

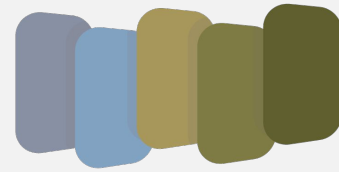
CSDMS

community surface
dynamics modeling system

Changing landscapes and seascapes: modeling for discovery, decision making, and communication

Greg Tucker, CSDMS Executive Director

CSDMS Annual (virtual) Meeting,
May 2021



CSDMS^{*}
community surface
dynamics modeling system



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

Earth-surface processes

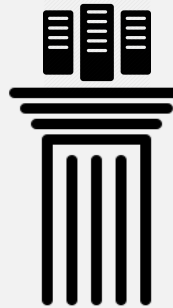


*share resources,
collaborate*



COMMUNITY
SUPPORT

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



COMPUTING
RESOURCES

learn and teach



EDUCATION
OPPORTUNITIES

2,075 members

75 countries

several hundred institutions

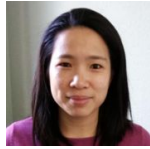


(*pronounced “systems”)

<https://csdms.colorado.edu>

Integration Facility at
University of Colorado
Boulder

TERRESTRIAL



Nicole Gasparini & Leslie Hsu

COASTAL



Andrew Ashton & Talea Mayo

MARINE



Julia Moriarty & Mike Steckler

EDUCATION (EKT)



Kehui (Kevin) Xu

CYBER & NUMERICS



Olaf David & Scott Peckham

HYDROLOGY



Christina Bandaragoda & Venkat Lakshmi

CARBONATES & BIOGENICS



Chris Jenkins & Peter Burgess

CHESAPEAKE



Raleigh Hood

GEODYNAMICS



Phaedra Upton & Mark Behn



CRITICAL ZONE



Lejo Flores & Michael Young



HUMAN DIMENSIONS



Moira Zellner & Derek Robinson

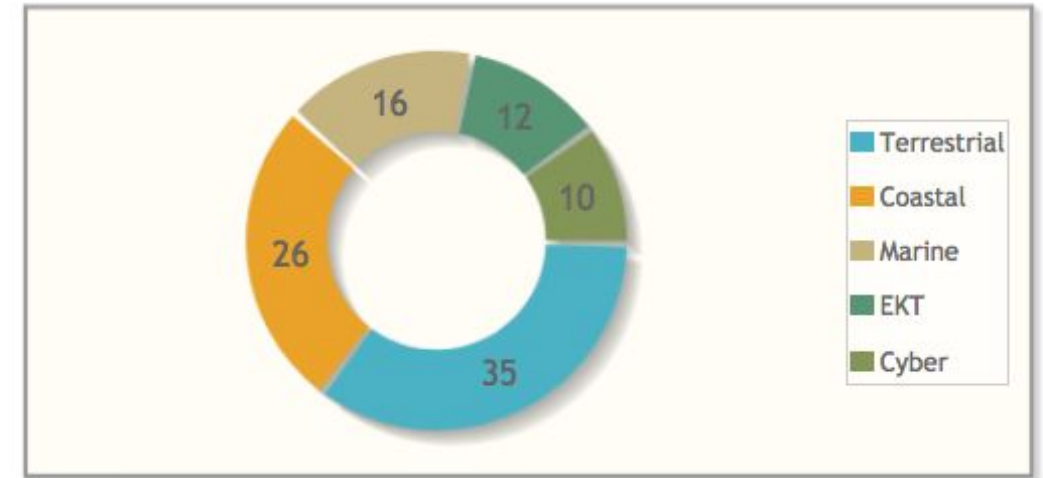
ECOSYSTEM DYNAMICS



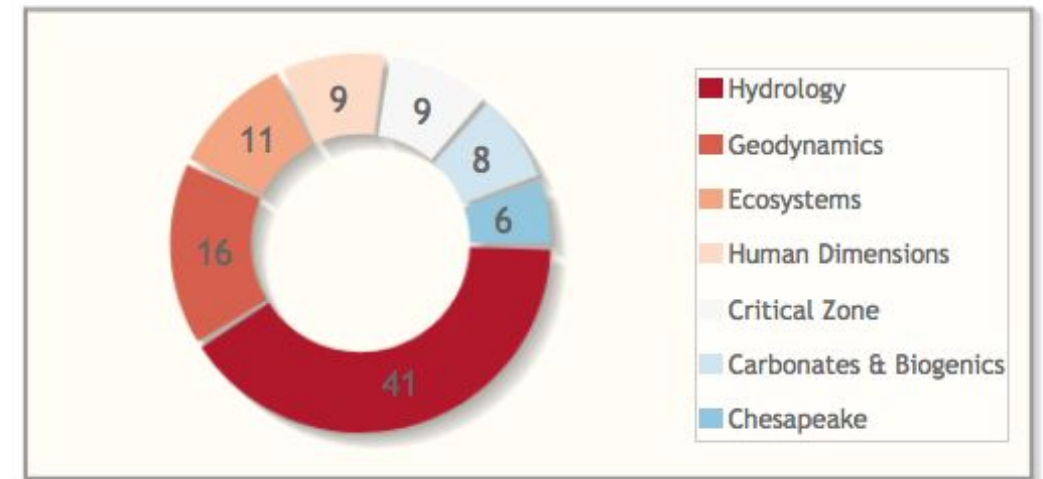
Brian Fath & Kim De Mutsert

Working & Focus Research Groups

Working Groups members (%)



Focus Research Groups members (%)





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

*share resources,
collaborate*



**COMMUNITY
SUPPORT**

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



**COMPUTING
RESOURCES**

learn and teach



**EDUCATION
OPPORTUNITIES**

Model Repository: new capabilities

Search the community model repository

CSDMS maintains a code and metadata repository for numerical models and scientific software tools. The CSDMS Model Repository, initialized in 2009, **now holds 397 open source models and tools**. Use the dialog below to select your set of models.

Domain [-]

☒ OR ☐ AND

☐ Carbonates and Biogenics

☐ Geodynamic

☐ Terrestrial

☐ Climate

☐ Human dimensions

☐ Coastal

☐ Hydrology

☐ Cryosphere

☐ Marine

☐ Ecosystems

☐ Planetary landforms

Dimension [+]

Scale [+]

Code status [+]

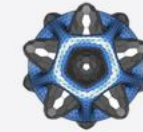
Keywords [+]

Last Name [+]

Program	Description	Domain	Developer
Landlab Code reviewed	Python software framework for writing, assembling, and running 2D numerical models	Coastal, Hydrology, Marine, Terrestrial	Greg Tucker
ESCAPE Code reviewed	parallel global-scale landscape evolution model	Climate, Hydrology, Marine, Terrestrial	Tristan Salles
Underworld2 Code reviewed	Underworld2 is an open-source, particle-in-cell finite element code tuned for large-scale geodynamics simulations.	Geodynamic	Louis Moresi

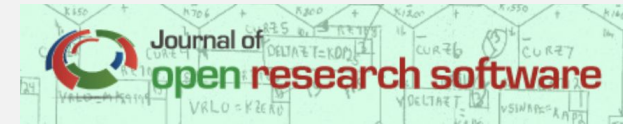
- New **dynamic search**
- **Dynamic, live – on the fly – filtering of models** based on user-selectable criteria
- **Why:** nearly **400** community contributed model and tool descriptions
- Includes peer **Code Reviewed** indicator

How to get your code peer-reviewed



The Journal of
Open Source Software

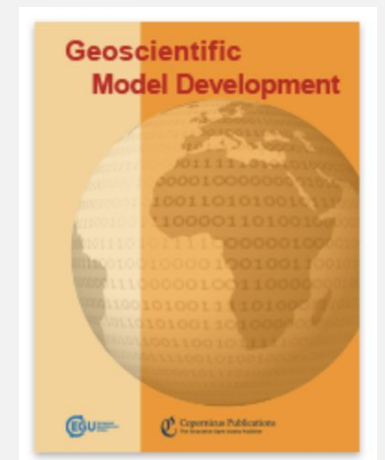
- Submit for publication in a software review journal
 - Ex: **Journal of Open Source Software, Journal of Open Research Software**



- Get a code peer-review and “badge”
 - Ex: **COMSESnet, pyOpenSci, ROpenSci**



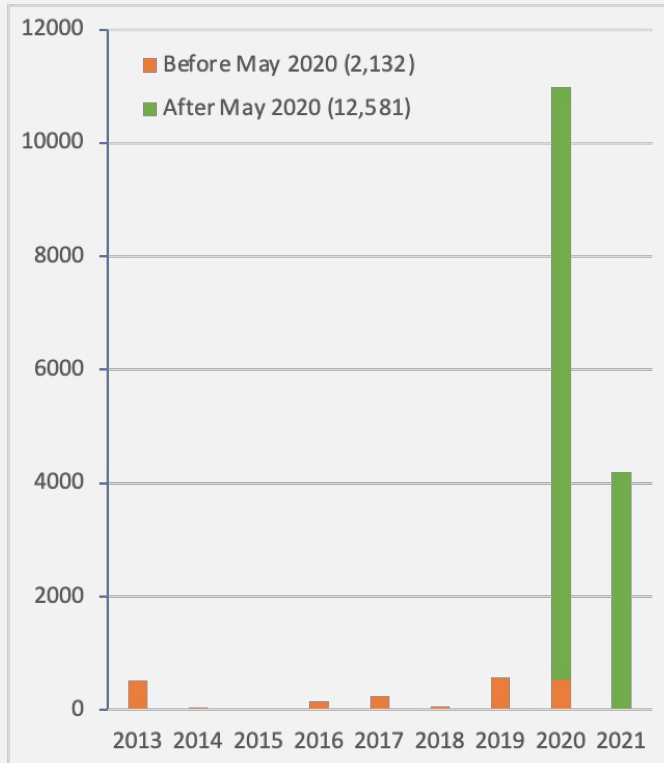
- Submit for publication a (written) paper about your software
 - Ex: **Geoscientific Model Development, Computers & Geosciences, Environmental Modelling & Software**



Model Repository: new capabilities

For each model:

- Comprehensive list of publications
- Model h-index
- Annual publications
- Annual citations



How:

Automated publication search for 141 of the 397 models based on keywords, resulted in a total of **14641 model references**

A screenshot of the CSDMS (Community Surface Dynamics Modeling System) website. The header shows the CSDMS logo and navigation links: Home, Community, Models, Education, Products, Services, About. A search bar is visible on the right. Below the header is a table listing various models and their associated statistics.

Model	Nr. of pubs	Citations	H-index
WRF	1184	77925	117
SWAT	1140	67645	108
VIC	587	26608	77
TOPMODEL	529	23876	77
MODFLOW	1018	29707	68
ApsimX	832	23680	68
SWAN	899	20381	62
OpenFOAM	1016	20507	56
Ecopath with Ecosim	362	11910	53
ROMS	441	14082	50
WAVEWATCH III ^TM	558	9117	48
HBV	239	7448	44
SICOPOLIS	134	5683	43
Princeton Ocean Model (POM)	350	9218	41
ADCIRC	411	6504	39
Delft3D	663	7818	39
LISFLOOD	147	5076	37
RHESSys	125	4801	36

References WRF

Publication(s)	Year	Type	Cited
Feng, Jin-Ming; Wang, Yong-Li; Ma, Zhu-Guo; Liu, Yong-He; 2012. Simulating the Regional Impacts of Urbanization and Anthropogenic Heat Release on Climate across China. Journal of Climate, 25, 7187–7203. 10.1175/JCLI-D-11-00333.1 (View/edit entry)	2012	Model application	104
Klemp, J. B.; Skamarock, W. C.; Dudhia, J.; 2007. Conservative Split-Explicit Time Integration Methods for the Compressible Nonhydrostatic Equations. Monthly Weather Review, 135, 2897–2913. 10.1175/MWR3440.1 (View/edit entry)	2007	Model overview	211
Skamarock, William C.; Klemp, Joseph B.; 2008. A time-split nonhydrostatic atmospheric model for weather research and forecasting applications. Journal of Computational Physics, 227, 3465–3485. 10.1016/j.jcp.2007.01.037 (View/edit entry)	2008	Model overview	1283
Skamarock, William C.; 2006. Positive-Definite and Monotonic Limiters for Unrestricted-Time-Step Transport Schemes. Monthly Weather Review, 134, 2241–2250. 10.1175/MWR3170.1 (View/edit entry)	2006	Model overview	67
Skamarock, W.C.; Klemp, J. B.; Dudhia, J.; Gill, D.O.; Barker, D.M.; Wang, W.; Powers, J.G.; 2005. A description of the Advanced Research WRF Version 2.. NCAR Tech Notes-468+STR.. (View/edit entry)	2005	Model overview	1532
Skamarock, William C.; 2004. Evaluating Mesoscale NWP Models Using Kinetic Energy Spectra. Monthly Weather Review, 132, 3019–3032. 10.1175/MWR2830.1 (View/edit entry)	2004	Model overview	656
Wicker, Louis J.; Skamarock, William C.; 2002. Time-Splitting Methods for Elastic Models Mething Forward Time Schemes. Monthly Weather Review, 130, 2088–2097. <2088:TSMFEM>2.0.CO;2 10.1175/1520-0493(2002)130<2088:TSMFEM>2.0.CO;2 (View/edit entry)	2002	Model overview	610
Done, James; Davis, Christopher A.; Weisman, Morris; 2004. The next generation of NWP: explicit forecasts of convection using the weather research and forecasting (WRF) model. Atmospheric Science Letters, 5, 110–117. 10.1002/asl.72 (View/edit entry)	2004	Model application	330
Wyszogrodzki, Andrzej A.; Liu, Yubao; Jacobs, Neil; Childs, Peter; Zhang, Yongxin; Roux, Gregory; Warner, Thomas T.; 2013. Analysis of the surface temperature and wind forecast errors of	2013	Model application	26

References are automatically added

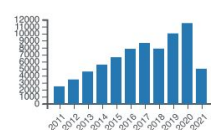
Our search algorithms might occasionally miss, or accidentally include a reference. If so, feel free add a missing reference by using the buttons below, or notify csdmsweb@colorado.edu

Add references

- > Use a DOI
- > Manually

Citations

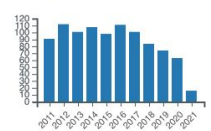
View all



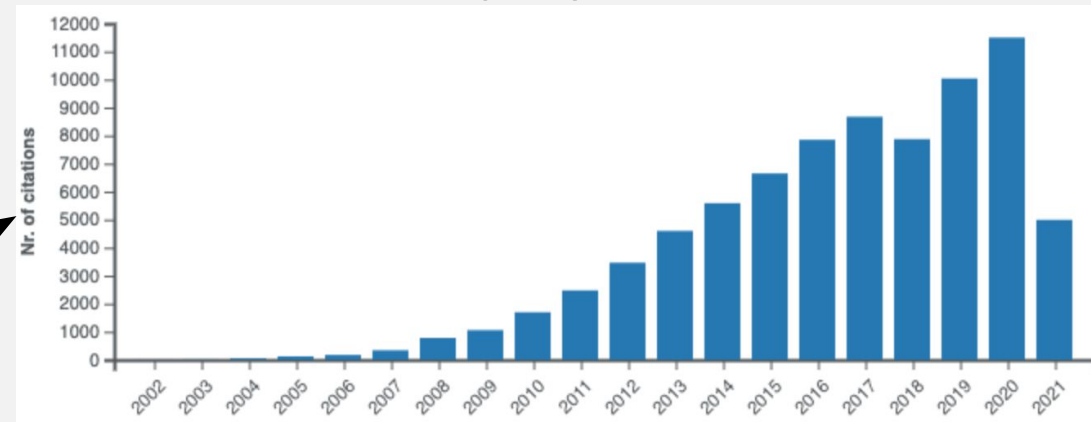
Nr. of publications: 1184
Total citations: 77925
h-index: 117

Publications per year

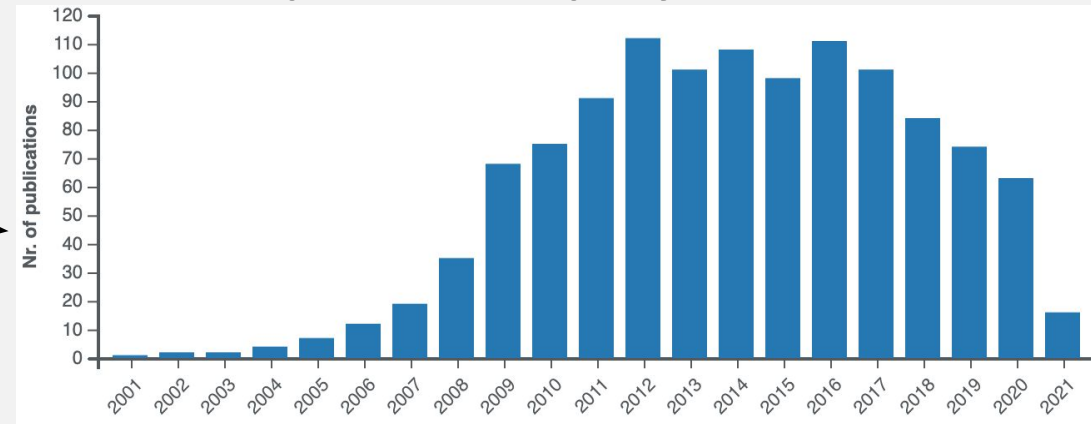
View all



Number of citations per year



Number of publications per year



Member support: Help Desk

<https://github.com/csdms/help-desk>

The screenshot shows the GitHub interface for the repository **csdms / help-desk**. The top navigation bar includes links for Pulls, Issues, Marketplace, and Explore. The repository page shows 6 Watchers, 4 Stars, and 0 Forks. The 'Issues' tab is selected, displaying 23 issues. A search bar shows the filter 'is:issue is:open'. Below the search bar, there are filters for Labels (13) and Milestones (0), and a 'New issue' button. The issues list is sorted by 'Sort' and includes columns for Author, Label, Projects, Milestones, Assignee, and Sort. The list of issues is as follows:

Issue Title	Issue Number	Opened On	By	Comments
Adding BMI to Fortran77 code	#104	Mar 29	Izhu5	15
Check SSL certs on JupyterHub	#97	Feb 9	mdpip	1
Compile a Windows Executable for the Coastal Dune Model	#96	Feb 5	micitz	9
List of models which have a BMI interface	#94	Jan 4	roelofversteeg	1
Coupling HydroTrend and SedFlux3D	#92	Dec 7, 2020	shbu1400	
New EKT Lab: Alternative mesh generation for Landlab	#91	Dec 1, 2020	elbeejay	4

Member support: research software engineer consulting

PROPOSAL SUPPORT



Enhance the **broader impacts** of your project by creating robust, reusable, and well-documented software

PROJECT SUPPORT



Engage support of a CSDMS
research software engineer through
a rate-based service agreement

Contact the CSDMS Integration Facility at csdms@colorado.edu

Software Cyberinfrastructure: **CSDMS Workbench**



1. Interface standard (BMI)



2. Language interoperability (Babelizer)



3. Model and data components



4. Model-building toolkit (Landlab)



5. Execution and coupling framework (PyMT)



Basic Model Interface (BMI): specifies a common set of control functions:



`initialize()`



`update()`



`get_value()`



`set_value()`



`finalize()`



The Journal of
Open Source Software

<https://doi.org/10.21105/joss.02317>



The Basic Model Interface 2.0:
A standard interface for
coupling numerical models in
the geosciences

Submitted 29 May 2020 • Published 23 July 2020

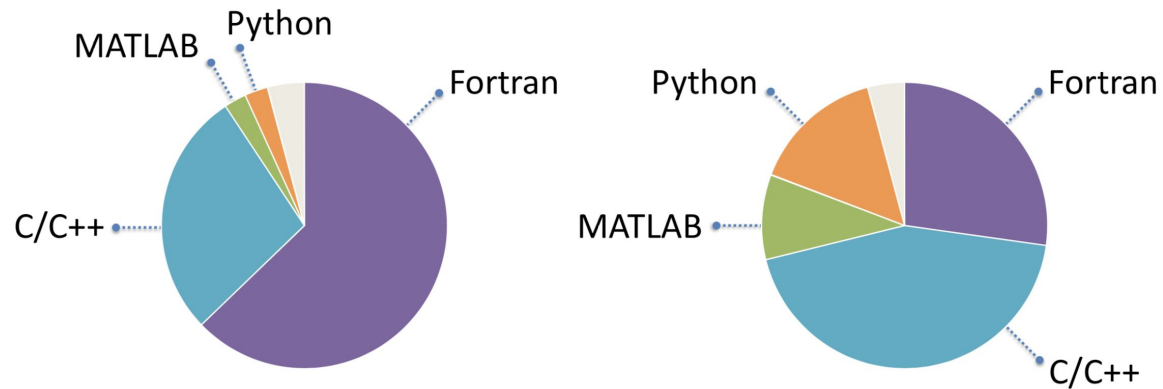
<https://bmi.readthedocs.io>

BMI webinar: <https://csdms.colorado.edu/wiki/Presenters-0409>

Language interoperability

The CSDMS Model Repository

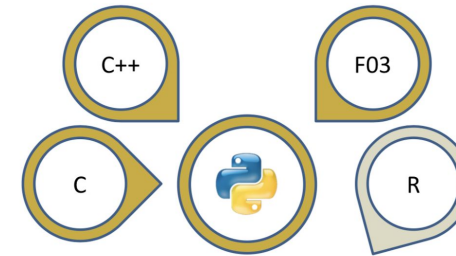
Over 300 community-contributed Earth-system models.



Fraction of Earth-system models as contributed to the CSDMS model repository as measured by lines of code (left) and number of models (right).

Language Interoperability: *The Babelizer*

Inter-language communication between models.

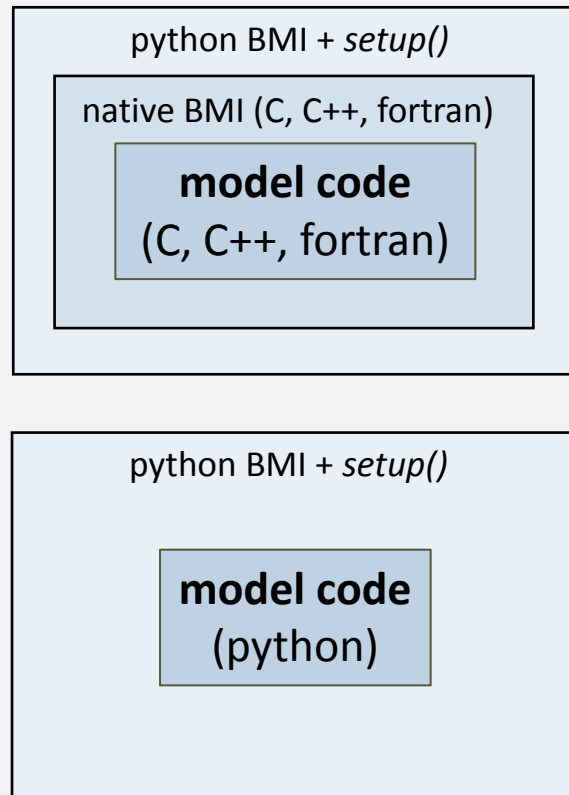


The CSDMS *Babelizer* automatically generates the necessary code to wrap shared libraries that expose a Basic Model Interface so that they can be imported into a Python environment. Currently, the Babelizer supports libraries written in C, C++, FORTRAN (and Python, obsv). We will look to add addition languages (like R) as needs arise.

<https://babelizer.readthedocs.io>

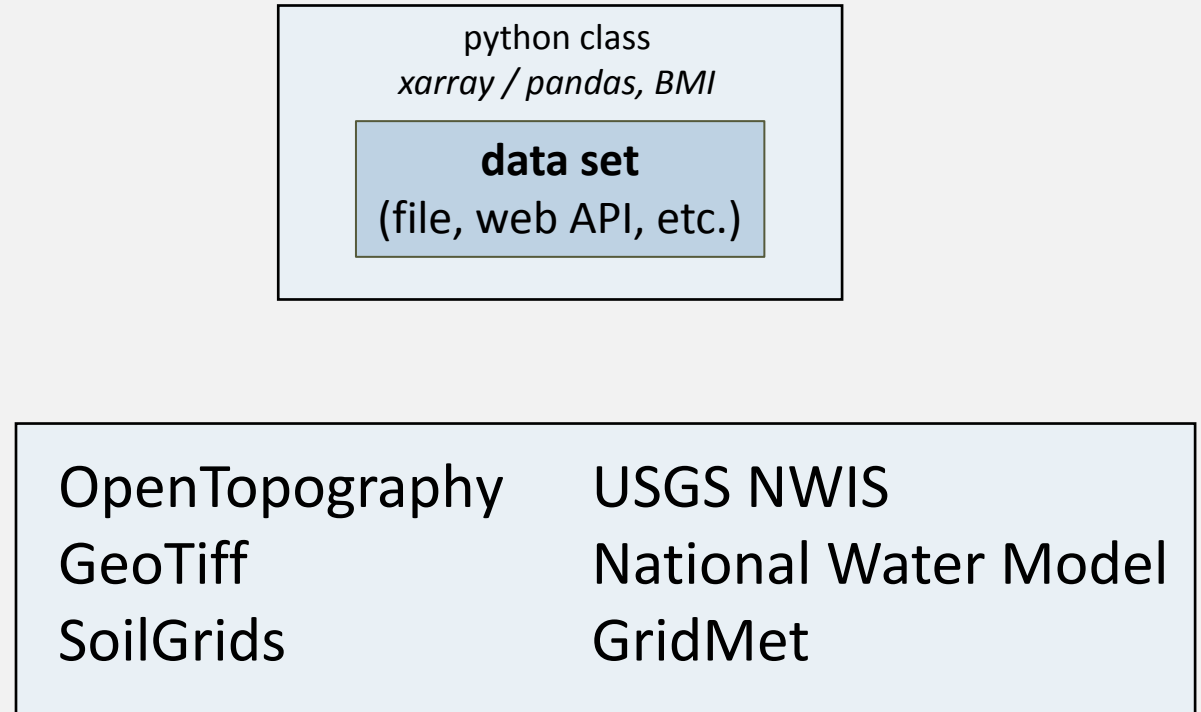
Modeling with interoperable **components**

Model Components



Currently available model components:
<https://pymt.readthedocs.io/en/latest/models.html>

Data Components



<https://csdms.colorado.edu/wiki/DataComponents>



<https://pymt.readthedocs.io>

a Python toolkit for coupling and running Earth surface models

[Install](#)

[Quickstart](#)

[User Guide](#)

[Examples](#)

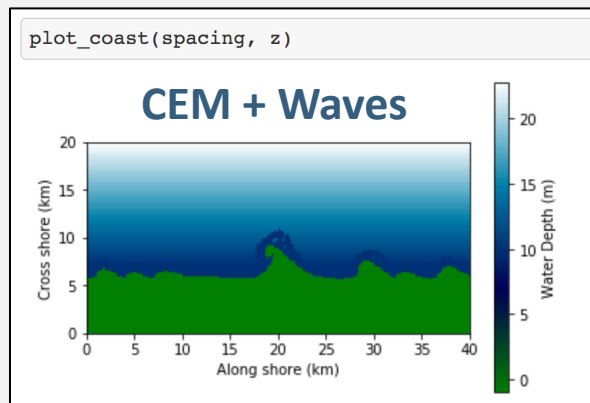
[Reference Manual](#)

[Source](#)

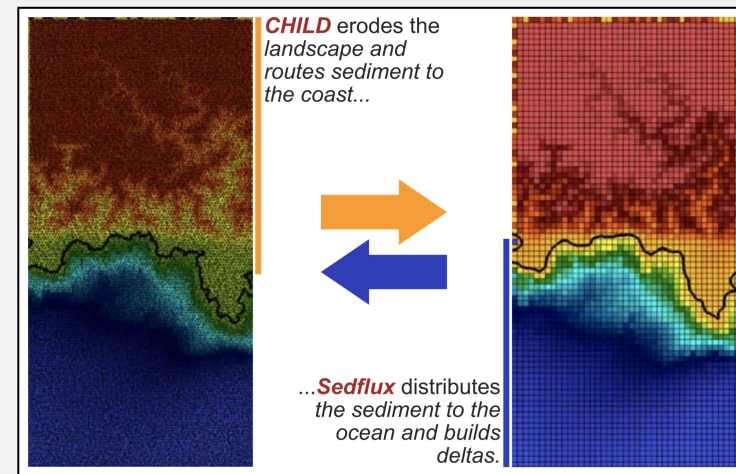
```
# Initialize the CEM and Waves models
from pymt import models
cem, waves = models.Cem(), models.Waves()
args = cem.setup(number_of_rows=100,
                  number_of_cols=200,
                  grid_spacing=200.)
cem.initialize(*args)
args = waves.setup()
waves.initialize(*args)
```

```
# (additional initialization code not shown)
```

```
# Run the models iteratively & exchange data
for time in range(num_time_steps):
    waves.update()
    angle = waves.get_value(wave_angle_name)
    cem.set_value(wave_angle_name, angle)
    cem.update()
```

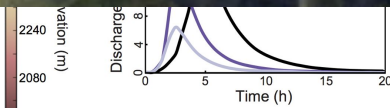
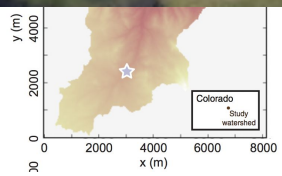


example of pymt grid mapping

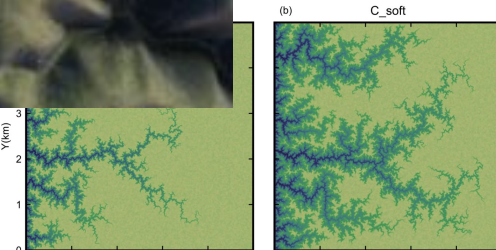




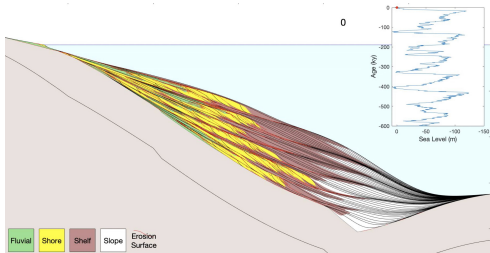
<https://landlab.github.io>



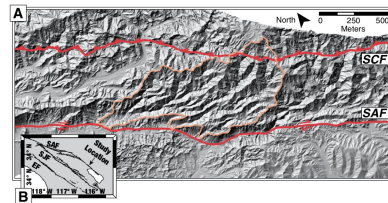
Rainfall-runoff (Adams et al., 2017)



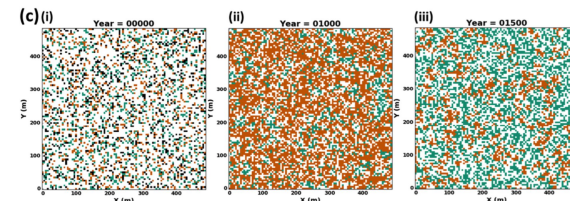
Post-glacial drainage nets (Lai & Anders, 2017)



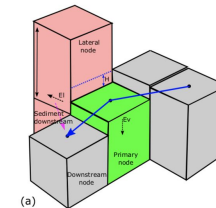
Basin stratigraphy (Steckler et al., in prep)



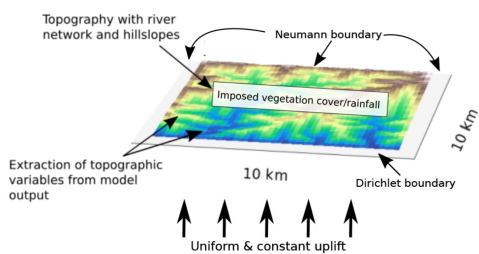
Tectonic shear (Gray et al., 2017)



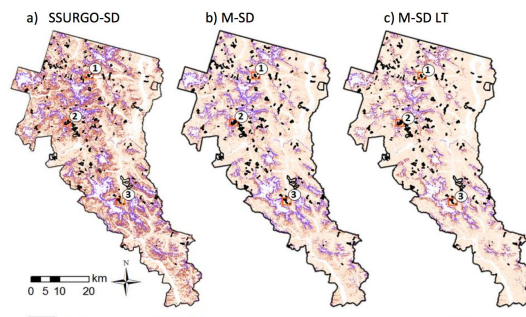
Vegetation dynamics (Nudurupati et al., in review)



Valley widening (Langston et al., 2018)



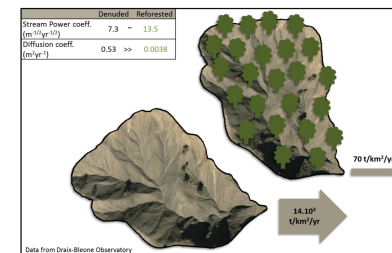
Vegetation & erosion (Schmid et al., 2018)



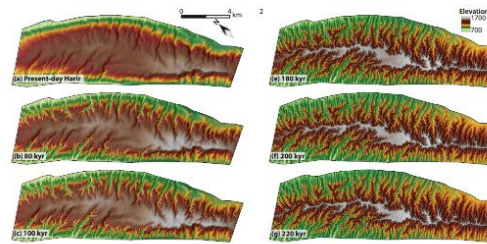
Landslide probability (Strauch et al., 2018)



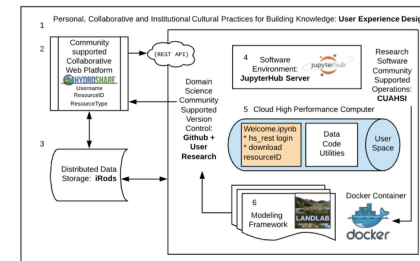
Tidal flow



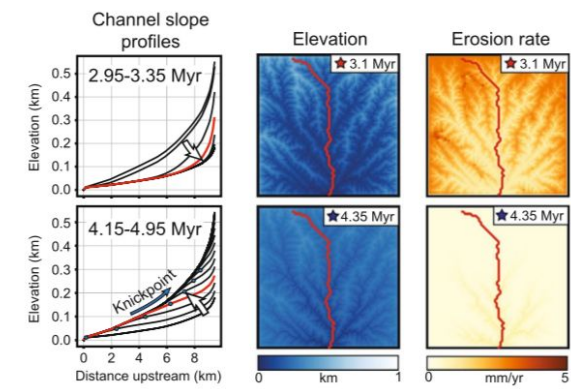
Sediment yield (Carriere et al., 2019)



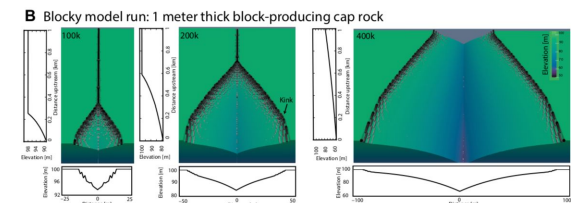
Evolution of anticlines (Zebari et al., 2019)



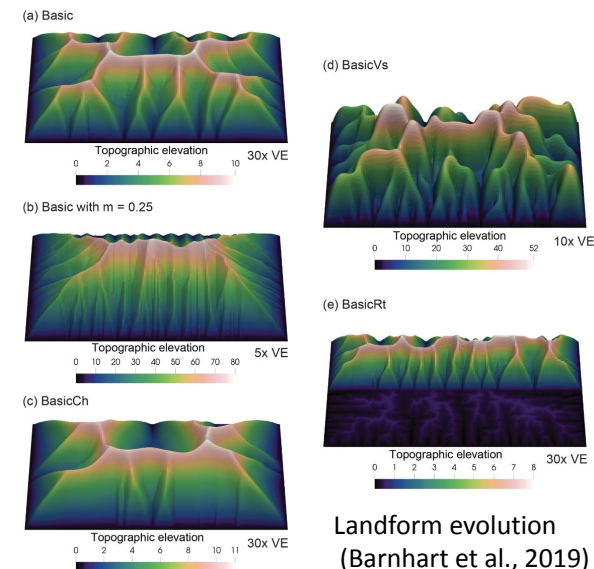
Hydrology education (Bandaragoda et al., 2019)



Sediment provenance as a signal of climate and tectonics in sedimentary basins (Sharman et al., 2019)



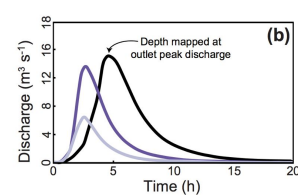
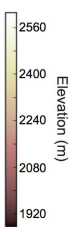
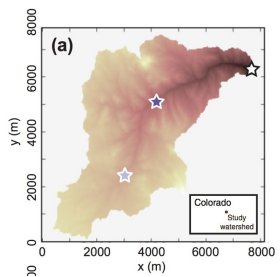
Influence of boulders on hillslope and channel evolution (Glade et al., 2019)



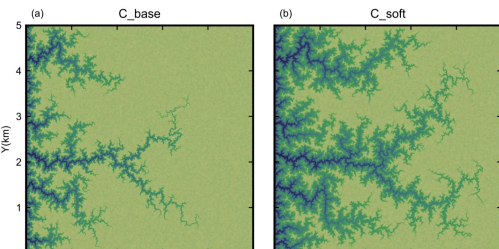
Landform evolution (Barnhart et al., 2019)



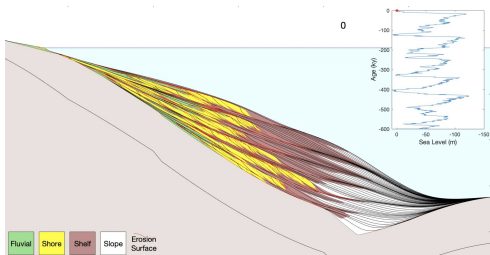
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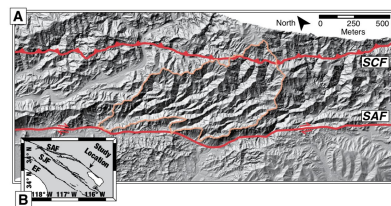
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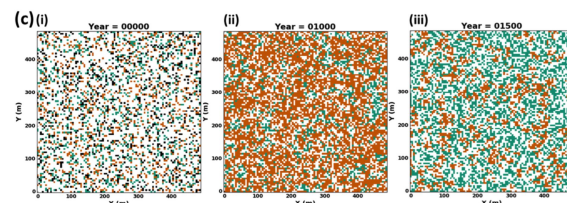
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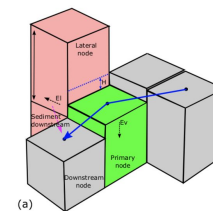
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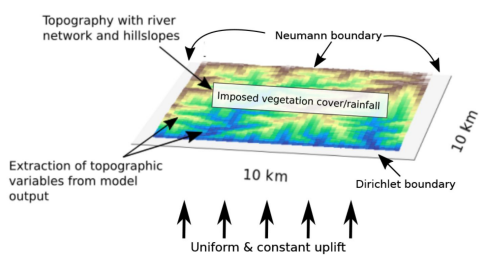
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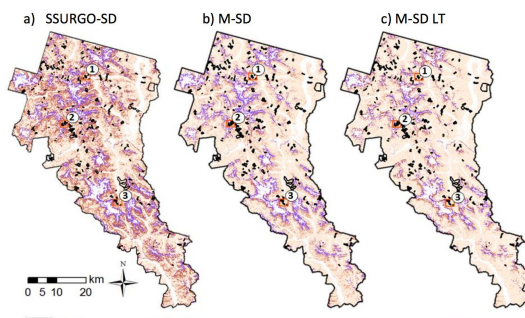
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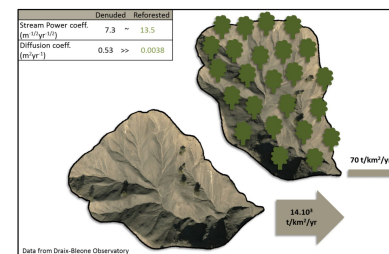
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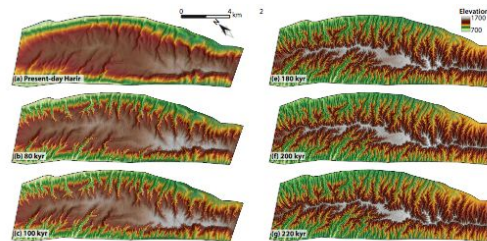
Landslide probability (Strauch et al., 2018)



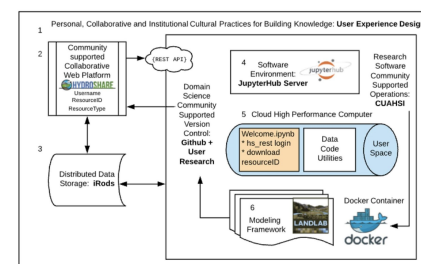
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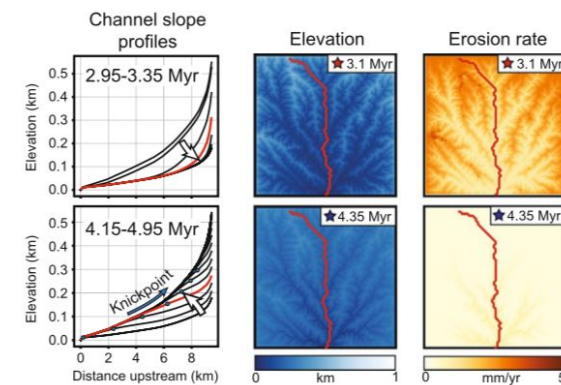
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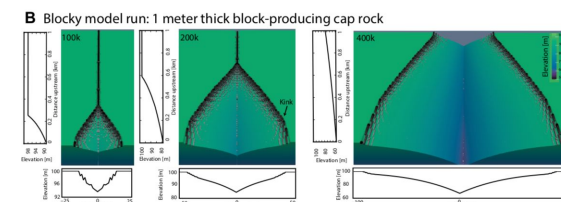
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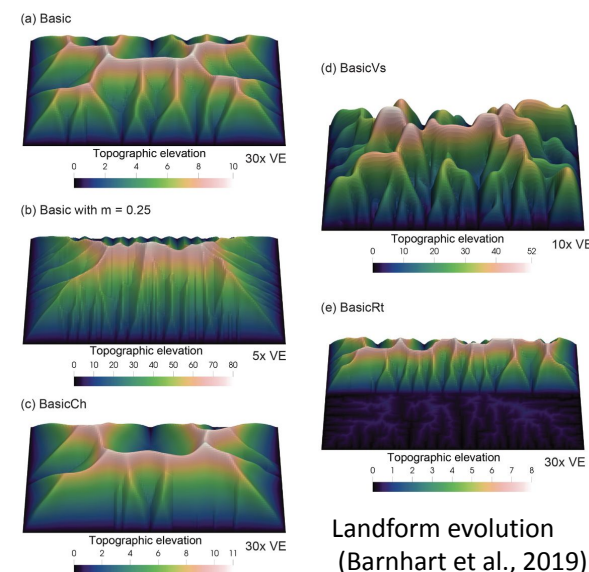
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Landform evolution (Barnhart et al., 2019)

Community publications using CSDMS tools & protocols, 2020 and early 2021

Anand, S. K., Hooshyar, M., & Porporato, A. (2020). **Linear layout of multiple flow-direction networks for landscape-evolution simulations.** *Environmental Modelling & Software*, 133, 104804, <https://doi.org/10.1016/j.envsoft.2020.104804>.

Barnhart, K.R., Hutton, E.W.H., Tucker, G.E., Gasparini, N.M., Istanbuluoglu, E., Hobley, D.E.J., Lyons, N.J., Mouchene, M., Nudurupati, S.S., Adams, J.M., and Bandaragoda, C. (2020) **Short communication: Landlab 2.0: A software package for Earth surface dynamics.** *Earth Surface Dynamics*, 8, 379–397, [doi:10.5194/esurf-8-379-2020](https://doi.org/10.5194/esurf-8-379-2020).

Barnhart, K. R., Tucker, G. E., Doty, S. G., Glade, R. C., Shobe, C. M., Rossi, M. W., & Hill, M. C. (2020). **Projections of landscape evolution on a 10,000 year timescale with assessment and partitioning of uncertainty sources.** *Journal of Geophysical Research: Earth Surface*, 125(12), e2020JF005795, <https://doi.org/10.1029/2020JF005795>.

Barnhart, K. R., Tucker, G. E., Doty, S., Shobe, C. M., Glade, R. C., Rossi, M. W., & Hill, M. C. (2020). **Inverting topography for landscape evolution model process representation: Part 1, conceptualization and sensitivity analysis.** *Journal of Geophysical Research: Earth Surface*, e2018JF004961. <https://doi.org/10.1029/2018JF004961>.

Barnhart, K. R., Tucker, G. E., Doty, S., Shobe, C. M., Glade, R. C., Rossi, M. W., & Hill, M. C. (2020). **Inverting topography for landscape evolution model process representation: Part 2, calibration and validation.** *Journal of Geophysical Research: Earth Surface*, e2018JF004963. <https://doi.org/10.1029/2018JF004963>.

Barnhart, K. R., Tucker, G. E., Doty, S., Shobe, C. M., Glade, R. C., Rossi, M. W., & Hill, M. C. (2020). **Inverting topography for landscape evolution model process representation: Part 3, Determining parameter ranges for select mature geomorphic transport laws and connecting changes in fluvial erodibility to changes in climate.** *Journal of Geophysical Research: Earth Surface*, e2019JF005287, <https://doi.org/10.1029/2019JF005287>.

Carriere, A., Le Bouteiller, C., Tucker, G.E., Klotz, S., and Naaim, M. (2020) **Impact of vegetation on erosion: Insights from the calibration and test of a landscape evolution model in alpine badland catchments.** *Earth Surface Processes and Landforms*. <https://doi.org/10.1002/esp.4741>.

Evans, M. J., Scheele, B. C., Westgate, M. J., Yebra, M., Newport, J. S., & Manning, A. D. (2020). **Beyond the pond: Terrestrial habitat use by frogs in a changing climate.** *Biological Conservation*, 249, 108712, <https://doi.org/10.1016/j.biocon.2020.108712>.

den Haan, R.J., van der Voort, M.C., Baart, F., Berends, K.D., van den Berg, M.C., Straatsma, M.W., Geenen, A.J.P., and Hulscher, S.J.M.H. **The Virtual River Game: Gaming using models to collaboratively explore river management complexity.** *Journal of Environmental Modelling and Software*, December 2020. doi:10.1016/j.envsoft.2020.104855

Hutton, E.W.H., Piper, M.D., and Tucker, G.E. **The Basic Model Interface 2.0: A Standard Interface for Coupling Numerical Models in the Geosciences.** *The Journal of Open Source Software*, July 2020. doi:10.21105/joss.02317

Iwanaga, T., Partington, D., Ticehurst, J., Croke, B.F.W., and Jakeman, A.J. **A socio-environmental model for exploring sustainable water management futures: Participatory and collaborative modelling in the Lower Campaspe catchment.** *Journal of Hydrology: Regional Studies*, April 2020. doi:10.1016/j.ejrh.2020.100669

Lai, J., & Anders, A. M. (2020). **Tectonic controls on rates and spatial patterns of glacial erosion through geothermal heat flux.** *Earth and Planetary Science Letters*, 543, 116348, <https://doi.org/10.1016/j.epsl.2020.116348>.

Lipp, A. G., Roberts, G. G., Whittaker, A. C., Gowing, C. J., & Fernandes, V. M. (2020). **River sediment geochemistry as a conservative mixture of source regions: Observations and predictions from the Cairngorms, UK.** *Journal of Geophysical Research: Earth Surface*, 125(12), <https://doi.org/10.1029/2020JF005700>.

Litwin, D.G., Tucker, G.E., Barnhart, K.R., and Harman, C.J. (2020) **GroundwaterDupuitPercolator: A Landlab component for groundwater flow,** *Journal of Open Source Software*, 5(46), 1935, <https://doi.org/10.21105/joss.01935>.

Lyons, N.J., Albert, J.S., and Gasparini, N.M. (2020). **SpeciesEvolver: A Landlab component to evolve life in simulated landscapes.** *Journal of Open Source Software*, 5(46), 2066, <https://doi.org/10.21105/joss.02066>.

Lyons, N. J., Val, P., Albert, J. S., Willenbring, J. K., & Gasparini, N. M. (2020). **Topographic controls on divide migration, stream capture, and diversification in riverine life.** *Earth Surface Dynamics*, 8(4), 893-912, <https://doi.org/10.5194/esurf-8-893-2020>.

Pan, B., Cai, S., & Geng, H. (2021). **Numerical simulation of landscape evolution and mountain uplift history constrain-A case study from the youthful stage mountains around the central Hexi Corridor, NE Tibetan Plateau.** *Science China Earth Sciences*, 1-13, <https://doi.org/10.1007/s11430-020-9716-6>.

Pfeiffer, A.M., Barnhart, K.R., Czuba, J.A., and Hutton, E.W.H. (2020). **NetworkSedimentTransporter: A Landlab component for bed material transport through river networks.** *Journal of Open Source Software*, 5(53), 2341, <https://doi.org/10.21105/joss.02341>.

Ratliff, K.M., Hutton, E.H.W., and Murray, A.B., 2021. **Modeling long-term delta dynamics reveals persistent geometric river avulsion locations,** *Earth and Planetary Science Letters*, 559, doi:10.1016/j.epsl.2021.116786.

Sheehan, C.E., and Ward, D.J. (2020). **Migrating Transverse Escarpments in Strike Valleys on the Colorado Plateau.** *Journal of Geophysical Research: Earth Surface*, 125(3), e2019JF005260, <https://doi.org/10.1029/2019JF005260>.

Shen, H., Lynch, B., Poulsen, C. J., & Yanites, B. J. (2021). **A modeling framework (WRF-Landlab) for simulating orogen-scale climate-erosion coupling.** *Computers & Geosciences*, 146, 104625, <https://doi.org/10.1016/j.cageo.2020.104625>.

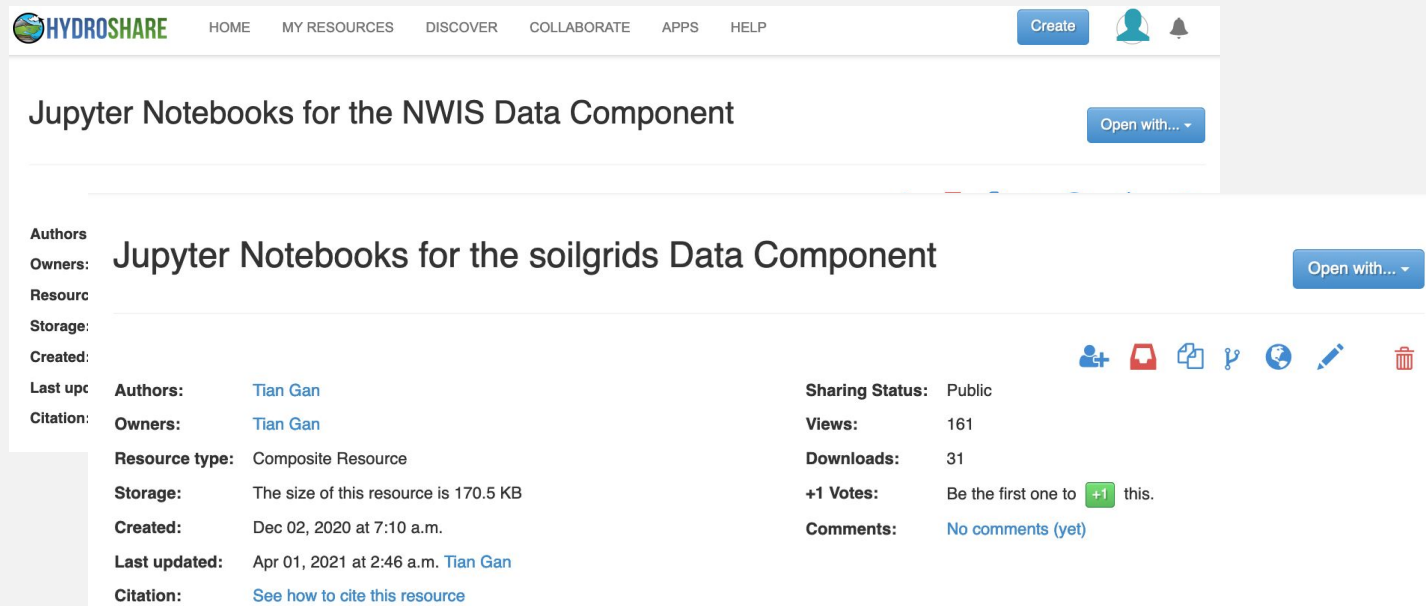
Tucker, G. E., Hobley, D.E.J., McCoy, S.W., and Struble, W.T. (2020) **Modeling the shape and evolution of normal-fault facets.** *Journal of Geophysical Research: Earth Surface*, 125, <https://doi.org/10.1029/2019JF005305>.

Wang, K., Jafarov, E., and Overeem, I. **Sensitivity evaluation of the Kudryavtsev permafrost model.** *Journal of Science of the Total Environment*, June 2020. <https://doi.org/10.1016/j.scitotenv.2020.137538>.

Walker, S. J., Wilkinson, S. N., van Dijk, A. I., & Hairsine, P. B. (2020). **A multi-resolution method to map and identify locations of future gully and channel incision.** *Geomorphology*, 358, 107115, <https://doi.org/10.1016/j.geomorph.2020.107115>.

CSDMS@HydroShare

- New model component added in CUAHSI JupyterHub
- Data components available in HydroShare
- Clinic in 2021 Annual meeting



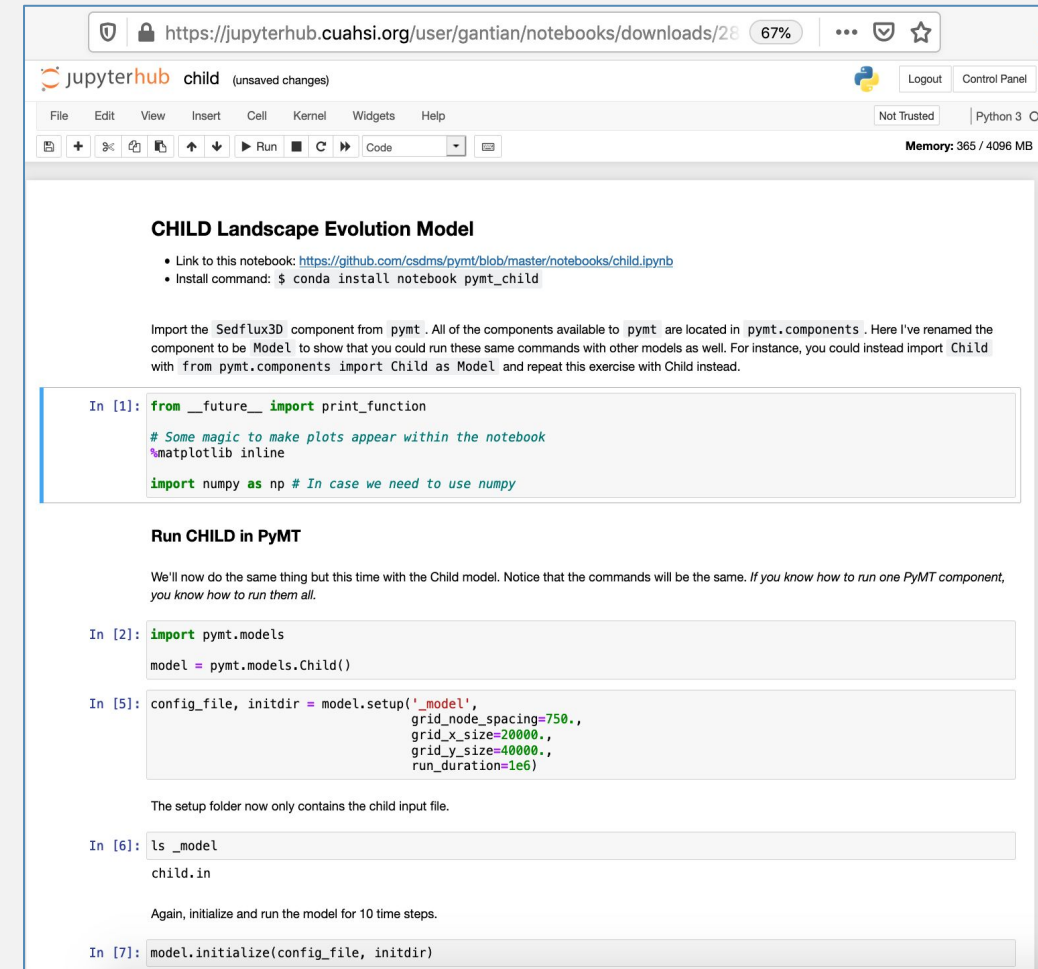
The image shows the HydroShare website interface. At the top, there's a navigation bar with links: HOME, MY RESOURCES, DISCOVER, COLLABORATE, APPS, HELP. A 'Create' button and a user profile icon are also present. Below the navigation bar, the main heading is 'Jupyter Notebooks for the NWIS Data Component'. A blue button labeled 'Open with...' is visible. Below this, there's a section for 'Jupyter Notebooks for the soilgrids Data Component' with a similar 'Open with...' button. On the left side, there's a sidebar with metadata for the resource:

- Authors: Tian Gan
- Owners: Tian Gan
- Resource type: Composite Resource
- Storage: The size of this resource is 170.5 KB
- Created: Dec 02, 2020 at 7:10 a.m.
- Last updated: Apr 01, 2021 at 2:46 a.m. Tian Gan
- Citation: See how to cite this resource

On the right side of the sidebar, there's a section for 'Sharing Status' and 'Views':

- Sharing Status: Public
- Views: 161
- Downloads: 31
- +1 Votes: Be the first one to +1 this.
- Comments: No comments (yet)

<https://hydroshare.org>



The image shows a Jupyter Notebook interface. The URL bar indicates the notebook is located at <https://jupyterhub.cuahsi.org/user/gantian/notebooks/downloads/28>. The notebook title is 'child (unsaved changes)'. The interface includes a menu bar (File, Edit, View, Insert, Cell, Kernel, Widgets, Help) and a toolbar with various icons. The main content area displays the notebook's text and code cells.

CHILD Landscape Evolution Model

- Link to this notebook: <https://github.com/csdms/pymt/blob/master/notebooks/child.ipynb>
- Install command: `$ conda install notebook pymt_child`

Import the `Sedflux3D` component from `pymt`. All of the components available to `pymt` are located in `pymt.components`. Here I've renamed the component to be `Model` to show that you could run these same commands with other models as well. For instance, you could instead import `Child` with `from pymt.components import Child as Model` and repeat this exercise with `Child` instead.

```
In [1]: from __future__ import print_function
# Some magic to make plots appear within the notebook
%matplotlib inline
import numpy as np # In case we need to use numpy
```

Run CHILD in PyMT

We'll now do the same thing but this time with the `Child` model. Notice that the commands will be the same. If you know how to run one `PyMT` component, you know how to run them all.

```
In [2]: import pymt.models
model = pymt.models.Child()

In [5]: config_file, initdir = model.setup('_model',
                                           grid_node_spacing=750.,
                                           grid_x_size=20000.,
                                           grid_y_size=40000.,
                                           run_duration=1e6)
```

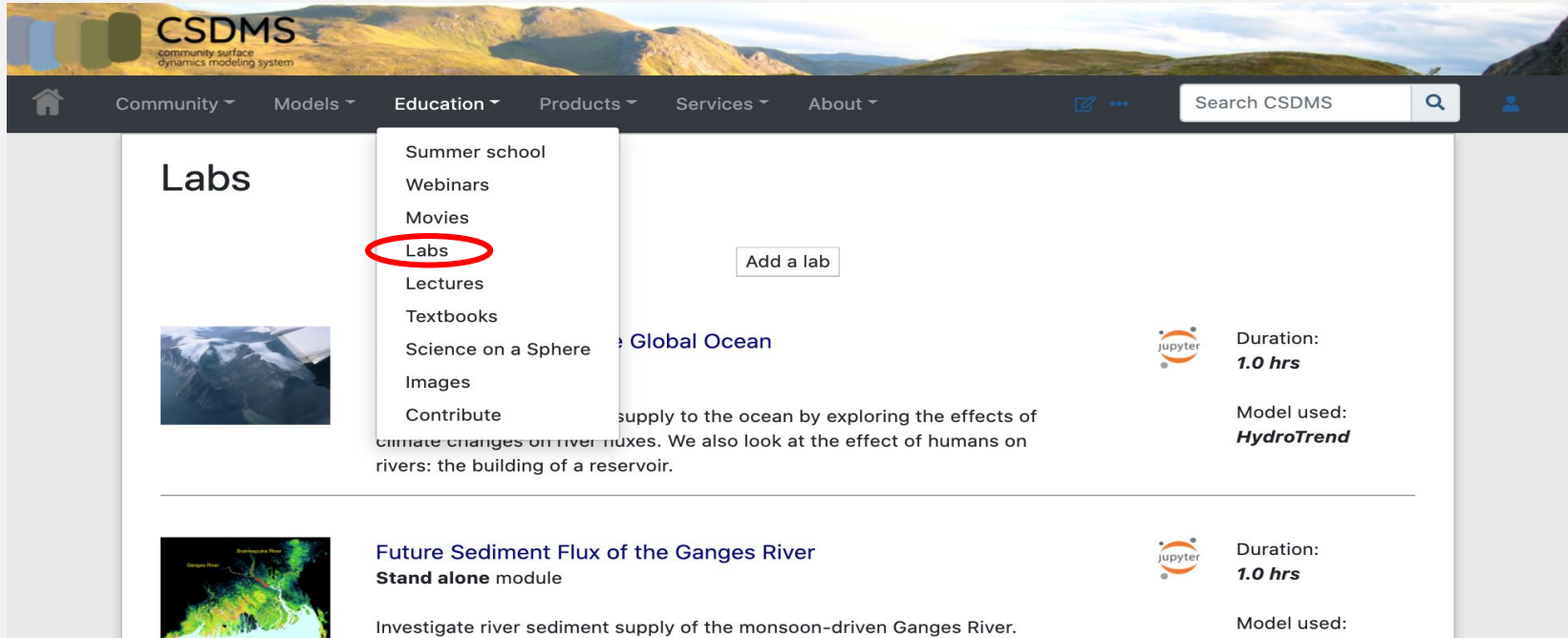
The setup folder now only contains the child input file.

```
In [6]: ls _model
child.in
```

Again, initialize and run the model for 10 time steps.

```
In [7]: model.initialize(config_file, initdir)
```

Labs for teaching & learning



- **22 labs available** (50% increase since last year)
- Many labs are based on **Jupyter Notebooks (NB)**
- Most NB can **directly run through Binder or CSDMS JupyterHub** and are downloadable to run local if preferred

Lab topics:

- **Rivers:** discharge - flood frequency - sediment load - evolution of meanders - evolution of channels
- **Permafrost:** spatial patterns of occurrence - active layer - future scenarios
- **Glaciers:** growth and retreat of a valley glaciers
- **Intro to CSDMS tools:** Landlab - BMI - PyMT
- **Data components:** SoilGrid - NWM

<https://csdms.colorado.edu>

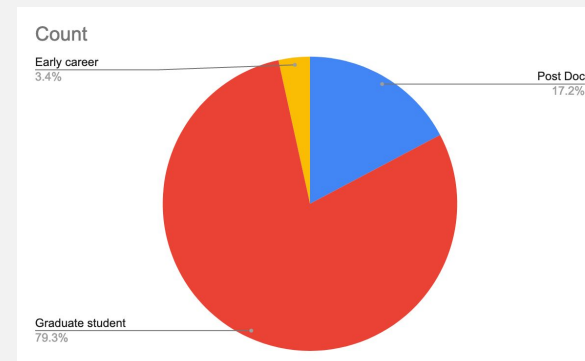
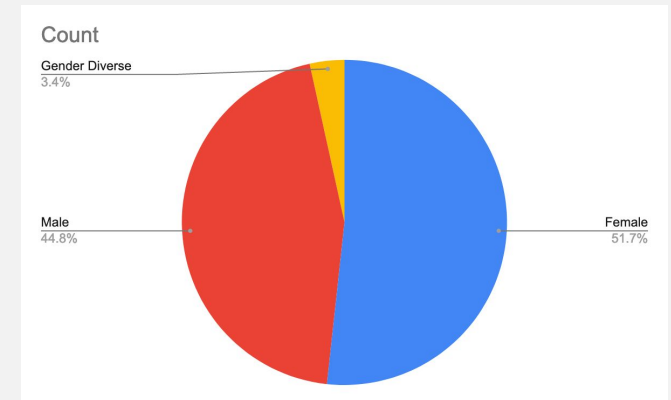
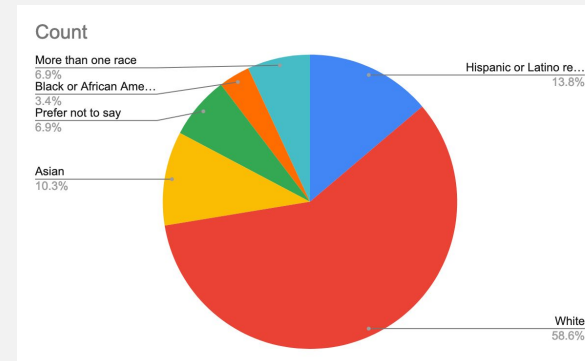
ESPIIn2021

8th - 17th June



Goal: expand the use of cyberinfrastructure among early-career members of the ESP research community with training that increases their competence and confidence with using cyberinfrastructure tools to advance the fundamental science of ESP.

- received 94 applications in March 2021.
- redesigned ESPIIn2021 to be online for 8 days
- developed non-biased selection metrics and blind candidate review
- Resulted in a diverse group of 29 participants
- 6 science lectures
- Professional panel



Webinars

CSDMS Community Surface Dynamics Modeling System

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CSDMS Webinars series

Upcoming

Date	Time	Presenter	Title
2021/05/06	09:00 am MDT	Lamprecht, Anna-Lena & Capella-Gutierrez, Salvador	FAIR & Research Software
2021/04/27		Barton, Michael	The Open Modeling Foundation Initiative: an International Partnership for Next Generation Modeling of Human and Earth Systems
2021/03/16		Zhang, Yu	Coastal Wetland Hydrology under Climate Change: Dynamics, Consequences, and Eco-morphologic Feedback
2021/01/21		Barnhart, Katy	Testing surface process models with numerical experiments: examples from landscape evolution and debris flow inundation

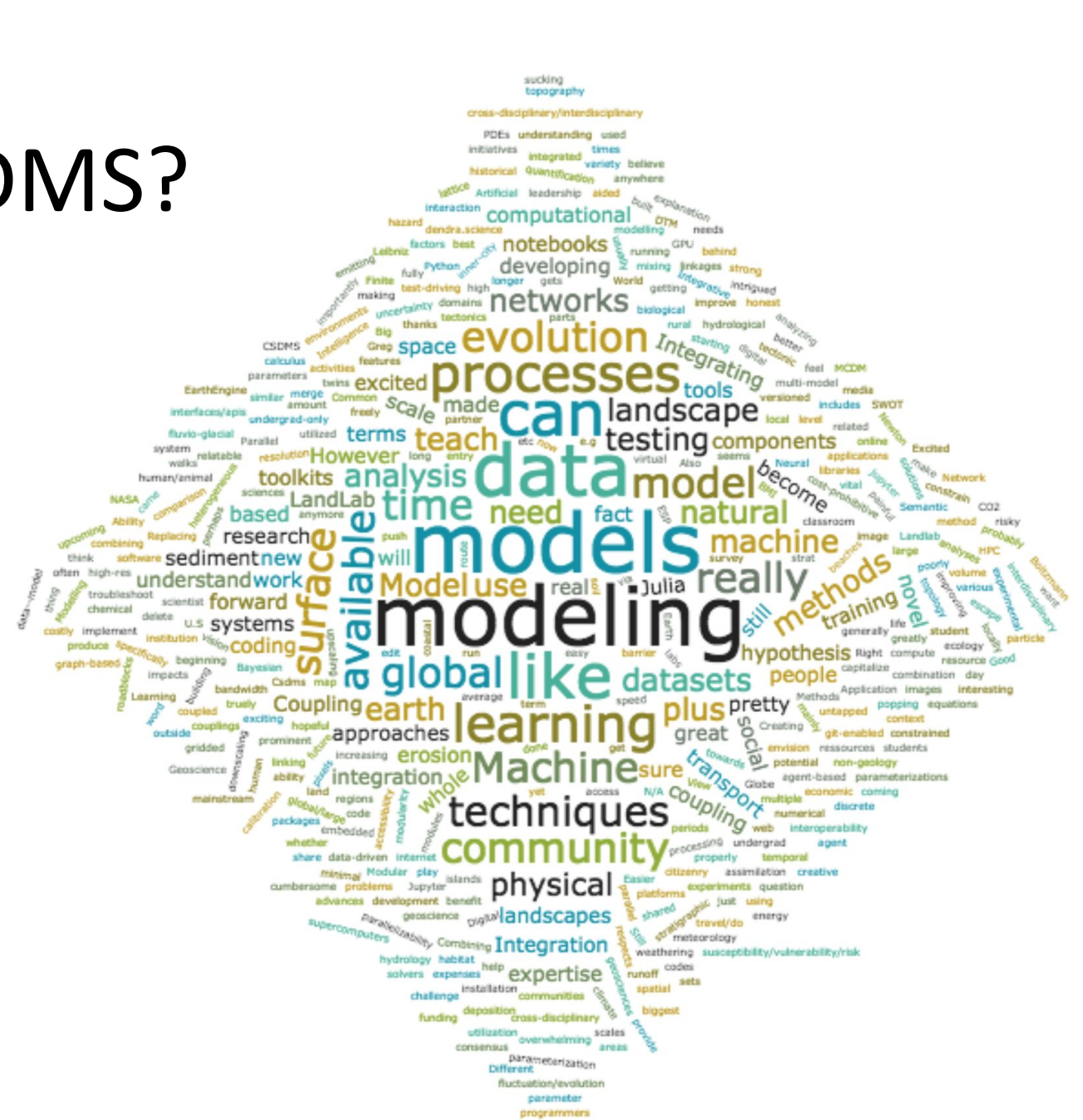
- Every semester 3-4 webinars
- **Wide variety of topics** around modeling, best modeling practices, modeling tools, etc.
- Webinars are **recorded & posted on CSDMS YouTube-channel**, so can be viewed later
<https://www.youtube.com/user/CSDMSmovie/playlists>

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

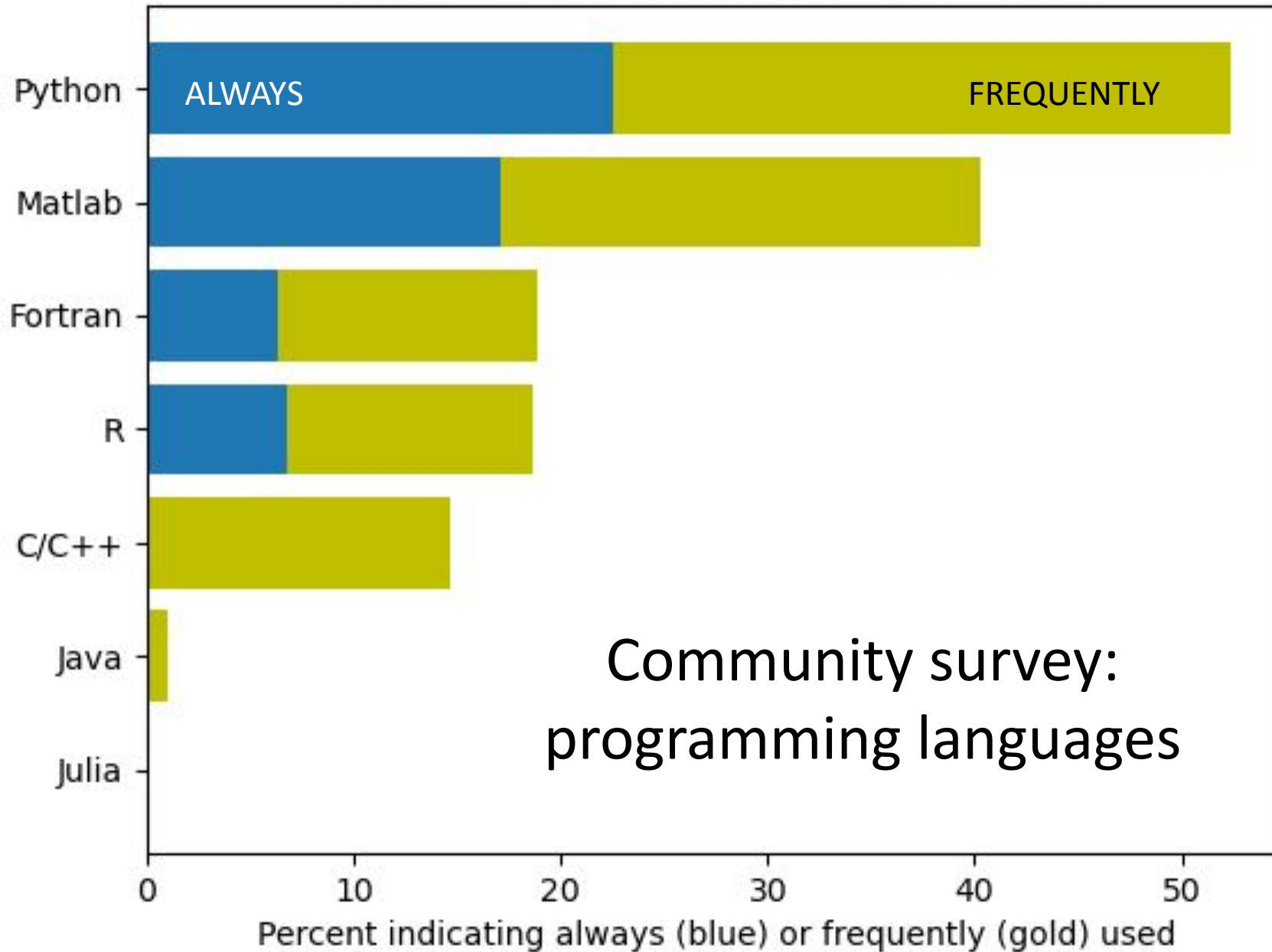
What's next for CSDMS?

We want to hear from you!

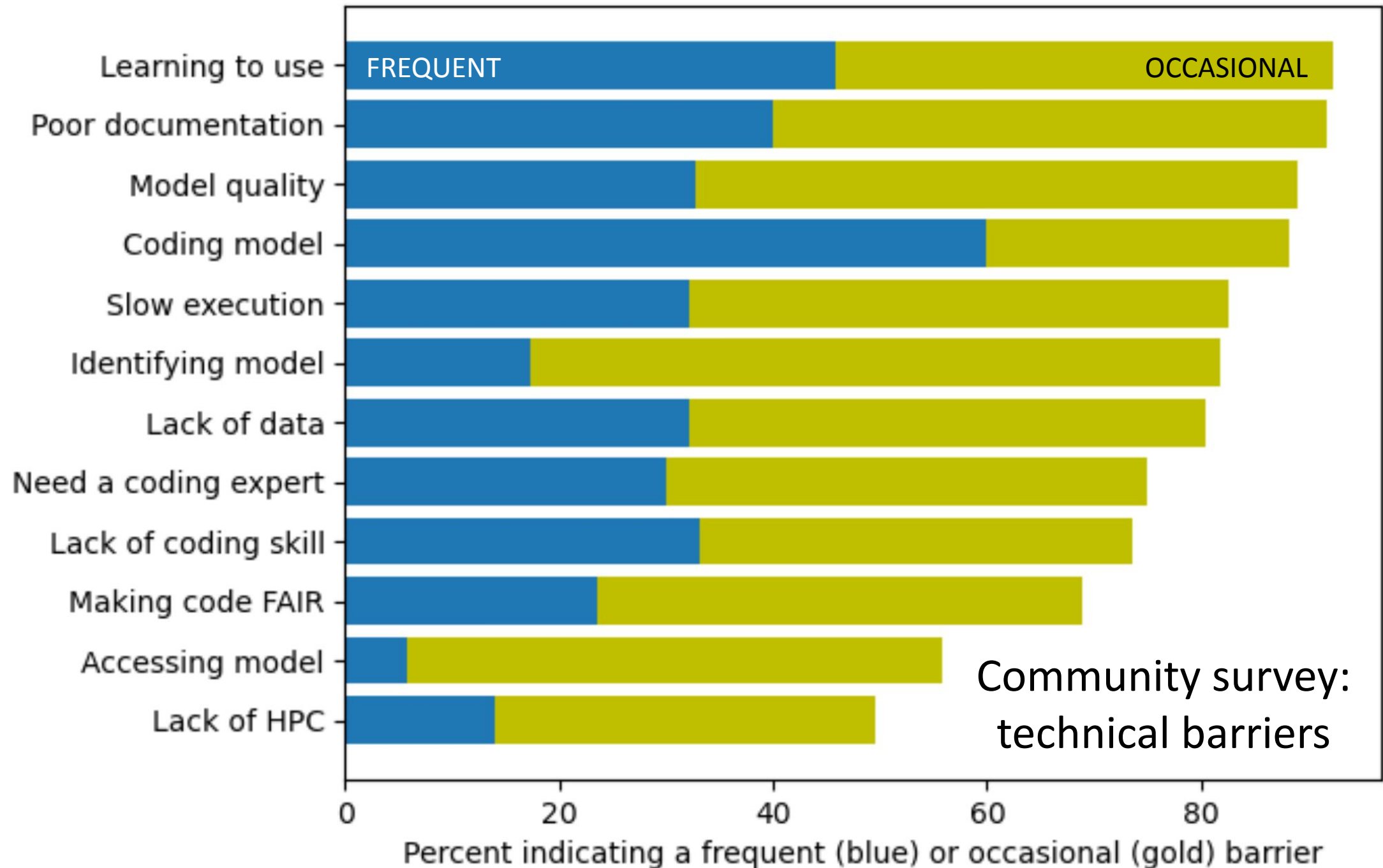
- Community survey
- Breakout discussions:
Tuesday & Wednesday
- Send your thoughts to:
csdms@colorado.edu



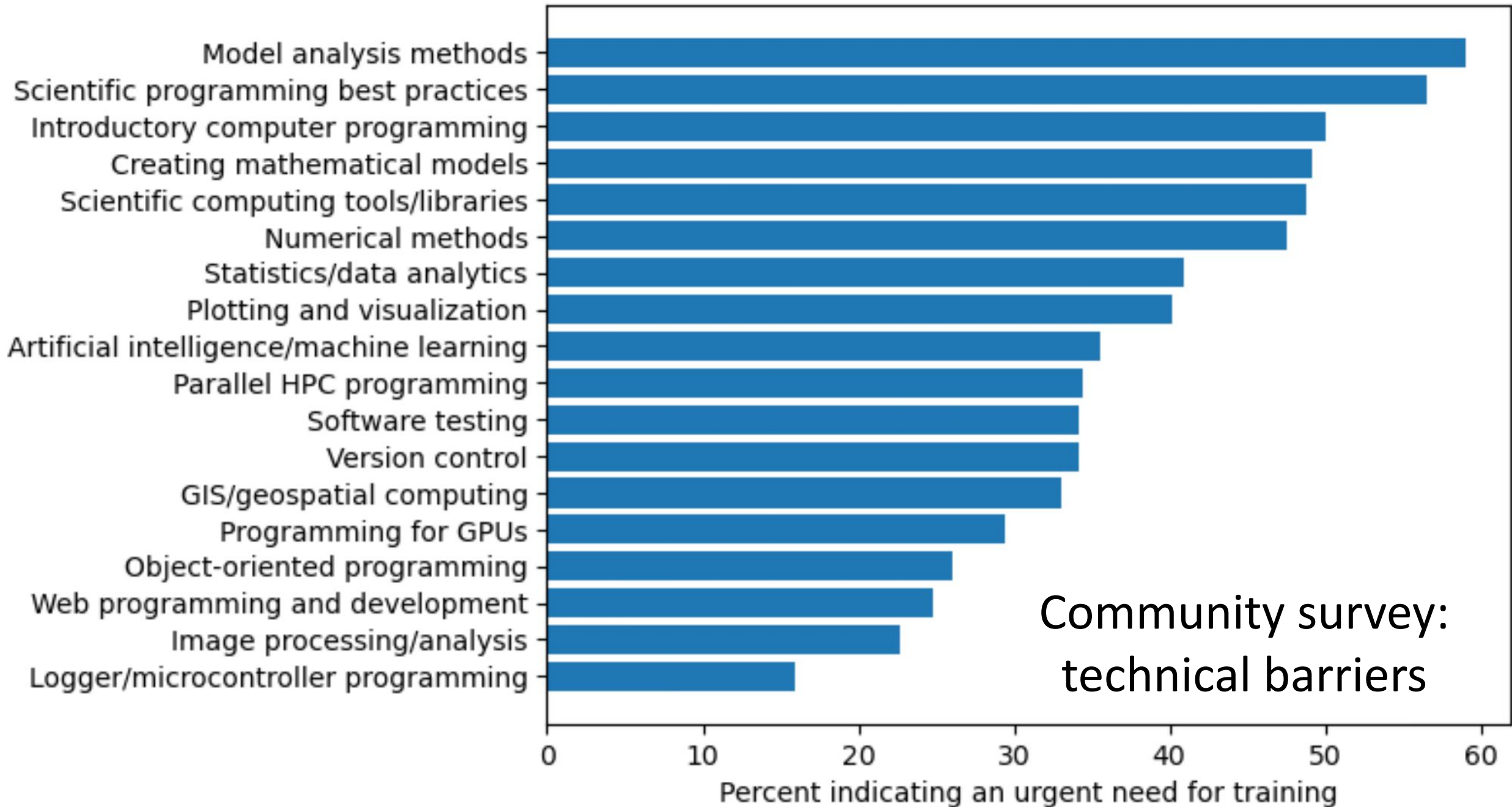
Survey results: programming languages



Survey results: barriers



Survey results: training needs



2021 CSDMS Integration Facility Staff



Greg Tucker
Executive Director



Irina Overeem
Deputy Director



Eric Hutton
Senior Software
Engineer



Albert Kettner
Cyber Com & Data



Mark Piper
Software Engineer



Lynn McCready
CSDMS Program
Coordinator



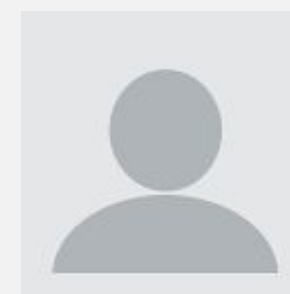
Tian Gan
Postdoc, RSE



Benjamin Campforts
Postdoc, ESPIn EKT



Chad Stoffel
IT Administrator



Jean Lindhal
Accountant



Meeting program

MONDAY 17 MAY	TUESDAY 18 MAY	WEDNESDAY 19 MAY	THURSDAY 20 MAY
	keynotes	keynotes	keynotes
	clinics	clinics	clinics
	breakout groups	breakout groups	science jam
opening & town hall awards ceremony happy hour	posters	posters	

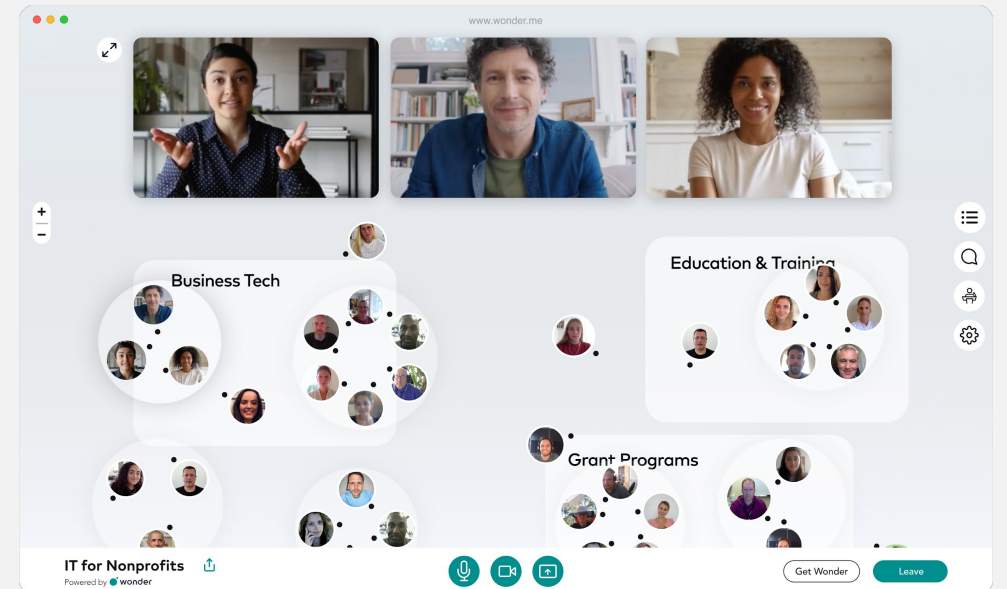
About the Science Jam

Self-organizing discussions on the
wonder.me platform

You pick the discussion topics...

Send topics before Thursday to:

csdms@colorado.edu





CSDMS
community surface
dynamics modeling system



*share resources,
collaborate*



COMMUNITY
SUPPORT

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



COMPUTING
RESOURCES

learn and teach



EDUCATION
OPPORTUNITIES

Questions?

What are your computing barriers and needs?

What would you like to see in CSDMS 4.0?

csdms@colorado.edu