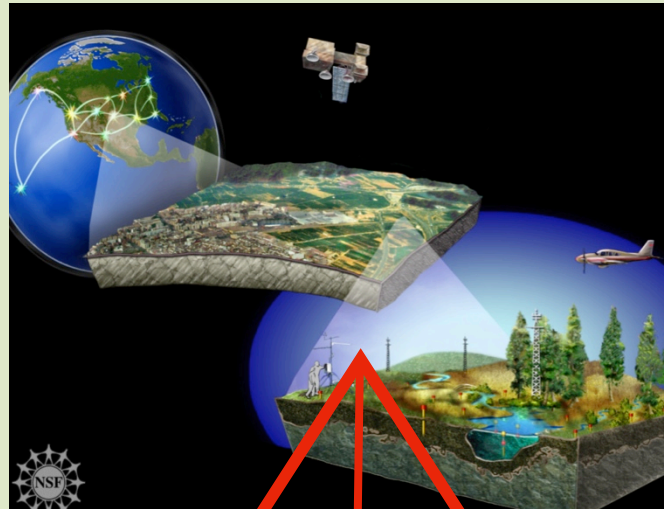


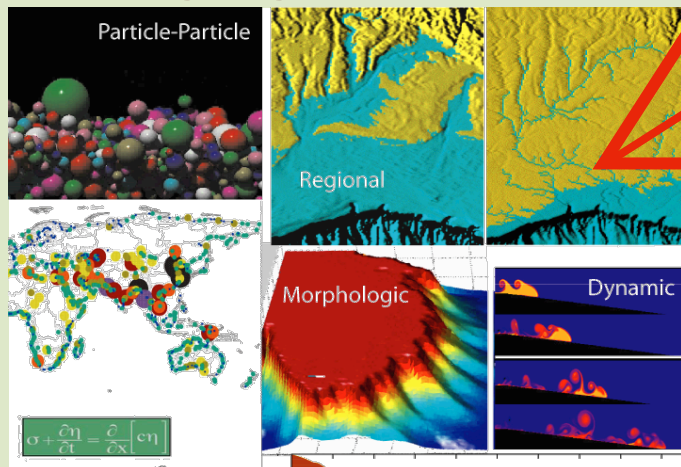


# Addressing 21<sup>st</sup> Century Environmental Infrastructure

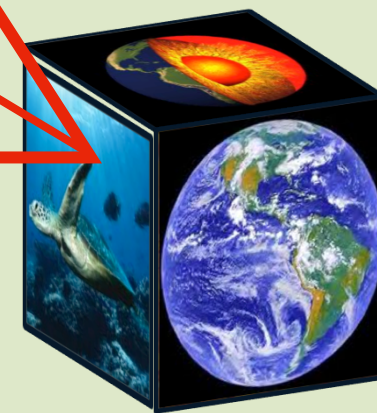


1) Sensing / Observing the Environment  
E.g. NEON, CZO

3) Model Development & Coupling E.g. CSDMS



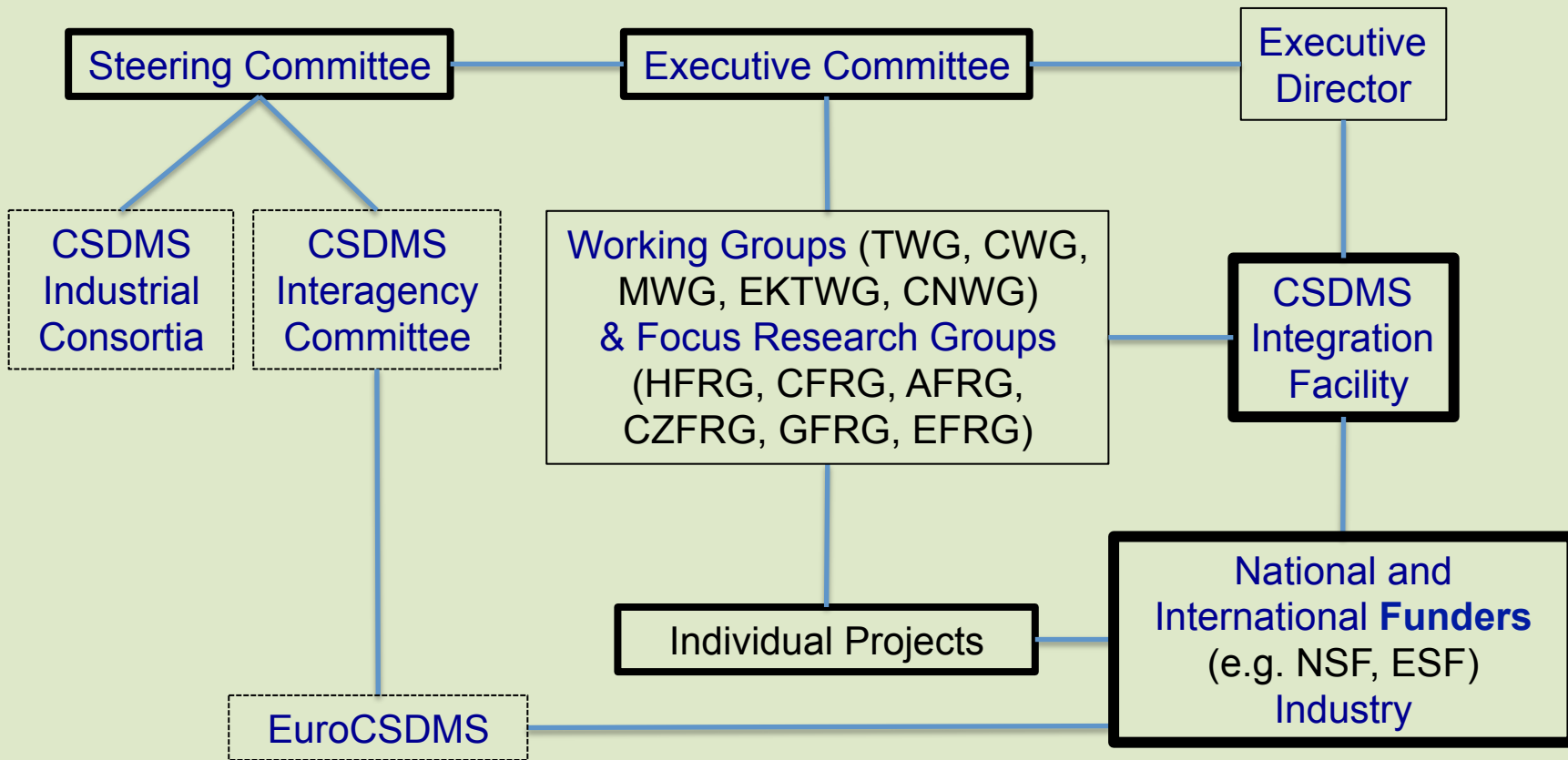
Detection  
Prediction  
Services



2) Big Data  
E.g. EarthCube



## CSDMS Governance Structure





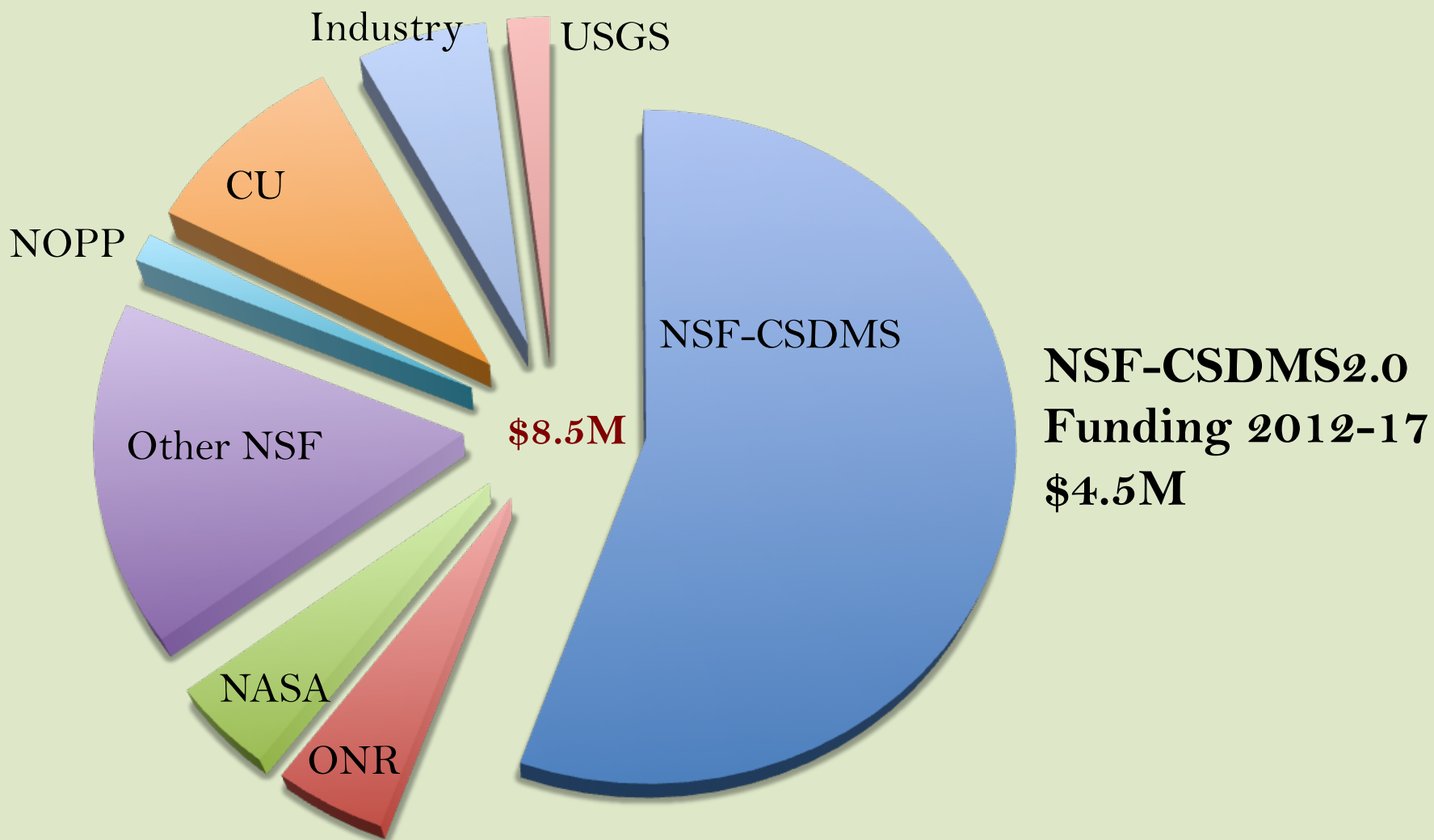


### Working Groups, Focus Research Groups, Initiatives

Terrestrial	540	Critical Zone (NSF/CZO)	20
Coastal	420	Geodynamics (NSF/GeoPRISMS)	50
Hydrology (CUAHSI)	400	Anthropocene (IGBP, CoMSES)	20
Marine	280		
Cyber	170	Earth - Ecosystem Initiative	
EKT	180	Coastal Vulnerability Initiative	
Carbonate (NSF/SPP)	70	Continental Margin Initiative	
Chesapeake (CCMP)	50		



# CSDMS1.0 Integration Facility Funding 2007-2012



# 1) CSDMS capacity building and community networking (04/07 to 04/13)



177 CSDMS workshops, symposia



25 CSDMS Short Courses (e.g. U.S.A., Germany, Korea, New Zealand)

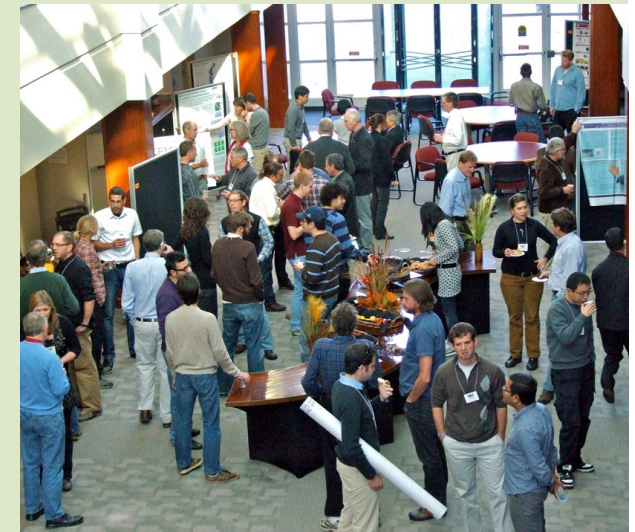
216 CSDMS Staff presentations

36 CSDMS Instructional Clinics



Annual Lifetime Achievement Award

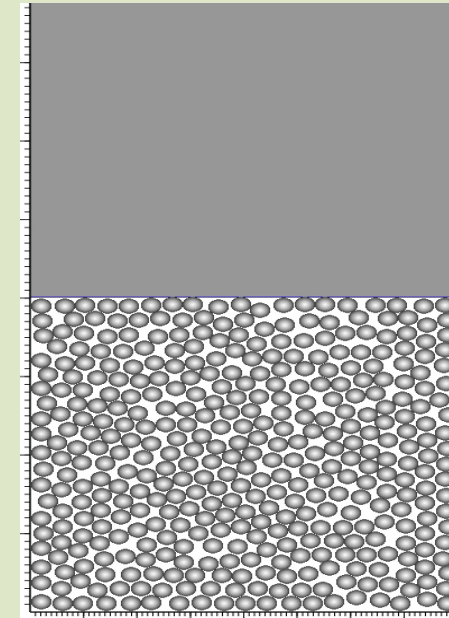
Annual Student Award



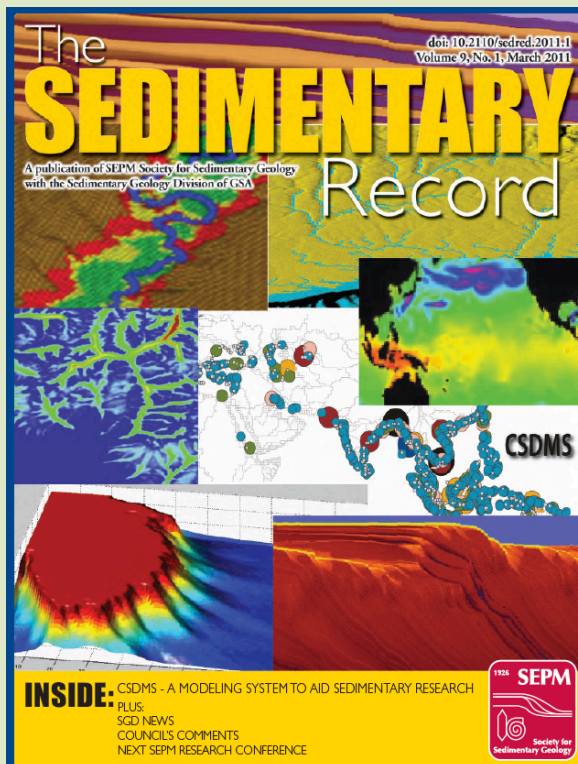


## 2) Open-source Model Repository

Domain	Models	Tools	Components
Terrestrial	80	48	33
Coastal	52	3	5
Marine	43	4	8
Hydrology	53	39	43
Carbonate	3	1	0
Climate	10	2	0



Zach Borden (UC Santa Barbara)



### Why Open Source?

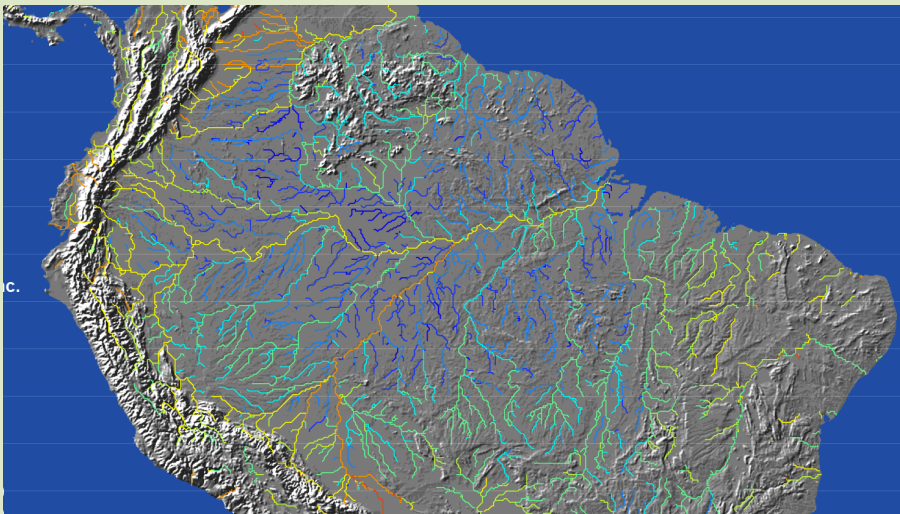
Source code exposes the scientific hypotheses embodied in a numerical model; allows for full peer review and replication of results, the foundation of modern science; and allows for reuse in new and clever ways, and reduces redundancy.



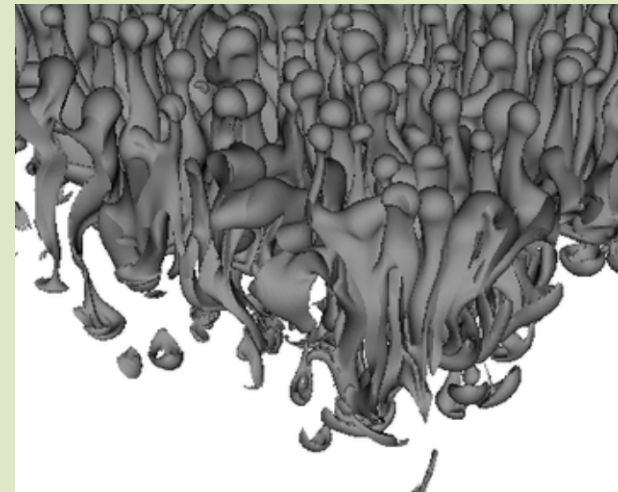


### 3) CSDMS HPCC support

Members run simulations on CU's HPCC *Beach* (8Tflop/s) & *Janus* (150Tflop/s), to: 1) advance environmental science; 2) develop open-source CSDMS models; 3) develop support services (e.g. data visualization).



Suspended sediment concentration, global, 10km resolution, daily, 50 years  
*Cohen et al., 2013, Computers & Geosciences*



Sediment-laden fresh water above salt water: non-linear simulations  
*Burns & Meiburg, in JFM*

# 4) CSDMS Education & Knowledge Products

## Real event movies

Movies in this playlist are movies that should challenge modelers in trying to capture these landscape dynamics into certain models



**Arctic coastal erosion 2010**  
by CSDMSmovie 1,776 views



**Tidewater glacier calving**  
by CSDMSmovie 240 views



**Tidal Bore China**  
by CSDMSmovie 299 views



**Tidal bore Anchorage**  
by CSDMSmovie 600 views



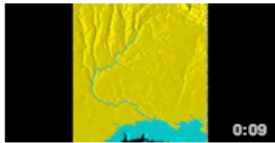
**Thaw Lake**  
by CSDMSmov

## Coastal animations

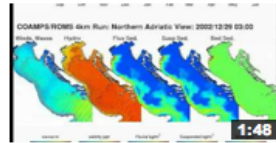
This gallery contains animations of coastal processes



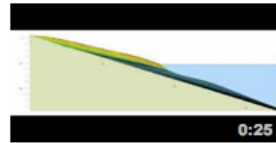
**Spit Evolution**  
by CSDMSmovie 5,321 views



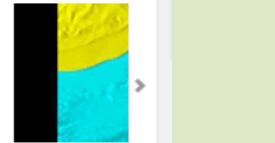
**Shelf Incision**  
by CSDMSmovie 349 views



**Sediment and Ocean processes**  
by CSDMSmovie 1,086 views



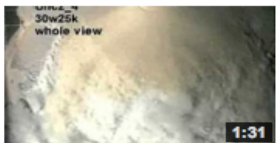
**Barrier Island**  
by CSDMSmovie 2,869 views



**Shelf Morph**  
by CSDMSmov

## Laboratory movies

Movies in this gallery show laboratory experiments that should challenge modelers in trying to capture these landscape dynamics into certain models



**Underwater Debris Flow**  
by CSDMSmovie 680 views



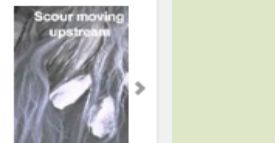
**Shoreline Transgression & Regression**  
by CSDMSmovie 1,070 views



**Sand Ripples**  
by CSDMSmovie 4,956 views



**Braided Stream Morphology**  
by CSDMSmovie 773 views

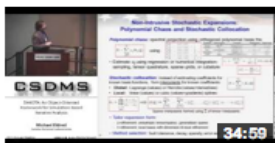


**Braided Stream delta**  
by CSDMSmov

## Recent uploads



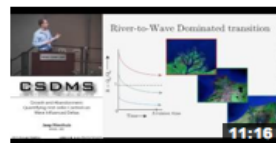
**CSDMSmeeting2013 by Michael Eltner**  
19:45



**CSDMSmeeting2013 by Michael Eltner**  
34:59



**CSDMSmeeting2013 by Wanyu Kim**  
30:15



**CSDMSmeeting2013 by Ivan Nishitani**  
11:16



**CSDMSmeeting2013 by Louis Marchetti**

CSDMS YouTube channel makes the “Top 50 most viewed channel” in the “non profit” category.

111 movies  
112,605 viewings  
(08/13)







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 Waipaoa 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/CGF/for/index.htm>

COMPUTERS & GEOSCIENCES ONLINE  
<http://www.elsevier.com/locate/cageo>

Available online at [www.sciencedirect.com](http://www.sciencedirect.com)

SciVerse ScienceDirect



0098-3004(201304)53:c;1-0

## Web stats:

**1,500 Content Pages (04/14);**  
**3,000 Uploaded Files (04/14);**  
**23 Million Views (04/14)**

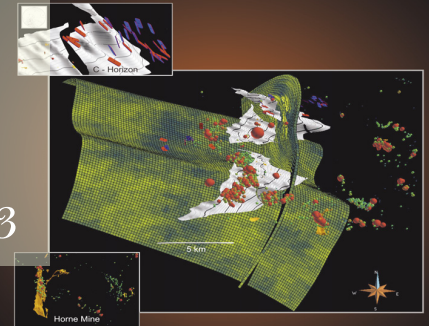


# COMPUTERS & GEOSCIENCES

AN INTERNATIONAL JOURNAL

200 Peer-reviewed  
 CSDMS papers,  
 books & book  
 chapters published  
 between 2007-2013

*Special Issue*  
 Modeling for Environmental Change  
*Guest Editors*  
 Albert J. Kettner and James Syvitski



EDITORS-IN-CHIEF  
 JEF CAERS  
 STANFORD UNIVERSITY

MICHAEL PIASECKI  
 CITY COLLEGE OF NEW YORK

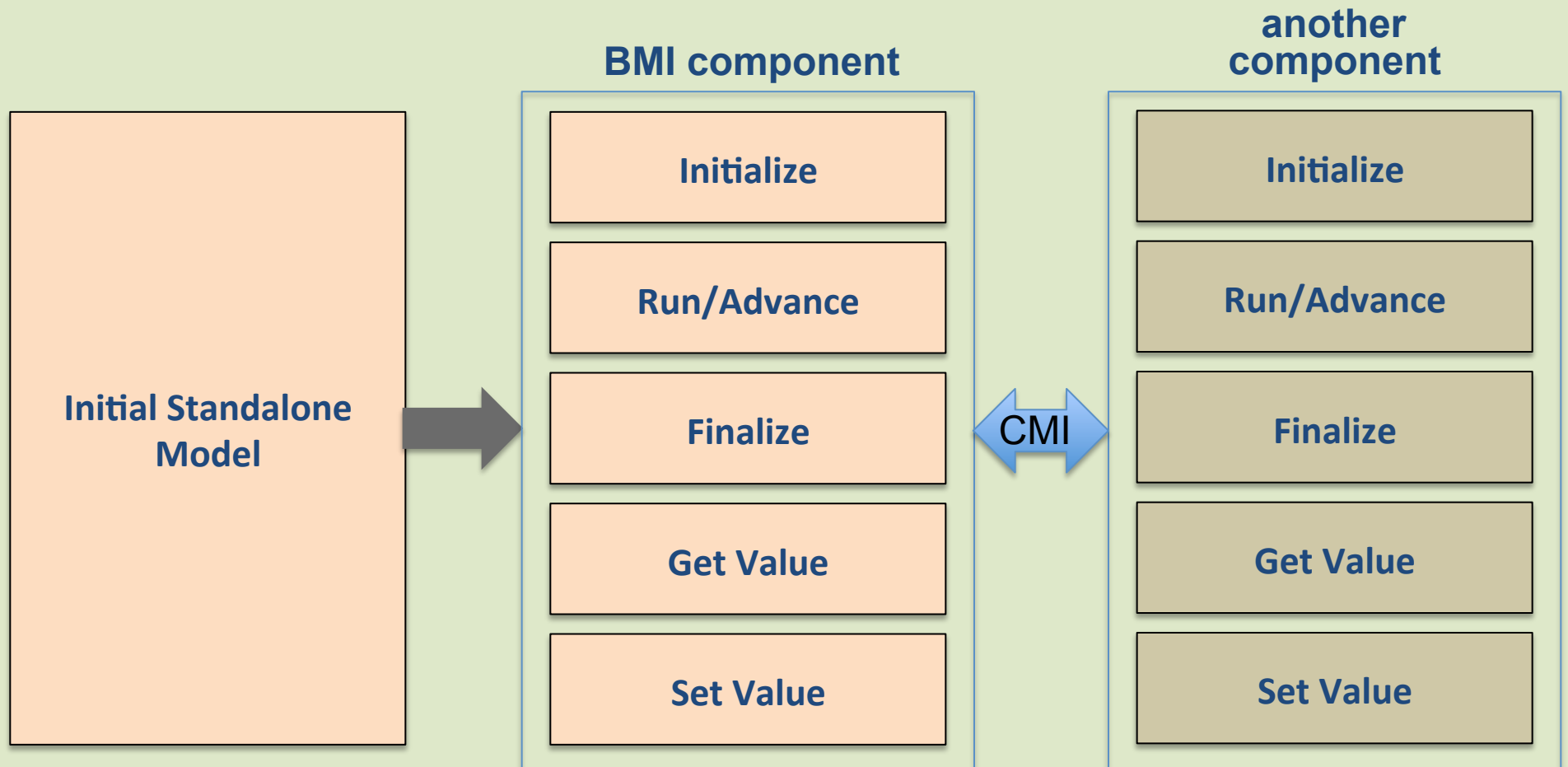


**CSDMS**

COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

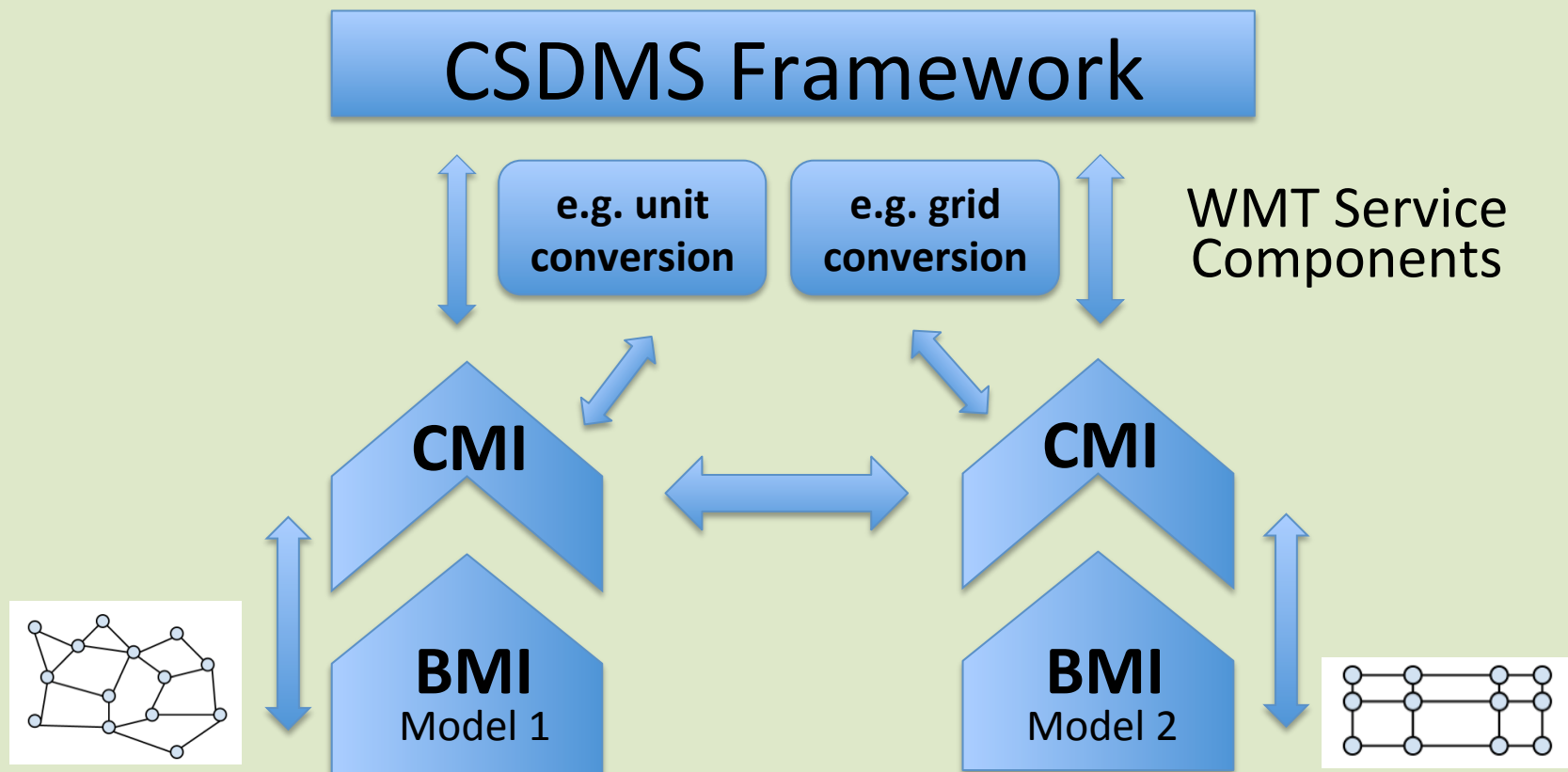
## 5) Model Coupling & Model Reuse

**CSDMS** pioneered the **Basic Model Interface or BMI** standards, a distillation of key ingredients of the main coupling systems (e.g. CSDMS, ESMF, OpenMI, OMS).



**CMI component = BMI component + CMI wrapping with Babel**

We use an automated wrapper to provide **BMI** components with a **CSDMS Component Model Interface (CMI)**, to test new components on a HPC using our Web Modeling Tool **WMT**, an environment that offers services for coupling different kinds of models.





# 6) WMT for running CSDMS-component models

## The CSDMS Web Modeling Tool

[➔ Sign In](#)

### ⚙ Model (\*Sedflux2D 1)

- ☰ Sedflux2D ▾
  - coastal\_en... ▾
    - ☰ CHILD ▾
      - coastal\_en... ↩ ▾
      - Sedflux2D ↩ ▾
      - base\_level ▾

baselevel +

### 🔧 Parameters (Sedflux2D)

Simulation run time (d)

#### Bathymetry

Use a bathymetry with a linear shelf and slope

CSV-formatted bathymetry file

Gradient of shelf (m)

Gradient of slope (m)

Width of shelf (m)

Width of model domain (m)

#### Sea Level

Use a linear rise/fall in sea level or user-defined

CSV-formatted sea-level file

Sea level at simulation start (m)

# 6) WMT for running CSDMS-component models

The CSDMS Web Modeling Tool

Email  Password  [Sign In](#)

**Model (\*Sedflux2D 1)**

**Sedflux2D**

- Show parameters
- Get information
- Delete

**Sedflux2D v2.1 (10.1594/IEDA/100161)**

Basin filling stratigraphic model. Sedflux2d simulates longterm marine sediment transport and accumulation into a 2D longitudinal basin over time scales of tens of thousands of years. It simulates the dynamics of strata formation of continental margins and includes turbidity currents and debris flows.

[http://csdms.colorado.edu/wiki/Model\\_help:Sedflux](http://csdms.colorado.edu/wiki/Model_help:Sedflux)

Model developer: Eric Hutton

**Parameters (Sedflux2D)**

Simulation run time (d)

*Bathymetry*

linear

sedflux2d\_bathy.csv

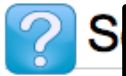
*Sea Level*

Use a linear rise/fall in sea level or user-defined

CSV-formatted sea-level file

Sea level at simulation start (m)

*baselevel*



SEDFLUX  
tens of the  
regional g  
estimates

### Model i

Sedflux co  
continenta  
The new v  
stratigraph  
along a riv  
include (1  
The spatia  
mode, the  
event-bas

$$t(x, y) = \frac{u_0 + u_c(x) + 7u(x, y)}{9} \quad (10)$$

$$u_c(x) = u_0 \sqrt{\frac{b_0}{\sqrt{\pi} C_1 x}} \quad (11)$$

$$u(x, y) = u_0 \sqrt{\frac{b_0}{\sqrt{\pi} C_1 x}} \exp\left[-\left(\frac{y}{\sqrt{2} C_1 x}\right)^2\right] \quad (12)$$

- Diffusion of seafloor sediments

- 1) Amount of bottom sediments that can be reworked by resuspension and diffusion

$$q_s = k(t, z, D) \nabla z = k \left( \frac{\partial z}{\partial x} \hat{i} + \frac{\partial z}{\partial y} \hat{j} \right) \quad (13)$$

- 2) Amount and direction of transport of the  $i$ th grain size

$$q_{si} = \beta_i q_s \quad (14)$$

- Sediment failure

- 1) Stability of a possible failure plane

$$F_{total} = \frac{\sum_{i=0}^N [b_i (c_i + (\frac{W_i}{b_i} - u_i) \tan \phi_i) \frac{\sec \alpha_i}{1 + \frac{\tan \alpha_i \tan \phi_i}{F_{total}}}]}{\sum_{i=0}^N W_i \sin \alpha_i} \quad (15)$$

- 2) excess pore pressure using Gibson's graphical approximation (1958)

$$u_i = \frac{\gamma' z_i}{a_i} \quad (16)$$

$$a \equiv 6.4 \left(1 - \frac{T}{16}\right)^{(17)} + 1 \quad (17)$$

$$T \equiv \frac{m^2 t}{c_v} \quad (18)$$

- River mouth turbidity currents

$$\frac{\partial u}{\partial t} = q_0 \sin \alpha C - \frac{E + C_d}{\rho} u^2 - q_0 \left( \frac{e^C - 1}{C} \right) \cos \alpha C \tan \gamma$$

### Model p

Input

---

Param

---

Input  
directo

---

Site p

---

Case p

### Uses p

This will b

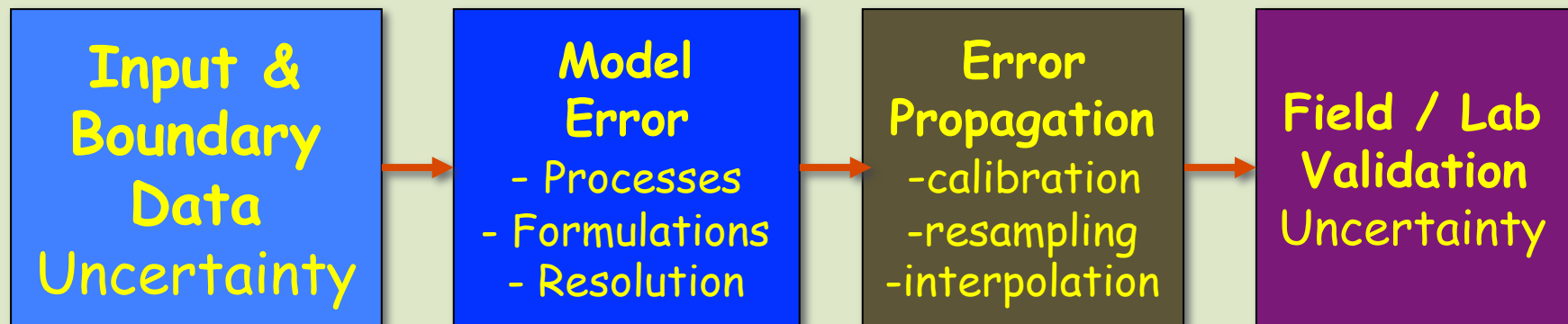
### Provide

This will b

### Main ec



## 7) Model Uncertainty:



### A Multilevel Parallel Object-Oriented Framework for:

- Design Optimization
  - Parameter Estimation
  - Uncertainty Quantification
  - Sensitivity Analysis
- 
- Working and Focus Research Groups to discuss

**DAKOTA Clinic  
& Uncertainty  
Discussion**

## 8) Model Intercomparison Experiments

- **CSDMS** offers the **WMT** framework for Users to ascertain the strengths & weaknesses of apparently similar models.
- Model Intercomparison Projects (**MIPs**) require :
  - ✧ **community involvement re: MIP data, and to help design the intercomparison experiments,**
  - ✧ **enhanced WMT functionality to ingest benchmark data & associated metadata,**
  - ✧ **software extensions for model components to ingest MIP data,**
  - ✧ **conversion of MIP data to new formats e.g. NetCDF.**
- **Working and Focus Research Groups to discuss**

## 9) The CSDMS Standard Names

Easily understood standard variable names set according to 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

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



# 9) Observational Targets for Modeling Exercises



Freemont Cu  
Mine Overspill



Ucayali R  
meanders



Mississippi  
Subsidence

## 9) Observational Targets for Modeling Exercises

# 2014 Annual Meeting Agenda

Tuesday	Wednesday	Thursday	Friday
Welcome talks	Keynotes (3)	Keynotes (3)	ExCom Meeting
Keynotes (2)	Clinics (4)	Uncertainty Disc (4)	SC Meeting
Gp Discussions (4)	Lunch	Lunch	Lunch
Lunch	MIPS Disc (4)	Keynotes (1)	
Clinics (3)	Keynotes (2)	Clinics (3)	
Keynotes (3)	Posters	Reports & Wrap-Up	
Posters	Banquet	Departures	



## 2014 Annual Meeting Goals

- 1) **State-of-the-Art Surface Dynamics Modeling** — posters & presentations
- 2) **Modeling Clinics:** *WMT, VSL3D, Carbo Suite, BMI & Standard Names, SNAC, Agent-based Modeling, IDA-Python, Veg Channels, ROMS, Landlab, Dakota*
- 3) **Set CSDMS' Group Goals and Activities** — focus on
  - i) increasing the number of BMI components,
  - ii) advancing sub-discipline fields through MIPs, and
  - iii) understanding model component uncertainty.
- 4) **Fostering of a Community**— Honors, Awards, and fun!