2016 Workshop: Networked instrumentation

Long title
Scientific discovery enabled through networked instrumentation
Conveners
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Description

The CEDAR system science initiative, the Solar and Heliophysics Decadal survey and recent GEM focus groups all recognize the need to understand global-scale ionospheric-thermopsheric-magnetospheric processes, variability and energy coupling mechanisms at multiple spatial and temporal scales. Both the CEDAR and magnetospheric instrumentation communities have made significant progress in understanding these processes, often through space-based instruments, individual ground-based instruments or clusters of instruments. With technological advances in the last decade, we are now able to create ground-based instrumentation at increasingly lower costs and can control and coordinate networks of instrumentation in real time using the internet. The lowered cost and increased simplicity enables replication of data collection at previously unimaginable scales leading to important new scientific insights. GPS TEC receivers, Ionosondes, Fabry-Perot networks, and the THEMIS ground-based observatories are some of the examples of how distributed systems make measurements over large scales possible.

In this workshop, we invite presentations related to:

1) New insights into systems science from networks of ground-based instruments; 2) Plans for new instrument networks and overarching science questions they will address; and 3) Input from modeling community on data needs that could be met by observations through networked instrumentation at various scales.

The presentations will have a 5-slide format, leaving time for a round-table type discussion on the need and potential for networked instrumentation to meet CEDAR and GEM science goals.

Agenda

4:00 Asti Bhatt: Setup/Opening remarks

4:05-4:20 Aaron Ridley: Gaps in scales needed for modeling

4:20-4:35 Carlos Martinis: Results from BU imager network

4:35-4:50 Brian Harding/Jonathan Makela: Results from NATION FPI network

4:50-5:00 Elizabeth Kendall/Asti Bhatt: Results from MANGO network of red-line imagers over continental US

5:00-5:15 Joseph Coberiate/Ethan Miller:Multi-Site Tomography of Ionospheric Disturbances

5:15-5:25 Ying Zou: Heliophysics System Observatory

5:25-5:35 Jesper Gjerlov: How do we combine AMPERE-SuperMAG-SuperDARN data?

5:35-5:45 Eric Donovan: Networked instrumentation to address gaps in scales

5:45-6:00 Open discussion

Justification

An outstanding challenge in upper atmospheric research, according to the 2011 CEDAR Strategic Plan document, is specifying the state of the space-atmosphere interaction region at a particular time and location. - This is a particularly difficult task considering the state parameters have significant levels of variability that often rival the value of the mean state. Similarly, the decadal survey committee identified the challenge of studying both ionospheric storm response and plasma-neutral coupling processes over global, regional and local scales. The most recent GEM focus groups have identified the need for global scale observations of multi-scale phenomena from ground-based instruments and the need to integrate the observations with global modeling efforts. Some of these focus groups include a) Transient Phenomena at the Magnetopause and Bow Shock and Their Ground Signatures, and b) Storm-Time Inner Magnetosphere-Ionosphere Convection.

The strategic plan document calls out the need for more extensive spatial and temporal observations of multiple parameters simultaneously. It also calla out the need for innovative observational networks, in the form of distributed arrays of

instrumentation covering many different spatial and temporal scales. The decadal survey committee suggested implementing ground-based capabilities as one of the listed imperatives to understand global-scale variability. Networks provide the insight and validation required to understand global-scale processes such as TIDs, the transport of energy during storm periods, and vertical coupling between different atmospheric regions.

Networks of instruments such as GPS, imagers, FPIs, and HF radars that have come online in last several years are crucial to addressing the system-science questions identified by both the CEDAR and GEM communities. The joint meeting of CEDAR and GEM communities is therefore the most appropriate avenue for this session. In this workshop, we will explore recent results from existing networked instrumentation, discuss the science enabled by observations of regional and global-scale processes, brainstorm new large-scale observational networks, and hear from the modeling community regarding the type of regional and global-scale observations required to improve and validate the models.

References: CEDAR strategic thrust #4 : Develop Observational and Instrumentation Strategies for Geospace System Studies AIMI Science Priority 2. Understand how tropospheric weather influences space weather. AIMI-1. Understand how the ionosphere-thermosphere system responds to, and regulates, magnetospheric forcing over global, regional, and local scales. AIMI-2. Understand the plasma-neutral coupling processes that give rise to local, regional, and global-scale structures and dynamics in the AIM system. AIMI Imperative 2. Provide a broad and robust range of space-based, suborbital, and ground-based capabilities that enable frequent measurements of the AIM system from a variety of platforms, categories of cost, and levels of risk. CEDAR: The New Dimension must be implemented in coordination with plans for more extensive observing networks, modeling efforts, and inter-disciplinary collaborations that together will yield exciting new scientific results. GEM focus groups: Transient Phenomena at the Magnetopause and Bow Shock and Their Ground Signatures (2012 - 2016; Hui Zhang, Q.-G. Zong, Michael Ruohoniemi, and David Murr; RA: SWMI) Storm-Time Inner Magnetosphere-Ionosphere Convection (2013 - 2017; Joseph Baker, Michael Ruohoniemi, Stanislav Sazykin, Peter Chi, and Mark Engebretson; RA: IMAG, MIC)

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