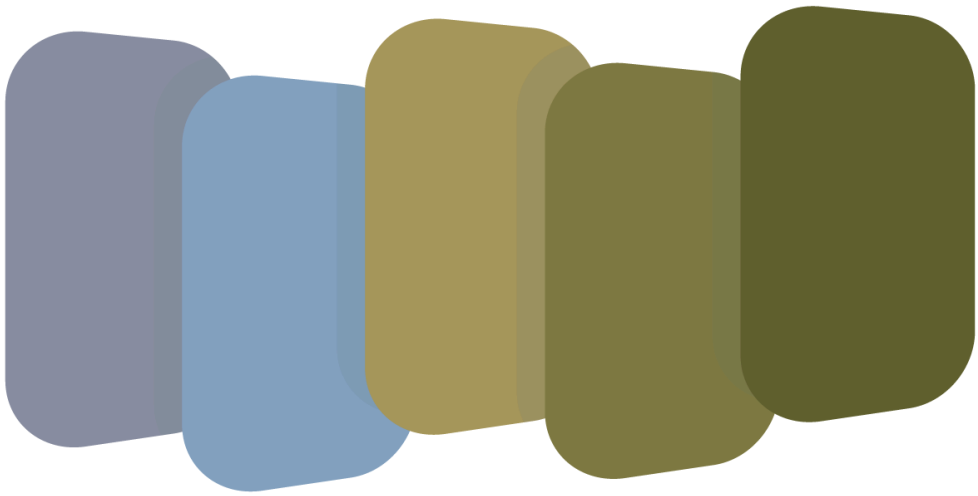

CSDMS

Community Surface Dynamics Modeling System: Strategic Plan 2023

Executive Summary

Vision

Growing and engaging an open and diverse community around earth surface process modeling to support interdisciplinary research, discovery, and applications.

Mission

CSDMS accelerates cross-disciplinary research and applications in earth surface processes by engaging and coordinating the research community; advancing open, collaboratively developed modeling software and protocols; and supporting education and outreach.

High-level strategic objectives

1. **Connect community:** Foster and grow a thriving community of practice around cross-disciplinary earth surface process modeling.
2. **Deploy models and modeling tools in cross-disciplinary research and applications:** Apply community models and model-data integration tools to deepen our understanding of Earth, and foster environmental stewardship and sustainability.
3. **Develop FAIR[1] research software:** Create, maintain, curate, and share open-source models, model-data integration tools, and related resources for earth surface research.
4. **Promote education and learning opportunities:** Provide training opportunities and learning resources for scientific computing and earth surface process modeling to advance community skills, lower barriers, and increase scientific engagement and participation.

[1] Findable, accessible, interoperable, reusable

What is CSDMS?

The Community Surface Dynamics Modeling System (CSDMS) deals with the Earth's surface: the ever-changing, dynamic interface between solid earth, hydrosphere, cryosphere, biosphere, and atmosphere. We are a diverse community of experts promoting the modeling of earth surface processes by developing, supporting, and disseminating integrated software modules that predict the movement of fluids, and the flux (production, erosion, transport, and deposition) of sediment and solutes in landscapes and their sedimentary basins.

The US National Science Foundation supports the **CSDMS Integration Facility** (CIF) to accelerate research and applications across earth-surface sciences by engaging and coordinating the scientific **community**, developing and curating state-of-art **cyberinfrastructure**, and providing opportunities and resources for **education**. CSDMS is an open, community-led organization that helps the research community collaboratively develop and use a shared, modular, and ever-improving system for computational modeling and data-model integration. The interested reader can learn more about CSDMS here: https://csdms.colorado.edu/wiki/About_CSDMS.

Strategic Objectives and Activity Areas

1. Connect Community

Foster and grow a thriving community of practice around cross-disciplinary earth surface process modeling. Goals and activities related to this objective are listed below, with current programmatic activities in *italics*.

A. Host community meetings and workshops that provide opportunities for members to connect with one another and share computationally oriented science across a range of disciplines that bear on earth surface processes.
    a. Host "all hands" community meetings.
        i. *Run CSDMS All-Hands Meetings each year 2022-2026*
    b. Host online video lectures.
        i. *Host a ~monthly webinar series with recordings available online*
        ii. *Provide online recordings of meeting keynote lectures via the web portal*

B. Promote inclusiveness and broad participation in computational earth surface science.
    a. Provide engagement opportunities for students and faculty at Minority-Serving Institutions (MSIs).
        i. *Offer site-based training programs ("Roadshows"; see below) at or near MSIs*
    b. Promote and support participation in early-career training programs by students from traditionally underrepresented groups.
        i. *Advertise Earth Surface Processes Institute (see below) broadly; offer stipends*
        ii. *Provide computational training workshops for an internship program geared toward community college students*

C. Foster communication with and among community members.
    a. Issue newsletters, social media posts, and website information.
        i. *Publish quarterly "On the Surface" email newsletters*
        ii. *Announce updates and opportunities on social media*
        iii. *Disseminate information through the CSDMS web portal*
    b. Help community members connect with and support one another online.

        i. *Operate an online CSDMS community forum*
    c. Encourage and support exchange of interactive, model-based research.
        i. *Manage submission and online publication of peer-reviewed executable ("notebook") articles associated with community meetings*
    d. Continually assess and adapt to community needs and interests.
        i. *Gather feedback from Group discussion sessions at meetings*
D. Operate a community-based governance and communication structure.
    a. Provide a low-bar membership pathway, including a group structure that brings together people with similar interests.
        i. *Operate and maintain functionality for new members to join CSDMS and affiliate with a group(s)*
        ii. *Involve constituent communities in governance and decision making by having chairs of groups serve as members of the executive committee*
    b. Be open and transparent.
        i. *Maintain and keep up-to-date web pages that provide metrics and relevant documents, such as annual progress reports and strategic plans*
E. Interact with partner organizations and projects.
    a. Maintain and build new relationships, and carry out joint projects with related community projects and organizations.
        i. *Work with sister entities such as CUAHSI, CCMP, CoMSES Net, CIG, ISEM, ISMC, AIMES, and CZnet on topics of mutual interest*
        ii. *Encourage (co-)sponsorship of relevant CSDMS Groups*
        iii. *Recruit Group chairs with close ties to relevant organizations*
    b. Create and maintain ties with relevant government agencies.
        i. *Interact with agencies and collaborate on projects of mutual interest*

2. Deploy Models and Modeling Tools in Cross-Disciplinary Research and Applications

Apply community models and model-data integration tools in cross-disciplinary applications to deepen our understanding of Earth, and foster planetary stewardship and sustainability.

A. Conduct and disseminate research that uses the community modeling system and related technologies.
    a. Explore and demonstrate the application of CSDMS tools across a variety of research problems and domains, such as:
        i. *Landsliding and its downstream impacts*
        ii. *Glacial and periglacial processes*
        iii. *Watershed hydrology*
        iv. *Sediment transport in river networks*
        v. *Long-term landscape evolution*
        vi. *Sedimentary basin stratigraphy*
        vii. *Coastal-zone sedimentary and biogeochemical processes*
        viii. *Interaction of solid earth and surface processes*
B. Explore the use of CSDMS tools and models beyond the research community.
    a. Test the application of CSDMS technology in participatory modeling.
        i. *Develop and test a prototype bridge to the fora.ai platform*
        ii. *Trial the use of this bridge by stakeholders in specific case studies*
C. Support remote-access computing facilities for community members.
    a. Provide cloud-hosted resources for running CSDMS models and tools.

i. *Operate a JupyterHub for community members to test out and apply CSDMS models and tools in research*

3. Develop and curate FAIR Research Software

Create, maintain, and share open-source models, model-data integration tools, and related computational resources for earth surface research.

A. Improve and maintain cyberinfrastructure for a modular, ever-improving modeling system.
   a. Develop, maintain, and extend collaborative, component-based modeling libraries and their associated documentation.
      i. *Extend, improve, and sustain Landlab Toolkit and its documentation collection*
   b. Develop, improve, and maintain tools that allow community-built numerical models to operate as components in a modular framework.
      i. *Integrate the Python Modeling Tool into Landlab Toolkit*
      ii. *Sustain and improve tools to componentize stand-alone model codes*
   c. Develop, maintain, and coordinate tools and protocols to support model-data integration.
      i. *Write, document, and maintain Data Components for programmatic access to specific datasets of broad interest.*
   d. Improve computational efficiency of existing tools and models.
      i. *Refactor elements of Landlab for enhanced performance*
B. Develop, coordinate, and promote interoperability standards for computational models.
   a. Coordinate development and specifications for the Basic Model Interface (BMI) standard and related ontology tools.
      i. *Coordinate the community-based Council of BMI*
      ii. *Maintain online documentation and templates for BMI*
      iii. *Extend BMI with additional languages and functionality extensions*
      iv. *Wrap selected codes with a BMI*
      v. *Provide a workflow for wrapping executables via file exchange*
      vi. *Support development of standard ontologies and related tools*
C. Enable sharing and FAIRing of community-developed model codes.
   a. Provide a comprehensive web-based community model repository and catalog with consistent, searchable metadata.
      i. *Sustain and improve the CSDMS Model Repository*
      ii. *Develop technology that enables users to launch cloud-hosted interactive tutorials for selected codes*
   b. Improve source-code quality, accessibility, and maintainability for community-contributed models.
      i. *Pre-build binary packages that can be installed using package managers*
      ii. *Collaborate with model developers to equip select code repositories with continuous integration for improved quality, reproducibility, and maintainability*
   c. Make it easier for users to try out tools and models interactively.
      i. *Operate a cloud-hosted JupyterHub server equipped with CSDMS software and interactive tutorials*
D. Promote the adoption and use of CSDMS computational tools and protocols by providing programs and resources for hands-on training, self-paced learning, high-quality documentation, and technical assistance.
   a. Include material on CSDMS tools in hands-on training programs.

        i. *Provide modules on CSDMS tools and practices in Earth Surface Processes Institute (ESPIn) and Roadshows (see below)*
    b. Provide direct research software engineering support to community members.
        i. *Offer online Research Software Engineer "office hours" consulting*
        ii. *Operate an online "Help Desk" where community members can post questions to Research Software Engineers*
        iii. *Provide project-level assistance via pro bono and contract-based consulting with Research Software Engineers*

4. Promote Education and Learning Opportunities

Provide training opportunities and learning resources for scientific computing and earth surface process modeling to advance community skills, lower barriers, and increase scientific engagement and participation.

A. Provide hands-on teaching and training in scientific programming, numerical modeling, and cyberinfrastructure tools.
    a. Host hands-on multi-day workshops and short courses for early career researchers.
        i. *Operate an annual Earth Surface Processes Institute (ESPIn)*
        ii. *Run ~2x annual CSDMS Roadshows*
    b. Provide clinic-style short courses at community events.
        i. *Sustain a "clinic" program at all-hands meetings*
B. Develop and disseminate online learning resources for community-relevant topics.
    a. Create and curate a web portal for sharing lab-style computational teaching packages.
        i. *Oversee and contribute to the CSDMS Labs collection*
        ii. *Maintain cloud-based servers for individual and classroom use, on which community members can run interactive learning materials*
    b. Create and curate independent learning materials on geoscientific data analysis and modeling.
        i. *Develop, host, and sustain self-paced online learning modules on scientific computing basics and geo-data-science applications*
        ii. *Develop training materials for instructor-led courses ("CSDMS Ivy")*
C. Promote awareness of new methods, tools, and applications related to geoscientific computing.
    a. Help community members do reproducible computational research.
        i. *Showcase reproducibility projects like WholeTale*
D. Develop and host visual-learning resources.
    a. Use simulation models to teach students and curious learners about earth-surface processes.
        i. *Develop and host an online, randomly driven source-to-sink simulation*