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

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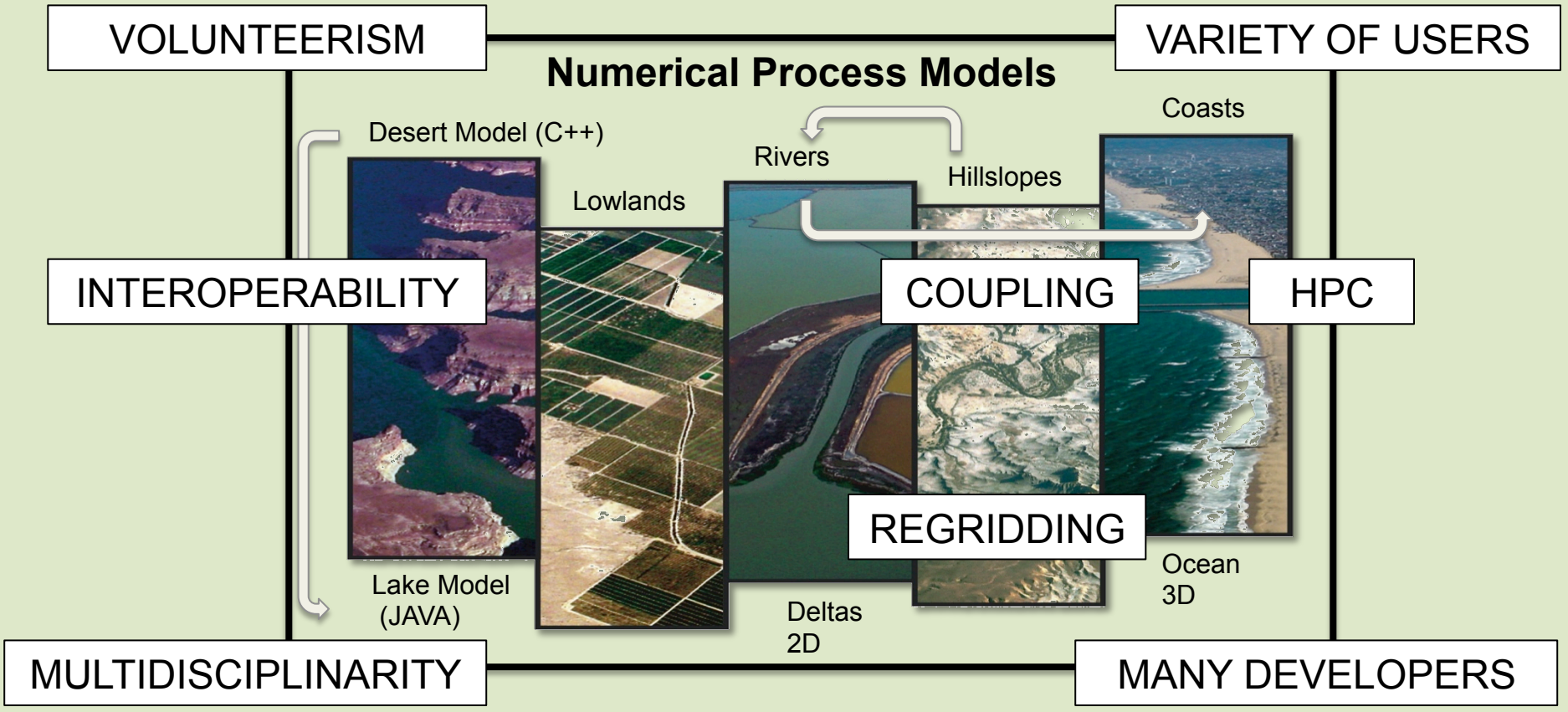
CSDMS Grand Challenge: Coordinate a large community to build a toolbox of surface dynamics component models



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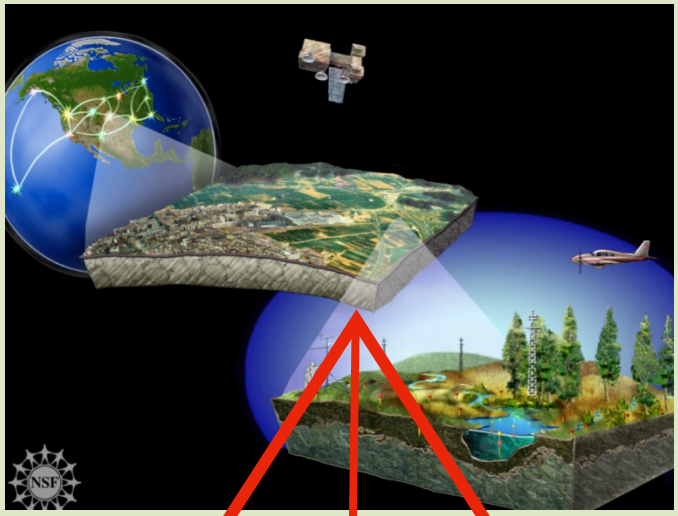
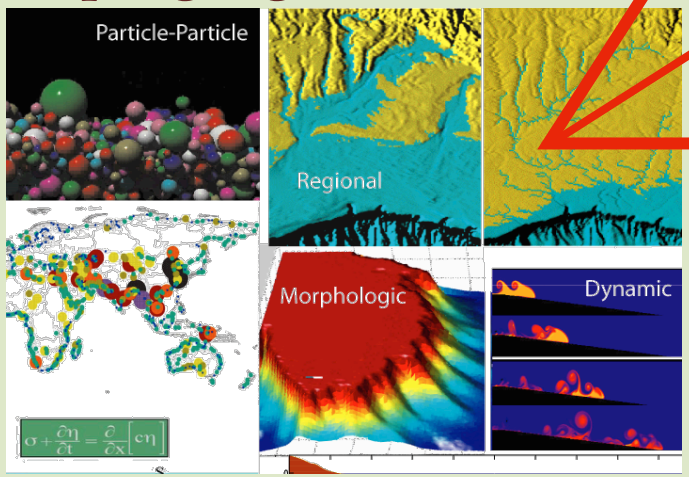
Addressing the 21st Century Environmental Infrastructure

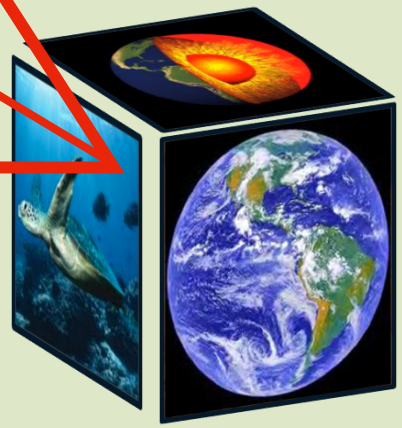


1) Sensing / Observing the Environment E.g. NEON, CZO

3) Model Development & Coupling E.g. CSDMS



Detection
Prediction
Services



2) Big Data E.g. EarthCube

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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

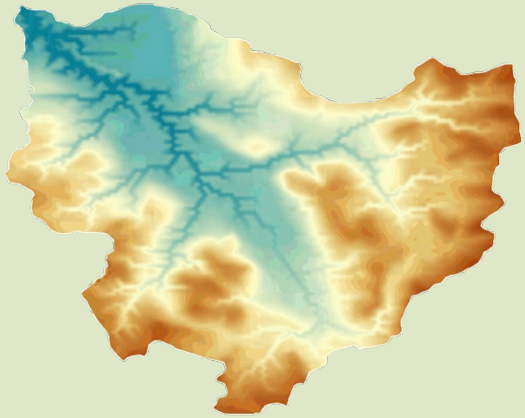
Critical Zone (CZO);
Geodynamics (GeoPRISMS);
Anthropocene (IGBP, CoMSES);

Earth - Ecosystem Initiative
Coastal Vulnerability Initiative
Continental Margin Initiative

Open-source Model Repository

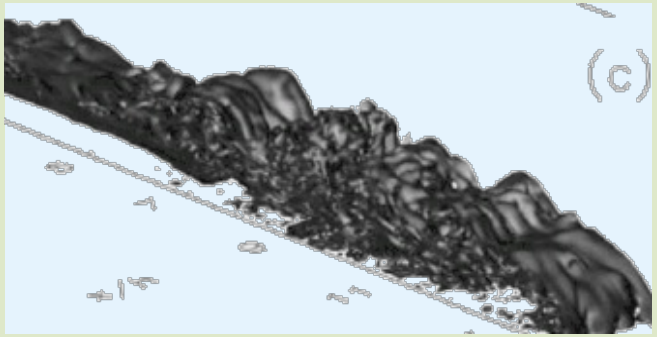
Model Domain:

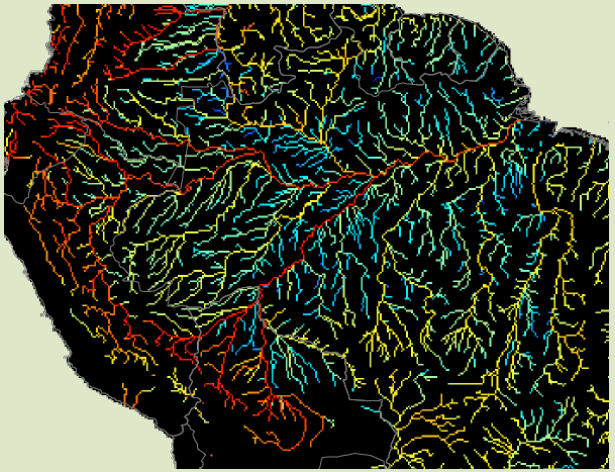
- Terrestrial incl. the Cryosphere
- Geodynamics & Stratigraphy
- Hydrology from reach to global
- Coastal & Marine
- Climate & Weather



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

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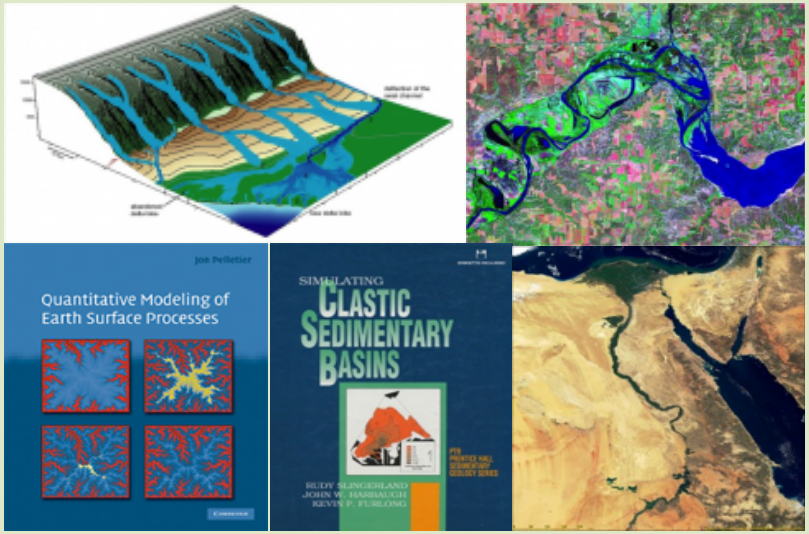
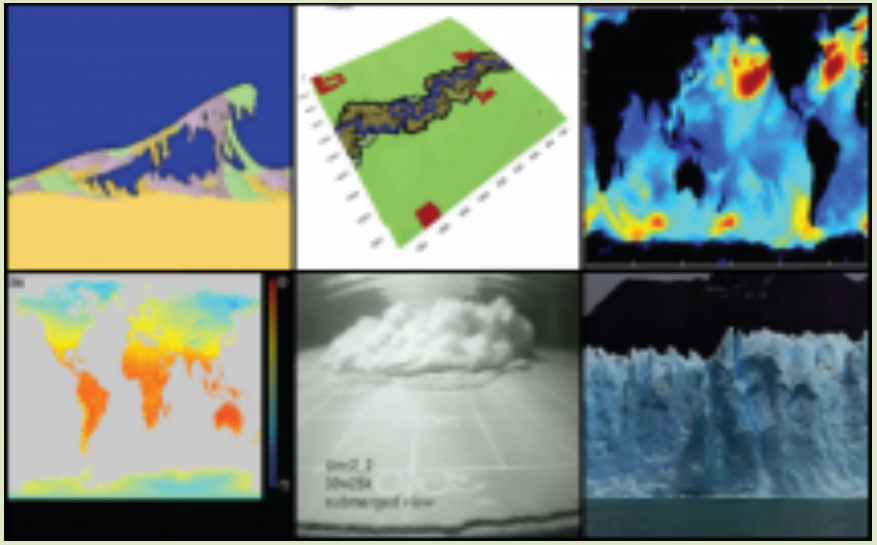
Please contribute to CSDMS Education Products



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



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

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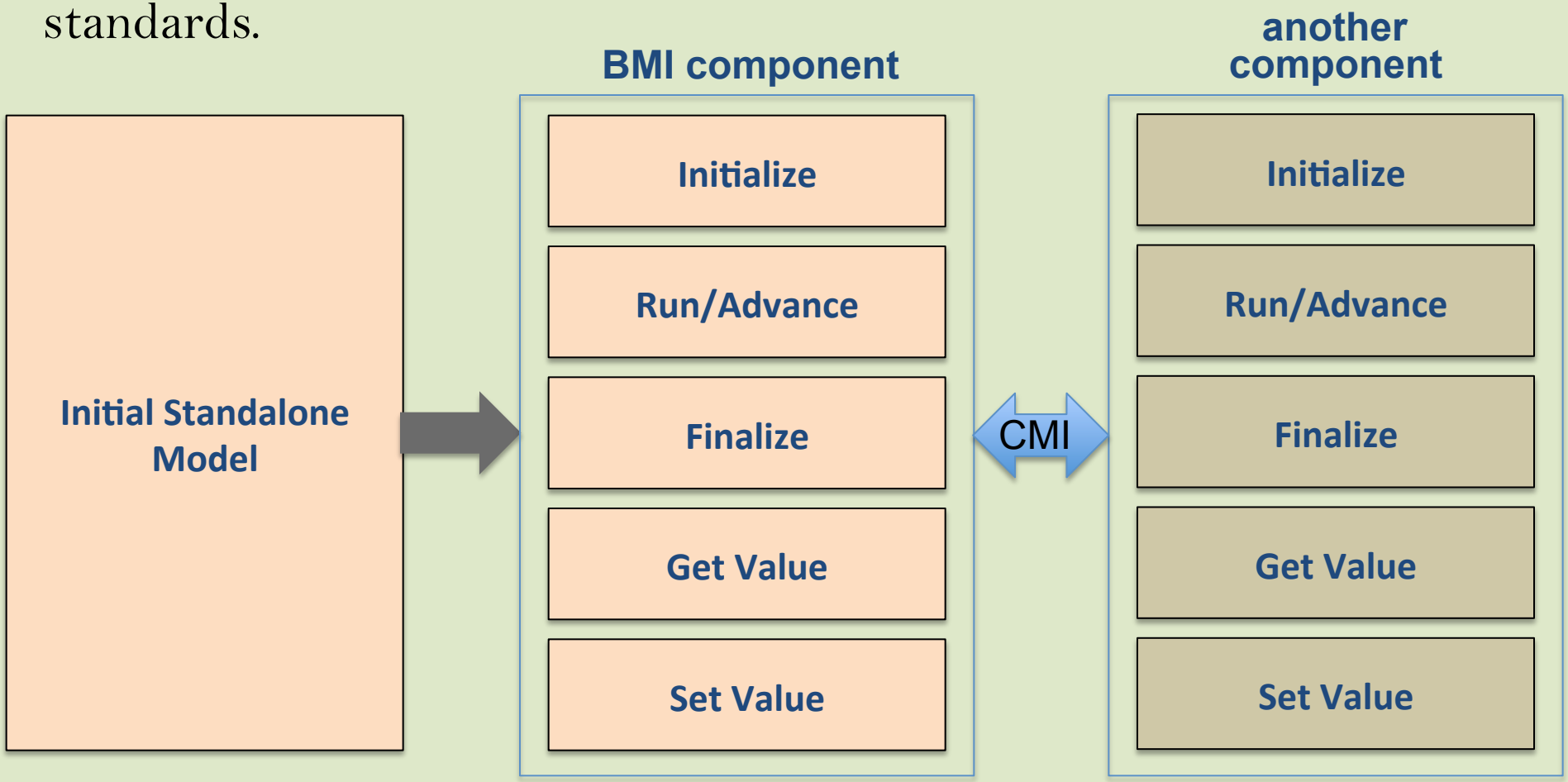
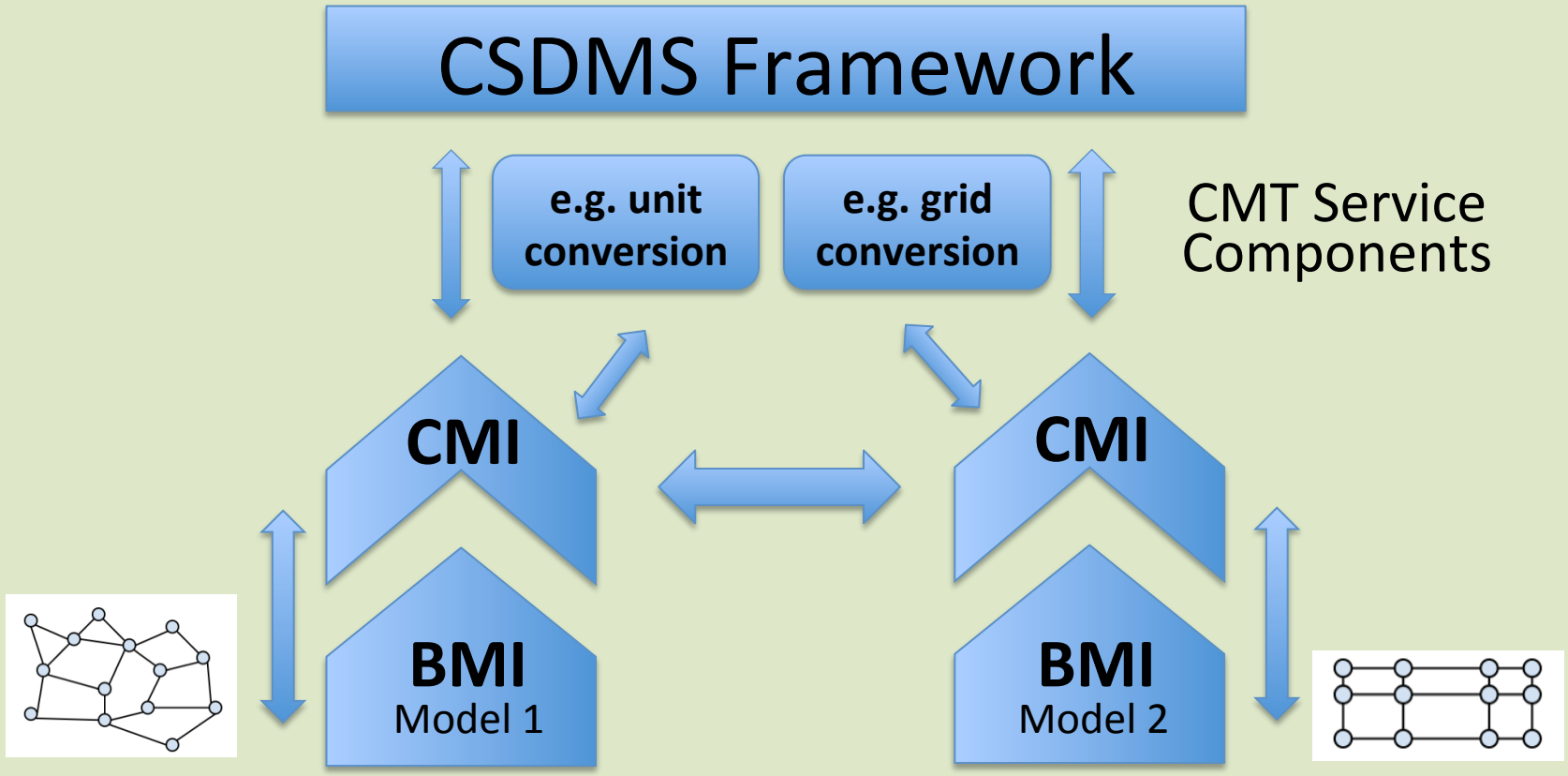
Working and Focus Groups are asked to converge on a high priority need/model for each year and, with advice from the IF staff, refactor the model to comply with **Basic Model Interface or BMI** standards.



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.



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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)

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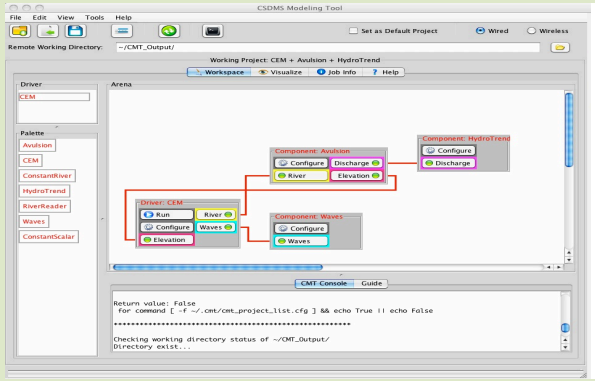
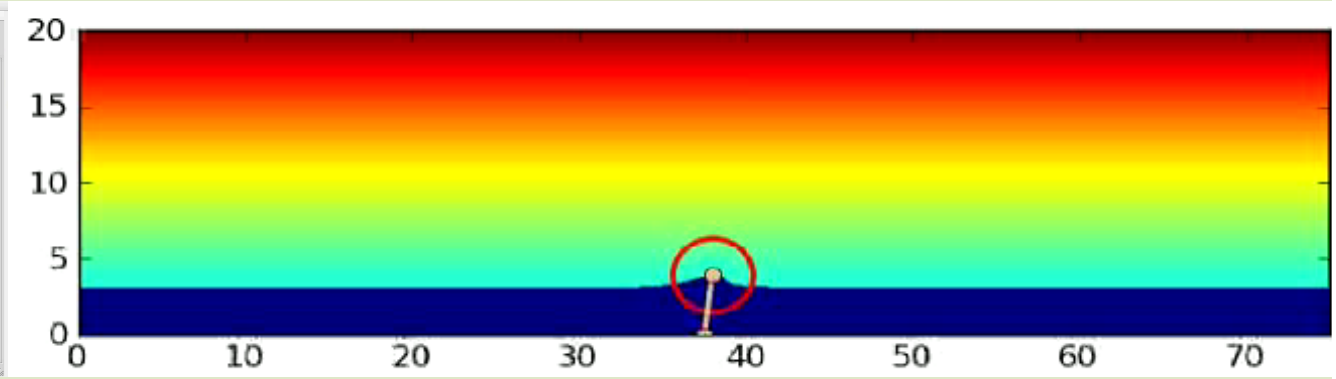
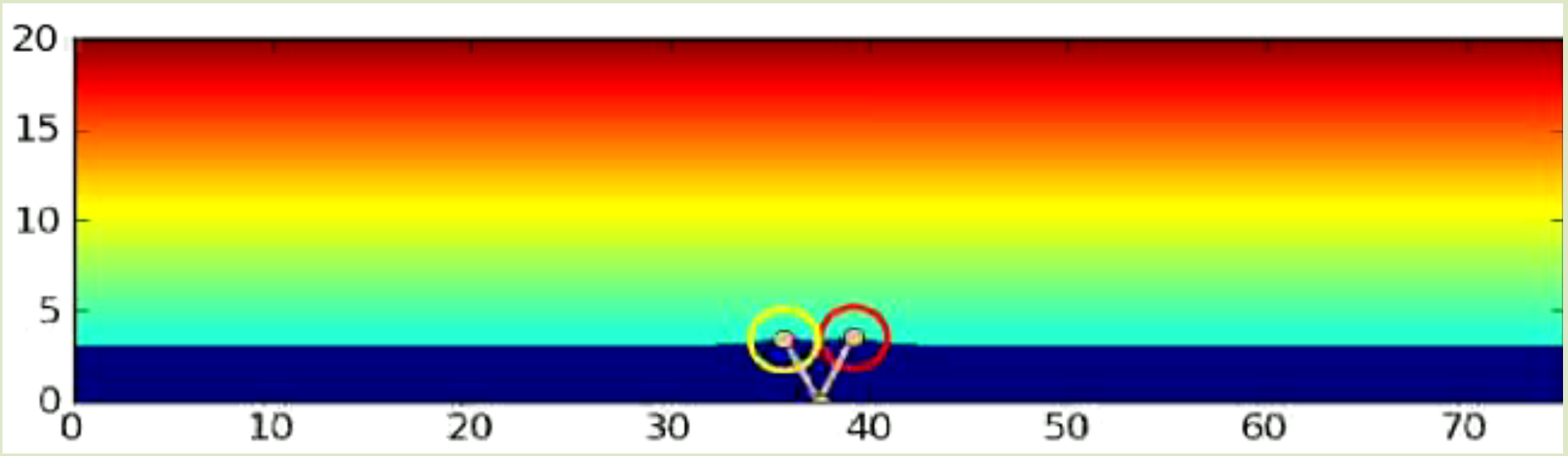
CMT E.g. 1: Coupled 3 legacy models and 1 new model: i) a coastal evolution model (CEM), ii) a delta avulsion model (Avulse), iii) a hydrological model (HydroTrend), and iv) a wave generator (WAVE).
Ashton et al., 2013, Computers & Geosciences 53: 21-29







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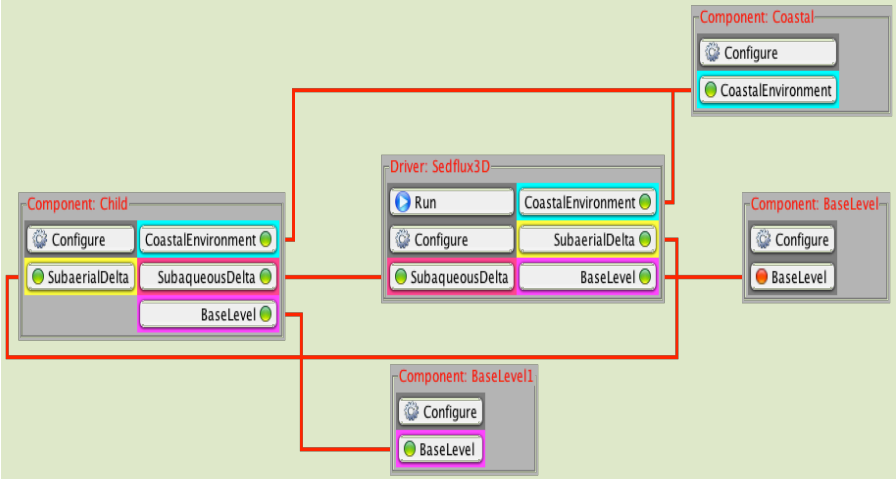
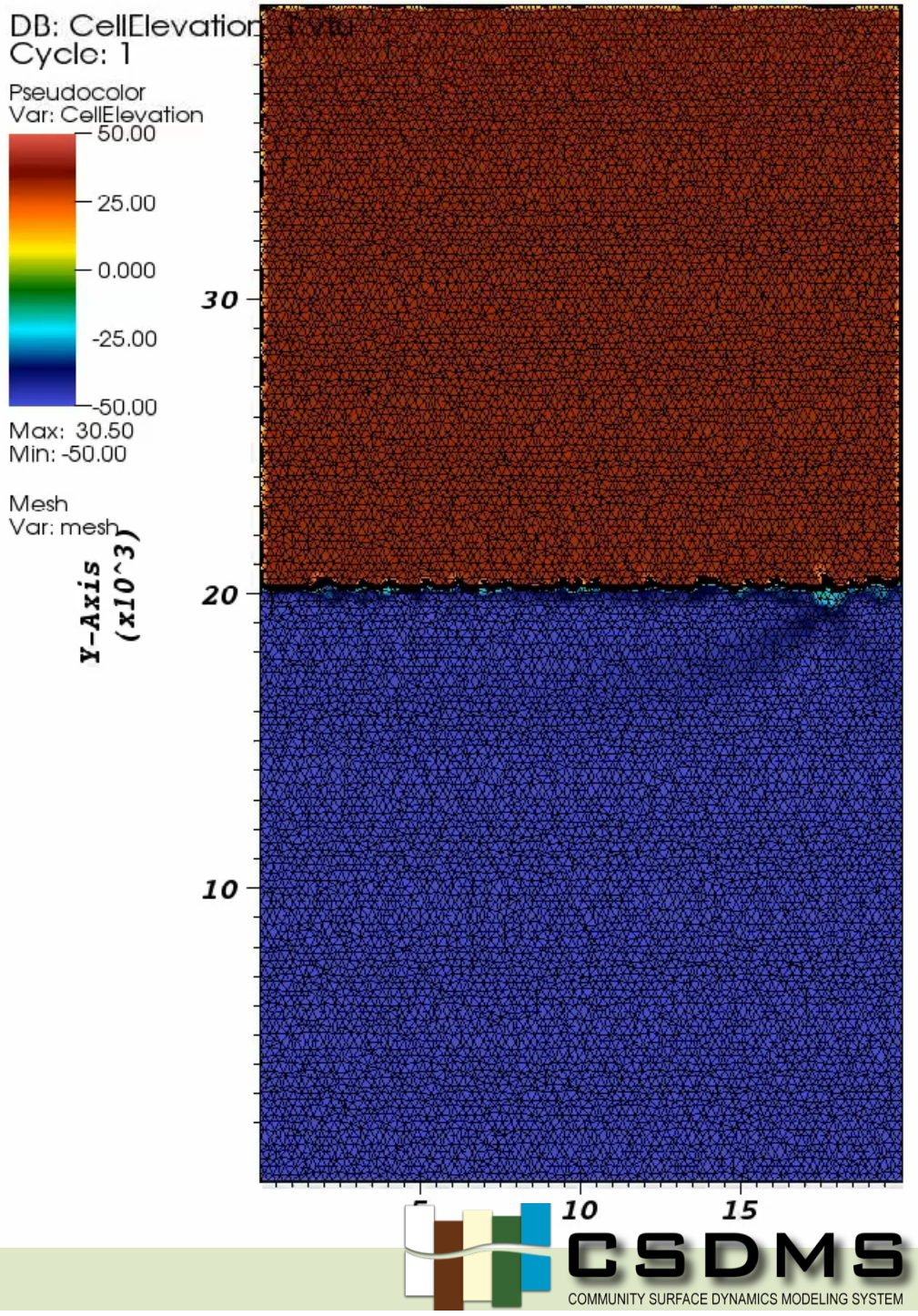
CMT E.g. 2: Coupled 2 legacy models : a LEM (CHILD) with a SEM (SedFlux) with different time steps, grids, units, etc





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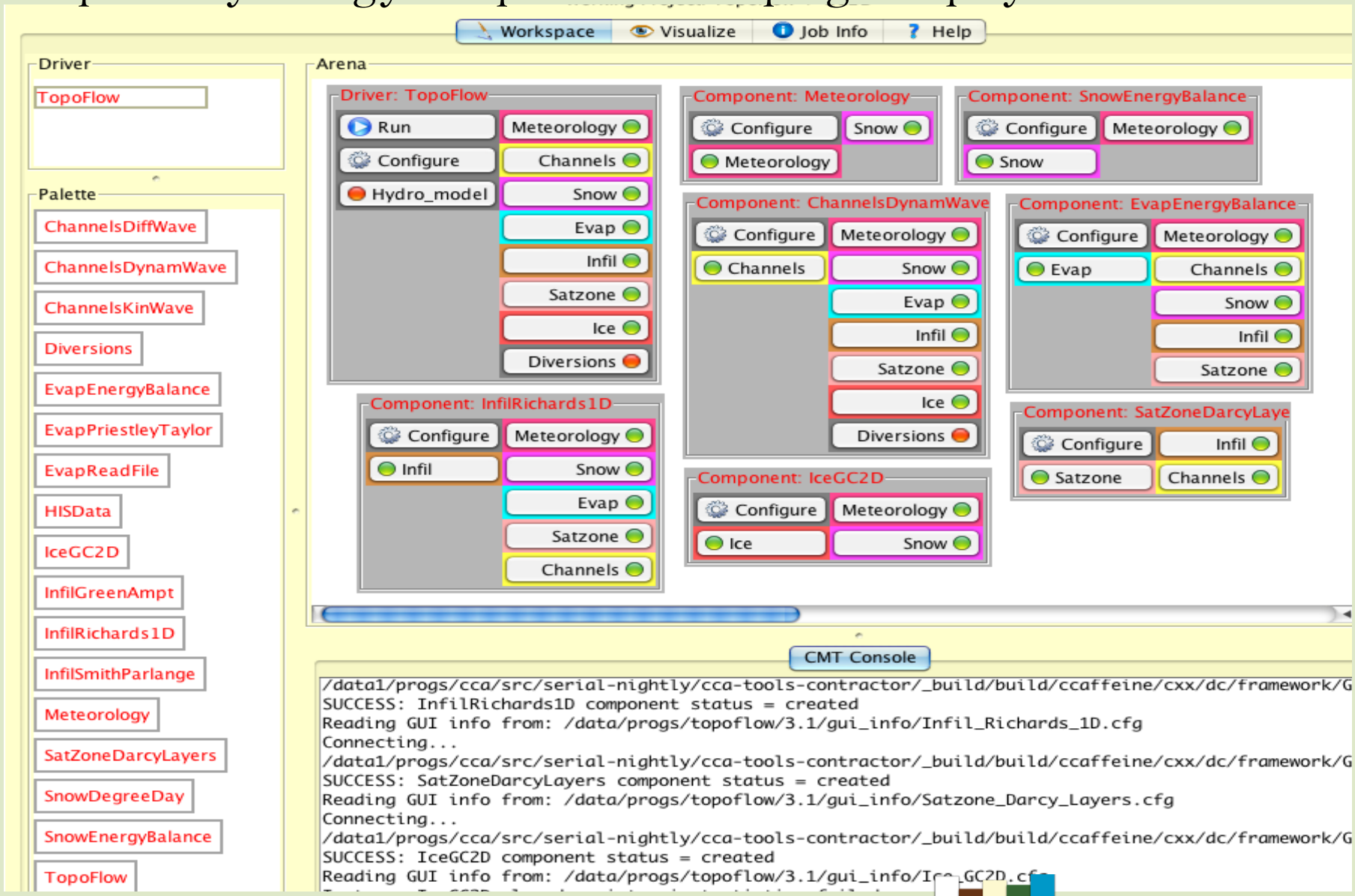
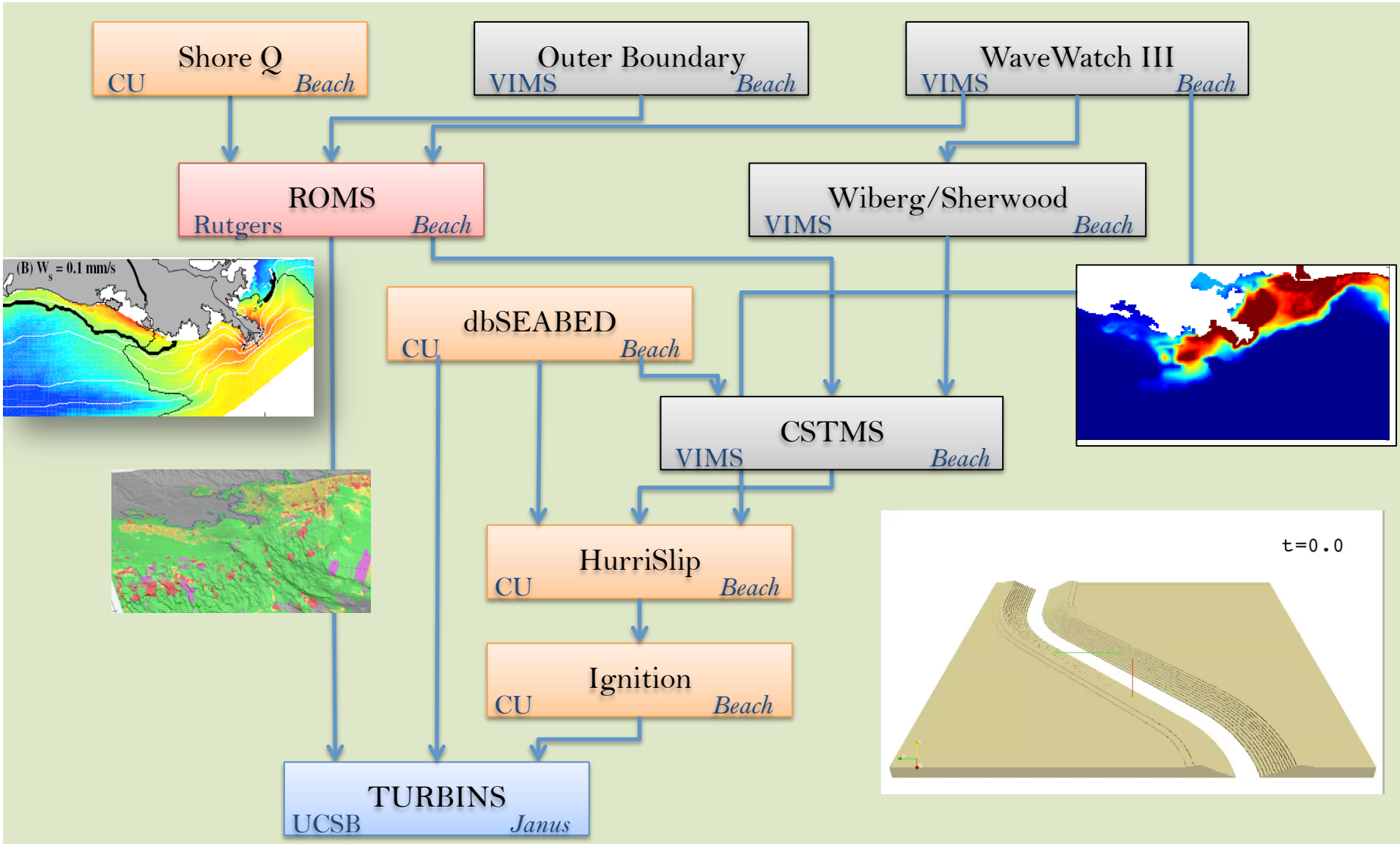
CMT E.g. 3: Refactoring of legacy model TopoFlow and coupling with up to 8 hydrology components with plug and play choices.





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:

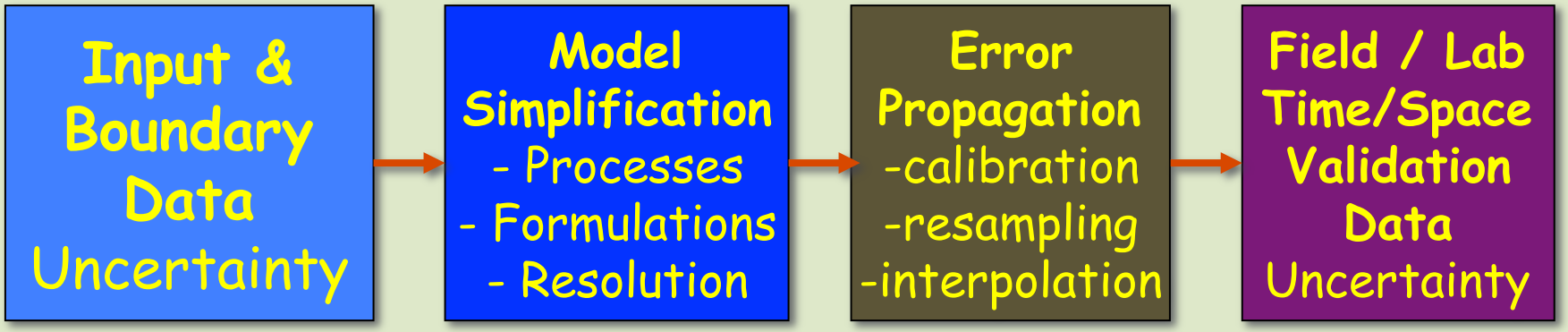
1) **Automated 'wrapping' tools** for development of moving BMI to CMI components; completed

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

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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 (**MIP**s) 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.

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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:

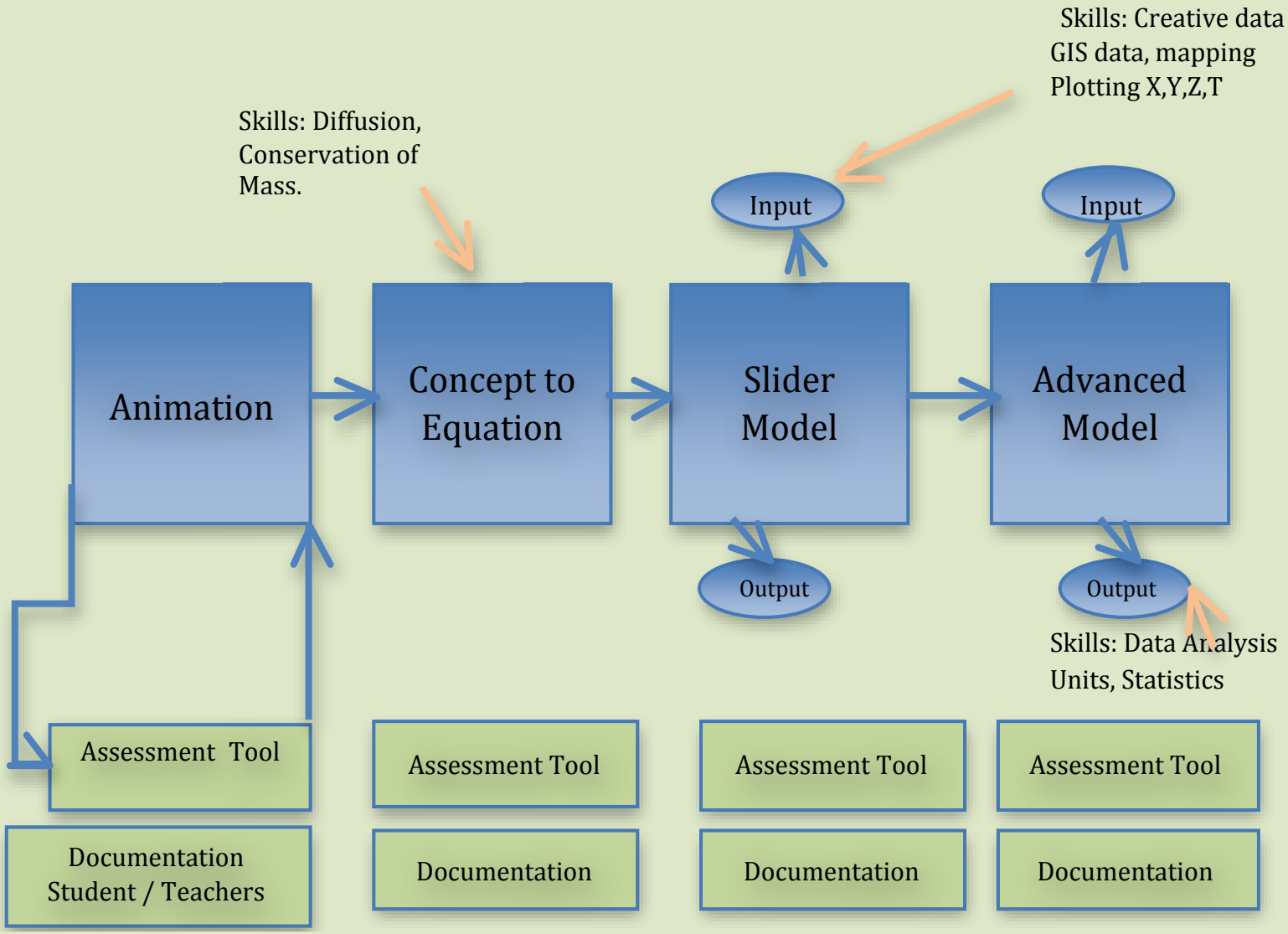
atmosphere_water__liquid_equivalent_precipitation_rate
bedrock_surface__2nd_time_derivative_of__elevation
earth_ellipsoid__equatorial_radius
soil__time_derivative_of__saturated_hydraulic_conductivity

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

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



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CSDMS 2.0 A Quantitative Surface Dynamics Educational Toolbox

NSF

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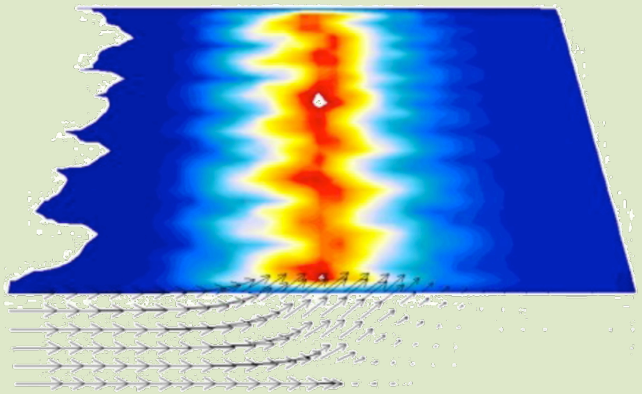
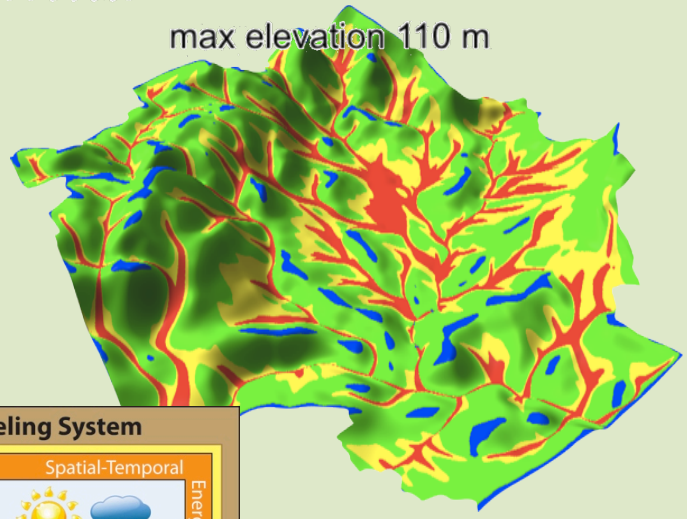
New Community Initiatives

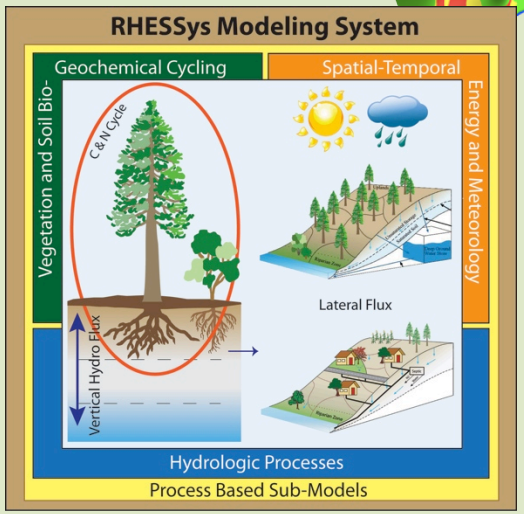
Geodynamics Focus Research Group to investigate the interplay among climate, geomorphology, and tectonic processes in governing surface processes and landscape evolution — possible cosponsor NSF's GeoPRISMS — Co-Chairs Phaedra Upton and Mark Behn

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







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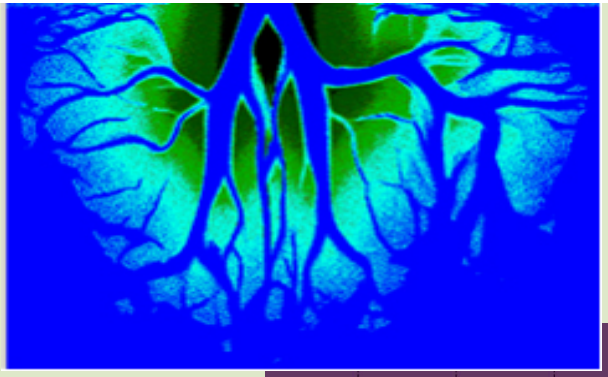
New Community Initiatives

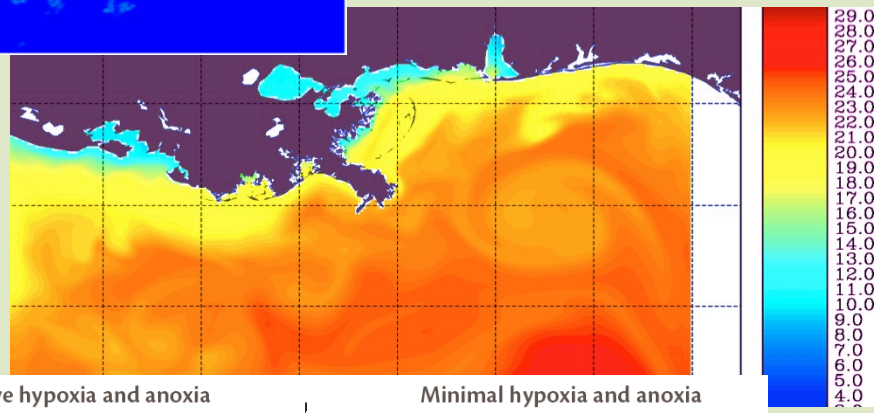
Coastal vulnerability modeling initiative: e.g. FESD-Delta Dynamics Collaboratory; NASA Delta Fingerprinting; Coastal Seas RFP; Belmont Forum CV proposals. Brad Murray to take the initial lead

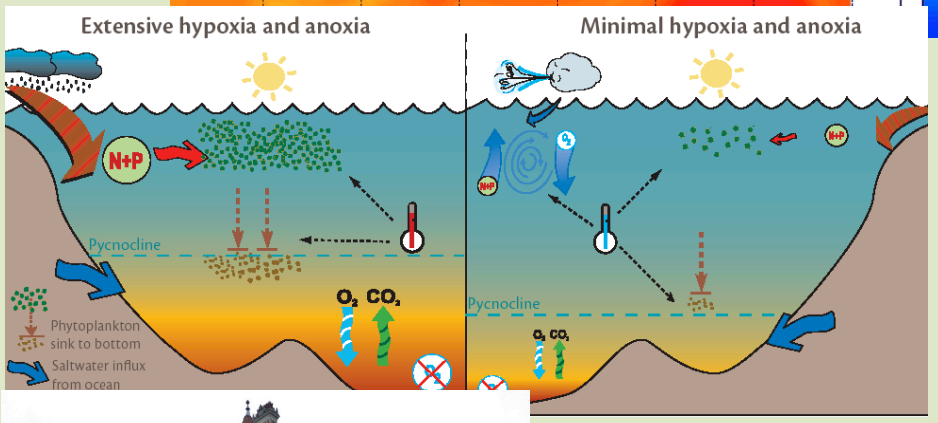
Continental margin modeling initiative, Courtney Harris is to lead this BOEM-funded initiative.

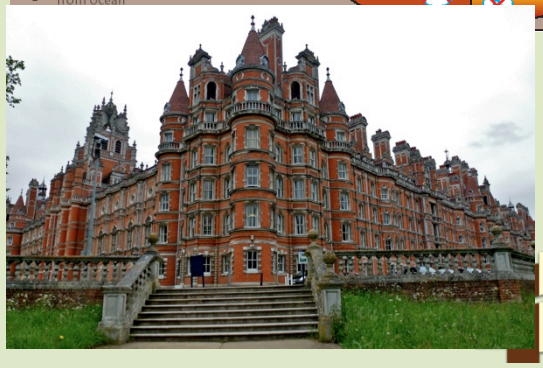
Earth - ecosystem modeling initiative to capture ecosystem dynamics and ensuing interactions with landscape processes — we are looking for leadership and co-sponsorship of this activity.

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.









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

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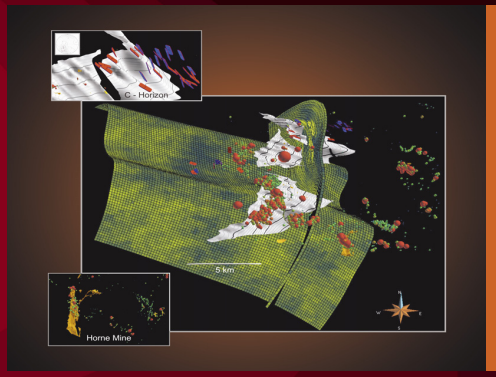
Special Issue
Modeling for Environmental Change

Guest Editors
Albert J. Kettner and James Syvitski



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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

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Welcome to CSDMS 2.0

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