CSDMS Newsletter - September 2023

CSDMS/Greg Tucker <csdms@colorado.edu>
Reply-To: CSDMS/Greg Tucker <csdms@colorado.edu>

Thu, Aug 31, 2023 at 7:00 AM

CSDMS
community surface dynamics modeling system

ON THE SURFACE

CSDMS Newsletter
September 2023

Join CSDMS

New to CSDMS Workbench

The following new components are now available for community use in the **CSDMS**

Workbench:

AdvectionSolverTVD – This component provides a generic numerical solution to advection problems. The component uses a second-order Total Variation Diminishing (TVD) scheme to minimize numerical diffusion when preventing oscillations that arise from linear, second-order methods. The user specifies which field or fields (it can be multiple) will be advected, along with either an advection-velocity field or (x, y) components of advection (if spatially uniform). The accompanying notebook tutorial describes the theory, and shows examples of how to use the component.

See the full list of Landlab Components here: https://landlab.readthedocs.io/en/master/reference/components/index.html

---

ROMS Data Component: can access the Regional Ocean Modeling System (ROMS https://www.myroms.org/) data from a NetCDF file, through either a local file path or an OPeNDAP URL. This Data Component wraps the ROMS output data with Basic Model Interface (BMI) and makes them easy to be coupled with other datasets or models that expose a BMI.

- documentation: https://pymt-roms.readthedocs.io/
- source repository: https://github.com/gantian127/bmi_roms
- pymt component: https://github.com/gantian127/pymt_roms

For tutorials and how to submit data components see here.

Scientific Variables Ontology

The Scientific Variables Ontology (SVO) is a framework for expressing scientific variables in machine-readable form. These representations are useful for tagging digital resources such as datasets and computational models. Documentation for a new version of the ontology is now available through the SVO website. New features include slash URIs, links to Wikidata, and templates for submitting GitHub issues for corrections to existing entities and suggestions for new entities. These enhancements are part of the Open Earthscape project.

CSDMS Fall Webinar Series

Register Now!

Please join us for the CSDMS 2023 Fall Webinar Series. This series will also include Euro-CSDMS focused webinars, convened by Sam Harrison, UK Center for Ecology and Hydrology, in October and November. Registration is required and link/details are provided below.

CSDMS Student Modelers (Runners Up)
September 13th, 2023 @ 9:00AM MDT

Derek Neuharth, ETH, Zurich

Evolution of divergent and strike-slip boundaries in response to surface processes

Numerical models are used to provide insight on how surface processes influence tectonics at divergent and strike-slip boundaries through two studies. The first study takes a detailed look at the evolution of rift systems using two-dimensional models. Specifically, we extract faults from a range of rift models and correlate them through time to examine how fault networks evolve in space and time. By implementing a two-way coupling between the geodynamic code ASPECT and landscape evolution code FastScape, we investigate how the fault network and rift evolution are influenced by the system's erosional efficiency, which represents many factors like lithology or climate. The second study uses the two-way numerical coupling between tectonics and landscape evolution to investigate how a strike-slip boundary responds to large sediment loads, and whether this is sufficient to form an entirely new type of flexural strike-slip basin.

Danghan Xie, Boston University

Responses of mangrove forests to sea-level rise and human interventions: a bio-morphodynamic modelling study

Mangroves preserve valuable coastal resources and services along tropical and subtropical shorelines. However, ongoing and future sea-level rise (SLR) is threatening mangrove habitats by increasing coastal flooding. Changing sediment availability, the development of coastal structures (such as barriers), and coastal restoration strategies (such as mangrove removal) not only constrain the living space of mangrove forests but also affect coastal landscape evolution. Due to limitations in studying various temporal and spatial scales in the field under SLR and human interventions, insights thus far remain inconclusive. Results of bio-morphodynamic model predictions can fill this gap by accounting for interactions between vegetation, hydrodynamic forces, and sediment transport.

Here we present a numerical modeling approach to studying bio-morphodynamic feedbacks within mangrove forests through a coupled model technique using Delft3d and Matlab. This approach takes into account (1) multiple colonization restrictions that control not only the initial mangrove colonization but also the subsequent response to SLR, (2) the possibility of coastal progradation and seaward mangrove expansion despite SLR under high sediment supply, (3) modulation of tidal currents based on vegetation presence and coastal profile evolution

which, in turn, affect mangrove growth and even species distributions, and (4) profile reconfiguration under SLR which may contribute to the infilling of new accommodation space.

REGISTER

Digital Twins of the Natural Environment: Achieving a Synergy of Process and Data Understanding

October 5th, 2023 @ 8:00AM MDT

Gordon Blair, UK Center for Ecology and Hydrology, United Kingdom

Digital twins are increasingly important in many domains, including for understanding and managing the natural environment. Digital twins of the natural environment are fueled by the unprecedented amounts of environmental data now available from a variety of sources from remote sensing to potentially dense deployment of earth-based sensors. Because of this, data science techniques inevitably have a crucial role to play in making sense of this complex, highly heterogeneous data. This webinar will reflect on the role of data science in digital twins of the natural environment, with particular attention on how resultant data models can work alongside the rich legacy of process models that exist in this domain. We will seek to unpick the complex two-way relationship between data and process understanding. By focusing on the interactions, we will end up with a template for digital twins that incorporates a rich, highly dynamic learning process with the potential to handle the complexities and emergent behaviors of this important area.

REGISTER

Modeling the Flow of Glaciers and Ice Sheets with icepack

November 14th, 2023 @ 10:00AM MST

Dan Shapero, University of Washington

icepack is a Python software package for simulating the flow of glaciers and ice sheets. Icepack is built on top of

the finite element modeling library Firedrake, which makes it possible to describe physics problems using a domain-specific language (DSL) embedded into Python. This DSL makes the code you write look much more like the underlying math. Using this DSL, we've been able to create an ice flow model that users can easily extend and modify -- for example, substituting in your own sliding law -- while at the same time insulating them from some of the messier aspects of numerical modeling. In this talk, I'll describe some of the design decisions that went into icepack and why we made them as well as how we've involved graduate students in the development process. Finally, I'll give a live demo and discuss some future directions.

REGISTER

IGM, a Data Assimilation and Glacier Evolution Model Boosted by Deep-Learning

December 6th, 2023 @ 8:00AM MST

Guillaume Jouvet, Inst of Earth Surface Dynamics, University of Lausanne, Switzerland

Deep-learning emulators permit to reduce dramatically the computational times for solving physical models. Trained from a state-of-the-art high-order ice flow model, the Instructed Glacier Model (IGM, https://github.com/jouvetg/igm) is an easy-to-use python code based on the Tensorflow library that can simulate the 3D evolution of glaciers several orders of magnitude faster than the instructor model with minor loss of accuracy. Switching to Graphics Processing Unit (GPU) permits additional significant speed-ups, especially when modeling large-scale glacier networks and/or high spatial resolutions. Taking advantage of GPUs, IGM can also track a massive amount of particles moving within the ice flow, opening new perspectives for modeling debris transportation of any size (e.g., erratic boulders). Here I give an overview of IGM, illustrate its potential to simulate paleo and future glacier evolution in the Alps together with particle tracking applications, and do a quick live demo of the model.

REGISTER

CSDMS Community Teaching and Research Resources

Open Earthscape Jupyter Hub - https://csdms.colorado.edu/wiki/JupyterHub
CSDMS EKT Labs - https://csdms.colorado.edu/wiki/Labs_portal
Office Hours (via Zoom) with a CSDMS Research Software Engineer - 9AM on Wednesdays. To register - https://csdms.colorado.edu/wiki/OfficeHours
CSDMS Help Desk - https://csdms.github.io/help-desk/

Save the Date!
Registration Opens in January

Important Deadlines:

- **Student Modeler Competition** submission deadline is January 19th, 2024. Submission requirements and additional details can be found here.
- **Call for Clinic presentations!** Each year a variety of clinics are available for registered meeting attendees. If you would like to provide a clinic, additional details and the submission form can be found here. Deadline to submit is December 1st, 2023. Submitters will be notified of acceptance decisions by January 5th, 2024.

- A limited number of **Travel Scholarships** will be available and the deadline to apply is February 9th, 2024. Application information will be available in mid-January.

2024 Earth Surface Processes Institute
July 29th to August 6th in Boulder, CO

The Earth Surface Processes Institute (ESPIn) is a six-day in-person summer school for 25 students. ESPIn offers hands-on training in numerical modeling, collaborative coding, and open-source software development, with an emphasis on best practices such as version control, unit testing, continuous integration, and open metadata/modeling standards. ESPIn introduces students to cyberinfrastructure such as the CSDMS Workbench via tutorials delivered on the OpenEarthscape JupyterHub. Students will be provided an opportunity to present their ESPIn team projects in a webinar that will be open for CSDMS community participation. Travel and subsistence support will be provided for all students. Application details for the 2024 ESPIn will be announced in a few months!

Community Member News

The co-winner (we had a tie this year!) of the CSDMS poster presentation award is

Ashanie Long-Reid, Western Washington University, for her presentation *"Simulated river channel response to a coarse sediment pulse with and without bed material abrasion".*

Congratulations to **Dominique Townsend**, University of Southampton, co-winner

of the poster presentation award for her presentation *"Identifying sediment transport pathways on a heavily managed and chronically eroding, mixed sediment beach".*

Join us on X!

Be the first to know about all the new resources!! For new products, job postings, events, breaking science, training opportunities and more, please follow us **@CSDMS** on X.

CSDMS is an NSF

sponsored program