

Lessons Learned for a Community Space Weather Modeling Program - The CISM Experience

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What is “Community Modeling”?

Can mean many things

- community use of models (e.g., CCMC)
- community modeling “challenges”
- applying models to community science & operations objectives

Focus here on model **development** by the community:

Community-directed, community-collaborative approach to problems that require contributions from the distributed community of modelers.

CISM experiences may offer some useful lessons...

Developing a suite of physics-based models that describes the space environment from Sun to Earth.

- 11 member institutions, W.J. Hughes, Boston University, PI
 - Alabama A&M, Berkeley, Colorado, Dartmouth, Maryland, NCAR, Rice, Predictive Science, Stanford, UT Arlington
- Major partnerships
 - AFRL ⇨ multiple modeling partnerships; USAF liaison
 - CCMC ⇨ communities' use & evaluation of CISM models
 - NOAA/SWPC ⇨ operational evaluation & use
- August 2002 - July 2012

www.bu.edu/cism

Research

- *Enabling research*
- *Model development*
- *Coupling*
- *Scientific use*
- *Systematic validation*

Education

- *Summer school*
- *Graduate community*
- *Undergrad research*
- *Grades 6-14 education*

Diversity

- *Recruitment & retention*
- *AAMU space science program development*

Knowledge Transfer

Provide models for:

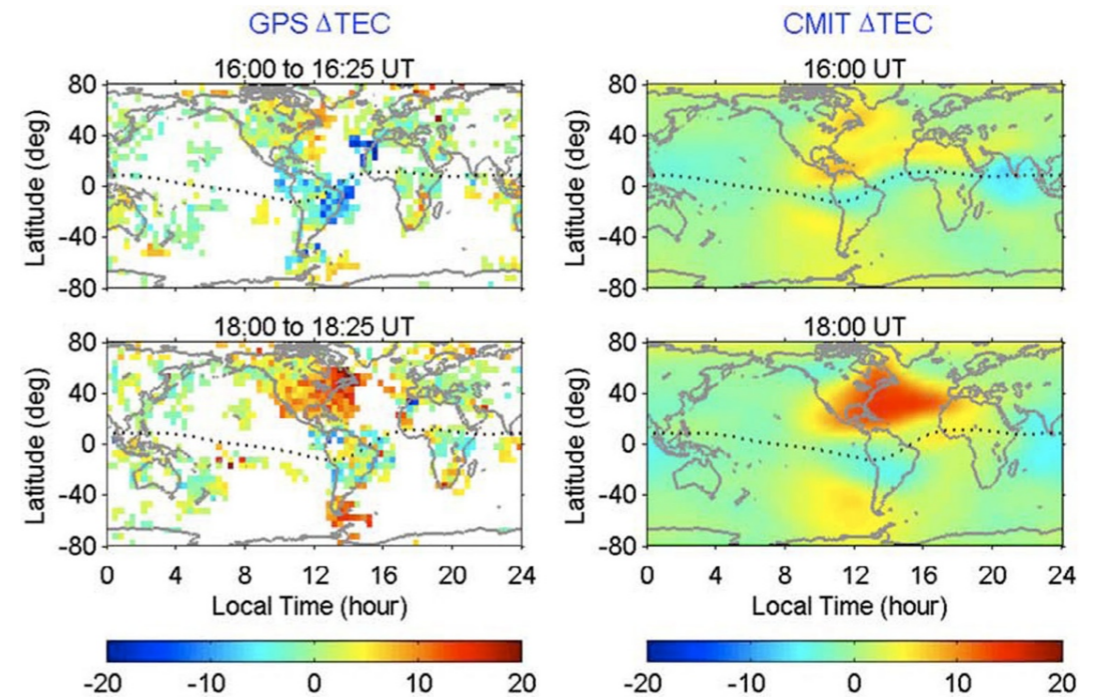
- *research community &*
- *operational environment*

What would be needed for community-based model development?

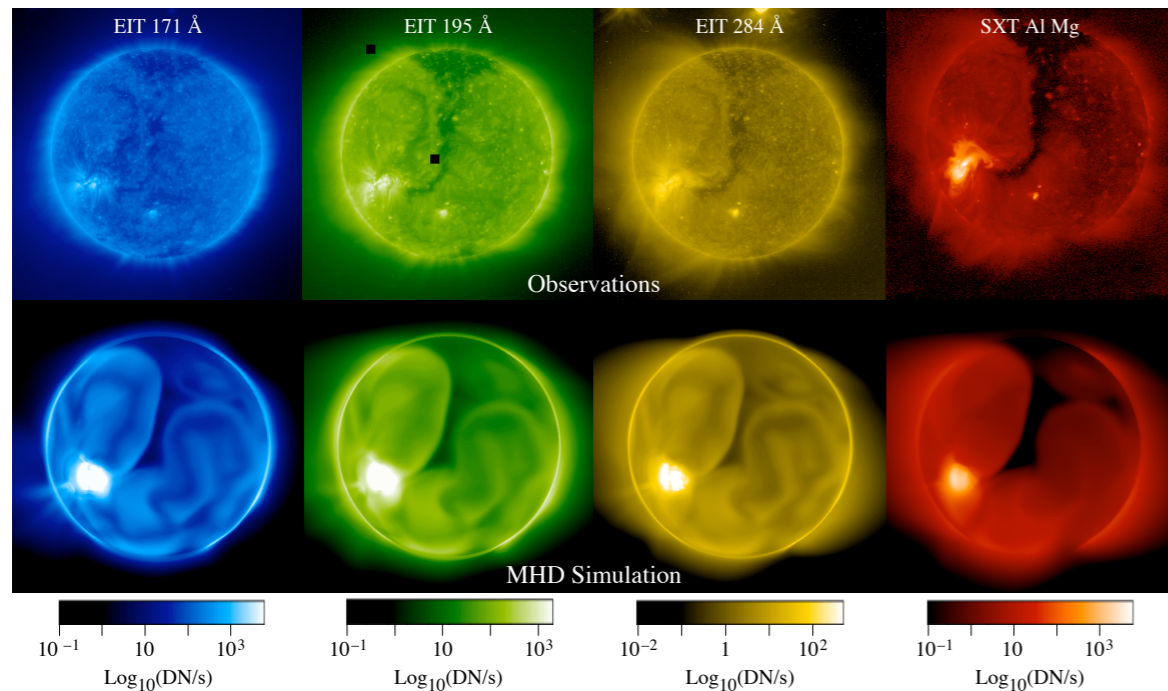
- Incentive
- Coordination, diverse approaches, flexibility
- Transition pathways to scientific & operational benefits
- Participation, accessibility, technical support
- \$ and stability

CISM Experience: Coupled Models

Coupling “component” models makes system interactions accessible to simulation.



Lei et al, J. Geophys. Res. 2008



But robust component model development must continue, and will pace many aspects of system-level modeling.

Diverse goals require a flexibly-coupled model suite.

Why community model development?

- Bring together community expertise
- Make system-level processes more accessible by combining modeled elements
- Develop scientific and operational capabilities that justify strong agency support
- Provide opportunities for individual modelers to explore interactions with other modeled processes or with a system model

CISM Experience: “Center Mode”

Center’s unifying goals, coordination, and stability expand and add value to what is possible for individual groups.

- Scientific accomplishments and new opportunities from sustained collaborations between modeling groups
- Leveraging research of participating groups
- Coordination of center-wide activities: systematic validation, model transition support, shared tools, young scientist community

Caveat: Large collaborations carry an overhead that’s worthwhile for some activities, but would be inefficient for others.

Possible Center-Like Elements of a Community Model Development Program

- Community direction -- Steering Committee?
- Broad participation & low entry barriers
- Visitor program for modelers, between groups & to operational agencies
- Student & young scientist exchanges
- Technical support (accessibility, software tools, repositories)
- Mechanisms for shared development

Balance is needed.

Center-mode makes sense where benefits justify overhead.

CISM Experience: Transition to Ops

- Developing forecast products from sophisticated research models requires much more than technical installation on new platforms.
- Needs sustained developer-forecaster collaboration; complex models can't be “thrown over the wall”.
- Forecaster-modeler partnership can productively address issues such as sensitivities to input data, forecast parameter derivation, model modifications, metrics clarification, and many others.
- One size does not fit all. The “optimum” model and appropriate metrics vary with differing needs of diverse end-users.
- Developer time spent on model transitions can displace work needed to sustain professional recognition and viability.

Transitioning Community Models

CCMC provides key pieces for community use of models:

- expert support for ingesting diverse models
- broad community use via user-friendly model runs-on-request
- runs archive
- model evaluations & feedback to users

Community model transitions to operations will need:

- Mechanisms to coordinate and support transitions of models with multiple contributing developers.
- Appropriate funding and professional recognition for developers supporting transitions.
- Means for forecaster-modeler transition partnerships (defined transition teams; targeted supporting grants?)

CISM Experience: Technical support

Center's critical-mass makes possible dedicated technical support and shared software development.

- Model coupling
- Software engineering support
- Visualization tools
- Model repository
- Lower threshold for productive participation by inexperienced scientists, new students, collaborators, etc.

Technical Support for Community Models

Effective community model *development* will need dedicated technical support for several shared needs

- mechanisms for shared model development and coupling
- code coordination (versioning, branch merges, repository)
- software engineering (testing, platform compatibility, libraries)
- promoting low-threshold participation by newcomers

CISM Experience: Funding & Stability

- CISM funding enables added-value “integrative” activities.
- Accomplishments depend upon leveraging strong model development programs in participating groups.
- Funding stability allows time required for coupling, testing, & refining independently developed models, and to support coupled model transitions.

Funding Community Model Development

- Community-based model development would support both scientific and operational needs.
- Incremental funding for center-like elements and transitions to operations would enable progress that will not occur through existing mechanisms.
- Robust component model development is critical. Community model development must not come at the expense of support for individual model development.

A mix of existing competed agency funding (both broad and targeted), with additional support for needed center-like tasks, seems reasonable to enable productive community model development.

Backup

