Metrics and Validation Focus Group

The Transition Years (2011-2012)

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The Recent Years (2013-2015)

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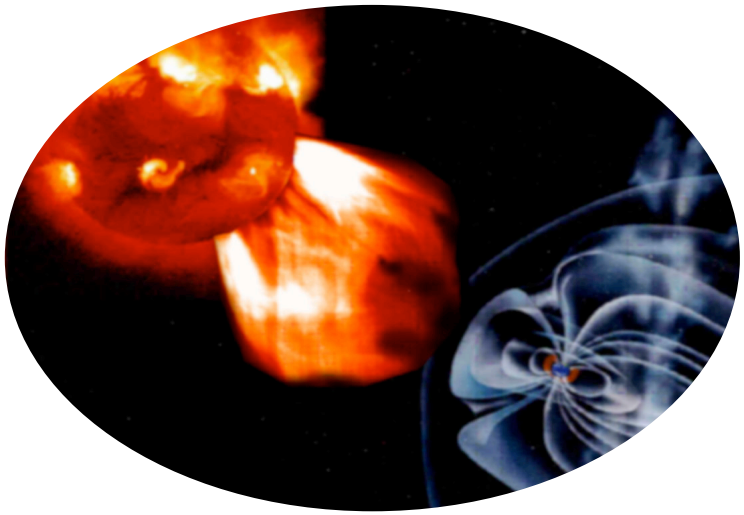

Motivation

- **Decadal Survey Goals related to GEM M&V**
  - Determine the origins of the Sun's activity and predict the variations in the space environment.
  - Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs.

Motivation

- **GEM White Paper**

The overarching goal of the GEM program is to explore, understand, and ultimately predict the dynamics of the geospace system by advancing increasingly realistic numerical simulations, including global and specialized regional models, and capabilities for synoptic observations. This overarching goal includes the following elements:

- **Advance modeling capabilities, including metrics and validation of first-principles and empirical models, and promote the broader use of models;**

Additional Remarks

- **CCMC validation and metrics of models describing various aspects of the solar wind – magnetosphere – ionosphere interaction.**
- **The progressively improving fidelity of atmospheric weather and climate models, combined with advanced measurement techniques that enable model validation and data assimilation while promoting scientific discovery, are apropos of the current trajectory of GEM program research.**

M&V Proposal

- Testing current models capabilities and identifying areas in need of future scientific development.
- Challenges: GGCM Modeling Challenge; ULF Challenge…
- New GGCM baseline model comparisons are needed to understand the differences between various modeling approaches and the role of different model settings in model performance, as well as collaborations with all GEM focus groups that have models ready for evaluation.
- Proposed joint GEM-CEDAR modeling challenge focused on magnetosphere/ ionosphere coupling
- The functions performed by this FG are timeless, however, because they represent the iterative cycle of model test and improvement that a GGCM goes through on its way to successfully predicting the space environment.
- Other: Ground-based magnetic perturbations, Regional K's, benchmarks, metrics
- CCMC: interactive on-line metric tools for community use

Publications (initiating list)

Publications within the last 5 years through CCMC related to GEM M&V:

- Pulkkinen, A., Rastaetter, L., Kuznetsova, M., Singer, H., Balch, C., Weimer, D., Toth G., Ridley, A., Gombosi, T., Wiltberger, M., Raeder, J., and Weigel, R., Community-wide validation of geospace model ground magnetic field perturbation predictions to support model transitions to operations, Space Weather, 11, 369-385, doi:10.1002/swe.20056, 2013.
- Rastaetter, L., G. Toth, M. M. Kuznetsova, and A. A. Pulkkinen (2014), CalcDeltaB: An efficient postprocessing tool to calculate ground-level magnetic perturbations from global magnetosphere simulations, Space Weather, 11, doi: 10.1002/2014SW001083.
- Rastaetter, L., J.-S. Shim, M. M. Kuznetsova, D. J. Knipp, L. M. Kilcommons, M. Codrescu, T. Fuller-Rowell, B. Emery, D. R. Weimer, R. Cosgrove, M. Wiltberger, J. Raeder, W. Li, G. Toth, D. Welling (2015), "GEM-CEDAR challenge: Poynting flux at DMSP and modeled Joule heat", submitted to Space Weather.
- A. Glocer, et al. (2015), Community-wide validation of geospace modeling challenge: regional and planetery K-index, to be submitted to Space Weather.

Community-wide model validation projects

- GEM Metrics Challenge
- GEM 2009 Baseline Model Comparison
- CEDAR ETI Challenge
- GEM-CEDAR Challenge
- SHINE Challenge
- ULF Wave Modeling Challenge

- Current status of GEM and CEDAR ETI community-wide challenges
- Click here for a PDF of the proposed event list for the storm impacts on geospace metrics study.

Metrics and validation at the CCMC

Operational geospace model validation

- Groundbased magnetic perturbations **dB/dt** and Regional-K index
- Auroral oval boundaries

Solar and heliosphere model validation

- Latest CCMC Model Validation Report (CCMC 2012 Workshop), P. MacNeice
- CCMC Metrics and V&V Report: Solar/Helio Models (CCMC 2010 Workshop), P. MacNeice

- CME arrival validation studies
- Ambient solar wind validation studies
- CME validation studies

Real-time Validation Activities

- Flare Scoreboard Planning Page
- CME Arrival Time Scoreboard

http://ccmc.gsfc.nasa.gov/challenges/index.php

Some Topics in M&V Sessions

- Geospace model evaluation progress and new results for regional geomagnetic activity predictions
- Innovative methods for model validation, including climatology
- Validating Models under Extreme Geomagnetic Conditions
- ULF Wave Modeling Challenge
- Model Uncertainty: Dealing with Uncertain Physical Processes and Boundary Conditions
- New Validation Results and Methods."
- How Validation Studies Guide Model Improvements."
- Validation of MHD models coupled with other modules such as the Ring Current and Polar Out- flow.
- GGCM Modeling Challenge
- Measuring Models Climatologically"