility access that includes integration of new or comparative measurement capabilities into existing facility cyberinfrastructure, 3) community-guided science planning and 4) development of novel education and outreach programs.

URL : http://leo.b2science.org/

Artistic rendering of the University of Arizona Landscape Evolution Observatory

Final ID: EP51F-07

Examining the effects of glacial erosion on the extent of glaciation

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Body: Landscapes modified by warm-based glacial activity in alpine settings show a distinct distribution of surface area with elevation (hypsometry), with a maximum in surface area just below the local snowline altitude. The emergence of this distinct hypsometric signature seems to be a consequence of effective glacial and periglacial erosion above the local snowline.
Here we examine the response of mountain range glaciations to this distinct topographic distribution, and investigate how its formation influences patterns of glacial extent, and therefore also patterns of glacial erosion, over several glacial cycles.

We use numerical modeling experiments, and show first how the hypsometry of characteristic natural landscapes affects glaciations for a simple climate forcing. The results suggest that glacial extent is highly sensitive to the hypsometry of glacially modified landscapes in addition to the climate forcing.

Secondly, we show, using a synthetic landscape, how the gradual development of the distinct glacial hypsometric maximum influences the extent of glaciations on a timescale comparable to the Quaternary period. A Quaternary-like climate forcing results in two different phases of glacial erosion, suggesting a first phase of cirque formation followed by a phase of main valley deepening after the mid-Pleistocene transition. The numerical modeling experiments therefore suggest a significant increase in glacial extent and glacial erosion across the mid-Pleistocene transition.

The results are obtained using iSOSIA, a higher-order ice sheet model approach, for simulating the flow of ice. Glacial erosion, represented by abrasion and quarrying processes, is approximated as functions of both sliding velocity, the amount of entrained sediment in the ice, and the bed slope in the direction of sliding. Temperature is linked to elevation through a constant lapse rate, ablation is a linear function of positive temperatures, and accumulation is a linear function of negative temperatures up to a maximum value.

Final ID: EP52A-02

Coupling video and in situ observations in a field scale meandering channel *(Invited)*

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Body: Complex flow and bed stress patterns produce variability in sediment transport that results in the transformation of ripples as they migrate around meander bends. We examine the connection between the estimated surface currents, near bed circulation, and bedform morphodynamics around a meander bend by coupling a variety of techniques including remotely sensed video for estimating surface currents and bedform migration rates along with in situ measurements including high-resolution velocity profiles and high frequency sonars scans of bedform growth and migration. Data were collected 9-20 July 2012 at the Saint Anthony Falls Laboratory Outdoor StreamLab (OSL), University of Minnesota. The OSL is comprised of a sandy (D50 = 0.7 mm) meandering channel approximately 40 m in length, 2.7 m in width, and 0.3 m in depth with a 0.7 % grade. Sediment transport during the experiment was bedload dominated. Riffles were installed upstream and downstream of the meander bend. Discharge was fixed at 199 L/s throughout the experiment and the sediment feed rate was 4 kg/min. The bed was initially configured to be nominally planar before the flow discharge was fixed. After several hours, bedforms appeared to be in equilibrium around the entire meander bend. Surface currents were estimated from remotely sensed images using a time resolved particle image velocimetry (PIV) technique for select time periods when flow tracers were introduced near the end of the upstream riffle. Two-component surface velocities will be compared with in situ, subsurface measurements of velocity obtained with a profiling acoustic Doppler velocimeter (ADV) across two transects along the channel meander. Additional measurements were obtained with a pair of pencil beam sonars configured to perform line scans at two locations around the meander and provide local estimates of bedform wavelength, height, and migration rate. A companion submission will focus on a technique for using remotely sensed video images to estimate bedform wavelength, height, migration rate, and shape around the meander bend.

Final ID: EP52E-04

Tracking landslides and landscape evolution using airborne lidar, InSAR, historical air photos, cosmogenic radionuclides, and numerical models *(Invited)*

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2. Geological Sciences, University of Canterbury, Christchurch, New Zealand.

Body: In mountainous landscapes, landslides often dominate sediment budgets and impose a distinct morphologic signature. Although landsliding can be highly variable in space and time, the availability of remote sensing imagery, erosion rates via cosmogenic radionuclides, and airborne lidar has greatly improved our ability to decipher patterns of landslide activity related to tectonics, lithology, and climate. Here, we summarize a suite of studies for landslide-dominated catchments in Northern California that collectively reveal how landslides drive landscape evolution. Using historical air photos and airborne lidar, we mapped active, slow-moving landslides and their transport rates in the mélange- and mudstone-dominated Eel River by tracking the displacement of markers such as trees and shrubs. The landslides exhibit branching forms in upslope areas and tend to coalesce downslope, delivering sediment directly into channel networks. Although active landslides account for only 7% of the landscape surface, their sediment flux amounts to more than 50% of the suspended sediment recorded at downstream sediment gauging stations. These landslides also exhibit multi-year variations that appear to reflect climate trends, such as the Pacific Decadal Oscillation. Using satellite-based interferometry, we show that these landslides vary seasonally, accelerating approximately two months after the onset of rainfall events in the fall. Surprisingly, this seasonal response does not depend on landslide size, challenging existing hydrologic models for landslide triggering.
Catchment-averaged erosion rates derived from cosmogenic radionuclides reveal strong local variations in erosion that appear to correspond with stream channel knickpoints along tributaries to the Eel River. These knickpoints are frequently observed using airborne lidar data while field studies demonstrate that they are comprised of massive collections of interlocking resistant coarse boulders (>10m) that will likely persist in the landscape for long time periods. Active landslides are less frequent upstream of these knickpoints and average slope angles are lower than downstream areas. These observations are consistent with results from a numerical model that incorporates landslide flux driven by a nonlinear rheology. Taken together, our results demonstrate that landslides do not occur randomly, but instead exhibit spatial and temporal patterns related to baselevel lowering, climate patterns with diverse timescales, and lithology. Combined with modeling, these results begin to provide predictive capability for erosion in catchments driven by slow-moving landslides.

Final ID: EP52D-01

Gravity and Turbidity Currents Interacting with Submarine Topography *(Invited)*

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Body: We will present an overview of high-resolution, Navier-Stokes based simulations of gravity and turbidity currents. The turbidity currents are driven by particles that have negligible inertia and are much smaller than the smallest length scales of the buoyancy-induced fluid motion. For the mathematical description of the particulate phase an Eulerian approach is employed, with a transport equation for the particle-number density.

We will discuss differences between two- and three-dimensional turbidity current dynamics, and we will introduce some effects due to complex topography. Results will be shown regarding the unsteady interaction of a gravity current with a submarine structure, such as a pipeline. Furthermore, we will discuss the linear stability problem of channel and sediment wave formation by turbidity currents.

Final ID: EP52D-02

Eddy-resolving simulation of lofting turbidity currents

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Body: Turbidity currents originate due to horizontal pressure gradient created by differences in sediment concentration. Often turbidity currents propagate as a ground hugging underflow because its bulk density is higher than the density of the ambient fluid. If the density of the interstitial fluid in turbidity current is smaller than the density of the ambient fluid, then turbidity current can become positively buoyant after sufficient sand grains have settled. The current then lifts off from the bottom surface and travels as a surface gravity current over the heavier ambient fluid. These types of lofting currents, where the buoyancy reverses its direction, have been observed when sediment laden fresh water enters the sea or during volcanic eruption that creates a pyroclastic flow. We use a lock-exchange configuration with mono-disperse and bi-disperse grains to study the lofting characteristics of turbidity currents. Most of the Reynolds-stress carrying eddies are resolved in Large-eddy simulation (LES) and their predictions are more accurate than Reynolds-averaged models where none of the eddies are resolved. We use LES to study lofting turbidity currents at high Reynolds numbers that are comparable to laboratory and field scale flows. Dynamic Smagorinsky model is used to parameterize the sub-grid scale stresses that are not resolved by the grid. Results show that the deposit profiles has a sharp decay at the lift-off point unlike a ground hugging turbidity current whose deposit profile has a slow monotonic decay from the lock region.

Final ID: EP52D-03

THE ONSET OF CHANNELLING IN A FLUIDIZED MUD LAYER

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Body: Fluidization of a soil occurs when the drag force exerted on the soil grains by upwelling water equals the submerged weight of the soil grains, hence reducing the effective (or contact) stress between the soil grains to zero. In nature, fluidization is commonly encountered in localized portions of highly saturated mud layers found in tidal flats, estuaries and lakes, where upward flow is initiated by significant pore water pressure gradients triggered by wave or tidal action. The water propagates through the fluidized mud layer by forming channels (or vents), carrying the fluidized mud to the surface and forming mud volcano structures. The presence of these fluidization channels alters the mud layer structure with implications on its hydraulic and geotechnical properties, such as the hydraulic conductivity. Despite the importance of these channels, the conditions that lead to their formation and their effects on the mud layer structure still remain poorly documented. The present study couples experimental and theoretical methods aimed at quantifying the conditions, under which fluidization of a saturated mud layer is accompanied by the formation of channels, and assessing the effects of channeling on the mud layer structure. Fluidization and channel formation in a mud layer were reproduced in the laboratory using a carefully designed fluidization column attached to a pressurized vessel (plenum). To eliminate any effects of the material, the mud was produced from pure kaolin clay and deionized water. Local porosity measurements along the mud layer prior, during and after fluidization were conducted using an Americium-241 gamma source placed on a fully automated carriage. Different water inflow rates, q, were applied to the base of the mud layer and the plenum pressure was monitored throughout the experiment. These experiments revealed that for high q values, a single vertical channel formed and erupted at the center of the fluidization column. Instead for low q values, the experiments suggested that a channel network formed within the mud layer leading to the eruption of multiple channels on the mud layer surface. The gamma source measurements captured quantitatively the porosity increase as the channel formed. The experiments were complemented with a theoretical analysis using the two-phase, flow mass and momentum governing equations. This analysis aims to establish a relation between the applied pressure, the fluid velocity and the local porosity of mud during the formation of the channels.

Final ID: EP52D-04

Understanding the state of the muddy seabed - a numerical study utilizing multiphase flow approach *(Invited)*

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Body: Understanding various modes of sediment transport under combined wave-current flows is critical to better predictions of coastal morphodynamics and hydrodynamic dissipation. For sediment transport in water, intergranular interactions and particle-fluid interactions are highly complex and represent a classic particle-laden flow problem with relatively low Stokes number and Bagnold number as comparing its gas-particle flow counterpart. For sediment transport induced by surface waves, the highly unsteady nature of the oscillatory flow, which is not fully turbulent, warrants a turbulence-resolving approach. In this study, recent findings on a diverse range of muddy seabed states revealed by 3D, turbulence-resolving simulations are reported. Assuming a small Stokes number, the Equilibrium approximation to the Eulerian two-phase flow equations is adopted. The resulting simplified equations are solved with a high-accuracy pseudo-spectral scheme in an idealized oscillatory bottom boundary layer (OBBL). For a typical energetic muddy shelf, the Stokes Reynolds number is no more than 1000 and all of the scales of flow turbulence and their interaction with sediments are resolved. With increasing sediment availability or settling velocity, the seabed state evolves from well-mixed sediment distribution, to the formation of lutocline and a complete laminarization of the OBBL. These findings have critical implications to offshore delivery of fine sediment and wave dissipation. New findings regarding the effect of rheological stress on the seabed state and new extensions to the model to improve the efficiency and flexibility of the numerical scheme for a wider range of sediment transport processes will also be discussed.

Final ID:

International Earth Science Organizations and You

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Description: The U.S. National Committee (USNC) for the International Union for Geodesy and Geophysics (IUGG) invites you to learn about international activities by U.S. scientists and opportunities in international science organizations. The town hall will feature brief presentations from a range of AGU disciplines, with ample time for questions and discussion. Refreshments will be served. Come join us and start participating in international geoscience.

Final ID: A53K-0295

Using self-consistent Gibbs free energy surfaces to calculate size distributions of neutral and charged clusters for the sulfuric acid-water binary system

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Body: We construct tables of reaction enthalpies and entropies for the association reactions involving sulfuric acid vapor, water vapor, and the bisulfate ion. These tables are created from experimental measurements and quantum chemical calculations for molecular clusters and a classical thermodynamic model for larger clusters. These initial tables are not thermodynamically consistent. For example, the Gibbs free energy of associating a cluster consisting of one acid molecule and two water molecules depends on the order in which the cluster was assembled: add two waters and then the acid or add an acid and a water and then the second water. We adjust the values within the tables using the method of Lagrange multipliers to minimize the adjustments and produce self-consistent Gibbs free energy surfaces for the neutral clusters and the charged clusters. With the self-consistent Gibbs free energy surfaces, we calculate size distributions of neutral and charged clusters for a variety of atmospheric conditions. Depending on the conditions, nucleation can be dominated by growth along the neutral channel or growth along the ion channel followed by ion-ion recombination.

Final ID: B53A-0651

On the geomorphic feedbacks between vegetation and topography in tidal marshes

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Body: Here we present modelling and observational results on the spatial distribution of morphological and vegetational patterns in tidal marshes arising from feedbacks between biomass production, inorganic sediment deposition, and soil accretion. We show, in a one dimensional context, how different, species specific, adaptation to local edaphic conditions leads to a set of almost discrete equilibria determined by these biogeomorphic feedbacks. In particular, the marsh zone near the channel that feeds the marsh with inorganic sediment, is controlled by sediment settling and the local equilibrium is set by the sensitivity of the local settling rate with respect to changes in elevation. In the marsh interior the sensitivity of organic soil production to changes in elevation is the factor controlling the elevation of the equilibrium state. Finally, we explore the role and effects of inorganic sediment trapping on the equilibrium states in the different marsh zones. Overall marsh morphological-biological patterns are determined by discrete and competing stable equilibria dictated by vegetation fitness as a function of elevation, which we suggest to be the chief cause of the well-known and widely occurring phenomenon of vegetation zonation.

Final ID: B53E-0707

Parameterization of an Active Thermal Erosion Site, Caribou Creek, Alaska

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Body: Thermokarst features are thought to be an important mechanism for landscape change in permafrost-dominated cold regions, but few such features have been incorporated into full featured landscape models. The root of this shortcoming is that historic observations are not detailed enough to parameterize a model, and the models typically do not include the relevant processes for thermal erosion. A new, dynamic thermokarst feature has been identified at the Caribou-Poker Creek Research Watershed (CPCRW) in the boreal forest of Interior Alaska. Located adjacent to a traditional use trail, this feature terminates directly in Caribou Creek. Erosion within the feature is driven predominantly by fluvial interflow. CPCRW is a Long-Term Ecological Research site underlain by varying degrees of relatively warm, discontinuous permafrost. This poster will describe the suite of measurements that have been undertaken to parameterize the ERODE model for this site, including thorough surveys, time lapse- and aerial photography, and 3-D structure from motion algorithms.

Final ID: B53E-0710

Quantifying Interdependence among Processes and Characterizing Dynamic Controls across Spatial Scales by Linking Climate, Hydrology and Ecosystem Models

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Body: The sub-arctic environment can be characterized as being in the zone of discontinuous permafrost. As such, most of the current and expected changes in climate and the associated hydrologic response (increases in precipitation, temperature, and active layer depth; decreased permafrost extent; and tree-line expansion and vegetation composition) will be experienced first in this region. One of the major challenges posed to the research community is to establish the link between permafrost and changes of the boreal forest to a warming climate and a changing freshwater system. This is a major challenge due to the high degree of fine-scale spatial and temporal heterogeneity in boreal hydrologic, thermal and ecologic processes, which are currently inadequately represented in both fine- and meso-scale hydrologic models.

Using the Caribou-Poker Creeks Research Watershed (located near Fairbanks, Alaska) as a test study site, we present a framework to improve meso-scale hydrologic simulations in the Alaskan boreal forest through improved parameterization derived from fine-scale ecohydrologic simulations. The fine-scale, storage-based, ecohydrologic model will integrate vegetation water use with permafrost dynamics along with the other major hydrologic processes within a Bayesian framework. Baseline simulations from both the fine-scale ecohydrologic model and a meso-scale hydrologic model (Variable Infiltration Capacity, VIC) will be made and compared. Meso-scale parameterizations, derived from the fine-scale simulations, will be implemented into the VIC model. Results will be evaluated by comparing the newly parameterized simulations with the baseline simulations as well as observations.

URL: www.iarc.uaf.edu

Final ID: B53F-0751

Impacts of Global Change Scenarios on Ecosystem Services from the World’s Rivers

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Body: Water is an essential building block of the Earth system and is critical to human prosperity. At the same time, humans are rapidly embedding themselves into the basic character of the water cycle without full knowledge of the consequences. Major sources of water system change include mismanagement and overuse, river flow distortion, pollution, watershed disturbance, invasive species, and greenhouse warming. A pandemic syndrome of risk to rivers--the chief renewable water supply supporting humans and aquatic biodiversity—is evident at the fully global scale, with a costly price-tag ($0.5Tr/yr) required for engineering-based management solutions aimed at fixing rather than preventing problems before they arise. A new project funded under the NSF’s Coupled Natural-Human Systems program aims to improve our current understanding of the geography of water-related ecosystem services, accounting for both biophysical and economic controls on these services, and assessing how new management strategies could enhance the resiliency of the global water system over a 100-year time horizon. Within the context of the many sources of threat summarized above, we see the coupling of human-natural systems to be intrinsic to the science at hand, through which we have formulated our central hypothesis: Human-derived stresses imposed on the global water system will intensify over the 21st century, reducing water-related freshwater ecosystem provisioning and supporting services, increasing the costs of their remediation, limiting and shifting the geography of key economic sector outputs, and threatening biodiversity. Addressing this hypothesis has forced a substantial advancement in current capabilities, namely to (i) extend analysis into the 21st century through scenarios, (ii) develop explicit links to freshwater ecosystem services, (iii) assess how the condition of ecosystem services influences the world economy through individual sectors (food, energy, domestic water supply, fisheries), and global trade, and (iv) identify critical thresholds, constraints, and feedbacks, and consider tradeoffs that could reduce emerging water resource constraints, preserve ecosystem services, and yield economic benefits in the future economy. The talk summarizes a strategy for realizing these advancements and presents a series of early results.

Final ID: EP53A-1013

Sediment transport via needle ice: a new method for diffusive transport on laboratory-scale hillslopes

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Body: Convex hilltops formed by diffusive sediment transport are a fundamental feature of soil-mantled landscapes worldwide. Additionally, the competition and interaction between hillslopes and valleys control basic topographic metrics, such as relief, drainage density, and breaks in slope-area scaling. Despite recent progress in erosive landscape experiments, no published work has explored the competition of hillslope diffusion and channel advection experimentally. Here, we present preliminary findings on the plausibility of needle ice driven frost creep as a mechanism for laboratory hillslope transport of wet sediment. In nature, needle ice is a diurnal form of ice segregation, whereby liquid water held in sediment pore space is driven upward toward a near-surface freezing front by a temperature-controlled liquid pressure gradient. As needles grow perpendicular to the surface, sediment is incorporated in the growing needle ice by temperature perturbations and associated downward shifts in the freezing front. Sediment then moves downslope due to melting or sublimation of the ice needles. We constructed a slope of saturated sediment in a freezer to constrain the temperature, grain size, and soil moisture limits on laboratory needle ice growth and sediment transport. Surficial sediment transport is measured during experimentation by tracking the movement of colored grains. Additionally, at the end of each run we measure depth-dependent sediment transport by taking slices of the experimental slope and observing the displacement of buried columns of colored grains. In agreement with past work, we find that with temperatures just below freezing, soil moisture above 35%, and silt-sized sediment, the moisture migration induced by freezing releases enough latent heat to maintain the location of the freezing front and encourage needle ice growth. Our experiments demonstrate that the amount of sediment incorporated during needle growth, i.e., the transport efficiency, can be controlled by systematically varying the frequency and/or duration of temperature perturbations. The rate of sediment transport on soil mantled hillslopes depends on topographic slope and transport occurs in an “active layer”, i.e., the soil mantle. We show that needle ice transports sediment diffusively and has great potential as a method for laboratory simulation of a soil-mantled hillslope since transport is confined to a layer only a few millimeters from the surface. Furthermore, while past experiments are limited to modeling landscape response to precipitation or uplift, our method to systematically control the vigor of hillslope processes will enable us to model potential climate-driven changes in hillslope transport efficiency.

Final ID: EP53A-1014

Terrestrial Laser Scanning of a Stream Bank During Naturally and Experimentally Induced Erosion by Groundwater Seepage

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Body: Bank erosion was characterized and quantified with a terrestrial laser scanner (TLS) and an in situ experiment for a stream that is incising into historic millpond sediment in the piedmont region of the southeastern United States. The volume removed from pre-millpond, millpond, and post-millpond bank layers during a 22-month period were determined with a series of TLS surveys. A total of approximately 12 m^3 of bank material was eroded, stemming predominantly from groundwater seepage, from an 11.5 m length of surveyed bank. The mechanisms and rate of failure stemming from groundwater seepage was then examined with an in-situ experiment. The experiment involved wetting the ground above the bank with pressure-regulated water emitters installed along a hose parallel to the bank. The response of the bank face to wetting was assessed with periodic TLS surveys and subsurface pore pressure measurements obtained with tensiometers installed to multiple depths parallel to the bank face. Based on the TLS surveys and experiment results, we present a comparison of (1) the natural and experimentally induced bank erosion, and (2) erosion mechanism characteristics in the pre-millpond, millpond, and post-millpond bank layers.

Final ID: EP53C-1041

EROSION BY THE STORM HELENA ON BASSE TERRE ISLAND – GUADELOUPE: PAST CLIMATIC CONSEQUENCES

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Body: It is generally accepted that extreme meteorological events are the main morphogenic agents in the tropical belt. In the lesser Antilles arc, these events have an average return period of 4 to 5 years since they are registered. We measured the erosive effects of the tropical storm Helena that hit the volcanic Basse Terre Island (Guadeloupe – Lesser Antilles Arc) on October 24, 1963, on aerial images taken few weeks after the event by the French “Institut Géographique National”(IGN). On the images, 253 landslides, which occured during the storm, were identified and mapped. These landslides were located in the center of the island in the watershed with major relief. If the thickness of the landslide was 1m, i.e. less than the thickness of the weathered layer, the total volume of displaced sediments corresponded to denudation of 1.4mm on the watersheds concerned by landsliding. The total volume of eroded material since the emplacement of lavas has been estimated for each watershed by measuring the volume of valleys. The average velocity of denudation has been estimated to 0.5mm/y since the lava emplacement. If the storm Helena is characteristic of the storms that hit Basse Terre during the Quaternary, the period of return of such extreme meteorological event should be nearer 15 years rather than 4 to 5 years. This longer value of the period of return is coherent with the lower surface temperatures recorded before the Holocene in the Caribbean and Atlantic oceans, which produced less storms then present-day conditions.

Final ID: EP53C-1047

Long-term fluvial response to Hawaiian Island subsidence through the Pacific Trade-Wind Inversion

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Body: The interaction of the subsiding, subtropical limb of the Hadley circulation and the easterly North Pacific Trade Winds establishes a persistent thermal inversion at about 2000 m above sea level in the subtropical Pacific near the Hawaiian Islands. The inversion restricts convective rainfall to the lower elevations of the windward flank of the Big Island of Hawaii. This results in stream channels that cross a 2-order-of-magnitude rainfall gradient, active ephemerally above the inversion and perennially below it. Over the last ~475 ka, the Big Island of Hawaii has subsided at a nearly steady rate of 2.6 mm/yr. This has lowered fluvial networks through the Trade Wind Inversion while simultaneously raising base level by ~1200 m. Given these long-term transient conditions, we present analytical solutions for the evolution of mean annual discharge for streams draining the conical windward flank of Mauna Kea. We show that, in our study area, stream discharge at any point with a modern elevation below ~2800 m ASL must continue to increase through time until that point is near or at sea level, and therefore that none of the stream channels on the eastern flank of Mauna Kea can be in “steady state”. We incorporate our time-discharge equations into simple 1D numerical models of stream profile evolution and compare these against characteristics of Hawaiian streams. We also present results from a 2D landscape evolution model of a Hawaii-like landscape that acknowledges this unique space-time gradient of precipitation.

Final ID: EP53C-1056

Interpreting climate-driven aggradation and incision along the fringes of a decaying mountain range

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Body: Flights of terraces that flank range fronts throughout the Rocky Mountains record episodic stream incision over at least the past 1.5 Ma. Recent work using cosmogenic radionuclides to date the ages of terraces in the Denver Basin along the Colorado Front Range suggests that these high surfaces were formed during glacial intervals and rapidly incised during interglacials. Climate change related to glacial-interglacial cycles has been suggested as a possible driver for the repeated aggradation and incision of these high surfaces. Potential mechanisms for increasing sediment supply and transport in rivers include variations over time in (1) periglacial weathering and hillslope transport, (2) the magnitude and timing of runoff and stream flow, and (3) sediment flux from intermittently glaciated major valleys. Lower temperatures during glacial intervals may increase physical weathering and transport of regolith downslope through frost cracking and frost creep, respectively, thus supplying the upland rivers with sediment that can be delivered to the basins. Frozen ground could generate enhanced runoff, leading to increased peak stream discharge during glacial intervals, and allowing the rivers to flush sediment from the mountains to the plains more effectively. Cold-period aggradation of the high surfaces in the basins and in mountain channels could also be linked to enhanced sediment flux derived from glaciers in the headwaters of the catchment. These three possible mechanisms raise the question of which of them (if any) is primarily responsible for the cycles of aggradation and incision that appear to have created the staircase-like terrace surfaces along the range front.

In this study, we use a landscape evolution model to determine whether any of these processes, in isolation, is sufficient to explain the observed rates and patterns of terrace formation and abandonment along the Colorado piedmont. We also use the model to determine whether the presumed rapid incision rates of terraces during interglacials can be attributed to reduced sediment supply alone or whether changes in hydrology must be invoked. We study an idealized catchment in which the upper half lies on resistant rock (representing the crystalline mountain range) and the lower half lies on soft rock (representing the adjacent sedimentary basin). In the model calculations, the efficiency of soil creep on hillslopes was varied based on recent estimates of frost-creep efficiency as a function of mean annual temperature over glacial-interglacial timescales. Preliminary results show that increasing hillslope transport efficiency over the model domain causes deposition in river channels in the low-relief basin, especially along the range front. Deposition also occurs to a lesser degree in river channels in the mountains. The model calculations also predict migrating channel positions in the basin during periods of increased sediment supply, and channel stability and entrenchment during periods of low sediment supply. These results suggest that temporal changes in hillslope diffusivity alone play an important role in sedimentation and incision in mountain-bounded basins.

Final ID: EP53C-1057

Frequency-dependent Response of Landscapes to Climatic Forcings

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Body: Whereas the existence of very pronounced orbitally-controlled periodicities is a major feature of Earth climate, its impact on landscape dynamics remains poorly understood. We use Landscape Evolution Models to systematically investigate the response of landscapes to a range of periodic oscillations in precipitation. The resulting sediment-flux evolution displays a pronounced sensitivity to the period of the input precipitation signal, such that, for a given erodibility, a specific period maximizes the amplitude of the response. This period of "resonance" scales as the inverse of the erodibility, but is progressively filtered out of the response when the intensity of hillslope diffusion increases. This frequency-dependent landscape behaviour displayed by our model provides a mechanistic perspective on Molnar's [2004] proposition that ubiquitous changes in Late Cenozoic continental denudation could result directly from modifications in the spectral content of the climatic signal.

Final ID: EP53D-1070

Quantification of Glacial Erosion with Shallow Ice Approximation and Thermally-Coupled, Stokes Flow Landscape Evolution Models.

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Body: Glacial erosion is instrumental in the evolution of mountain topography. Glacial landscape evolution models reproduce many large-scale topographic features at the orogen scale. However, detailed comparisons at the scale of individual glaciers are in general lacking but hold potential for quantifying the mechanisms of glacial erosion. Over long timescales (>10,000 yr), glacial erosion is typically simulated using a modified shallow ice approximation (SIA) approach. This approach has reproduced a variety of known geomorphologic features. In this study, we evaluate the strengths and weaknesses of shallow ice and Stokes flow glacial landscape evolution models. Our emphasis is placed on the patterns and rates of glacial erosion over multiple glacial-interglacial cycles and for valley glaciers of varying size and thickness.

We present a comparison of two different numerical models for glacial erosion. A modified version of the ICE Cascade model is used in both approaches for calculation of the partial-degree day glacial mass balance, temporally variable orographic precipitation, snow avalanching, basal ice superfreezing, and basal water buoyancy feedback in large overdeepenings. We then compare the predicted ice flow field and erosion patterns using a modified SIA (within ICE Cascade) as well as predictions for thermally-coupled, Stokes flow calculated using COMSOL Multiphysics. Simulations are conducted for a range of amplitudes and periodicity in surface temperature change between glacial and interglacial cycles.

If the erosion rate scales with the sliding velocity, then any percent differences between the velocities in the models translate into equivalent differences in erosion rates. Both models predict similar patterns in sliding velocity, and resulting erosion rates, however the magnitude is variable. In a comparison of the two models during a time of glacier recession, the modified-SIA model predicts sliding velocities around 3.5 m/yr whereas the Stokes flow approach predicts around 3.0 m/yr (14% different). However, these results are sensitive to the assumed bed topography. The modified-SIA requires a smooth topography to avoid numerical stabilities and does not allow for glacier flow simulation on the rougher topography present within the landscape evolution model (or in a real digital elevation model). Calculation of the flow velocity on the rougher topography with the Stokes flow model yields sliding velocities around 5.0 m/yr (70% different). From other example runs during different climatic conditions, the Stokes flow approach can predict sliding velocities ranging from 10-15% variation from the modified-SIA, whereas with the rougher topography the variation can range from 20-70%. These results highlight the sensitivity of the glacial erosion pattern to the assumed mechanical model for ice flow. The sensitivity of these results to different glacial histories and topographic geometries is also discussed. Extrapolated over geologic time scales and multiple glacial-interglacial cycles these results suggest that consideration of the full-stress field with a Stokes flow model may be necessary when comparing model predictions to observed chronologies of glacial erosion.

Final ID: EP53E-1080

Decadal to Millennial scale erosion rates in the Nepal Himalayas

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Body:

On a sub-millennial time scale the spatial distribution of erosion is controlled to first order by tectonics, relief, and possibly precipitation, and secondly by vegetation, lithology, temperature and human activity. The Himalayas form a very distinct orographic barrier with a pronounced rainfall gradient from the South to the North and have a very rugged terrain, causing highly dynamic surface processes and fast erosion rates. Thus, the Himalayas provide an ideal site of investigation to study erosion and constrain its controlling factors.

In this contribution we present an integrated comparison of mean catchment erosion rates, calculated from in-situ produced ^{10}Be cosmogenic isotope concentration in river sands (representative for millennial time scales) and suspended sediment measurements (integrating the annual to decadal time spans). We discuss erosion rates and patterns in the context of precipitation-landscape features of the studied catchments. The samples cover all major rivers, and several minor tributaries of the Narayani watershed ($30,000 \ km^{2}$) in central Nepal. They represent all lithologies, topographic units and climate regimes across the Himalayan range.

The erosion rates, both from cosmogenic nuclide analysis and suspended sediment measurements, range from 0.1 to 4 mm/yr. These agree well between the two methods and also with already published data for the major outlet stations at the Himalayan front. However, in the Middle and High Himalayas the cosmogenic erosion rates are significantly higher than those from suspended sediment measurements. While on the short term (intra-annual) a clear relation between precipitation and erosion can be observed, the cosmogenic erosion rates show no clear dependency with the basin wide precipitation pattern. Furthermore, no relation could be observed with the dominant lithological units and the degree of glaciation. Our observations confirm the overall established relationship between erosion rates, relief and slope, showing clearly that topography exerts a predominant control on spatial erosion rates on the millennial timescale. However, we observe a different relationship between main stream basins ($> 250 \ km^{2}$) and small tributary basins ($< 250 \ km^{2}$). Small basins show in general lower erosion rates than larger basins for respectively the same topographic characteristics.

Final ID: EP53H-01

Vegetal Encroachment on Point Bar Deposits as a Control on Width Variation in Meandering Rivers ***(Invited)***

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Body: Most meandering rivers have vegetated floodplains. As this vegetation encroaches on point bars, it helps stabilize the sediment there. The river can then undergo slow migration and channel deformation, all the while maintaining channel coherence. Yet streams that appear to have the same degree of meandering can nevertheless show marked variation in channel width, as measured from vegetation line to vegetation line. The top image shows a reach of a tributatary of the Ob River, Russia, and the bottom image shows a reach of the Trinity River, Texas. In both cases, the flow is from right to left. In the case of the Ob tributary, the point bars are completely vegetated, and streamwise variation in width is rather muted. In the case of the Trinity River, the point bars are not completely vegetated, and streamwise variation in width is rather strong. Here we present two numerical models of migrating, meandering rivers in which channel width is self-specified in terms of the dynamics of bank erosion and deposition. In one of these models, bank vegetation is assumed to immediately encroach on newly-created point bar deposits. This mode of encroachment is shown to strongly contain the channel, so muting width variation. In the other model, newly-created point bar deposits remain bare for a period of time before vegetation is allowed to stabilize them. This results in less effective containment of the channel and stronger streamwise width variation.

Final ID: GC53C-1292

Possible dynamics of technological metals in the Anthropocene

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Body: An increase in human population and the concomitant increase in technology usage has resulted in significant metal extraction from the Earth's crust. Though a portion of used metal is recycled, a notable fraction of this technological material ultimately ends up as waste products necessitating the use of newly mined ore to sustain technological growth. With the globally decreasing grade of crustal ore, it may be increasingly compelling to use waste (in landfills and tailing piles) as ore, resulting in the emergence of a recycling loop. Mass recycling (e.g. water, nutrients, or elements) is a fundamental component in most sustained Earth systems (Lenton and Watson, 2011) and the dynamics associated with recycling of technological mass will likely play a key role in the Anthropocene if human technological growth is to be a sustained phenomenon.

To investigate the possible dynamics of recycling I use a compilation of the anthrobiogeochemical copper cycle (Rauch and Graedel, 2007; Rauch and Pacyna, 2009) as the framework for developing a 'box model' of copper flows in the Anthropocene. Copper fluxes between reservoirs (both human and non-human) are parameterized as proportional to the copper contained in the reservoir, with rate constants derived from published stock and flow data. The source of copper input to the human system is determined by concentration, therefore initial copper input is derived from in situ crustal ore. As high grade ore is depleted, reservoirs constructed from the anthropogenic waste stream (such as landfills and tailing piles) are 'mined' as they are enriched in copper relative to bulk soil and bulk crust. In this manner the onset of metal recycling is driven by large copper concentrations in 'waste' reservoirs relative to decreasing concentrations in unused crustal stock. Loss of copper as emissions or effluent from anthropogenic reservoirs still necessitates the extraction of newly mined copper from the Earth. I investigate the future makeup of copper flows (percentage of newly mined ore vs anthropogenic waste 'ore') into the anthropogenic system under different usage scenarios. The dynamics of other technological metals will also be explored.

Final ID: GC53C-1295

Human induced flooding of the Indus River in 2010: How it changed the landscape

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Body: Major rivers in densely populated areas are typically heavily engineered to fulfill. water needs and importantly to ensure protection for citizens and structures. The Indus River forms no exception to this. The river has been dammed and engineered for centuries, comprising one of the largest irrigation networks in the world. The engineered river system results in a reduction of its outflow to 10% of its historical value, with commonly no flow at the outlet for several months of the year. During July 2010, extensive flooding occurred causing ~2,000 fatalities and ~20 million people were displaced for weeks to months due to a peak discharge that was not exceptional in any sense (~10 year reoccurrence interval). The northern breach was located near the Sukkur Barrage and likely caused by undercapacity of the engineered channel.

We analyzed AMSR-E, ASTER-A1 and MODIS satellite data to map the propagation of the Indus flood wave in the main channel and through the major breaches. The flood wave traveled through the main channel in ~20 days and much slower through newly-formed avulsion pathway onwards from the breach at Sukkur Barrage (~42 days).Analysis of MODIS reflectance changes between pre- and post-flood imagery allowed analysis of the extent of sandy flood deposition as well as quantification of channel migration patterns.

The river channel migrates over 100’s of meters during the July 2010 flood event controlled by massive pointbar accretion and river cutbank erosion and slumping. Lateral migration averaged ~340m in just 52 days along a 1000km stretch of the Indus River. Crevasse splaying is widespread and appears to occur as a flow stripping process both upon the point bars as well as in river outer bends. Crevasse deposits extend generally less than 2 km from the main channel axis. The mapped flood deposits are analyzed for different river stretches and quantitatively related to river gradient and sinuosity.

The 2010 Indus flood shows an example of a heavily engineered system, it provides us with insights on flood water propagation and sedimentation and river migration in a river system with many dams and stopbanks.

Final ID: GC53C-1296

Early Anthropogenic Transformation of the Danube-Black Sea System

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Body: Over the last century humans have altered the export of fluvial materials leading to significant changes in morphology, chemistry, and biology of the coastal ocean. We present sedimentary, paleoenvironmental and paleogenetic evidence to show that the Black Sea, a nearly enclosed marine basin, was affected by land use long before the modifications of the Industrial Era. Sediment loads delivered by Danube River, the main tributary of the Black Sea, significantly increased as land use intensified in the late Holocene, which led to a rapid expansion of its delta. In the same time, although watershed hydroclimate was spatially and temporally variable over the last, surface salinity dropped systematically in the Black Sea. Lastly, proliferation of diatoms and dinoflagellates at the time of intensive deforestation in Eastern Europe points to an anthropogenic pulse of river-borne nutrients that radically transformed the food web structure in the Black Sea. We discuss the significance of our findings for the evolution of sedimentary landscapes, biogeochemistry, and ecosystems in regional seas and the global coastal ocean as well as for human societies from their watersheds.

Final ID: GC53C-1301

A distributed analysis of Human impact on global sediment dynamics

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Body: Understanding riverine sediment dynamics is an important undertaking for both socially-relevant issues such as agriculture, water security and infrastructure management and for scientific analysis of landscapes, river ecology, oceanography and other disciplines. Providing good quantitative and predictive tools in therefore timely particularly in light of predicted climate and landuse changes. Ever increasing human activity during the Anthropocene have affected sediment dynamics in two major ways: (1) an increase is hillslope erosion due to agriculture, deforestation and landscape engineering and (2) trapping of sediment in dams and other man-made reservoirs. The intensity and dynamics between these man-made factors vary widely across the globe and in time and are therefore hard to predict. Using sophisticated numerical models is therefore warranted. Here we use a distributed global riverine sediment flux and water discharge model (WBMsed) to compare a pristine (without human input) and disturbed (with human input) simulations. Using these 50 year simulations we will show and discuss the complex spatial and temporal patterns of human effect on riverine sediment flux and water discharge.

Final ID: H53E-1581

Effect of catchment spatial characteristics on groundwater inflows influencing the thermal regimes of a Danish lowland stream using high resolution temperature measurements

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Body: Temperature is a vital stream physical property recognized for its influence on other physical, chemical and biological processes of riverine ecosystems. Discrete groundwater discharge zones in a stream system are known to moderate or alter the thermal regimes particularly during the periods of large diurnal fluctuations. This study examines the effect of catchment spatial characteristics on groundwater discharge zones influencing the thermal regimes of a Danish lowland stream using high resolution temperature measurements and a stream temperature model.
An Agilent Distributed Temperature Sensing (DTS) unit (N4386A) with 1.8 km long fiber optic cable was used to collect temperature from Stream Elverdamsåen at 1 m spatial and 3 min temporal resolution. The DTS data collection period was intermittently spread over a year from August 2010 to August 2011 capturing both the spatial and seasonal dynamics of the groundwater discharge zones. In total, 16 discrete groundwater discharge zones were identified from the DTS datasets representing summer, 16 in winter and 19 in spring, albeit with only four interactions contributing in all three seasons. Local heterogeneity of the unconfined fractured clayey till and antecedent precipitation was found to influence the distribution of groundwater water discharge zones thereby directly influencing the stream thermal regimes. A physically based one dimensional stream temperature model was setup for the study reach to fit the observed high resolution DTS data by calibrating the groundwater inflow estimates. With 19 influx locations contributing a total of 13.5 l/s, each inflow source has to be calibrated for an accuracy of less than 1 l/s. To overcome the resultant uncertainty, the inflow locations were grouped into four stream sections exhibiting different thermal characteristics and the model was calibrated for sectional inflow estimates to mimic the respective thermal regimes. The resultant sectional groundwater inflow estimates were 4 l/s for 0-750 m, 3 l/s for 750-1200 m, 1 l/s for 1200-1350 m and 5l/s for 1350-1750 m. The sections are compared with catchment characteristics (geology, topography, land use) and used to set up a spatially distributed hydrological model. This study illustrates the combined use of DTS and stream temperature model to understand the effect of non- uniform groundwater inflows on stream thermal regimes.

Final ID: H53O-01

Spatial organization of bio-geomorphic features in tidal marshes *(Invited)*

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Body: Marshes display striking zonation patterns, i.e. vegetation patches of approximately uniform composition with sharp transitions among them. Such ubiquitous patterns are traditionally explained as the result, on one hand, of the spatial distribution of edaphic conditions (dominant in the lower areas of the marsh, where physical conditions are harshest) and, on the other hand, of interspecific competition (dominant in the higher zones, where stress is low). This contribution presents modelling and observational results showing how the coupled dynamics of inorganic sediment transport, local organic sediment production, and topographic evolution can generate bio-geomorphic zonation patterns. In particular, ecological and topographic structures emerge as a result of co-existing multiple equilibria associated with species-specific adaptations to local edaphic conditions largely determined by hydrological drivers.

Final ID: IN53D-01

Providing Data Access for Interdisciplinary Research ***(Invited)***

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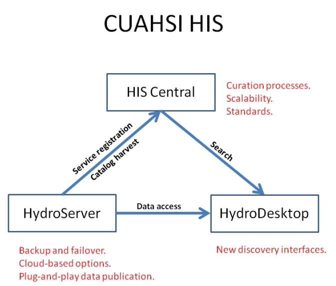
Body: Developing an interdisciplinary understanding of human and environmental interactions with water requires access to a variety of data kinds collected by various organizations. The CUAHSI Hydrologic Information System (HIS) is a standards-based, services-oriented architecture designed for time-series data. Such data represents an important type of data in water studies. Through the efforts of HIS, a standard transmission language, WaterML2, has been adopted by the Open Geospatial Consortium and is under consideration by the World Meteorologic Organization as an international standards. Web services have also been developed to retrieve data and metadata. HIS is completed with a metadata catalog, hosted by San Diego Supercomputing Center, which indexes more than 20 million time series provided from over 90 different services. This catalog is supported through a hierarchically organized controlled vocabulary that is open for community input and mediation. Data publishers include federal agencies, universities, state agencies, and non-profit organizations such as watershed associations. Accessing data from such a broad spectrum of sources through a uniform service standard promises to truly transform the way in which hydrologic research is done. CUAHSI HIS is a large-scale prototype at this time, but a proposal is under consideration by the National Science Foundation to operationalize HIS through a data facility, tentatively called the CUAHSI Water Data Center.

Establishing HIS is an important step to enable research into human-environment interactions with water, but it is only one step. Other data structures will need to be made accessible and interoperable to support this research. Some data—such as two-dimensional GIS coverages—already have widely used standards for transmission and sharing. The US Federal government has long operated a clearinghouse for federal geographic data that is now being augmented with other services such as ArcGIS OnLine. Other data, such as gridded data, have standard storage formats (e.g., netCDF) but its native format is not convenient for water research. Some progress has been made to “transpose” these data sets from gridded data to a grid of virtual gages with time series. Such a format is more convenient for research of a limited spatial extent through time. Advances in relational data base structure now make it possible to serve very large data sets, such as radar-based precipitation grids, through HIS. Expanding the use of a standards-based services-oriented architecture will enable interdisciplinary research to proceed far more rapidly by putting data onto scientists’ computers with a fraction of the effort previously required.

URL : http://his.cuahsi.org



Final ID: V53F-02

Using Neutron Scattering to Understand How Porosity opens in Weathering Rocks to Form Regolith *(Invited)*

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Body: At the Earth's surface, bedrock formed at high temperature and pressure re-equilibrates to surficial conditions. During this equilibration, a mantle of disaggregated rock known as regolith forms due to interactions between minerals, water, biota, organic matter, and gas. To understand the initial stages of regolith formation, we are making observations showing how pores open and become connected in low porosity rocks during weathering. Pores ranging in size from nanometers to microns are probed using neutron scattering to investigate the mineral - pore interface. For example, we have used neutron scattering to analyze the interface between unweathered and weathered shale, andesite, diabase, and granite. Scattering intensity increases with extent of weathering as the porosity and surface area increases. The interface inside rocks that scatters neutrons can sometimes be characterized as a mass fractal while in other cases the interface is a surface fractal. Furthermore, in basaltic and granitic material, scattering occurs from both, i.e., from pores (mass fractal) and bumps on pore surfaces (surface fractal). In contrast, in scattering from shale, only one fractal is observed. The fractal dimensions also vary with the extent of weathering. For example, in several cases we have observed that weathering causes the mass fractal to transform to a surface fractal as pores become interconnected. We also hypothesize that surface fractal dimensions may decrease when weathering reactions are transport-limited. As we use neutrons to explore the interface of pores inside rocks during weathering, we hope to develop models for predicting these processes quantitatively.

Final ID: EP53F-04

Variations of Morphologic Changes induced by Tropical Storm Debby along Three Barrier Island, West-Central Florida, USA

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Body: Tropical Storm Debby generated sustained high waves and elevated water levels for nearly three days from June 24th to 26th, 2012, inducing substantial changes in beach and nearshore morphology. In addition, the storm winds and high waves approached the coast from a highly oblique angle from the south, driving substantial northward longshore sand transport, opposite to the regional net annual southward transport. A total of 145 beach and nearshore profiles along 3 adjacent barrier islands were surveyed 2 weeks before and one week after the storm impact. Overall, dune, beach, intertidal, and immediate subtidal areas suffered erosion, while deposition was measured over the nearshore bar. Beach recovery in the form of ridge and runnel development occurred as the storm energy subsided. Substantial longshore variations of storm-induced beach changes were measured, including both severe dune/beach/berm erosion and storm berm accretion, and both onshore and offshore migration of nearshore bar. Factors controlling these longshore variations include: 1) the oblique approaching of the storm forcing, 2) pre-storm beach morphology and chronic erosional or accretional trends, 3) sediment supply, and 4) tidal inlet and beach interactions. Wide spreading dune scarping occurred along the 30-km studied coast. Based on the pre- and post-storm survey data, a balanced sediment budget is obtained accounting for sand volume loss from dune, beach, intertidal, and subtidal zones, and sand gains over the nearshore bar and along the northern sections of the beach.

Final ID: EP53H-04

River bifurcation: Learning from non-bifurcating experimental channels. ***(Invited)***

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Body: The generation and maintenance mechanisms for river bifurcation and distributary network in fluviodeltaic system remain in question. Here we present results from two sets of experiments that developed non-bifurcating channels, which suggest specific conditions for river bifurcation and provides insight inversely. The fluviodeltaic channels in these physical experiments were externally controlled to maintain either elongated channels or channels graded without avulsion and/or bifurcation. The first set of experiments used a downstream migrating feed point, which limited the ability of the delta to fill all the available space in the lateral direction thus leaving unfilled, open water on either side. The existence of well-defined and strongly-prograding levees prevents a lunate bar formation and limits river bifurcation. The second set of experiments used a shelf geometry over which the delta prograded beyond the distinct shelf edge into deep water. The feeder river was graded when the delta toe reached the shelf edge and therefore the foreset could not aggrade. This graded stage continued with no channel planform pattern until the delta toe could again prograde. Any processes that remove deposit from the frontal part of the delta (e.g., alongshore current, bypass of sediment to deep-water) could significantly hamper channel migration and bifurcation. Although fluviodeltaic channels show many similar processes to channels in river basins, downstream changes in channel length due to delta progradation result in differences in bifurcation behavior.

URL : http://www.ig.utexas.edu/people/staff/delta/research/

Final ID: EP53H-06

Records of transient avulsion-related river patterns in ancient deposits: evidence for different styles of channel-floodplain coupling *(Invited)*

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Body: River mobility and avulsion are important controls on how course and fine sediment are distributed across alluvial basins. In some systems, broad distributary channel networks that form during channel avulsions contribute significantly to overbank aggradation within the basin and help transport relatively coarse sediment from the channel out onto the floodplain. In contrast, avulsion-related deposits are virtually absent in other systems, which primarily avulse either through incision or with no significant aggradational phase preceding channel relocation; in these systems, overbank sedimentation primarily comprises relatively fine floodplain deposits.

In order to constrain the conditions under which distributary-channel networks develop during avulsions, we evaluate channel, avulsion, and floodplain deposits in several ancient units including the Ferris (Maastrichtian/Paleocene, Wyoming), Fort Union (Paleocene, Wyoming), Wasatch (Paleocene/Eocene, Colorado), and Willwood (Paleocene/Eocene, Wyoming) formations. Ancient deposits afford the opportunity to observe multiple (tens to hundreds) channel-avulsion realizations and evaluate characteristic spatial and temporal variability in channel, avulsion, and floodplain deposits within a basin. In each formation, spatial relationships and grain-size distributions of channel, proximal-overbank, distal-overbank, and, where present, avulsion deposits are compared. The thickness, width, and stratigraphic frequency of crevasse-splay and avulsion deposits are characterized in each formation, and paleosol development is documented in order to provide information about relative differences in floodplain conditions (particularly sedimentation rate and floodplain drainage) throughout each unit. We compare these results to modern systems and numerical models.

Several formations contain abundant and distinctive evidence of prograding sediment wedges preceding avulsed channels (Willwood Formation and some members of the Wasatch formation), while others contain virtually no avulsion-associated deposits (Ferris Formation). The Fort Union Formation and one member of the Wasatch Formation show a mix of both. These results largely reflect depositional processes and not preservation bias within ancient deposits.

Evidence from ancient deposits also suggests sediment partitioning between channels and floodplains was mediated by crevasse-splay production and avulsion, where some systems were “tuned” to produce large splay deposits and other systems produced only infrequent, small splays. Systems that readily produced splay deposits are associated with more prominent avulsion deposits, and splay production seems to be influenced by the particle-size distribution of sediment carried in the channel and floodplain drainage conditions (where abundant fine-sand and coarse-silt sediment and relatively well-drained floodplain conditions promote crevasse-splay production).

Avulsion deposits reflect a transient distributary phase associated with a marked increase in local overbank sedimentation rates, but this phase is not ubiquitous to all avulsive systems. The persistence of conditions that promote or inhibit crevasse-splay and avulsion-deposit production may strongly influence channel-floodplain coupling in aggrading fluvial systems.

Final ID: EP53F-07

Morphodynamics and Sedimentology of a Falling Stage Sandy Fjord Delta, Goose River, Labrador

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Body: Sediment size and degree of cohesion are thought to exert a strong control on the morphodynamic processes, planform shape and clinoform stratigraphy of deltas. To test model predictions concerning these two parameters, we present a morphometric and stratigraphic analysis of a sandy delta formed where the Goose River flows into Goose Bay at the western end of Lake Melville, Labrador. Goose River delta sediments consist of arkosic, heavy-mineral-rich sand (D50 = 225 to 600 microns) with very little silt and clay, placing this delta at the coarser-grained, non-cohesive end of the spectrum. The delta started to form approx. 7000 years ago as the Laurentide ice sheet retreated and post-glacial rebound created a relative base level fall of approximately 4 mm/yr. The current tidal range in Goose Bay averages 0.5 m, and the average wave height is negligible. Results from our 2012 field season show that the delta planform consists of two moribund lobes at elevations of ~ 5 m and ~ 2 m and a presently active delta at sea level. Aerial photography from 1951 to 2012 show there has been surprisingly little progradation despite active channel change at the six-month timescale and an assumed base level fall of 244 mm during that period. A topographic section along a dipline consists of three treads and two clinoform risers. The bottomset tread is a virtually featureless fjord bottom at ~35 m from which a first clinoform rises to a second tread at ~-15 m. The second tread is a sandy platform onto which an upper clinoform downlaps. This upper sandy clinoform ranges in dip from 9 to 17 dg. and passes into the topset at an elevation of ~ -1 m. The topset consists of braid-like trapezoidal unit bars that in GPR show little evidence of wave, alongshore current, or ice reworking, even though they are submerged at higher high tides. The planform, bar geometries and facies, and clinoform dips and dip-directions are remarkably consistent with model predictions from Delft3d.

Final ID: EP54A-01

Morphodynamics of tidal networks: advances and challenges *(Invited)*

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Body: Tidal embayments are complex environments at the boundary between land and sea. Their evolution, natural or human-induced, feeds back onto ecological, economic and societal functions. Overall, the ability to manage tidal embayments successfully and maintain their value hinges on our knowledge of the system. The morphological behaviour of tidal embayments, however, is very complex because of the variety of feedback mechanisms which lead to morphological change. In recent years, numerical studies have highlighted that the feedback between the hydrodynamics, sediment transport and morphological evolution can lead to the development of tidally-forced morphological networks characterized by slowly-evolving bifurcating channels. Both tidal range and the initial bathymetry appear to have a strong control on the morphological characteristics of the tidal network by affecting final basin hypsometry and channel patterns. Although promising, none of the numerical models presented in the literature and capable of simulating the growth of a tidal network have been scrutinized against field or laboratory data. Here, we show and discuss the performance of one of those numerical models against detailed laboratory data. Preliminary results indicate that numerical simulations can reproduce the general features of pattern development but that a better description of many fast- and small-scale processes is needed to achieve better model-data agreement.
Unsurprisingly, the model shows a strong sensitivity to frictional effects and resuspension parameterizations.
Numerical models of morphodynamics tend to neglect some physical or biological processes that affect the short- and long-term evolution of tidal networks. In terms of physical processes, wind waves, interacting with the ebb shoal and tidal currents at the mouth of the embayment can significantly affect hydro- and morphodynamics. Under high wave conditions waves can break in the inlet area producing wave induced circulation. Effects of waves can be also transferred to the inner basin, by increasing the mean water levels. These changes in the hydrodynamics result in different sediment transport patterns and morphological equilibrium conditions. Of equal importance is the role of vegetation whose presence can affect the evolution of channels and intertidal areas. For the case of mangroves, we show that vegetation can modify the branching and landward expansion of tidal channels and can induce changes in the channel cross-sectional area. In agreement with results from authors studying other types of vegetation, we show that mangroves play an even more important role under sea-level rise conditions by enhancing the ability of intertidal areas to keep up with changes in water levels.
This presentation will critically discuss these advances pointing out limitations and research areas that still remain a challenge and that hamper our understanding of the evolution and functioning of tidal embayments.

Final ID: H54F-03

Integration of Urban Features into a Coupled Groundwater-Surface Water Model

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Body: To better understand the feedbacks between urban development and water availability, we are coupling an integrated hydrologic model with an urban growth model, both of the Baltimore, Maryland, USA region. The urban growth model SLEUTH has been calibrated, validated and run by collaborators at Shippensburg University. We are using ParFlow.CLM as the integrated hydrologic model. This model is applied to the 13,000 sq. km. Baltimore metropolitan area, which spans the Gunpowder and Patapsco watersheds.

The model domain includes both Piedmont and Coastal Plain physiographic provinces. We have incorporated characteristics of both the natural hydrogeologic system and the superimposed urban environment. Standard hydrogeologic information such as hydraulic conductivity of fractured bedrock, Coastal Plain sediments, and surficial soils, as well as saprolite thickness, porosity, and specific storage properties have been included. We have also quantified a number of aspects representing urban development, such as residential and municipal well pumping, municipal reservoir use, lawn watering, and water supply pipe leakage estimates. We have represented impervious surface coverage using low surface hydraulic conductivity values. The land surface fluxes in CLM (Common Land Model) use surface land cover and therefore represent reduced evapotranspiration in urban areas. A study of urban and natural watershed inflows and inflows in this region indicated some urban features significantly modify catchment water balances. We are particularly interested in the effects of these urban hydrologic features on groundwater recharge in the Baltimore area.

Prior to inclusion of subsurface heterogeneity, we initialized the model by running it hourly from 2000 to 2007. The initialization was generated by a dynamic spin-up process, using the UMBC High Performance Computing Facility. Observed meteorological forcing, such as hourly precipitation and air temperature, are used by the land surface model, CLM. CLM is used to calculate spatially-variable evapotranspiration and land-energy fluxes. Through this spin-up process, we observed evidence of subsurface storage and surface runoff response to seasonal and interannual precipitation forcing.

Final ID: S54D-03

Understanding Earthquake Processes in the Central and Eastern US and Implications for Nuclear Reactor Safety

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Body: All of the early site permits and new reactor licensing applications, which have been submitted to the U.S. Nuclear Regulatory Commission (U.S. NRC), are located in the Central and Eastern United States (CEUS). Furthermore, among the 104 commercial nuclear power plants (NPPs) already licensed to operate in the US, 96 are located in the CEUS. While there are many considerations in siting commercial NPPs, the perceived lower seismic hazard in the CEUS compared to the Western United States is one of the reasons why the majority of operating and potential future nuclear reactors are located in the CEUS. However, one important criterion used in the licensing and safe operation of a nuclear power plant is its seismic design basis, which establishes the plant’s ability to withstand ground motions produced by moderate- to large-sized earthquakes without suffering any damage to its critical safety related structures, systems, and components. The seismic design basis for a NPP is site specific and determined using up-to-date knowledge and information about seismic sources surrounding the site and seismic wave propagation characteristics. Therefore, an in-depth understanding of the processes generating earthquakes (tectonic or man-made) and the seismic wave propagation characteristics in the CEUS is crucial.

The U.S. NRC’s seismic review process for evaluating new reactor siting applications heavily relies upon up-to-date scientific knowledge of seismic sources within at least 320 km of a proposed site. However, the availability of up-to-date knowledge and information about potential seismic sources in low-seismicity regions is limited and relevant data are sparse. Recently, the NRC participated in a joint effort to develop new seismic source models to be used in the CEUS seismic hazard studies for nuclear facilities. In addition, efforts are underway to better understand the seismic potential of the Eastern Tennessee Seismic Zone. While very large and successful scientific experiments such as EarthScope, provide great opportunities to gather new data to further enhance our current understanding of the seismicity and tectonics of the CEUS region, there is also a heightened need for continuation of small-scale scientific missions geared toward understanding of seismic sources in low-seismicity regions. Although such regions are not high-priority areas of research and they do not usually receive the needed attention of funding agencies and the larger scientific community, extensive studies in these areas are still needed. Creating awareness and interest of the needs for seismic studies in such regions is a critical issue from a regulatory perspective. The U.S. NRC’s open government philosophy based processes provide excellent opportunities for the involvement of research and educational communities in the regulatory processes related to seismic hazards in the US. This presentation will discuss the available processes for public participation in the US NRC new reactor licensing decisions and highlight some key research areas that will benefit seismic hazard estimations in the CEUS.

Final ID: IN54B-05

Modeling Frameworks, Workflows and Community Modeling: Where are we now and where do we go from here? *(Invited)*

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Body: A workflow is essentially a sequence or chain of operations where each operation produces an intermediate product that is passed along to the next operation. Workflow research has its roots in manufacturing and addresses issues such as (1) how workflows are represented and stored, (2) efficient or optimal methods for organizing the work required to complete a project and (3) how products are passed between operations. Workflows are a natural part of doing science, because the emphasis on reproducibility makes it important to record (in a standardized way) the exact sequence of steps used to obtain a result or produce a final product. On a computer, each operation in a workflow is typically performed by a separate computer program. In this context, the workflow itself may be saved as a computer program that encompasses those in the sequence. It can then be re-executed, perhaps with different initial data. As a computer program, there is the possibility of "swapping out" the program that performs a particular operation in the workflow and replacing it with an alternative.

Component-based modeling and integrated environmental modeling (IEM) are terms used to describe modeling frameworks that allow model components to be dynamically linked to create new composite models. The focus is on flexible reuse of well-tested code. Within academia, industry and federal agencies there is currently a great deal of interest in this approach to modeling. Examples include the Community Surface Dynamics Modeling System (CSDMS), the Earth System Modeling Framework (ESMF) and systems that use the Open Model Interface (OpenMI). In many respects, these modeling frameworks are examples of workflow systems, that is, they are container programs that encompass other programs and allow details of how the programs are configured and coupled to be saved and re-executed. However, the model components are often connected in a nonsequential, web-like and iterative manner. Their intermediate products are shared sets of state variables that are updated frequently in time. The coupling is often tight in the sense that components access the dynamic products of other components as references to locations in memory (and not as files). It is also possible for several components to be running in parallel (on separate processors) at the same time.

While current modeling frameworks make it relatively easy to couple model components together, they do not address the important issue of data acquisition and preparation. Model components often read input data from files and getting the required data for a region and time period of interest and then getting it into the format required by the model can be extremely time-consuming. Numerous data preparation steps such as finding, downloading, mosaicking, regridding and reprojection are often necessary. Opportunities for addressing this problem with workflow technology will be discussed along with some of the technical challenges that remain and some that have already been addressed.

URL : http://csdms.colorado.edu

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Overland flow in sand dunes: feedbacks between aeolian and hydrological processes

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Body: During the summer of 2005, Hurricane Dennis overwashed the eastern portion of St. George Island, part of the northwest barrier island chain located along the Florida Panhandle. In this paper, LiDAR-based morphological changes of the barrier island are analyzed, along with the short-term post-storm recovery of secondary dunes. Vegetation deterred dune migration, thus favoring dune growth and reducing erosion due to wind. In contrast, the absence of vegetation inhibited dune growth. Low-elevation areas within the dunes were subject to flooding via saturation overland flow following moderate storm surges and rainfall events. Using a high resolution topographic survey and simple hydrology models, we estimate the discharge and velocities from storm surge return flow and saturation overland flow. Results show that return flow velocities are of the same magnitude as the critical velocity necessary to mobilize sand when a hydraulic connection between the watershed and back-barrier bay is present. Storms of moderate strength and rainfall intensity may be sufficient to keep the return channels open within the back-barrier, thus providing natural conduits for water exchange from overwash events during extreme storm surges triggered by hurricanes. We conclude that hydrological and aeolian processes are strictly coupled in dune fields characteristic of many barrier islands along the US coast.

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River channel lateral migration and strath terrace evolution: Quantitative predictions using a new bank coupling approach

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Body: Terrace formation and abandonment is commonly interpreted to record a pulse of vertical river incision due to changes in climate, tectonic uplift, or base level. However, the ability of channel migration to alter the terrace record through eroding terraces or forming new terraces under steady vertical incision has not been explored quantitatively. Moreover, few tools currently exist to distinguish terraces that record such intrinsic stream dynamics from those that record events with significance for the geologic record. To address these knowledge gaps, we constructed a numerical model to simulate terrace formation by a meandering single-thread river under a variety vertical and lateral erosion rates. Sediment and bedrock surfaces are tracked during each simulation, allowing the lateral erosion rate to respond to heterogeneous bank composition. Traditional grid-based models for coupling channel migration and bank composition are highly resolution-dependent within computational limits. Consequently, we have developed a new numerical method, Lagrangian Boundary Tracking (LBT), which tracks the bank position as an advancing front rather than as a channel boundary mapped onto a grid. The LBT method improves upon grid-based approaches primarily by reducing memory requirements to tractable levels. We use this new modeling framework to explore terrace formation for a variety of channel dimensions and incision rates, and assess whether the presence of terraces or particular terrace attributes can be diagnostically linked to formation process.

Final ID: IN54A-06

The Community Surface Dynamics Modeling System: Experiences on Building a Collaborative Modeling Platform *(Invited)*

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Body: The Community Surface Dynamics Modeling System – CSDMS- develops a software platform with shared and coupled modules for modeling earth surface processes as a community resource. The framework allows prediction of water, sediment and nutrient transport through the landscape and seacape. The underlying paradigm is that the Earth surface we live on is a dynamic system; topography changes with seasons, with landslides and earthquakes, with erosion and deposition. The Earth Surface changes due to storms and floods, and important boundaries, like the coast, are ever-moving features. CSDMS sets out to make better predictions of these changes. Earth surface process modeling bridges the terrestrial, coastal and marine domains and requires understanding of the system over a range of time scales, which inherently needs interdisciplinarity. Members of CSDMS (~830 in July 2012) are largely from academic institutions (~75%), followed by federal agencies (~17%), and oil and gas companies (~5%). Members and governmental bodies meet once annually and rely additionally on web-based information for communication. As an organization that relies on volunteer participation, CSDMS faces challenges to scientific collaboration. Encouraging volunteerism among its members to provide and adapt metadata and model code to be sufficiently standardized for coupling is crucial to building an integrated community modeling system. We here present CSDMS strategies aimed at providing the appropriate technical tools and cyberinfrastructure to support a variety of user types, ranging from advanced to novice modelers. Application of these advances in science is key, both into the educational realm and for managers and decision-makers. We discuss some of the implemented ideas to further organizational transparency and user engagement in small-scale governance, such as advanced trackers and voting systems for model development prioritization through the CSDMS wiki.
We analyzed data on community contributions and novice user engagement and evaluate the effectiveness of CSDMS' strategies toward these two challenges over the first 5 years based on member and user data, surveys, computing logs and web log analysis. Analysis shows that sponsored member participation in annual meetings (~30%) is relatively high. Direct CSDMS governance relies on ~4% of members. About 15% of members contributed code and metadata, and 18% use the common supercomputing resources. Technological development and documentation lie predominantly in hands of funded members, and a small number of others (~3% together). Potential new users are trained in clinics and courses, and on a one-to-one basis with quantified positive effects on self-efficacy and recruitment of new advanced developers.

Final ID: EP54B-07

Effects of Imposed Variable Rates of Lateral Subsidence on a Deltaic System *(Invited)*

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Body: Fluviodeltaic systems exist on Earth often under complex tectonic conditions, thus creating a myriad of motivations to understand the deltaic landscape evolution associated with tectonic activity. We present results from a series of six experiments conducted in the Sediment Transport and Earth-surface Processes (STEP) basin facility at the University of Texas at Austin. The STEP basin has a dimension of 4-m long, 5-m wide, and 1.5-m deep, and contains a hinged table that acts as a subsiding basin basement, which can be raised or lowered to create many different subsidence patterns in combination with placement of the sediment source. We utilized the table to impose lateral basement tilting to examine the effects of spatially varying rates of subsidence on an evolving fluviodeltaic system. The hinge axis at the center of the basin maintained constant base level at the location and thus created a bisection of the evolving delta such that relative base level fall occurred on one side of the delta (uplift), while a relative base level rise occurred on the other side of the delta (subsidence). The differential relative base-level changes on both sides of the rotation axis were applied to each experiment with a different rate, and thus causing variations in the overall asymmetrical shoreline planform pattern. The slow-tilting runs resulted in stronger shoreline progradation in the relatively uplifted side of the basin due to the shallow water depth in front of the delta, and thus caused asymmetrical shoreline pattern. However during the fast-tilting runs, the dominant section of prograding shoreline shifted to the subsiding side of the basin because rapid tilting prevents progradation on the uplifted side and instead steer the channels in the direction of subsidence. The tectonically influenced fluvial processes organize into the unique deltaic coastal pattern, providing insight into the integration of small-scale processes and large-scale landform.

URL : http://www.ig.utexas.edu/people/staff/delta/research/

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Assessment of the Area Ratio Method and the value of gages for predicting runoff in intermittently gaged portions of the Great Lakes basin

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Body: The Area Ratio Method (ARM) has been used by the National Oceanic and Atmospheric Administration's Great Lakes Environmental Research Laboratory since the 1980s in order to provide a historical time series of runoff to the Great Lakes for calibration of the Large Basin Runoff Model, which is used in predictions of Great Lakes water levels. The ARM operates on 121 subbasins in the Great Lakes basin, extrapolating from gaged areas to subbasin totals by multiplying the ungaged portion of each subbasin by the ratio of the sum of discharge measured at the most downstream gages in the subbasin to the sum of the contributing area of those gages. The ARM model is, to our knowledge, the only model that incorporates daily observations of discharge into simulations of historical runoff over the entire Great Lakes Basin. This is a significant achievement of ARM, because complete spatial coverage of runoff estimates from land is critical for understanding and predicting changes in water level, and incorporation of gage data may offer an advantage in reduction of uncertainty. The simplicity of ARM data requirements in ungaged basins (stream discharge and contributing area of most-downstream gages) and the inclusion of daily observations at gages has remained an advantage in this unique international basin, where data coordination is an important concern for more complex models. However, the skill of the ARM model in simulating historical runoff has not previously been tested, and the model's uncertainty is unknown. The objectives of this research are to (1) establish a method for quantifying ARM uncertainty in intermittently gaged basins, (2) evaluate the skill of the ARM for simulating runoff, and (3) determine the value of individual gages for informing estimates of runoff to the lakes. The Clinton River watershed in Michigan provides the test bed for this research, although the methods developed can be applied to the remaining subbasins of the Great Lakes. We find that while the uncertainty is dependent on the proportion of the subbasin that is gaged, the specific set of gage(s) used in the ARM estimates also has a significant impact on model skill.

Final ID: EP54B-08

Unique and Generic Signatures of Transient Wave Ripple Evolution ***(Invited)***

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Body: As bedforms arise through the co-evolution of flows and bed topography, they record environmental conditions, control bed roughness, and create intricate patterns that are signatures of sediment transport mechanics. Defects in bedform patterns – irregularities that disrupt an otherwise uniform array of crests and troughs – are common in both modern sediments and the rock record. Some types of defects are thought to be manifestations of transient adjustment to changing flow conditions, but the exact significance of many defects is unknown. For example, defects in sand ripples generated by wave-driven oscillatory flows can range from occasional bifurcations or terminations of ripple crests to highly disordered beds, but there is no framework for quantifying or interpreting these patterns.

We investigated the role of defects in transient wave ripple evolution using laboratory wave tank experiments and bedform evolution modeling. In the experiments, we subjected a rippled bed to an instantaneous change in wave conditions and monitored the response with time-lapse photography and spectral analysis. We find that certain defects are characteristic of transient adjustment mechanisms. For example, secondary crests that arise in troughs accommodate shortening of the ripple wavelength, whereas sinuous, fragmented crests are characteristic of a lengthening wavelength. After a period of rapid initial adjustment, these characteristic defects are eliminated, leaving a bed with only a few sparse defects.

The small size of the laboratory tank makes it difficult to study the subsequent evolution of the sparse defects, and so we turn to a numerical model of bedform evolution. The model consists of two components: a linearization of the Navier-Stokes equations that allows us to approximate the shear stress on an arbitrary bed profile, and an evolution equation for the bed topography based on mass conservation and sediment flux. We performed numerical experiments similar to the laboratory experiments, but on a larger domain. The adjustment initially involves characteristic defects similar to those observed in the wave tank, which then transition to a sparser set of defects that persist long after the initial defects subside. The long-lived defects, which include bifurcating crests, terminating crests, and closed loops, are among the most common types observed in the geologic record, and are eliminated so slowly that natural systems may not have time to reach a defect-free state before the next episode of rapid adjustment occurs.

Unlike the defects that develop during initial adjustment, the long-lived defects do not appear to be unique to wave ripples, or even to bedforms. Rather, they are similar to defects that occur in various settings involving elongated, quasi-parallel features, including vegetation bands, animal stripes, and optical wave fronts. Our analysis indicates that some bedform defects are useful signatures of flow and sediment transport dynamics, whereas others may simply be topologically inevitable.