

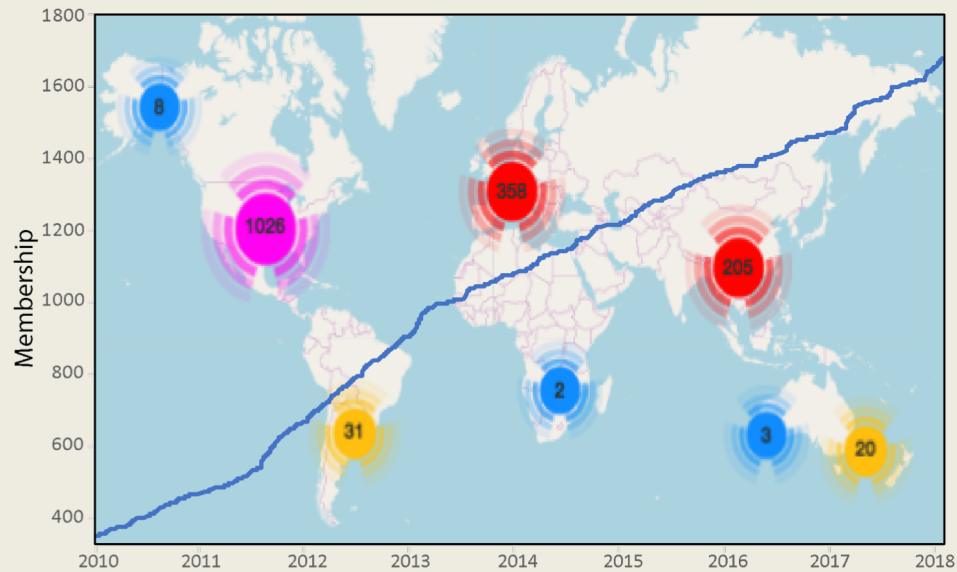


CSDMS
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

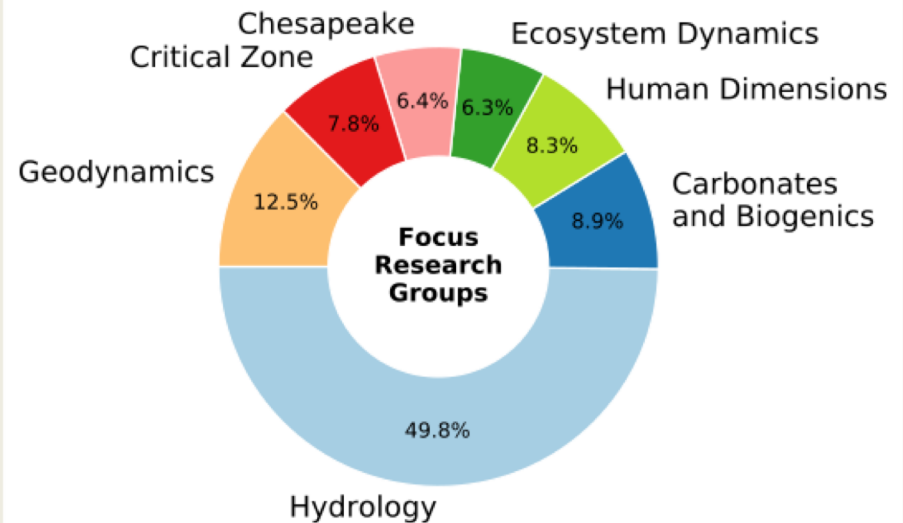
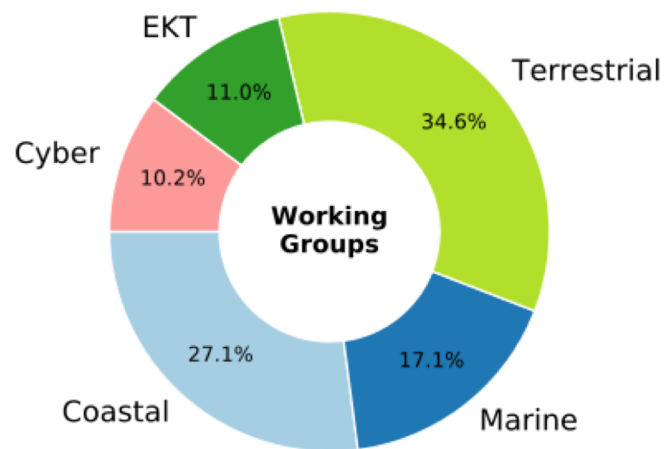
CSDMS Tools for Flood Modeling

Greg Tucker, CSDMS Executive Director
CIRES and Department of Geological Sciences
University of Colorado, Boulder

CSDMS community



~1,740 members



CSDMS supports computational modeling in earth-surface science by engaging ***community***, developing ***computing*** resources, and promoting ***education***

*share resources,
collaborate*



**COMMUNITY
SUPPORT**

*create, run, test, analyze,
and apply models*



**COMPUTING
RESOURCES**

learn and teach



**EDUCATION
OPPORTUNITIES**

WEB PORTAL AND MODEL REPOSITORY



CSDMS
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

Community ▾ Models ▾ Education ▾ Products ▾ Services ▾ About ▾

Search CSDMS

CSDMS Model repository

- [Watch this movie](#) to learn about the full functionality of the model repository.
- And [here are some options](#) if you would like to publish your code.

All models

Number of models: 225, Number of tools: 87, WMT compliant: 35

Type: All of the models mentioned below

Terrestrial models

Number of models: 100

Type: Landscape evolution, groundwater models

Coastal models

Number of models: 10

Type: Coastline evolution, wave refraction models

Hydrological models

Number of models: 74

Type: Hydrologic models

Program	Description
Anuga	ANUGA is a hydrodynamic modelling tool that allows users to model complex 2D geometries.
AnugaSed	Add-on package to ANUGA with modules for sediment transport
Avulsion A.k.a. Debouche	Stream avulsion model
Badlands	Basin and landscape dynamics
CREST	The Coupled Routing and Excess Storage (CREST) model is a model developed to simulate the spatial and temporal variation of atmospheric subsurface water fluxes and storages by cell-to-cell simulations.
CVFEM Rift2D	multi-physics numerical model that simulates rock deformation, transfer in response to ice sheet loading of multiple cycles
DHSVM	DHSVM is a distributed hydrologic model that explicitly represents vegetation on water fluxes through the landscape.
DLBRM	Distributed Large Basin Runoff Model
DR3M	Distributed Routing Rainfall-Runoff Model--version II
Delft3D	3D hydrodynamic and sediment transport model
EF5	Ensemble Framework For Flash Flood Forecasting

Fiamig, Zac

Examples of hydrodynamic models in CSDMS repository:

- Anuga / AnugaSed
- Delft3D
- GEOCLAW
- TELEMAC
- DHSVM
- VIC
- DLBRM
- DR3M
- OverlandFlow
- PRMS
- TopoFlow

MEETINGS AND WORKSHOPS

Geoprocesses, geohazards - CSDMS 2018

May 22-24th 2018 in Boulder Colorado, USA





EDUCATION OPPORTUNITIES

RESOURCES FOR EDUCATORS

CSDMS
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

Community ▾ Models ▾ Education ▾ Products ▾

Webinars
Movies
Labs
Lectures
Textbooks
Science on a Sphere
Images
Contribute

7	8	9
4	SOURCE CELL	6
1	2	3

Hydrology and Flow Routing
Learn about flow routing over a landscape and basic algorithms for numerical modeling of combined hillslope and river sediment transport processes. [WMT Modeling Exercise on flow routing](#)

Stream Response to Rain
Introduction to hydrological process modeling. Learn about stream responses to different rainfall events. Explore hydrographs. [Modeling Stream Response to Rainfall](#)

RESOURCES FOR LEARNING

CSDMS
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

Programming with Python

The best way to learn how to program is to do something useful, so this introduction to Python is built around a common scientific task: data analysis.

Our real goal isn't to teach you Python, but to teach you the basic concepts that all good scientific programming depends on. We use Python in our research because:

1. we have to use something for examples;
2. it's free, well-documented, and runs almost everywhere;
3. it has a large (and growing) user base among scientists; and
4. experience shows that it's easier for novices to learn than most other languages.

We are ultra-idiographic as examples in this set of lessons. > All Parentheses (printed) >> Learners need to understand

Get Started with Python

These lessons cover the basics of using Python 2.7 for numerical modeling. Some previous experience in s helpful but not necessary. [Python Tutorial](#)

Upcoming webinars

Date	Time	Presenter	Title	
2018/10/09	10:00 am MDT	Overeem, Irina	Using CSDMS in the Classroom	Register
2018/11/12	10:00 am MST	Piper, Mark	CSDMS Basic Model Interface (BMI)	Register

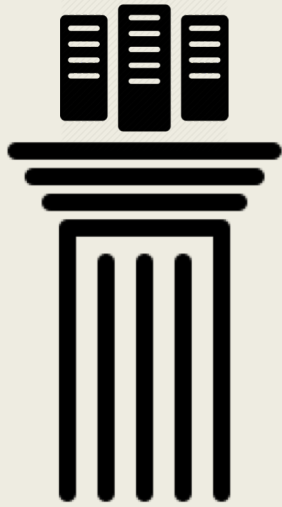
Watch past webinars

Date	Presenter	Title
2018/09/14	Tucker, Greg	Landlab Toolkit overview

Post-conference hackathon

CSDMS will host a one-day post-conference hackathon on Friday May 26th, 2017, organized by Eric Hutton and Mark Piper.

HIGH-PERFORMANCE COMPUTING FACILITY



COMPUTING RESOURCES

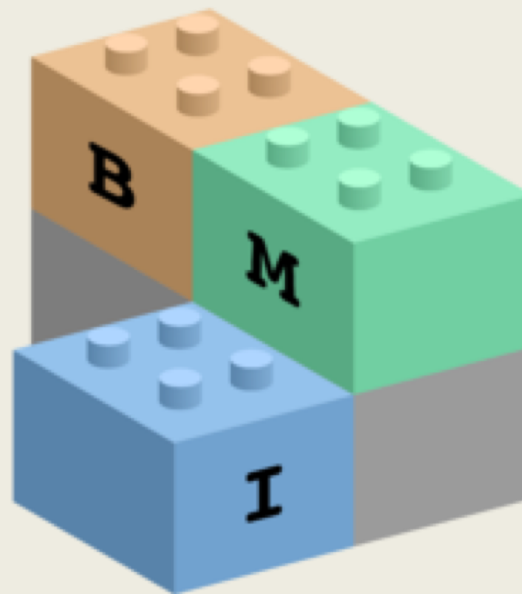
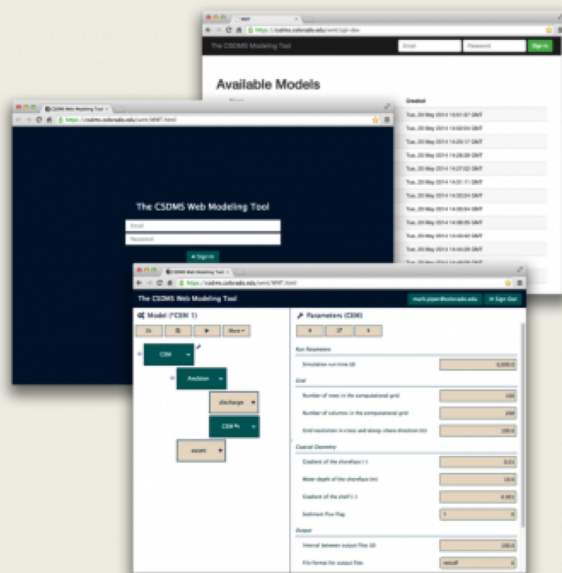
Hardware

CSDMS has purchased compute nodes that operate as part of the *Blanca* cluster. The specifications for the CSDMS nodes are:

- 2x 14-core 2.4 GHz Intel “Broadwell” processors
- 128 GB RAM at 2400 MHz
- 1x 1 TB 7200 RPM hard drive
- 10 gigabit/s Ethernet

As of 10/02/2018, CSDMS owns 2 compute nodes and has the intention to expand this by at least 2 nodes for the 2018 academic year. In addition to these nodes, CSDMS members also have access to the larger cluster based on current usage.

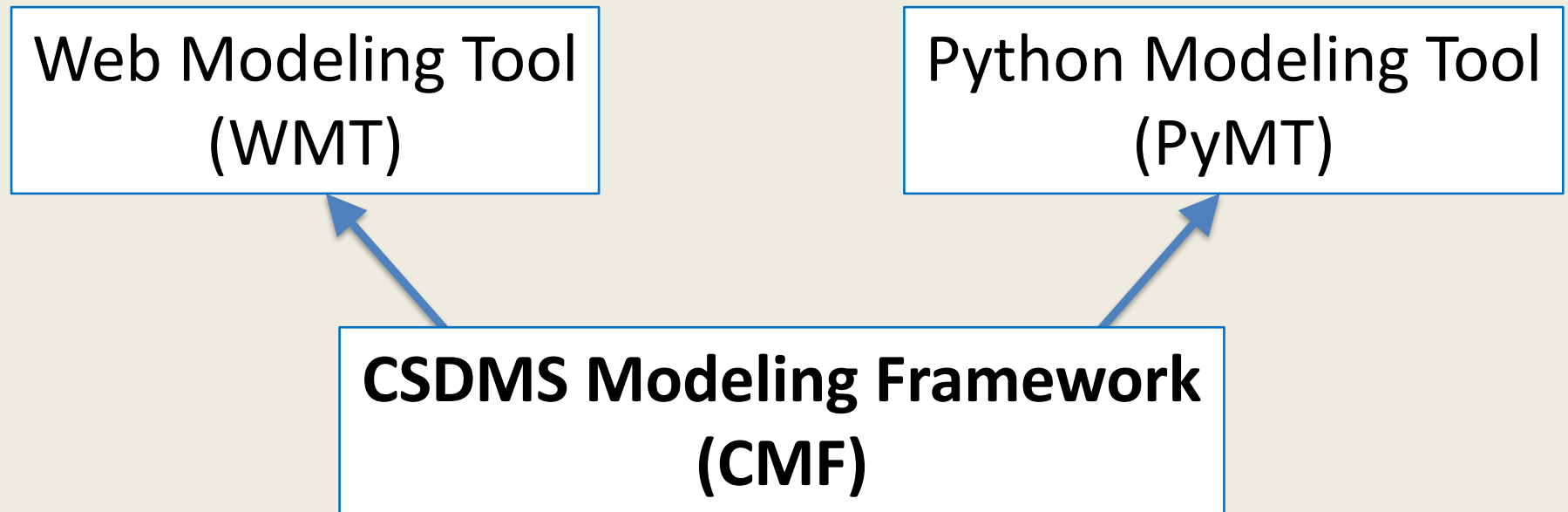
MIDDLEWARE FOR RUNNING AND COUPLING MODELS: *PLUG-AND-PLAY*



PyMT



CSDMS component-based modeling tools



Model codes become **components**:

- Can be run stand-alone or coupled to other components
- Framework provides *service components*, e.g., for re-gridding

Supported languages:

- C / C++
- Fortran
- Python
- Java

Web Modeling Tool

<https://csdms.colorado.edu/wmt/>

The CSDMS Web Modeling Tool

Model (CEM + Waves + Avulsion + RiverIO)

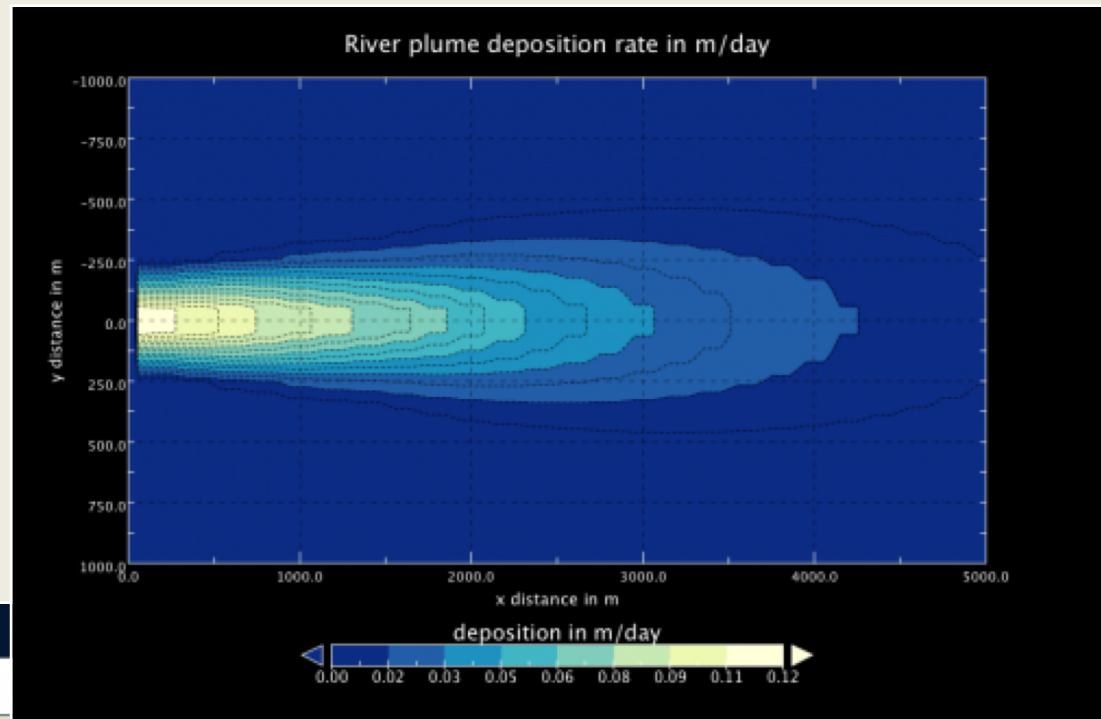
CEM Avulsion River CEM Waves

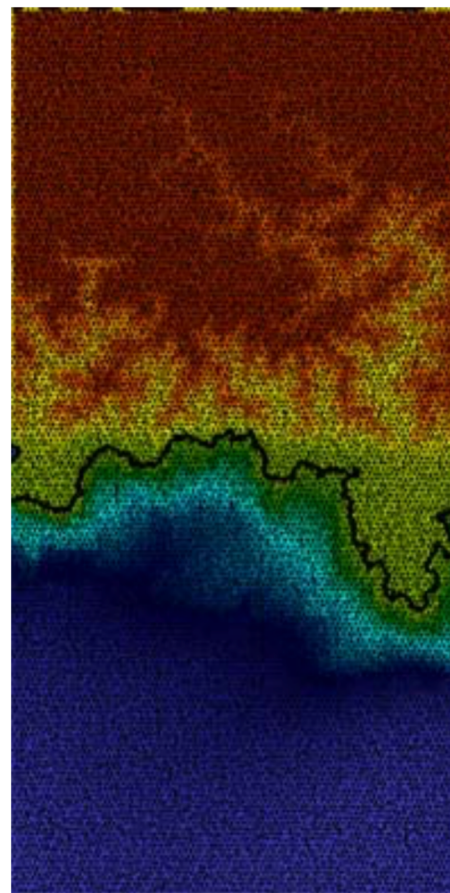
Open Model...

Available models: CEM + Waves + Avulsion + | Labels

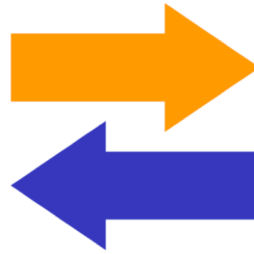
owner: Irina.overeem@gmail.com
creation date: 2015-05-22T13:06:02

Open Cancel

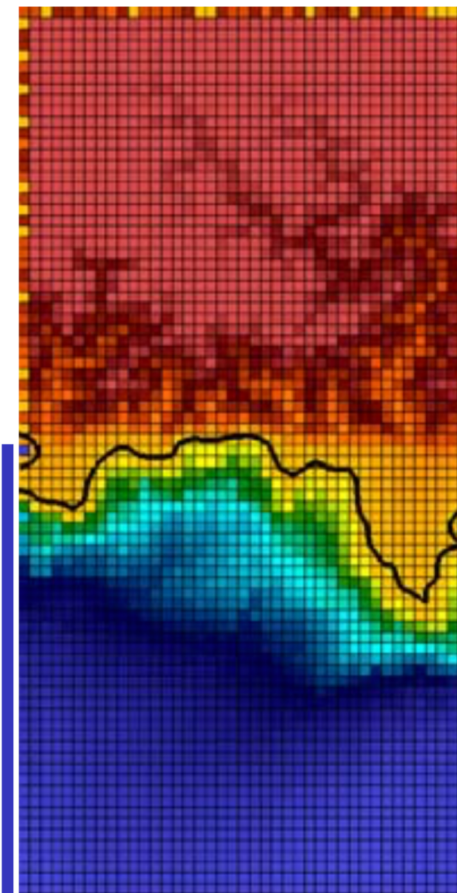




CHILD erodes the landscape and routes sediment to the coast...



...**Sedflux** distributes the sediment to the ocean and builds deltas.



```
from pymt.components import Sedflux3D, Child
```

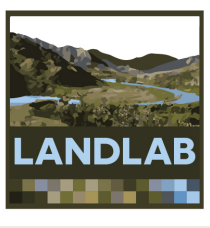
```
child = Child()
sedflux = Sedflux3D()
```

```
child_in, child_dir = child.setup('_child',
                                   grid_node_spacing=500.,
                                   grid_x_size=40000.,
                                   grid_y_size=20000.,
                                   run_duration=1e6)

sedflux_in, sedflux_dir = sedflux.setup('_sedflux',
                                         river_bed_load_flux=0.,
                                         river_suspended_load_concentration_0=.001,
                                         river_suspended_load_concentration_1=.001,
                                         run_duration=1e6 * 365.)
```

```
child.initialize(child_in, dir=child_dir)
sedflux.initialize(sedflux_in, dir=sedflux_dir)
```

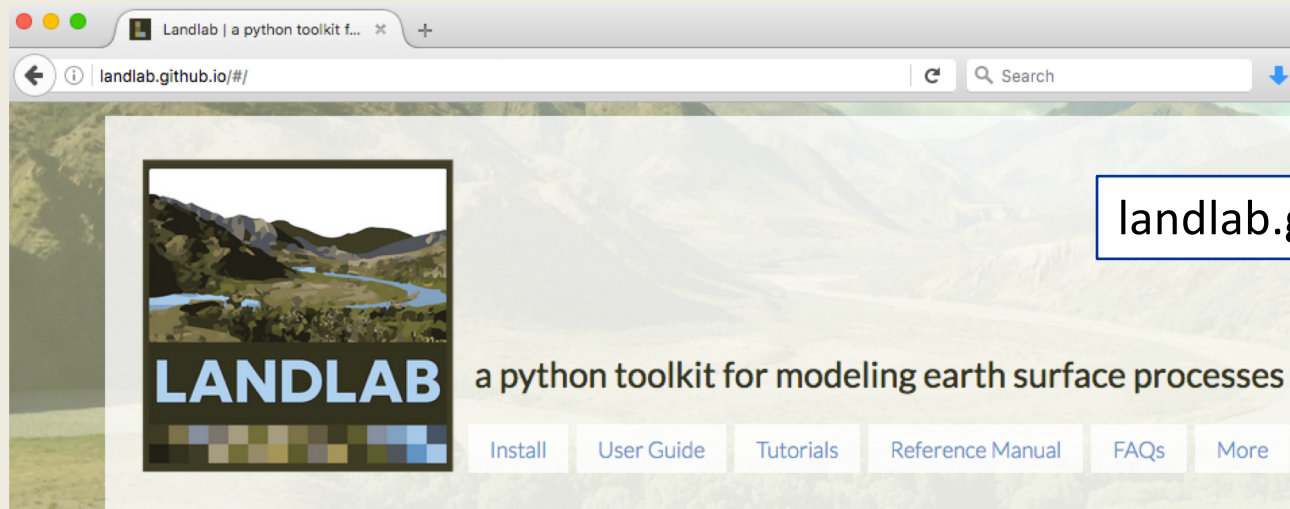
PyMT: the Python Modeling Tool



LANDLAB

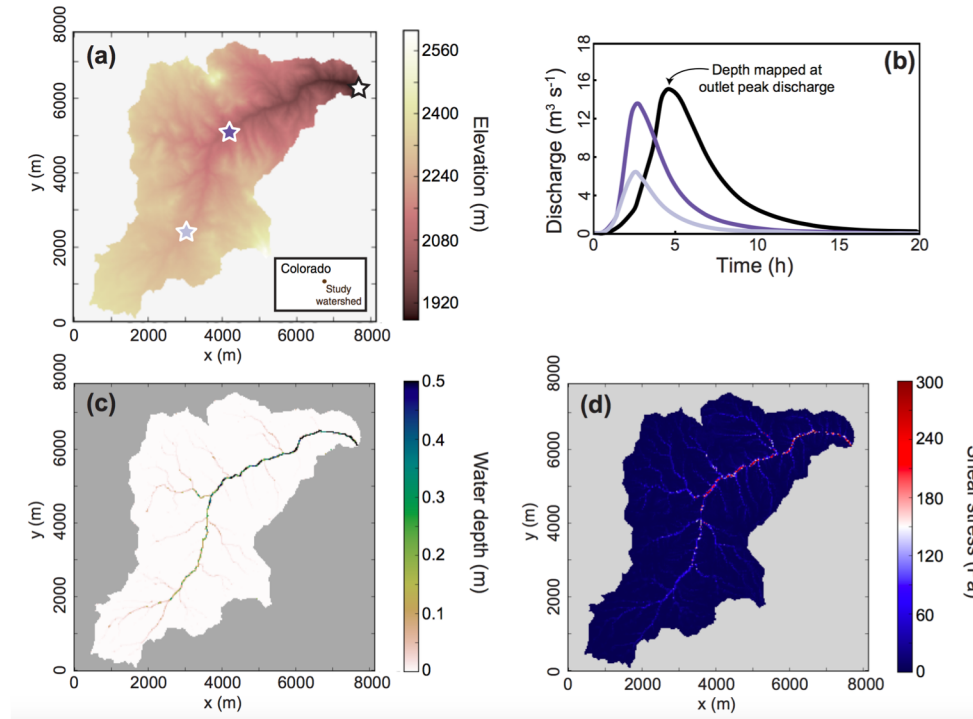


- Python-language programming library
- Efficient creation of 2D numerical models
- Geared toward (but not limited to) hydrology & geomorphology
- **Gridding:** 2D structured or unstructured grids
- **Plug and play:** reusable components
 - Examples: *OverlandFlow*, *SoilInfiltrationGreenAmpt*

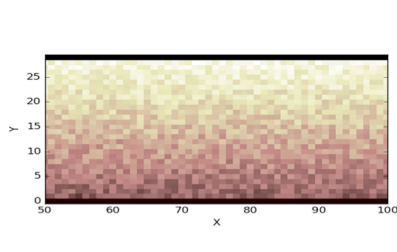


landlab.github.io

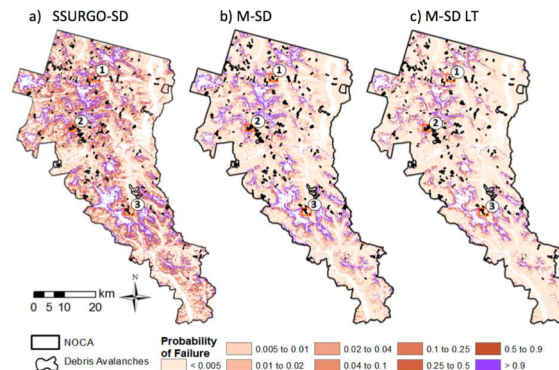
Examples of Landlab-built models



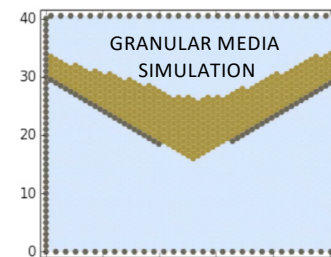
Rainfall-runoff
(Adams et al., 2017)



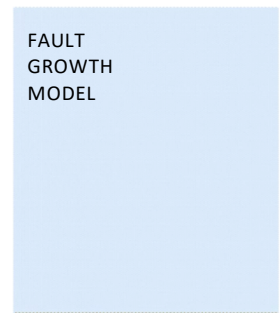
Tectonic geomorphology
(Gray et al., 2017)



Landslide probability (Strauch et al., 2018)



Cellular automata
(Tucker et al., 2016)



FAULT
GROWTH
MODEL

Where to learn more?

- CSDMS web portal: <http://csdms.colorado.edu>
- Webinars: <https://csdms.colorado.edu/wiki/Webinars>
- Landlab: <http://landlab.github.io>
- PyMT: <https://github.com/csdms/pymt>
https://github.com/mcflugen/pymt_hydrotrend/blob/master/notebooks/Hydrotrend_lesson_1.ipynb

Summary



CSDMS Model Repository provides easy access to >200 community model codes



CSDMS Education Repository includes material for teachers and learners



Computing tools like PyMT and Landlab make it easier to build, explore, and couple numerical models