2017 Workshop: SSWB

Long title
Grand Challenge: Storms and Substorms Without Borders (SSWB) 3: Refinement and Synthesis
Grand Challenge
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Description

The CEDAR Grand Challenge workshop “Storms and Substorms Without Borders” (SSWB) has been held at both the 2015 CEDAR meeting and the 2016 joint CEDAR-GEM meeting. SSWB has been coordinated with the GEM focus group on Storm-time Inner Magnetosphere-Ionosphere Convection (SIMIC), and there have also been two sessions at the 2015 and 2016 AGU Fall Meetings explicitly linked to SSWB efforts. Our focus is to understand the response of the coupled magnetosphere, ionosphere, and thermosphere system to storms and substorms as a whole system. Specifically, we seek to identify and investigate the underlying coupling processes and cross-scale interactions between the magnetosphere and the ionosphere-thermosphere (the M-I-T system). We request a final CEDAR grand challenge session at the 2017 meeting to conduct refined model-data comparisons, to synthesize understanding from previous sessions, and to highlight areas where advances are still needed in understanding.

In this final SSWB set of sessions, we will execute a second, refining round of model runs and observational comparisons centered on the ongoing community SAPS Focus Study (see definition below). To streamline efforts, study intervals from previous SSWB and AGU sessions have been selected to maximize scientific yield.

SAPS Focus Study definition: SAPS electric field structures are narrow channels of westward flows (poleward electric fields) encountered both in the subauroral

ionosphere and the conjugate inner magnetosphere during a variety of geomagnetic conditions, including geomagnetic storms (both main and recovery phases), as well as during non-storm periods of variable convection and substorms. These channels are localized primarily in the dusk-to-midnight local time sector equatorward of the auroral oval boundary. On some occasions, they are observed to persist for many hours. The spatial localization and the pronounced structured nature of SAPS channels make them an ideal focus for targeted investigations of our current understanding of the physics of the magnetosphere-ionosphere coupling processes involved in the generation and evolution of SAPS, and for testing the capabilities of numerical models to reproduce the observed phenomena.

Session 1: SAPS Focus Study refined simulations

Session 1 will examine results of refined simulations (“round 2”) of the subauroral ionosphere - thermosphere - magnetosphere response in the SAPS Focus Study. SAPS has been one of the more important problems that both GEM and CEDAR have in common, for both modeling and observations. The list of questions that emerged from our previous effort is summarized as follows: what are the key physical processes leading to SAPS, and how well do models of SAPS compare with actual observations? Does the mid-latitude trough exist in the preceding interval, and how do the trough and SAPS channel relate to each other? Does SAPS generate the trough, or is the trough a pre-existing condition for SAPS and does the SAPS then deepen the trough? What is the nature of the M-I-T feedback during events (i.e., does the inner magnetosphere simply drive the ionospheric effects or does the ionosphere respond back on the magnetosphere in a significant way)? What is the relationship between SAPS and substorms? How do model predictions of SAPS under less disturbed conditions (i.e., substorms only) differ?

The targeted intervals have been selected based on available observations and on results presented at prior SSWB and AGU sessions:

(1) March 16, 2013 04-10 UT (pre-storm SAPS); (2) March 17, 2013 06-20 UT (main phase SAPS); (3) March 20, 2013 04-10 UT (recovery phase SAPS).

Comparison with observations is critical to making further progress. We invite data analysis and modeling results relevant to any of the topics listed above, that specifically build on previous results presented at SSWB and AGU meetings. The detailed description of the session, and links to modeling and data information

available from previous sessions, will be sent out by CEDAR/GEM mailing list (beginning of May).

Contributions of simulation results in this session should include, if possible, predicted subauroral electric fields in the afternoon to post-midnight MLT sector, relevant electrodynamic quantities such as ionospheric conductivities, inner magnetospheric particle and fields distributions, total electron content (TEC), field-aligned currents, magnetic field perturbations, or anything else that may help in unraveling the dynamics of plasma processes involved in the formation of SAPS.

Session 2: Synthesis and Identification of Future Challenges

In the second and summarizing session, we invite participants to engage in a robust community discussion of what we have learned in the SSWB effort on the nature of SAPS, the role of plasma instabilities, the control of occurrence of SAPS by solar wind and IMF parameters, ionospheric preconditioning influence on SAPS appearance, and the role of the inner magnetospheric pressure-bearing plasma in determining SAPS lifetimes. We will do this through a guided, workshop format discussion in which the community is welcome to provide 1-2 slides of content as part of short, focused discussions on the successes and remaining challenges in understanding mid-latitude and sub-auroral response to storm conditions in the coupled M-I-T system, as seen through the lens of SAPS and related effects both in the ionosphere and magnetosphere. A short introduction and summarizing of the main findings from the SSWB and AGU sessions will be provided at the beginning of this session by the organizers.

A key community goal that we will work toward in this final session is an identification of those system features on which we have a good understanding, and those features where we need further investigations through modeling and/or observational studies. This will include information such as: What spatial and/or temporal resolution is required for accurate modeling of SAPS response? What observational networks and coverage are required for a correct understanding in both a large and small scale sense across MLT and latitude boundaries? Where do modeling equations and efforts break down, and what approaches are needed to solve the problem? What implications exist for multi-scale efforts to understand the storm time response of the M-I-T system?

Agenda

Tuesday 10:00-12:00

- Wenbin Wang - "SAPS simulations with LFM-TIEGCM"
- Colby Lemon and Margaret Chen - "Updated results of March 2013 storm simulations and comparison with DMSP"
- Yiqun Yu - "Effects of electric field methods on modeling the inner magnetosphere-ionosphere coupling processes"
- Yang Lu and Yue Deng - "SAPS simulation with UCLA-RCM and GITM coupled model"
- Mike Ruohoniemi - "SAPS SuperDARN climatology"

Wednesday 10:00-12:00

- Stan Sazykin - "SAPS modeling"
- Evgeny Mishin - "SAID modeling-observations controversy during St Patrick's Day 2013" - presented by Phil Erickson
- Shunrong Zhang - "Thermospheric poleward wind surges at midlatitudes during great storm intervals (driven by SAPS)"
- Joe Huba - SAPS modeling
- Jonathan Krall - Modeling of persistent plumes (presented by J. Huba)
- Phil Erickson - "Overview and synthesis for SSWB efforts on SAPS modeling"
- General discussion
- Identification of future improvements needed in our understanding of M-I coupling at sub auroral latitudes

Justification

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from previous sessions, and to highlight areas where advances are still needed in understanding. All of these topics are at the heart of the Decadal Survey and the CEDAR Strategic Plan since they directly address whole atmosphere / geospace system coupling in an electrodynamic, plasma, and neutral sense.

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