

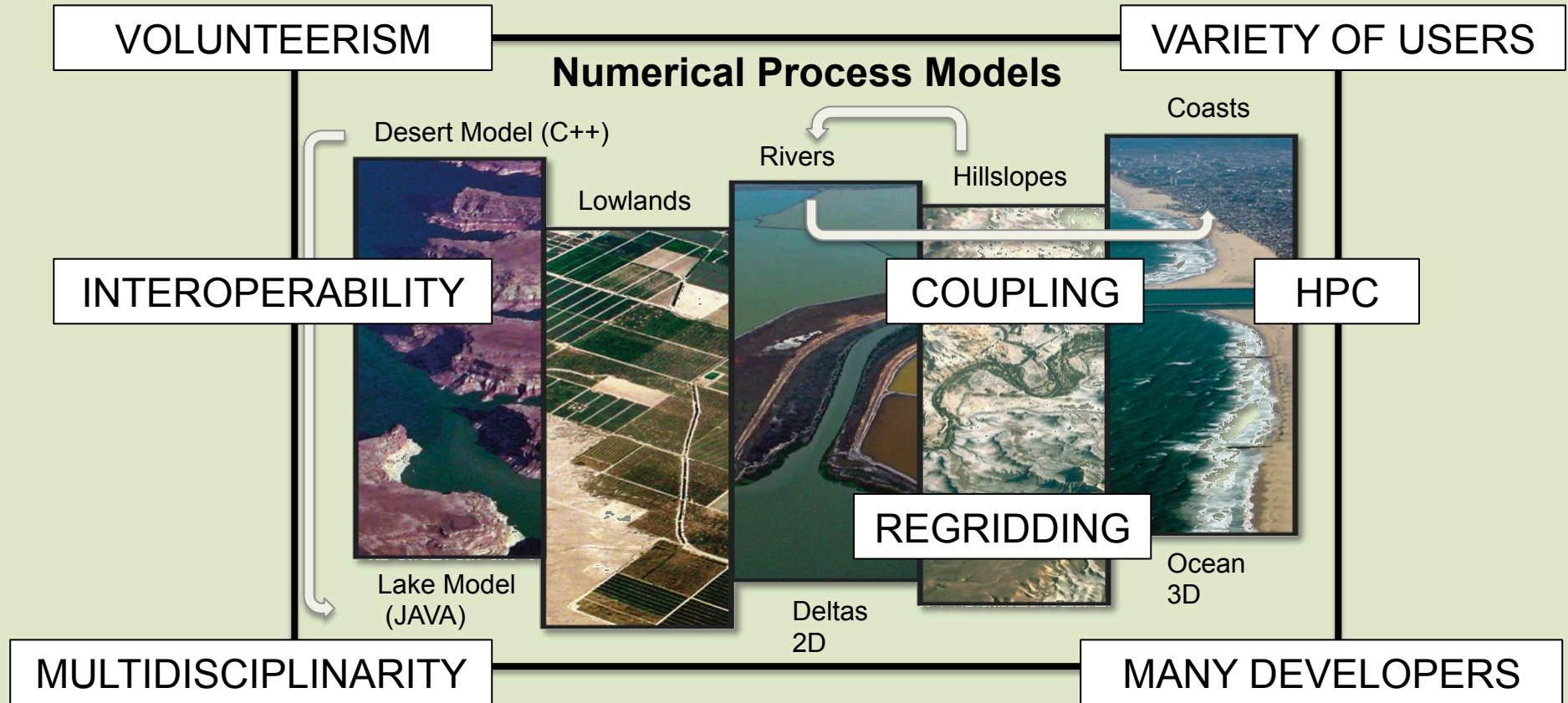
Welcome to CSDMS 2.0

where the **Community Surface Dynamics Modeling System** develops, integrates, disseminates & archives software to define the earth's surface dynamics

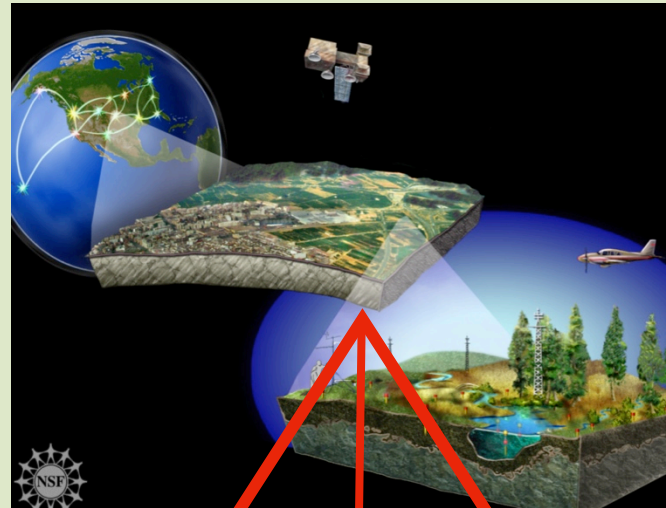
James Syvitski, CSDMS Executive Director



CSDMS Grand Challenge: Coordinate a large community to build a toolbox of surface dynamics component models

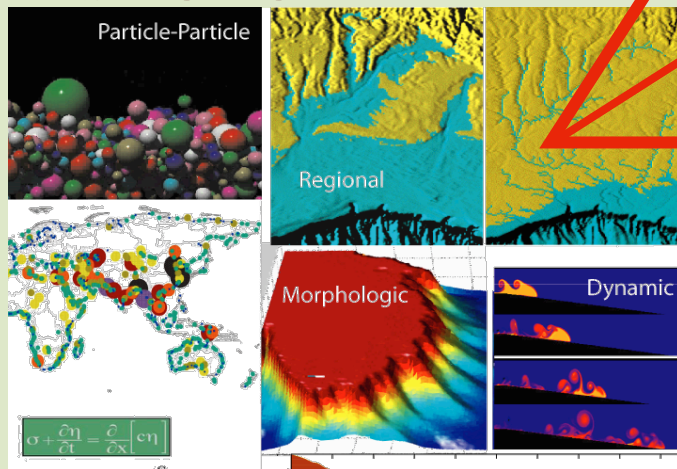


Addressing the 21st Century Environmental Infrastructure

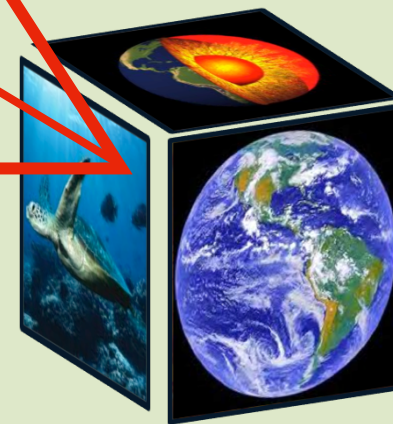


1) Sensing / Observing the Environment
E.g. NEON, CZO

3) Model Development & Coupling
E.g. CSDMS



Detection
Prediction
Services



2) Big Data
E.g.
EarthCube





Working Groups, Focus Research Groups, Initiatives

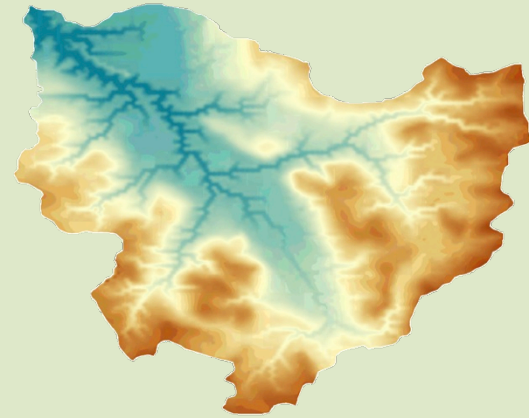
Terrestrial	460
Coastal	355
Hydrology (CUAHSI)	350
Marine	240
Cyber	150
EKT	155
Carbonate (NSF)	65
Chesapeake (CCMP)	50

- Critical Zone (CZO);
- Geodynamics (GeoPRISMS);
- Anthropocene (IGBP, CoMSES);
- Earth - Ecosystem Initiative
- Coastal Vulnerability Initiative
- Continental Margin Initiative

Open-source Model Repository

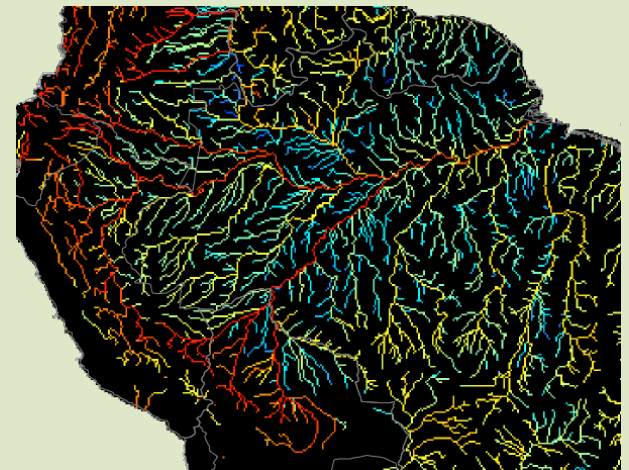
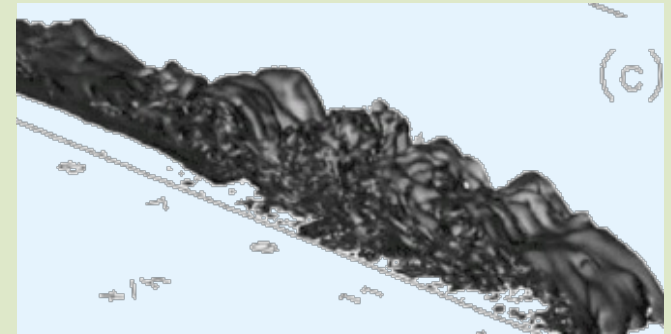
Model Domain:

- Terrestrial incl. the Cryosphere
- Geodynamics & Stratigraphy
- Hydrology from reach to global
- Coastal & Marine
- Climate & Weather



Model Types:

- ✓ Landscape / Seascape Evolution Models
- ✓ Morphodynamic Models
- ✓ Transport / Circulation Models
- ✓ Agent-based Models
- ✓ GIS Models
- ✓ ADM, SWEM, RANS, LES & DNS Models
- ✓ Abiotic & Biotic Models



CSDMS HPCC support

Use criteria for members run simulations on CU's HPCC *Beach & Janus*

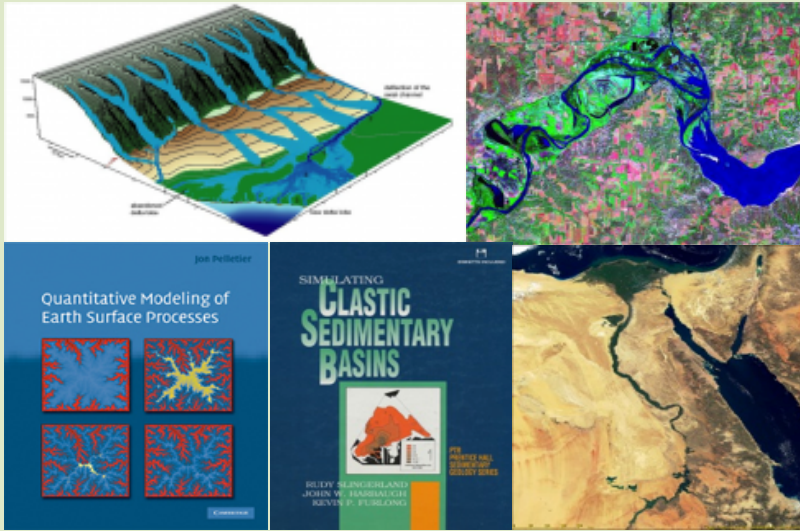
- Running CSDMS models to advance science
- Developing a model for the CSDMS model repository.
- Developing visualizations systems in support of CSDMS models.

Beach 8Tflop/s HPCC; 88 nodes; 704 x 3-GHz cores; 2 to 4 GB/core memory; non-blocking infiniband; ~100TB RAID storage.

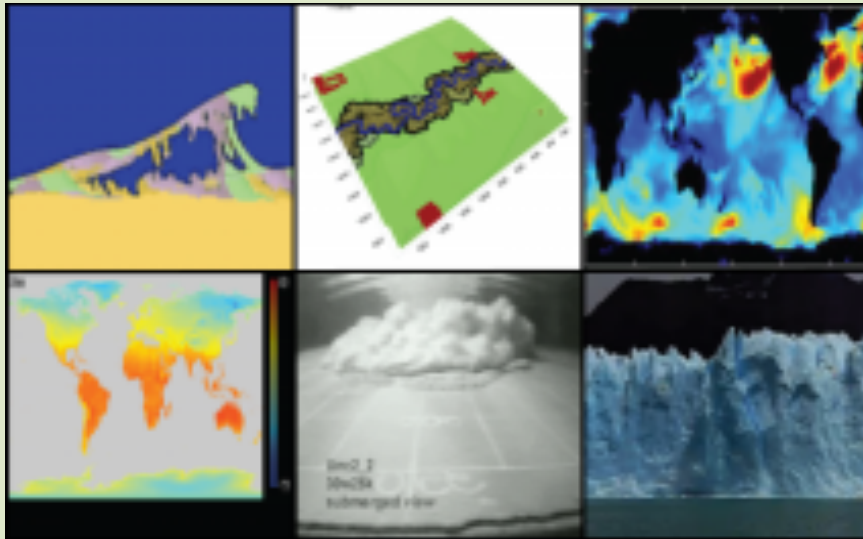


Janus 150 Tflop/s; 1368 nodes, 16,416 x 2.8-GHz cores, 2 GB/core memory; non-blocking Infiniband; 1PB of RAID storage; 3PB offsite storage

Please contribute to CSDMS Education Products



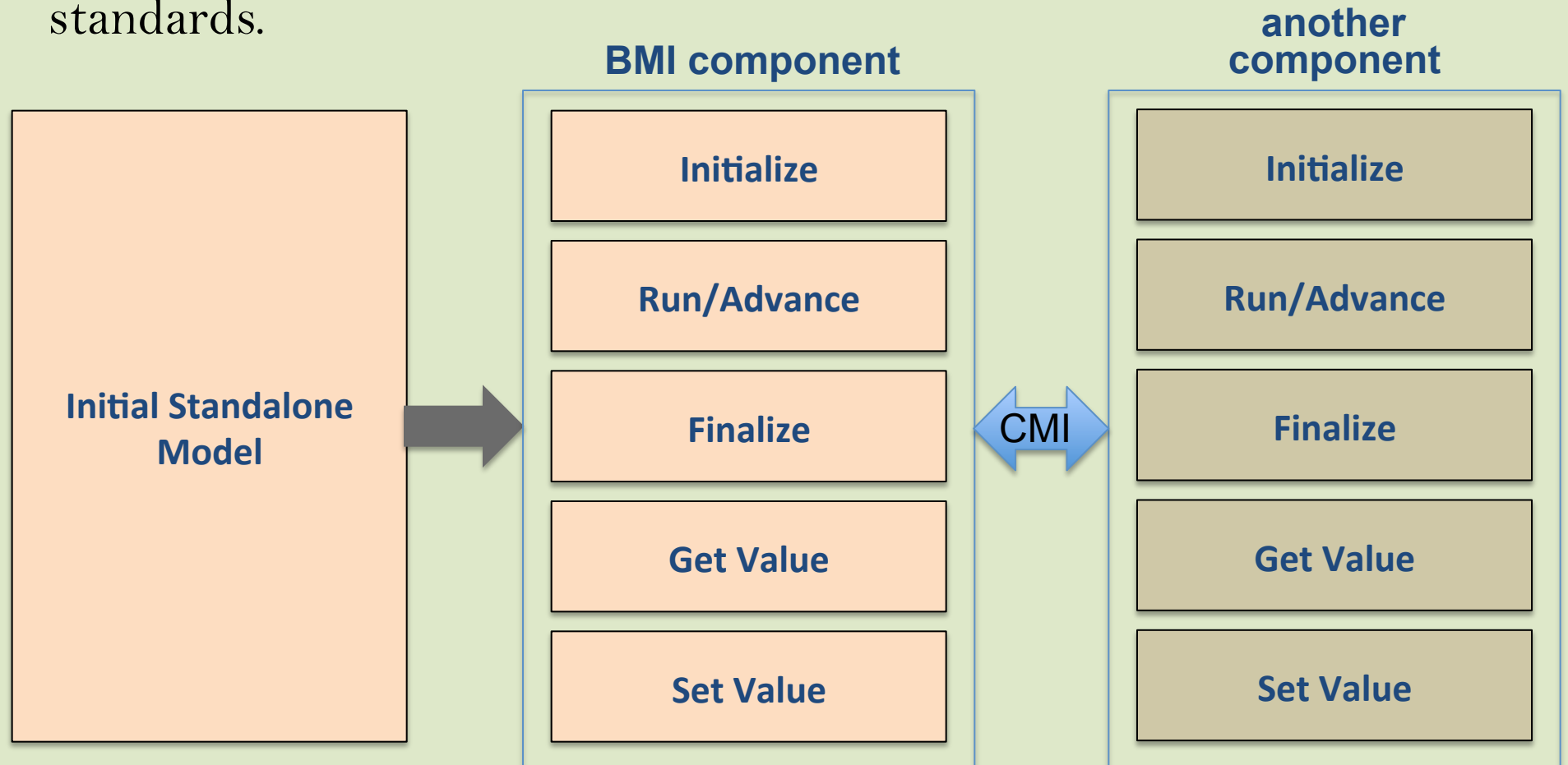
- ✧ Student labs
- ✧ Modeling short courses
- ✧ Lectures
- ✧ Textbooks
- ✧ Meeting presentations



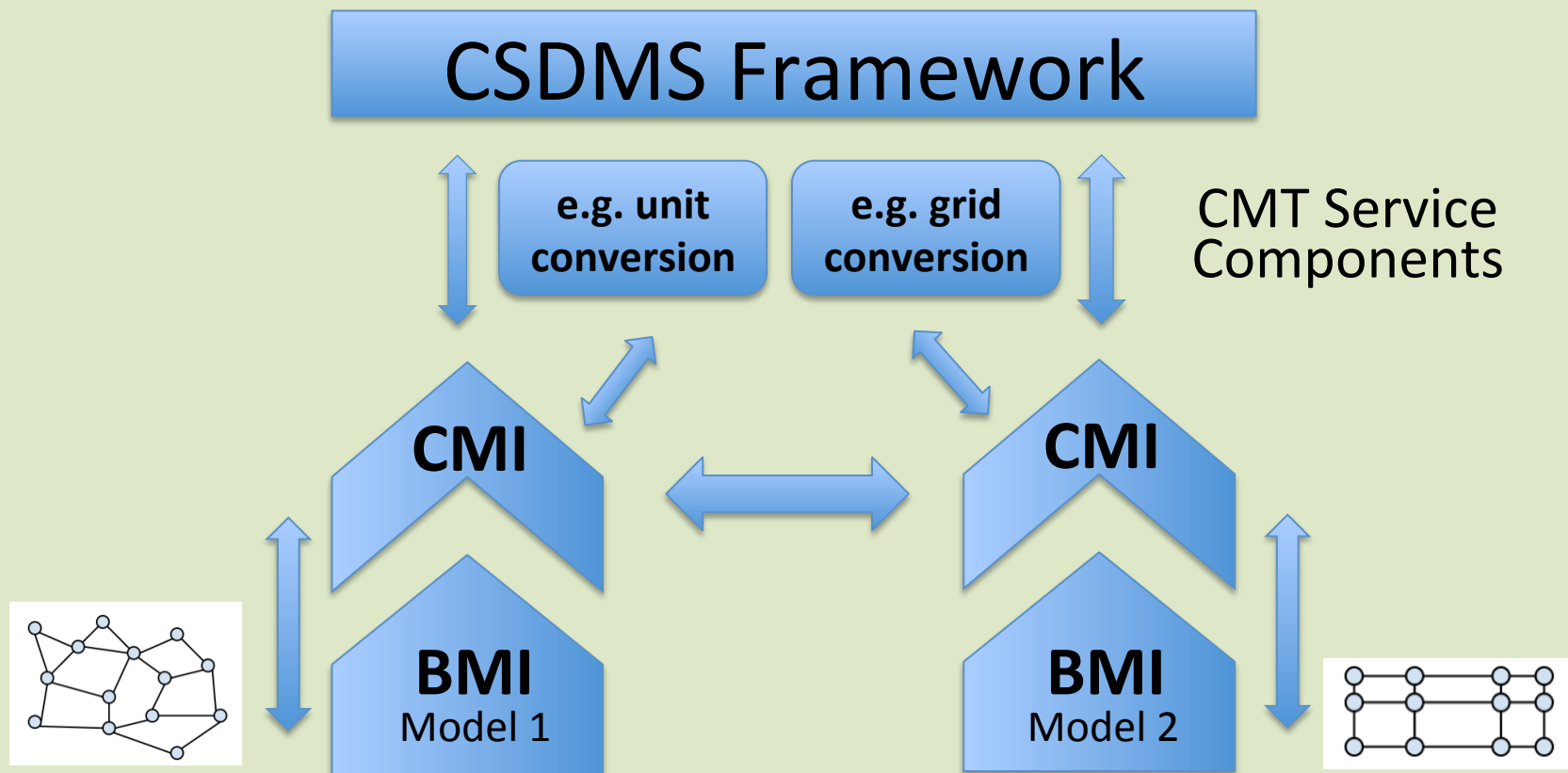
- ✧ Real event movies
- ✧ Laboratory movies
- ✧ Model animation
- ✧ Imagery



Working and Focus Groups are asked to converge on a high priority need/model for each year and, with advice from the IF staff, refactor the model to comply with **Basic Model Interface or BMI** standards.



This includes generating XML– GUI file & help pages; providing input/output test data. IF staff will wrap the **BMI** component with a **CSDMS Component Model Interface (CMI)** and test on a CSDMS HPCC using **CMT** to provide services for coupling different kinds of models. Coupled simulations could lead parties to publish a paper.



CSDMS Component Modeling Tool or CMT is a “plug and play” programming environment to handle these model differences:

- Programming language (C, C++, Fortran, Java, Python, etc.)

Solution: Babel and Bocca (CCA toolchain)

- Computational grid (triangles, rectangles, Voronoi, etc.)

Solution: CSDMS-ESMF regridder (parallel, spatial interpolator)

- Time-stepping scheme (fixed, adaptive, local)

Solution: CSDMS Temporal interpolation tool

- Variable names “semantic mediation”

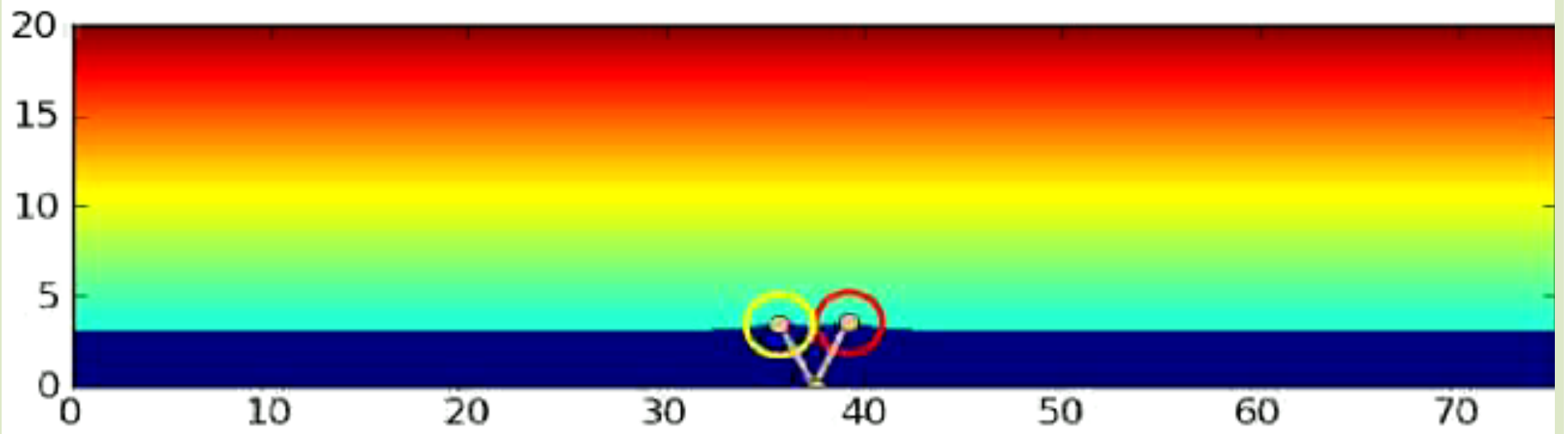
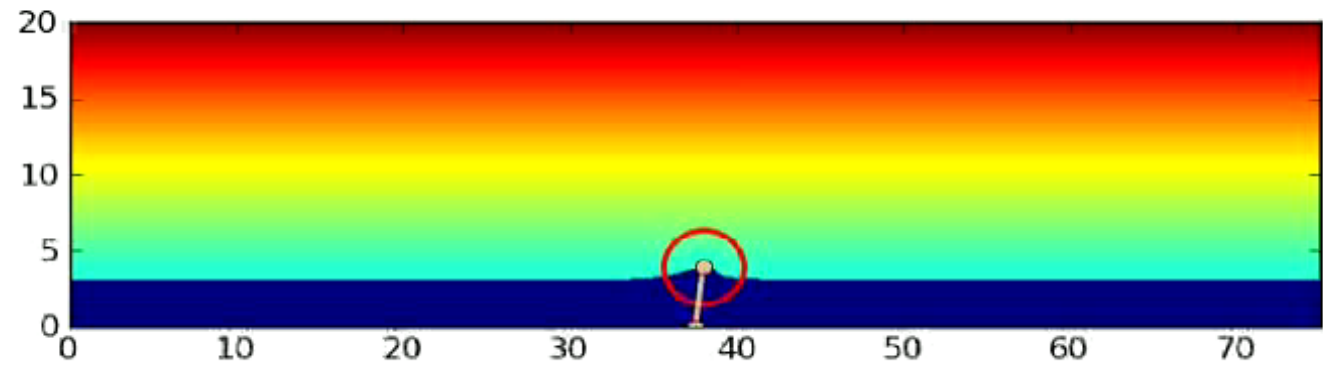
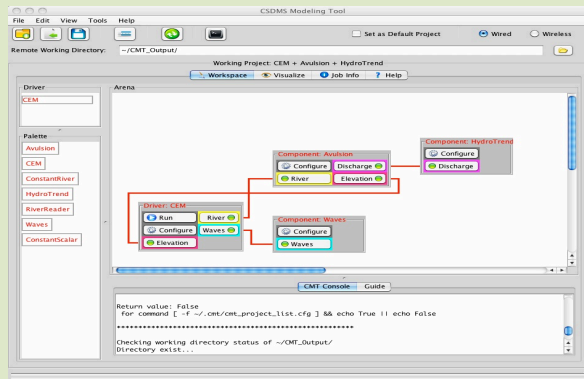
Solution: CSDMS Standard Names

- Variable units

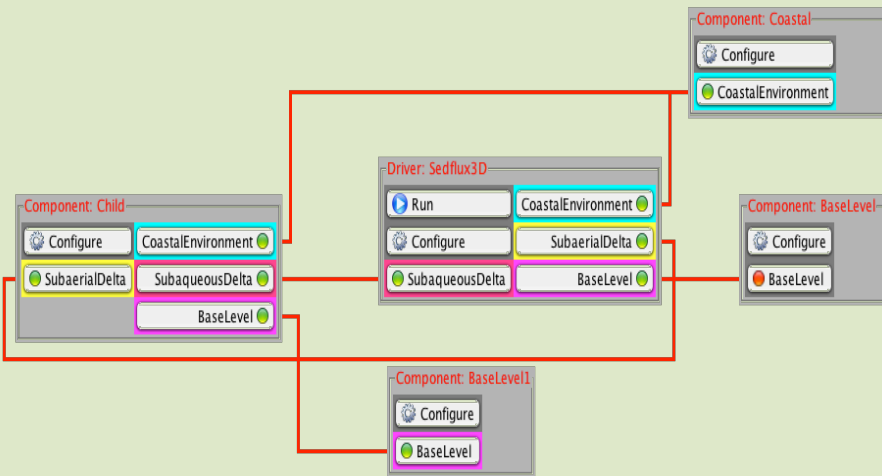
Solution: UDUNITS (Unidata)



CMT E.g. 1: Coupled 3 legacy models and 1 new model: i) a coastal evolution model (CEM), ii) a delta avulsion model (Avulse), iii) a hydrological model (HydroTrend), and iv) a wave generator (WAVE).
Ashton et al., 2013, Computers & Geosciences 53: 21-29

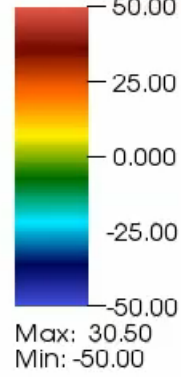


CMT E.g. 2: Coupled 2 legacy models : a LEM (CHILD) with a SEM (SedFlux) with different time steps, grids, units, etc



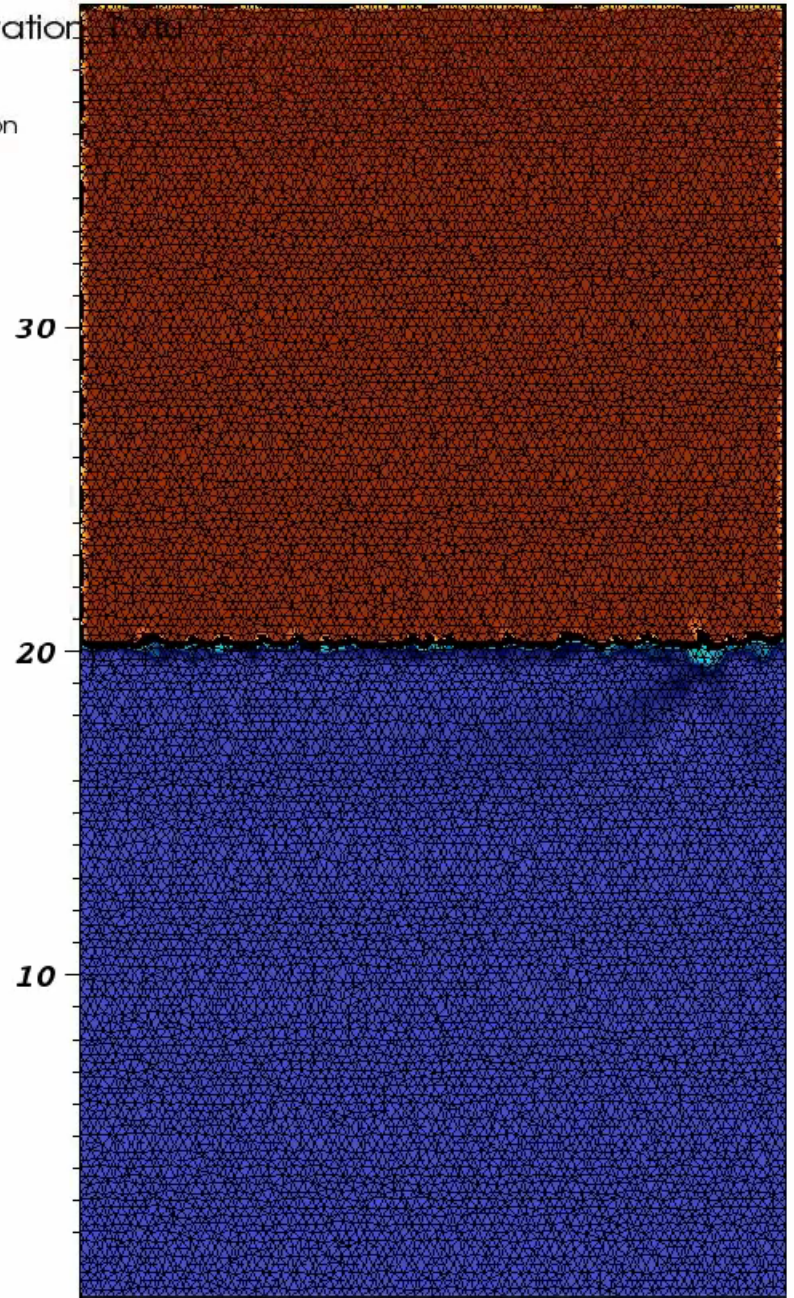
DB: CellElevation
Cycle: 1

Pseudocolor
Var: CellElevation



Mesh
Var: mesh

Y-Axis
($\times 10^3$)



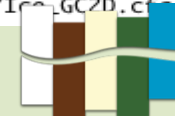
CMT E.g. 3: Refactoring of legacy model TopoFlow and coupling with up to 8 hydrology components with plug and play choices.

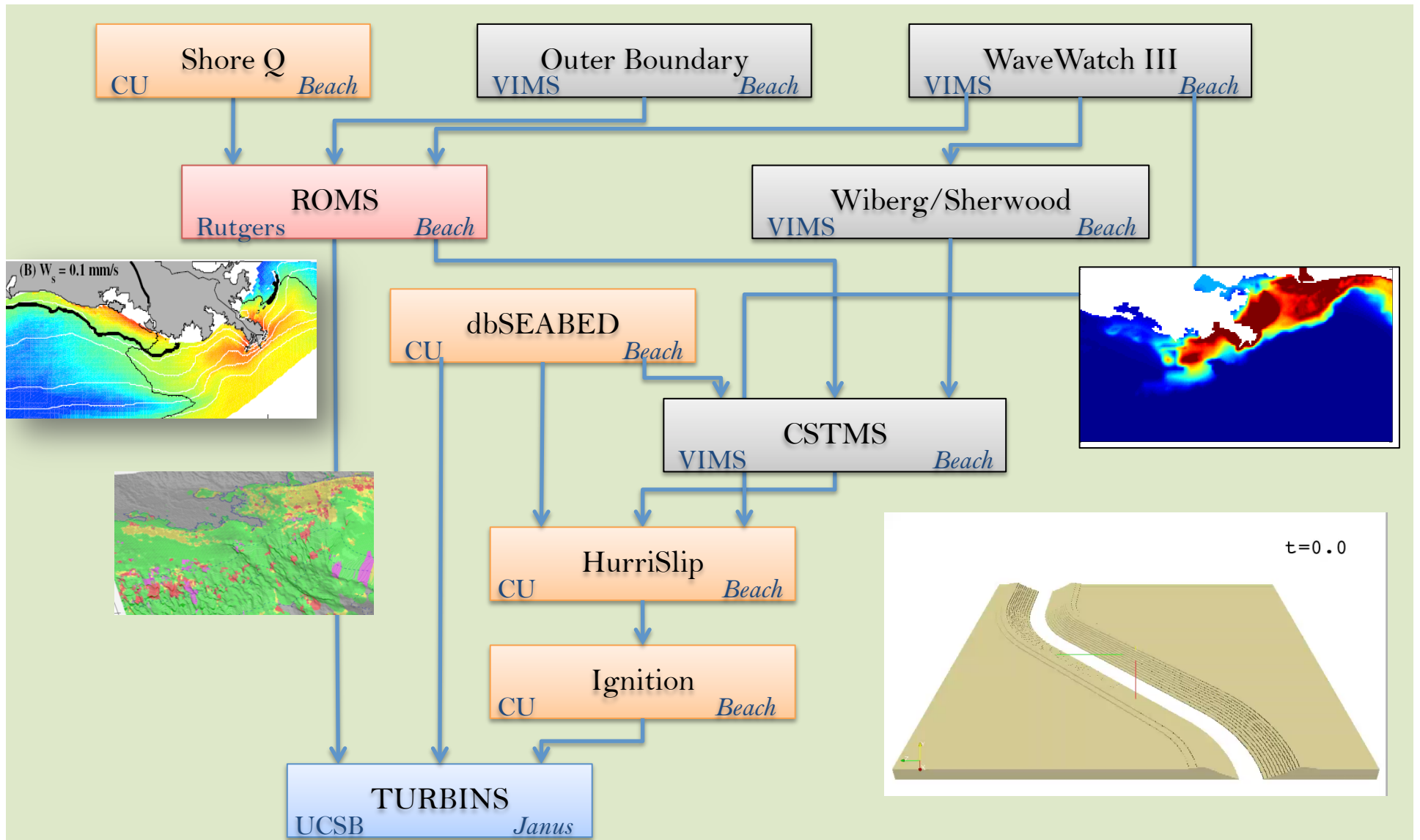
The screenshot displays the CMT software interface. At the top, there is a menu bar with 'Workspace', 'Visualize', 'Job Info', and 'Help'. The main workspace is divided into several sections:

- Driver:** A dropdown menu showing 'TopoFlow'.
- Palette:** A vertical list of component names: ChannelsDiffWave, ChannelsDynamWave, ChannelsKinWave, Diversions, EvapEnergyBalance, EvapPriestleyTaylor, EvapReadFile, HISData, IceGC2D, InfilGreenAmpt, InfilRichards1D, InfilSmithParlange, Meteorology, SatZoneDarcyLayers, SnowDegreeDay, SnowEnergyBalance, and TopoFlow.
- Arena:** A central area containing several component configuration panels:
 - Driver: TopoFlow:** Includes 'Run', 'Configure', and 'Hydro_model' buttons, and a list of components: Meteorology, Channels, Snow, Evap, Infil, Satzone, Ice, and Diversions.
 - Component: Meteorology:** Includes 'Configure' and 'Snow' buttons, and a 'Meteorology' component.
 - Component: SnowEnergyBalance:** Includes 'Configure' and 'Meteorology' buttons, and a 'Snow' component.
 - Component: ChannelsDynamWave:** Includes 'Configure' and 'Meteorology' buttons, and a list of components: Channels, Snow, Evap, Infil, Satzone, Ice, and Diversions.
 - Component: EvapEnergyBalance:** Includes 'Configure' and 'Meteorology' buttons, and a list of components: Evap, Channels, Snow, Infil, and Satzone.
 - Component: InfilRichards1D:** Includes 'Configure' and 'Meteorology' buttons, and a list of components: Infil, Snow, Evap, Satzone, and Channels.
 - Component: IceGC2D:** Includes 'Configure' and 'Meteorology' buttons, and a list of components: Ice and Snow.
 - Component: SatZoneDarcyLaye:** Includes 'Configure' and 'Infil' buttons, and a list of components: Satzone and Channels.

At the bottom, there is a 'CMT Console' window showing the following log output:

```
/data1/progs/cca/src/serial-nightly/cca-tools-contractor/_build/build/ccaffeine/cxx/dc/framework/G
SUCCESS: InfilRichards1D component status = created
Reading GUI info from: /data/progs/topoflow/3.1/gui_info/Infil_Richards_1D.cfg
Connecting...
/data1/progs/cca/src/serial-nightly/cca-tools-contractor/_build/build/ccaffeine/cxx/dc/framework/G
SUCCESS: SatZoneDarcyLayers component status = created
Reading GUI info from: /data/progs/topoflow/3.1/gui_info/Satzone_Darcy_Layers.cfg
Connecting...
/data1/progs/cca/src/serial-nightly/cca-tools-contractor/_build/build/ccaffeine/cxx/dc/framework/G
SUCCESS: IceGC2D component status = created
Reading GUI info from: /data/progs/topoflow/3.1/gui_info/Ice_GC2D.cf
```





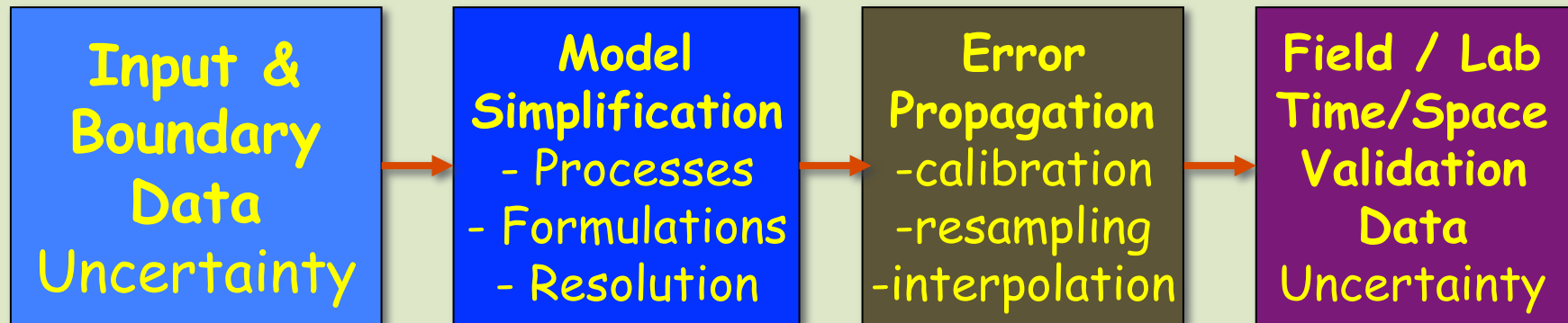
E.g. Complex 1-way coupling: Extreme oceanic and atmospheric events generating turbidity currents in the Gulf of Mexico,

CSDMS 2.0 Cyber-Infrastructure advances:

- 1) **Automated ‘wrapping’ tools** for development of moving BMI to CMI components; **completed**
- 2) **Web-based Component Modeling Tool (CMTweb)** to allow users to run CMT through a web browser; **command line prototype**
- 3) **CSDMS software stack on other HPC clusters**; **installed but not maintained on *janus***
- 4) **Pre-built executables of individual models** to run on a wider range of platforms; **TBD**



CSDMS 2.0 Model Uncertainty Service Component:



A Multilevel Parallel Object-Oriented Framework for:

- Design Optimization
- Parameter Estimation
- Uncertainty Quantification
- Sensitivity Analysis



CDMS 2.0 Model Benchmarking & Model Intercomparison

- Users need insights into strengths & weaknesses of apparently similar models.
- CMT modeling environment is well-suited for model intercomparison experiments
- Numerous geoscience model intercomparison projects (**MIPs**) already have relevant benchmark data sets made publicly available.
- Appropriate benchmark data should be integrated into CMT, and this will require:
 - ✧ **community involvement to identify & document data, and design intercomparison experiments,**
 - ✧ **enhanced CSDMS web content management functionality to ingest benchmark data & associated metadata,**
 - ✧ **software extensions to allow CSDMS components to ingest the data, &**
 - ✧ **conversion of data sets when necessary to new formats such as NetCDF.**
- Working and Focus Research Groups should include Model benchmarking and model intercomparison activities in their medium range goals. We need an EAGER team to begin.



CSDMS 2.0 Semantic Mediation & Ontologies for Models

The CSDMS Standard Names

CSDMS Standard Names use a template for creating unambiguous and easily understood standard variable names according to a set of rules, used to retrieve/match values and metadata.

The template is:

object name + [**operation name**] + **quantity name**

Examples:

atmosphere_water__liquid_equivalent_precipitation_rate

bedrock_surface__2nd_time_derivative_of__elevation

earth_ellipsoid__equatorial_radius

soil__time_derivative_of__saturated_hydraulic_conductivity

Model developers *do not* replace variables in their code but only *provide a mapping dictionary* of their input and output variables to CSDMS Standard Names and a *Model Metadata File* with assumptions, units, grid type, etc.



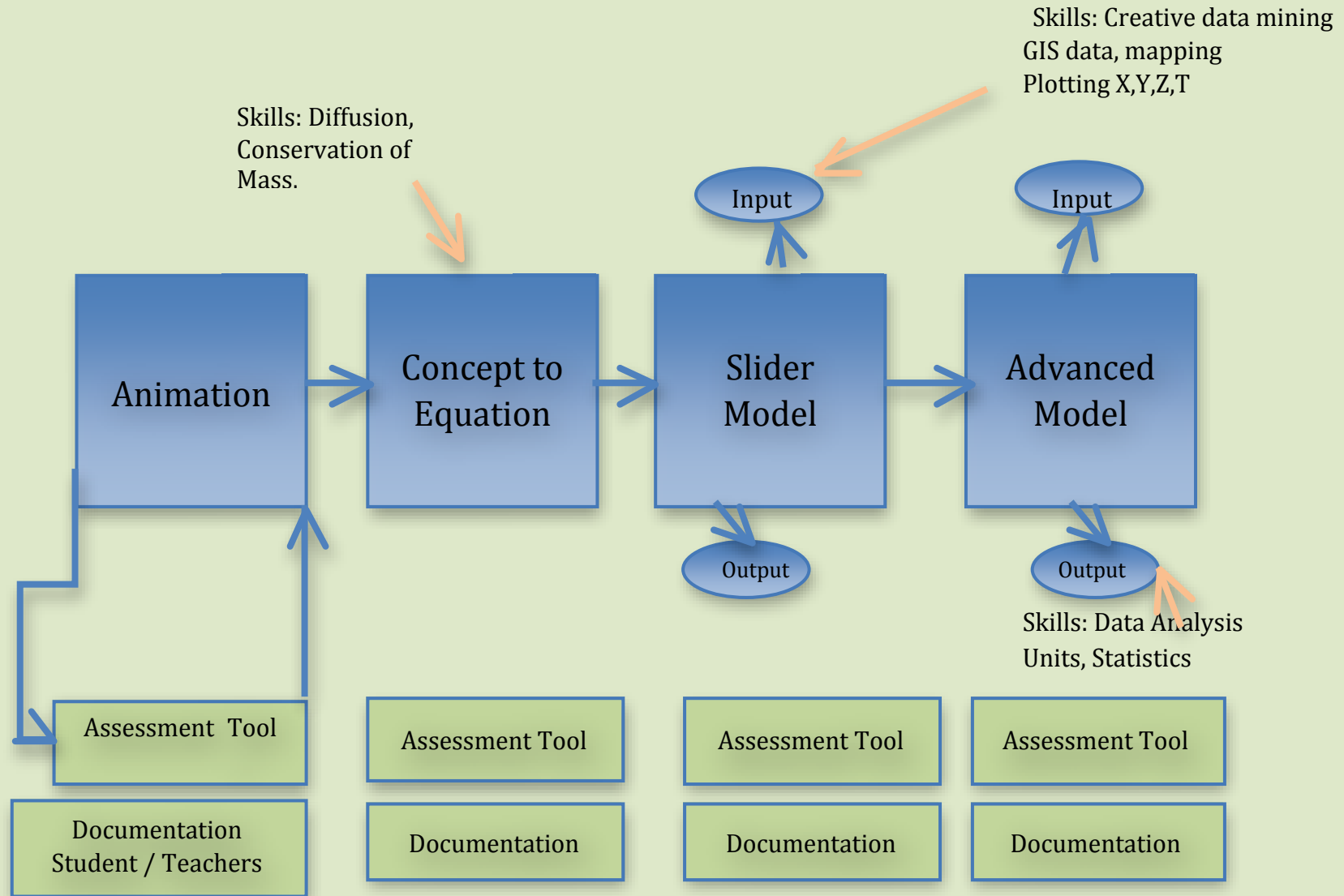
CSDMS 2.0 Web Innovation and Maintenance

Model info	
Authors	[hide]
Albert Kettner	
Source code	[hide]
<ul style="list-style-type: none">• Download• View source 	
DOI	[hide]
<ul style="list-style-type: none">• HydroTrend version: 3.0.2 Doi: 10.1594/IEDA/100135	
QR-code	[hide]
	
<i>Link to this page</i>	
Other models by this author	[hide]
<ul style="list-style-type: none">• HydroTrend	

E.g. An automated “Model info” box is created for each model questionnaire page to serve model developers and users with summary information regarding the code author(s) of each numerical model and a download link for the source code. Model authors name is linked to his user profile page. A QR-code image is displayed and a unique identifier or DOI (Digital Object Identifier) is assigned for all models that are physically part of the CSDMS repository.



CSDMS 2.0 A Quantitative Surface Dynamics Educational Toolbox



CSDMS 2.0 A Quantitative Surface Dynamics Educational Toolbox

The screenshot shows the 'Science On a Sphere' website interface. At the top, the text reads 'Science On a Sphere® National Oceanic and Atmospheric Administration'. To the right is the NOAA logo. Below the header is a navigation bar with a search box and links for 'About', 'Locations', 'Gallery', and 'Contact'. The main content area features a grid of 30 circular globe icons representing various datasets. The grid is flanked by vertical navigation bars labeled 'SOS Locations', 'First Steps', 'Data Catalog', and 'Scripts & Lesson Plans'. Below the grid, the text 'Select from over 300 datasets' is displayed.

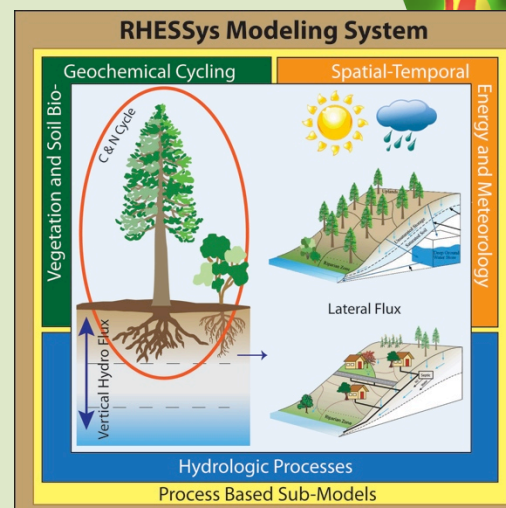
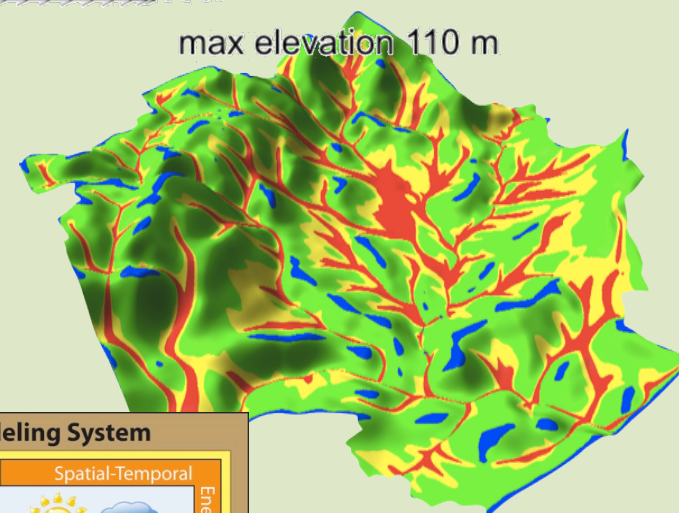
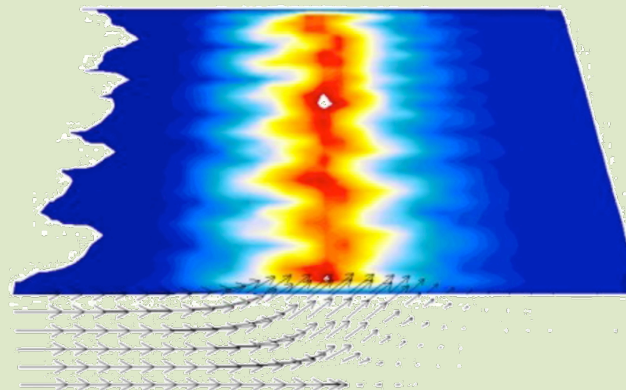


New Community Initiatives

Geodynamics Focus Research Group to investigate the interplay among climate, geomorphology, and tectonic processes in governing surface processes and landscape evolution — possible cosponsor NSF's GeoPRISMS — Co-Chairs Phaedra Upton and Mark Behn

Anthropocene Focus Research Group to incorporate mechanistic models of human influences on landscapes and ecosystems — cosponsors IGBP & CoMSES — Co-Chairs Mike Ellis & Kathleen Galvin

Critical Zone Focus Research Group, to foster communication on CSDMS architecture & protocols, and CZO-developed models & data --- cosponsor NSF's CZO --- Chair Chris Duffy



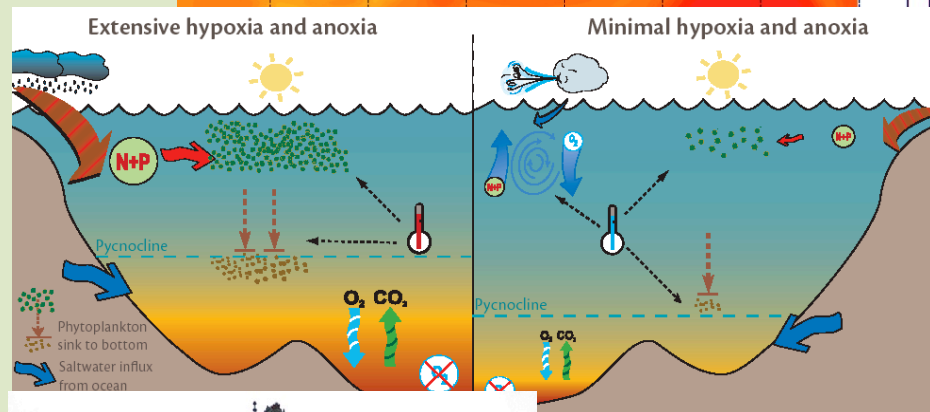
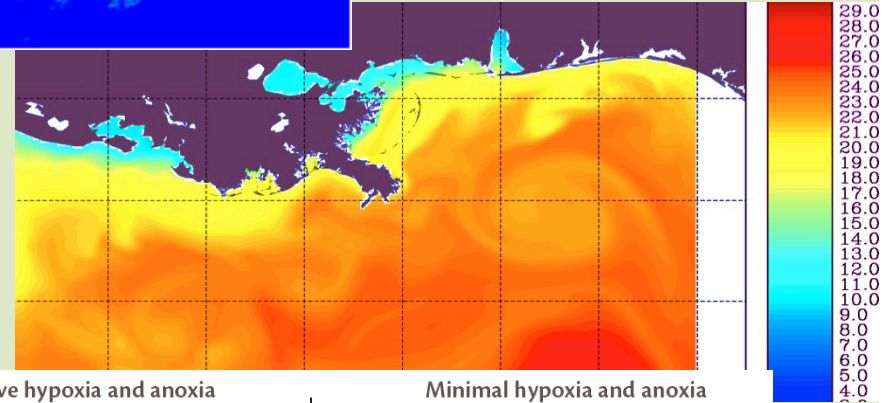
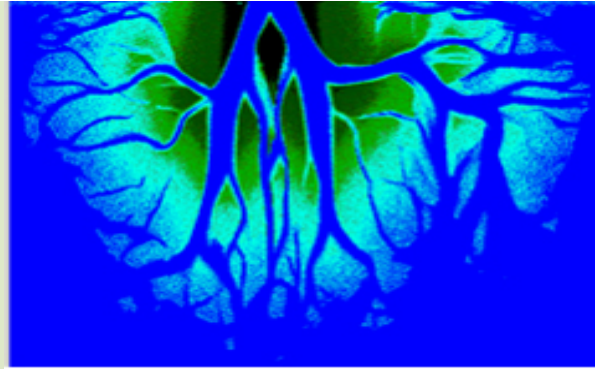
New Community Initiatives

Coastal vulnerability modeling initiative: e.g. FESD-Delta Dynamics Collaboratory; NASA Delta Fingerprinting; Coastal Seas RFP; Belmont Forum CV proposals. Brad Murray to take the initial lead

Continental margin modeling initiative, Courtney Harris is to lead this BOEM-funded initiative.

Earth - ecosystem modeling initiative to capture ecosystem dynamics and ensuing interactions with landscape processes — we are looking for leadership and co-sponsorship of this activity.

EuroCSDMS will be to foster collaborative open-source technologies to evaluate and predict the global, regional and local response to environmental change — presently led by Peter Burgess.





Volume 53, April 2013

CONTENTS



Abstract/Indexed in: App Sci & Techno Index; Camb Scientific Abs; Chemical Abs; Comp Abs; Comp Cnts; Current Cnts/CompuMath; Current Cnts/Physics, Chemical, & Earth Sci; Current Cnts/SciSearch Dbase; Els BIOBASE; Eng Index; GEOBASE; Geo Bib & Index; INSPEC; Info Science Abs; Petrol Abs; Research Alert; Science Citation Index; Wilson App Sci & Techno Abs. Also covered in the abstract and citation database SciVerse SCOPUS®. Full text available on SciVerse ScienceDirect®.

Albert J. Kettner and James P.M. Syvitski	1	Modeling for environmental change
Scott D. Peckham, Eric W.H. Hutton and Boyana Norris	3	A component-based approach to integrated modeling in the geosciences: The design of CSDMS
Rocky Dunlap, Spencer Rugaber and Leo Mark	13	A feature model of coupling technologies for Earth System Models
Andrew D. Ashton, Eric W.H. Hutton, Albert J. Kettner, Fei Xing, Jisamma Kallumadikal, Jaap Nienhuis and Liviu Giosan	21	Progress in coupling models of coastline and fluvial dynamics
A. Brad Murray, Sathya Gopalakrishnan, Dylan E. McNamara and Martin D. Smith	30	Progress in coupling models of human and coastal landscape change
Jorge Lorenzo-Trueba, Vaughan R. Voller and Chris Paola	39	A geometric model for the dynamics of a fluvially dominated deltaic system under base-level change
Phaedra Upton, Albert J. Kettner, Basil Gomez, Alan R. Orpin, Nicola Litchfield and Michael J. Page	48	Simulating post-LGM riverine fluxes to the coastal zone: The Waipooa River System, New Zealand
E.W.H. Hutton, J.P.M. Syvitski and A.B. Watts	58	Isostatic flexure of a finite slope due to sea-level rise and fall
N. Matell, R.S. Anderson, I. Overeem, C. Wobus, F.E. Urban and G.D. Clow	69	Modeling the subsurface thermal impact of Arctic thaw lakes in a warming climate
Sagy Cohen, Albert J. Kettner, James P.M. Syvitski and Balázs M. Fekete	80	WBMsed, a distributed global-scale riverine sediment flux model: Model description and validation
Tzu-hao Yeh and Gary Parker	94	Software for evaluating sediment-induced stratification in open-channel flows
Catherine Villaret, Jean-Michel Hervouet, Rebekka Kopmann, Uwe Merkel and Alan G. Davies	105	Morphodynamic modeling using the Telemac finite-element system
Enrica Viparelli, J. Wesley Lauer, Patrick Belmont and Gary Parker	114	A numerical model to develop long-term sediment budgets using isotopic sediment fingerprints
Karen Campbell, Irina Overeem and Maureen Berlin	123	Taking it to the streets: The case for modeling in the geosciences undergraduate curriculum
Peter M. Burgess	129	CarboCAT: A cellular automata model of heterogeneous carbonate strata
M.M. Nasr-Azadani, B. Hall and E. Meiburg	141	Polydisperse turbidity currents propagating over complex topography: Comparison of experimental and depth-resolved simulation results
Scott D. Peckham and Jonathan L. Goodall	154	Driving plug-and-play models with data from web services: A demonstration of interoperability between CSDMS and CUAHSI-HIS

*Code available at <http://www.iamg.org/CGEditor/index.htm>

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<http://www.elsevier.com/locate/cageo>

Available online at www.sciencedirect.com

SciVerse ScienceDirect

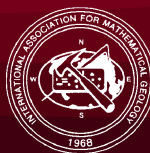


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398

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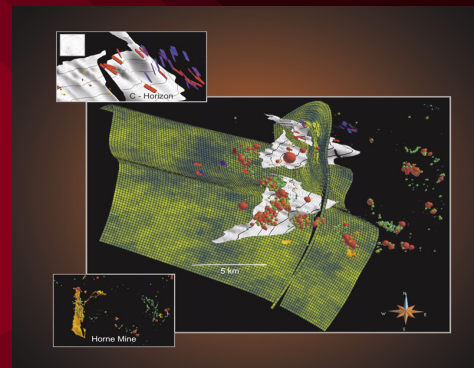
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Guest Editors
Albert J. Kettner and James Syvitski



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CITY COLLEGE OF NEW YORK



CSDMS
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

2013 CSDMS Annual Meeting: CSDMS 2.0 Moving Forward

7 Keynote & 3 Student / Postdoc Plenary Talks

PIHM, ADCIRC, Arctic Coastal M, Particle M, ROMS, DDC, DAKOTA, Delta M, UnderWorld, Glacier M

2 Poster Sessions 5 to 6:15 Day 2 & 3

1 Banquet Day 2 at 7pm Marriott (Lifetime, Poster & Student Awards)

6 1-hr and 4 2-hr Clinics in 3 parallel sessions (Day 2 & 3)

Carbonate, CMT, Turbins, BMI, Xbeach, OpenFOAM, NumPy, NumMeth, WRF, GRASS

18 Breakouts in 5 parallel sessions

2 sessions for developing long-term Strategic Plans of established Working & FRGs

2 sessions for developing short & mid-term Strategic Plans of Working and FR Groups

1 session for developing initial Strategic Plans of new FR Groups & Initiatives

Geodynamics, Anthropocene, Critical Zone, Coastal Vulnerability



Welcome to CSDMS 2.0

