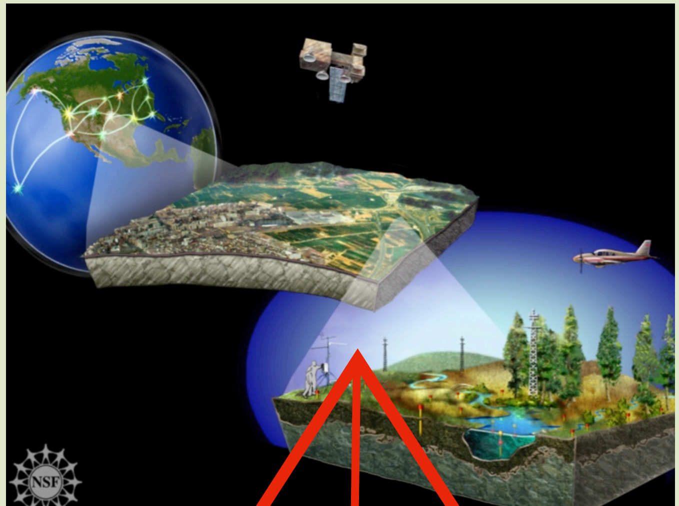
The **Community Surface Dynamics Modeling System** develops, integrates, archives & disseminates software to define the earth's surface dynamics

James Syvitski, CSDMS Executive Director

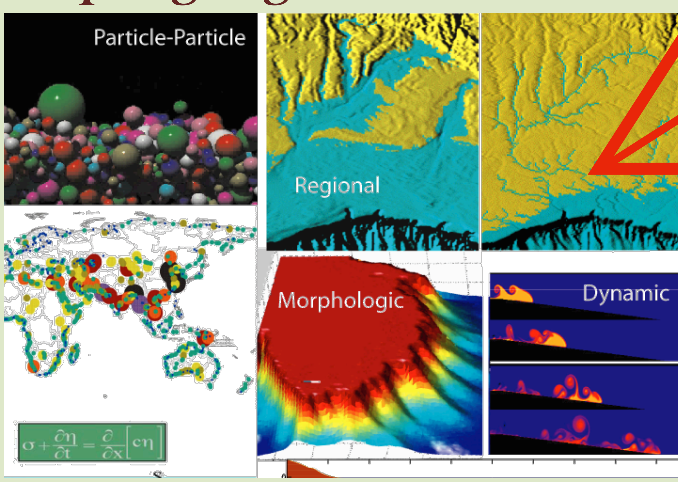
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

Addressing 21st Century Environmental Infrastructure

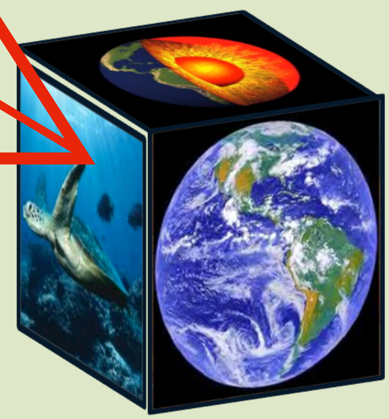


1) Sensing / Observing the Environment E.g. NEON, CZO

3) Model Development & Coupling E.g. CSDMS

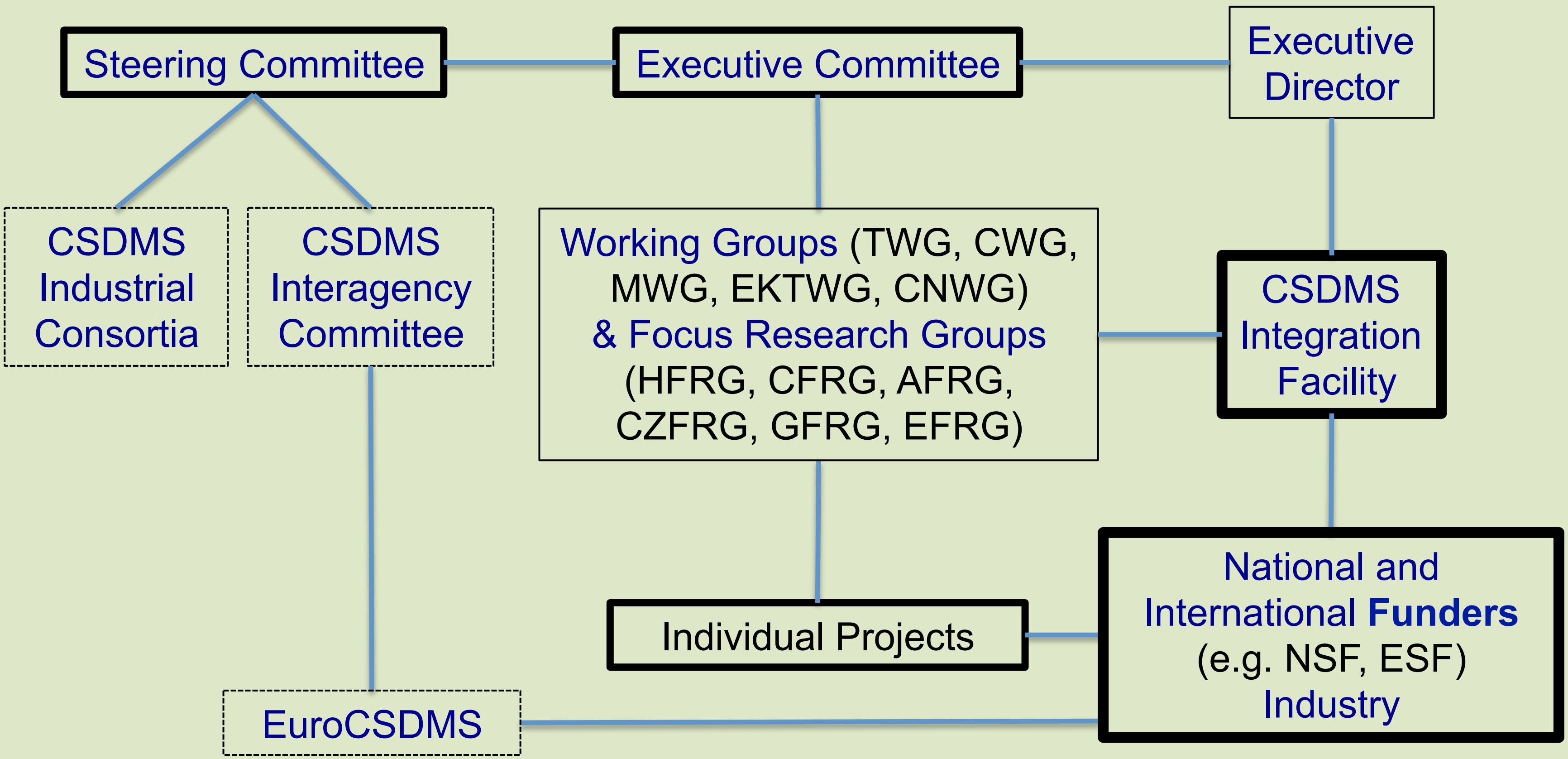


Detection
Prediction
Services



2) Big Data E.g. EarthCube

CSDMS Governance Structure



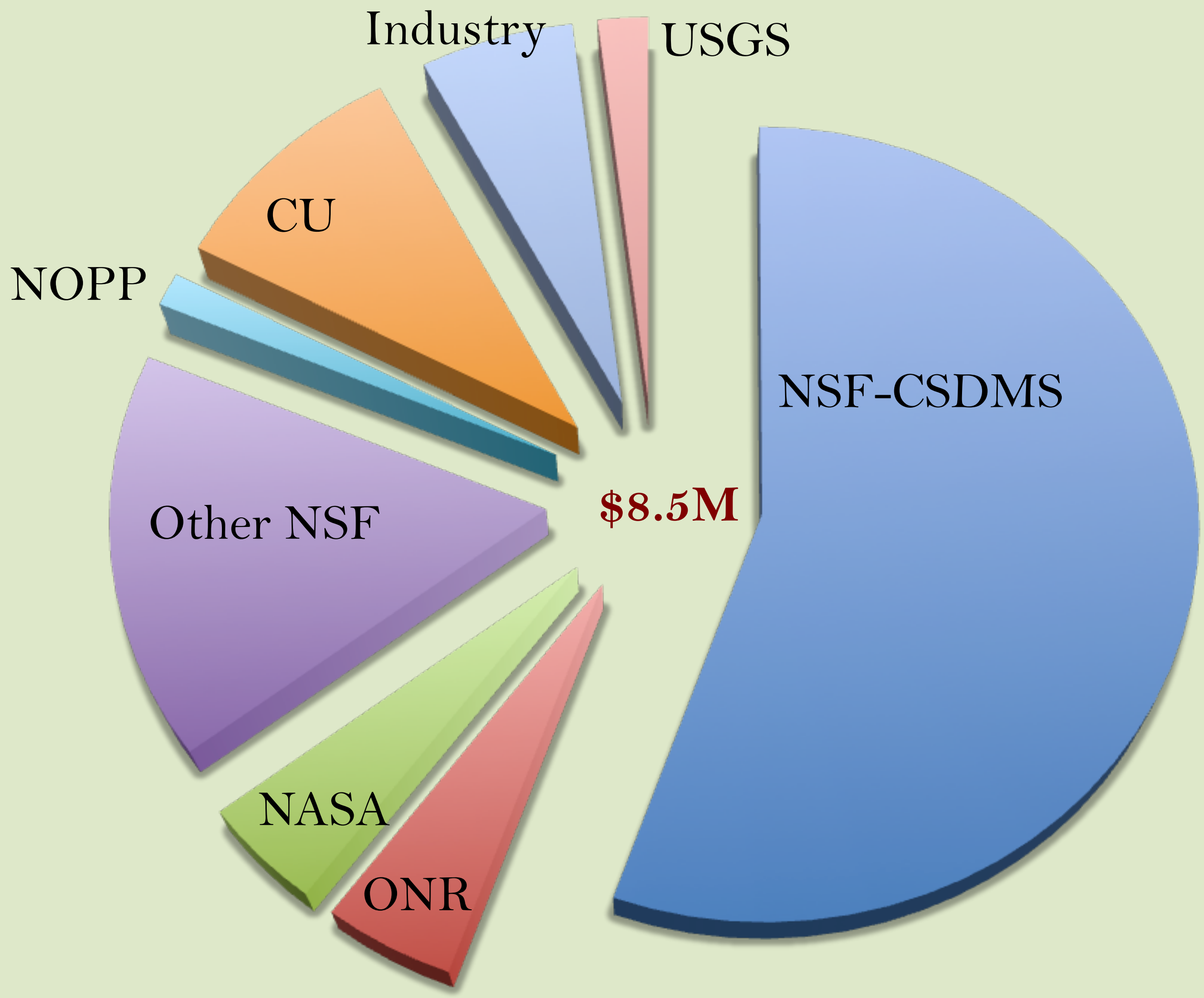
Working Groups, Focus Research Groups, Initiatives

Terrestrial	540
Coastal	420
Hydrology (CUAHSI)	400
Marine	280
Cyber	170
EKT	180
Carbonate (NSF/SPP)	70
Chesapeake (CCMP)	50

Critical Zone (NSF/CZO)	20
Geodynamics (NSF/GeoPRISMS)	50
Anthropocene (IGBP, CoMSES)	20

Earth - Ecosystem Initiative
Coastal Vulnerability Initiative
Continental Margin Initiative

CSDMS1.0 Integration Facility Funding 2007-2012



NSF-CSDMS2.0 Funding 2012-17 $4.5M

1) CSDMS capacity building and community networking

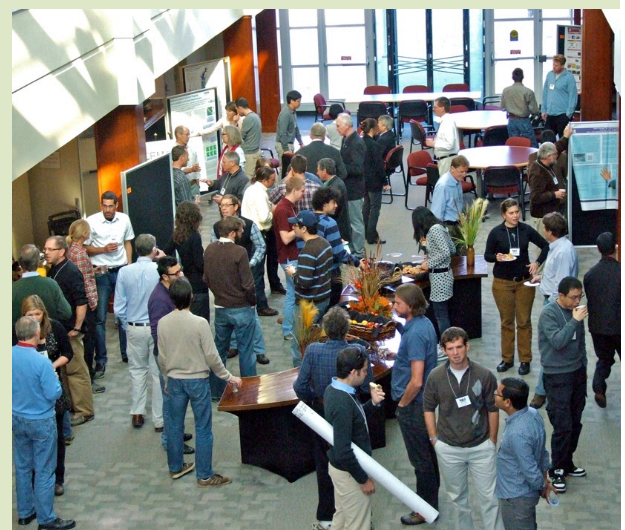
(04/07 to 04/13)

177 CSDMS workshops, symposia

216 CSDMS Staff presentations

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

36 CSDMS Instructional Clinics



Annual Lifetime Achievement Award

Annual Student Award

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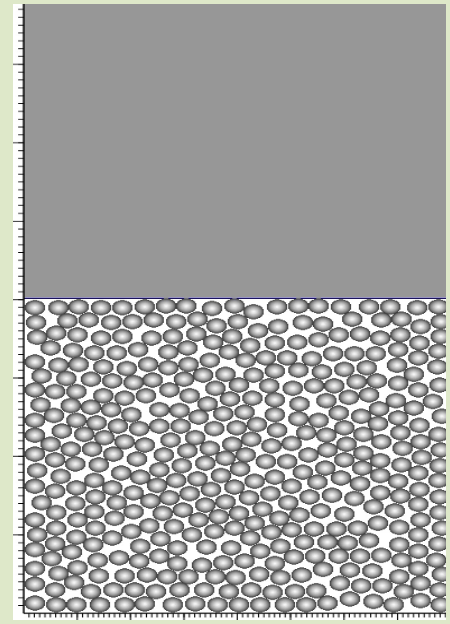
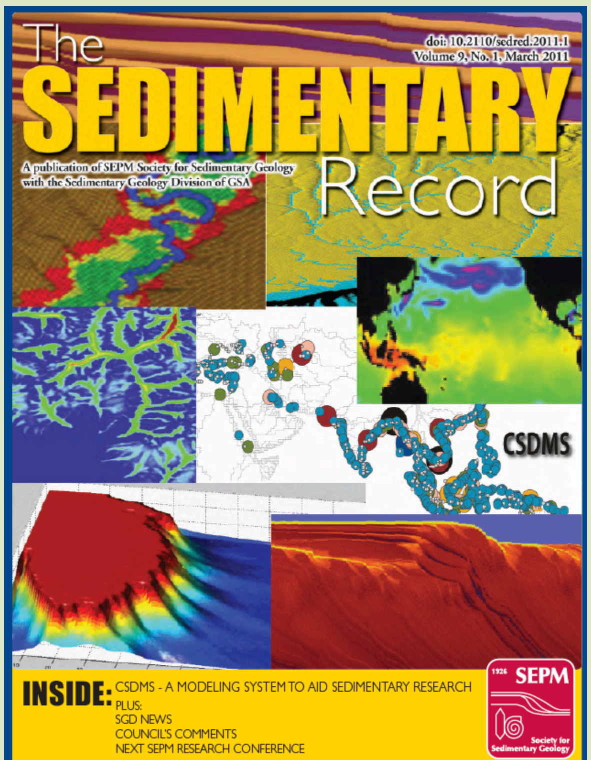
2) Open-source Model Repository

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.

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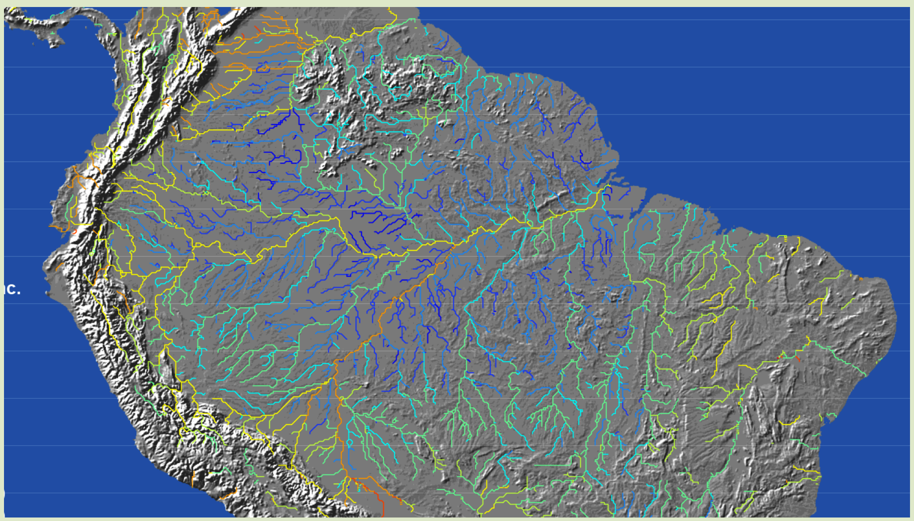
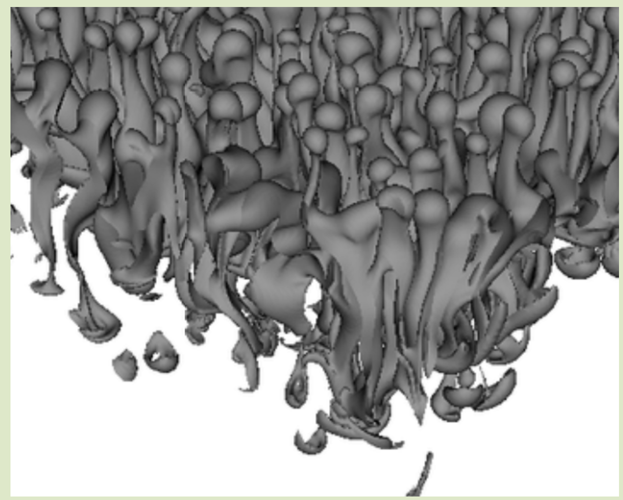
3) CSDMS HPCC support

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

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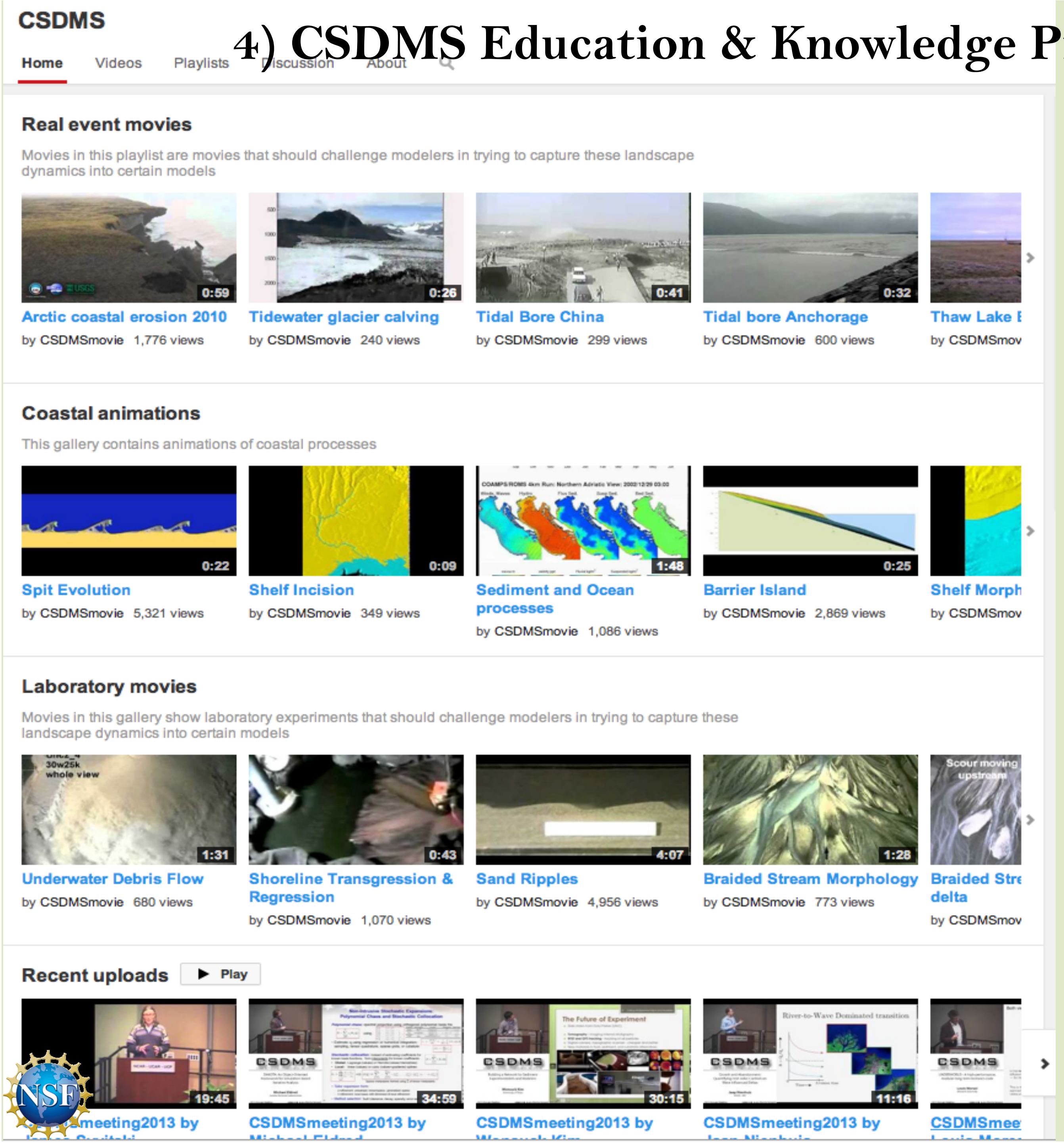
4) CSDMS Education & Knowledge Products



CSDMS YouTube channel makes the **"Top 50 most viewed channel"** in the **"non profit" category.**

111 movies
112,605 viewings
(08/13)

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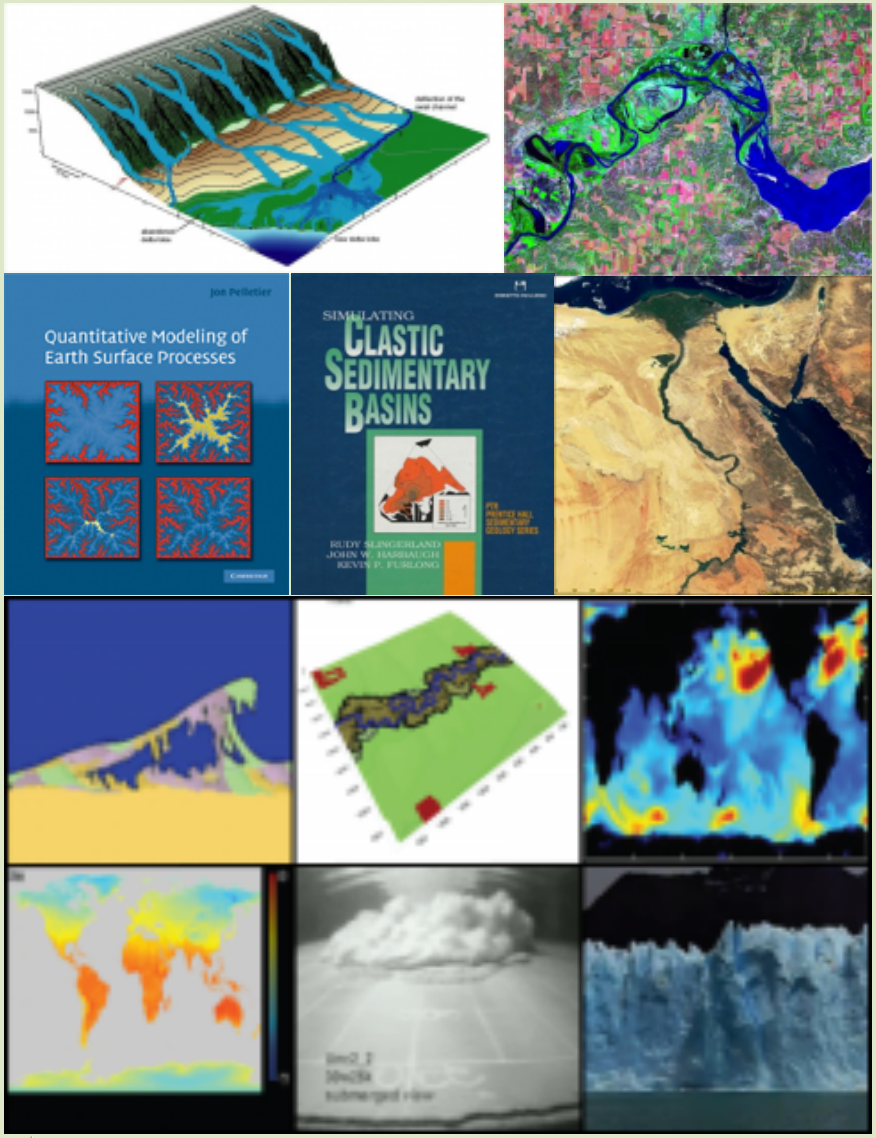
4) CSDMS Education Products & Services



- ✧Student labs (16+)
- ✧Modeling short courses (8+)
- ✧Lectures (250+)
- ✧Textbooks (5)
- ✧Global domain datasets (69+)

Integration Facility Training

- ✧ 10 grads,
- ✧ 2 undergrads,
- ✧ 3 PDFs,
- ✧ 70 Visiting Scientists

NSF

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

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

Available online at www.sciencedirect.com

SciVerse ScienceDirect

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

COMPUTERS & GEOSCIENCES Vol. 53 (2013) 1–162

3 CSDMS C&G Special Issues

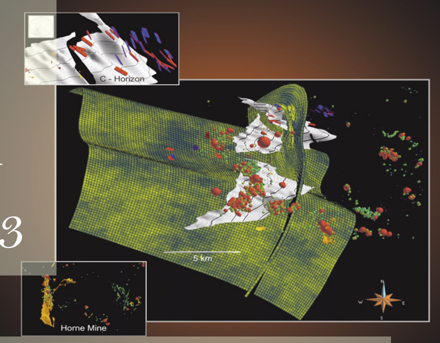
COMPUTERS & GEOSCIENCES

AN INTERNATIONAL JOURNAL

Special Issue
Modeling for Environmental Change

Guest Editors
Albert J. Kettner and James Syvitski

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



Web stats:

1,500 Content Pages (04/14); 7,700 Total Pages (04/14)

3,000 Uploaded Files (04/14); 208,000 Page Edits (04/14)

23 Million Views (04/14)

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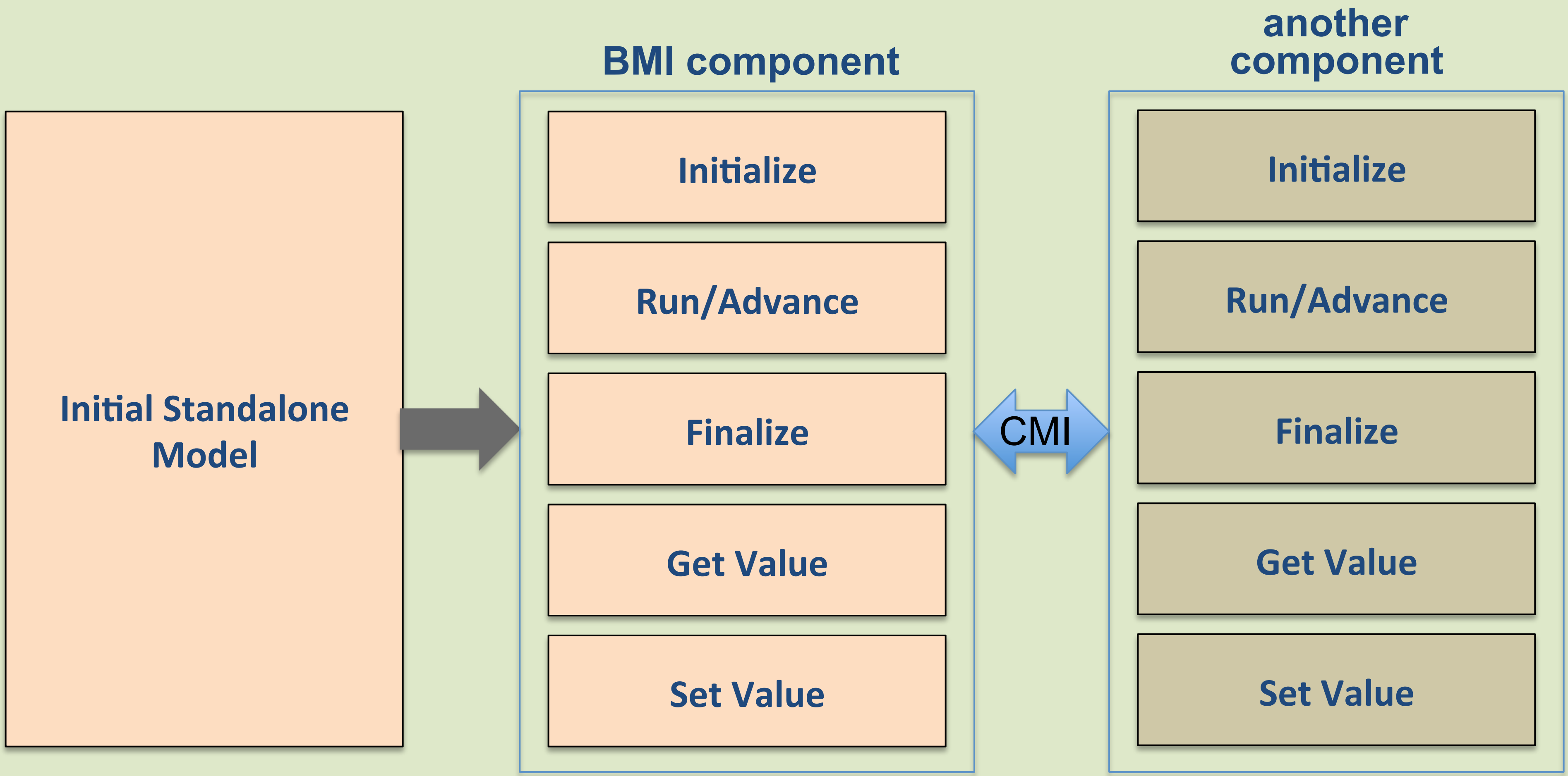
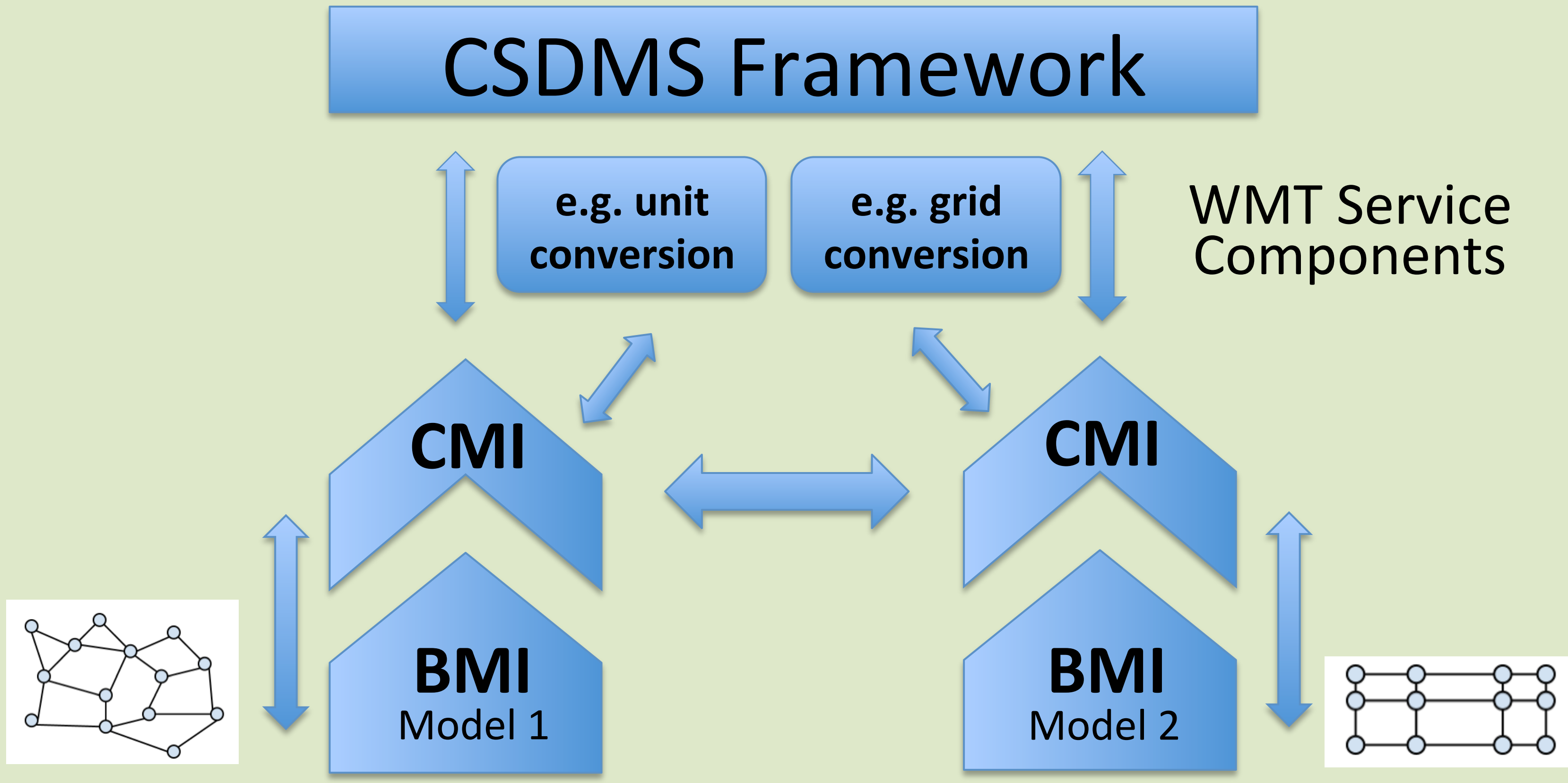
5) Model Coupling & Model Reuse

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).



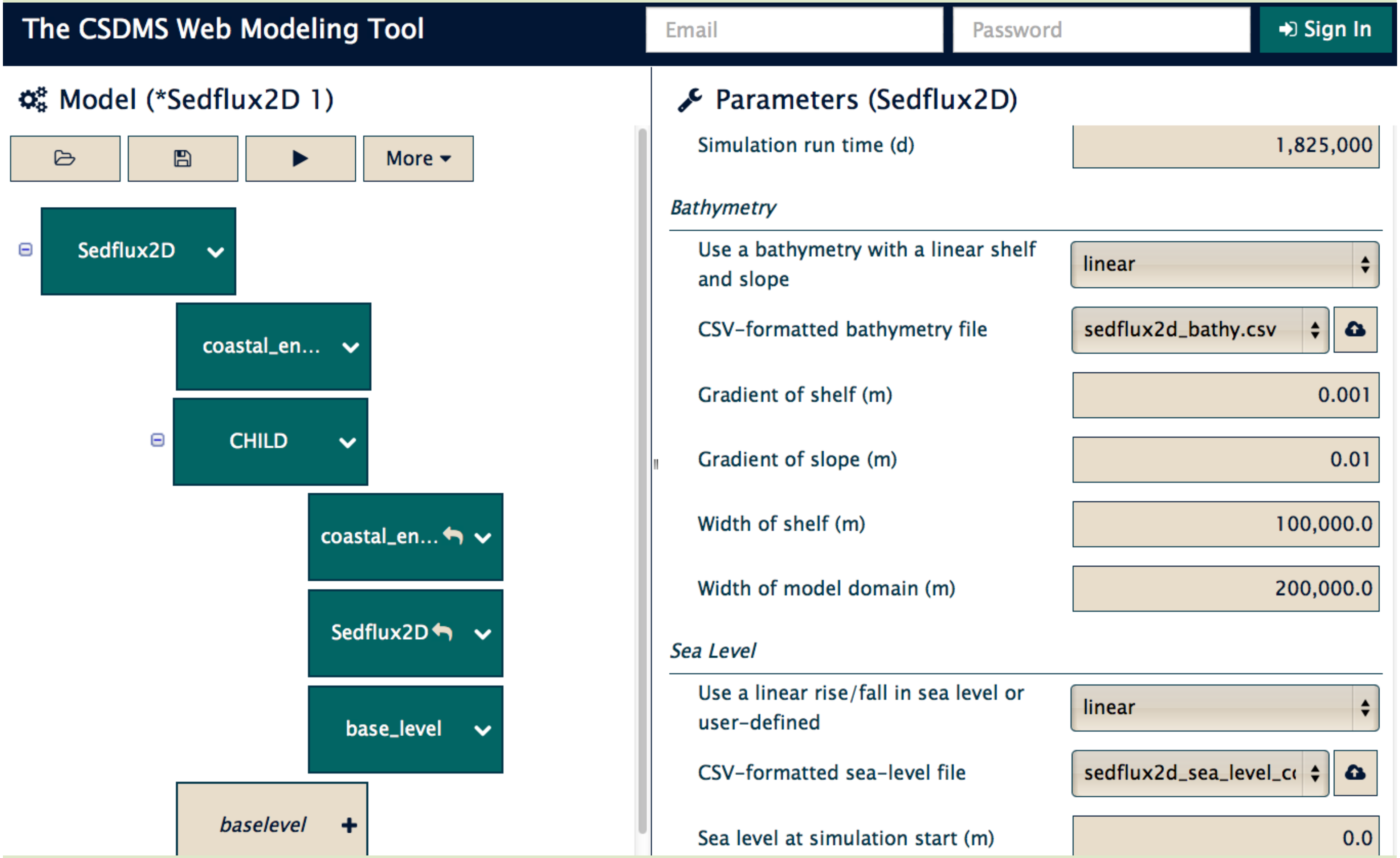
CMI component = BMI component + CMI wrapping with **Babel**

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

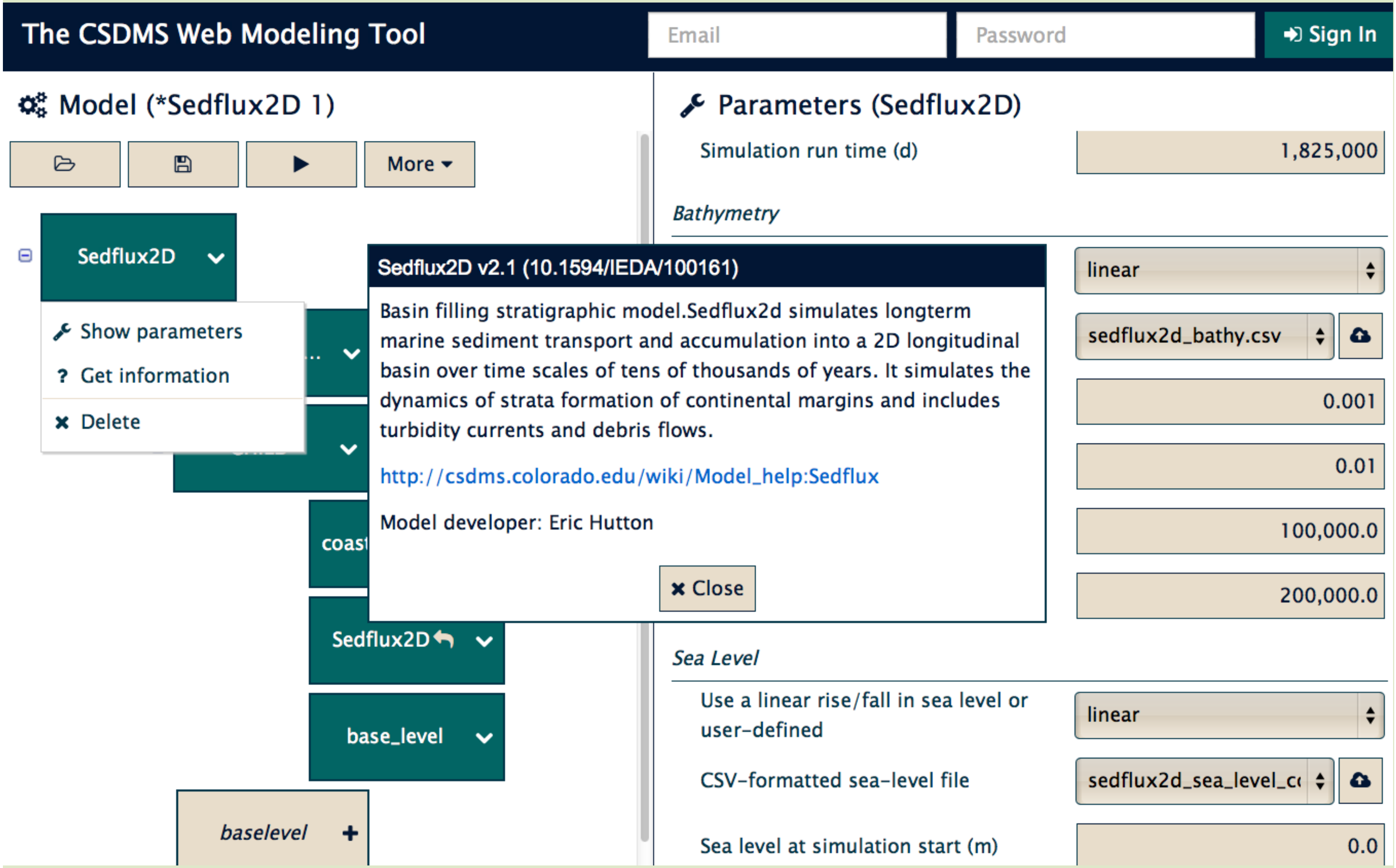


BMI Clinic

6) WMT for running CSDMS-component models



6) WMT for running CSDMS-component models



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

$$u_c\left(x\right)=u_0\sqrt{\frac{b_0}{\sqrt{\pi}C_1x}} \quad (11)$$

$$u\left(x,y\right)=u_0\sqrt{\frac{b_0}{\sqrt{\pi}C_1x}}exp[-\left(\frac{y}{\sqrt{2}C_1x}\right)^2] \quad (12)$$

- Diffusion of seafloor sediments

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

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

2) Amount and direction of transport of the ith grain size

$$q_{si}=\beta_iq_s \quad (14)$$

- Sediment failure

1) Stability of a possible failure plane

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

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

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

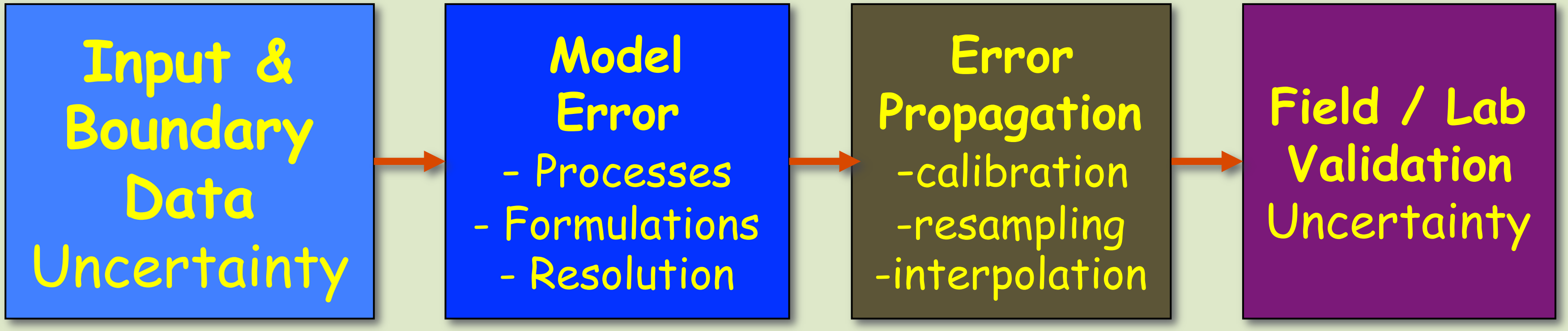
$$a\equiv 6.4\left(1-\frac{T}{16}\right)^{(17)}+1 \quad (17)$$

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

- River mouth turbidity currents

$$\frac{\partial u}{\partial \ldots}=g_0sin\alpha C-\frac{E+C_d}{\ldots}u^2-g_0\left(\frac{e^C-1}{\ldots}\right)cos\alpha Ctan\gamma \quad (19)$$

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 (**MIP**s) 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**

MIP Discussion

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

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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	

NSF CSDMS COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

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!

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