2016 Workshop: GEM CEDAR Modeling Challenge

Long title
GEM-CEDAR Modeling Challenge
CEDAR-GEM
Conveners
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Description

The workshop will review progress in on-going CEDAR-GEM coordinated magnetosphere-ionosphere-thermosphere model validation activities and metrics studies, focus on tasks associated with model-data comparisons, such as appropriate metrics selection for specific applications, preparation of observational data, uncertainty assessment, sensitivity analysis of model outputs to external drivers and other input parameters, boundary conditions, modeling assumptions, adjustable parameters. We will discuss ideas for community-wide initiatives to build upon successes and to address challenges of metrics and validation activities. We will review the progress in assessment of capabilities to model ionosphere-thermosphere response to geomagnetic storms. We will specifically focus on processes and boundaries in auroral region – a hub for magnetosphere-ionosphere-thermosphere coupling.

We will kick off the GEM Ionospheric Conductance Challenge with a discussion of ionospheric conductance observations and modeling. We will use this meeting to define the goals of a new conductance modeling challenge.

This workshop will:

1) address the CEDAR Strategic Thrust #5 as the workshop will facilitate collaboration among modelers, data providers and research communities in order to address the differences between various modeling approaches, to track model improvements over time, and to provide feedback for further model improvement; 2) address magnetosphere-ionosphere-thermosphere-magnetosphere (M-IT) coupling to better understand relationship between ionosphere-thermosphere (IT) dynamics and energy input from the magnetosphere that is relevant to one of scientific goals of the Decadal Survey for Solar and Space Physics; 3) define and begin one of the key initiatives of the GEM Focus Group of Modeling Methods and Validation ("GEM-CEDAR Ionospheric Conductance Challenge"); 4) define best approach to validation and metrics selection for auroral boundaries specification and predictions; 5) define ways to assess modeling capabilities to quantify geomagnetic storm driven thermospheric neutral densities and ionospheric disturbances.

During last five years since the first CEDAR-GEM Modeling Challenge Workshop, the CEDAR-GEM Challenge focuses on various scientific and operational aspects of magnetosphere and ionosphere/thermosphere models' performance and challenges of assessment of modeling capabilities. This year we will review where these ongoing challenges stand now and will discuss a path forward.

Because we are combining the ongoing GEM-CEDAR challenges with the new initiative of the GEM Modeling Methods and Validation focus group, we are requesting 6 hours of meeting time.

(Note to organizers: The GEM Modeling Methods and Validation Focus Group has requested 4 hours of GEM-CEDAR joint sessions through the GEM organizers for the Ionospheric Conductance Challenge. In lieu of that previously requested time, we are combining with the ongoing GEM-CEDAR modeling challenges and requesting a total of 6 hours for our joint validation efforts.)

Agenda

Session 1 (13:30-15:30, Monday, 06/20) will focus on overview topics related to model validation:

1. Review the status the CEDAR-GEM Model Validation Challenge projects: Ja Soon Shim (GSFC/CCMC) (13:30 – 13:45)
2. Introduction to GEM Ionospheric Conductance Challenge: Mike Liemohn (U-M) (13:45 – 13:55)

3. Challenges related to data availability and how to address these challenges for specific model validation projects
   • Challenges in Data Availability for Model Validation: Yongliang Zhang (APL) (13:55 – 14:10)
   • Robert Robinson (CUA) (14:10 – 14:25)
   • Larisa Goncharenko (MIT Haystack Observatory) (14:25 – 14:40)
4. Event-based metrics, expanding event list (pdf): benefits, challenges, guidelines (14:40 – 14:55)
5. General Discussions on Model Validations (14:55 – 15:30)
   • How to address uncertainty in models and data?
   • What is the best approach to model-data comparison of 2D features (e.g., global TEC and FAC)?
   • How to quantify physical phenomena?

Session 2 (16:00-18:00, Monday, 06/20) will focus on current research and future plans for:

1. Quantification and validation of phenomena in auroral region
   • Lutz Rastaetter (GSFC/CCMC) (16:00 – 16:15)
   • Poynting Flux /FAC from DMSP: Delores Knipp/Liam Kilcommon (CU) (16:15– 16:40)
2. Validation and metrics selection for auroral boundaries specification and predictions
   • FUV Auroral Images/Products for Model Validation: Yongliang Zhang (APL): (16:40 – 16:55)
   • FAC validation in global MHD: Slava Merkin (APL) (16:55– 17:10)
   Discussion (17:10 – 17:20)
3. Quantification and validation of storm-driven ionospheric/thermospheric disturbances
   • SAMI3/RCM Modeling of storms: Joe Huba (NRL) (17:20 – 17:35)
   • ISR-based climatology and modeling: Shunrong Zhang (MIT Haystack Observatory) (17:35 – 17:50)
   Discussion (17:50 – 18:00)

Session 3 (13:30-15:30, Tuesday, 06/21) will focus on formulating the specifics of the Ionospheric Conductance Challenge with a discussion of which conductance validation goals will be the most timely and helpful to the GEM-CEDAR community.

1. Summary of CEDAR-GEM Challenges and Introduction of Ionospheric Conductance Challenge: Katie Garcia-Sage (CUA) (13:30 – 13:35)
2. Scene setting talks
   • Dan Welling (13:35 – 13:50)
   • Ryan McGranaghan (13:50 – 14:05)
3. Discussion:
   • Contributed talks on conductance (14:05 – 14:30)
   • Next steps for a conductance challenge (14:30 – 15:30)

Justification

Geospace and Ionosphere/thermosphere research is increasingly relying on numerical simulations. Model coupling is heavily utilized to advance our understanding of the connection between the magnetosphere and ionosphere/thermosphere. The GEM and CEDAR communities has recognized that due to the maturity and increasing complexity of state-of-the-art space science and space weather models and coupled model chains, there is a great need for a systematic and quantitative assessment of different modeling approaches. For example, there is a need to understand and quantify how thermosphere-ionosphere-magnetosphere model coupling affect the model performance and model-data agreements. There is a need for performance tracking tools as well as the detailed feedback necessary to improve models. There is a challenge to identify and quantify physical phenomena in data and in models and to define an approach to measure model-data and model-model agreements. There is an even bigger challenge to find the way to quantify knowledge and understanding. Quantifying the confidence and predictive accuracy of model calculations is a key element of the Research-to-Operations transition problem. There is a need to understand which aspects of spatial and temporal characteristics of space environment parameters are the most important for specific research or space weather forecasting and analysis applications.

In recognition that model validation is a challenging research task CEDAR and GEM communities initiated GEM GGCM (in 2008) and CEDAR Electrodynamics Thermosphere Ionosphere (in 2009) Model Validation Challenges. The CEDAR-GEM Model Validation Challenge, built upon GEM GGCM (2008) and CEDAR ETI (2009) Challenges was initiated during the previous Joint GEM-CEDAR Workshop in 2011. The CEDAR-GEM Model Validation Challenges is focusing on physical parameters, spatial domains and aspects of model validation of interest to both communities.

The Community Coordinating Modeling Center (CCMC) is supporting the Modeling Challenges and maintaining a web site with interactive access to model output archive and observational data used for metrics studies.

Over the years since the Joint CEDAR-GEM 2011 Workshop the CEDAR-GEM Challenge energized collaboration between GEM and CEDAR communities and interaction between research and operation communities in developing metrics for space weather models. Challenge activities led to a number of joint publications. The CEDAR-GEM Challenge demonstrated the value of systematic and coordinated model validation projects and paved the way for community-coordinated model validation activities.

The GEM Focus Group of Modeling Methods and Validation (MM&V) which begins this summer has made Ionospheric Conductance one of their key initiatives and will also use this session to define and begin their Ionospheric Conductance Challenge. The MM&V Focus Group is interested in addressing the challenges and potential pitfalls of conductance observations and modeling, related parameters (e.g. particle precipitation), as well as feedback effects with magnetospheric processes.

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