2014 Workshop: Networked Instrumentation

Long title
Grand Challenge: Scientific discovery enabled by networked instrumentation; current state-of-the-art and future opportunities
Grand Challenge
Conveners
Asti Bhatt
Elizabeth Kendall
Jonathan Makela
Description

The CEDAR system science initiative and the Solar and Heliophysics Decadal survey both recognize the need to understand global-scale ionospheric-thermopsheric processes, variability and energy coupling mechanisms at multiple spatial and temporal scales. As a community, CEDAR has made significant progress in understanding these processes, however, most ground-based observations have either been highly localized or made through focused campaigns. With technological advances, 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. This 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 many distributed systems make measurements over large-scale 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 5-slide format, leaving time for a round-table type discussion on the need and potential for networked instrumentation to meet CEDAR science goals.

Justification

An outstanding challenge in the upper atmospheric research, according to the CEDAR strategic plan document 2011, is specifying the state of the space-atmosphere interaction region at a particular time and location; a limitation manifest by 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. As a community, we have made significant progress in addressing some of these challenges, typically through campaigns localized in space and time. The strategic plan document called out the need for more extensive spatial and temporal observations of multiple parameters simultaneously. It also called 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. 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 query the modeling community regarding the type of regional and global-scale observations required to improve their research.

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.

Improving measurements to give insight into CEDAR system science is a challenge to the entire community. A further challenge is identifying the right set of

measurements at global scales that would improve predictive capabilities of models. Through this workshop, we plan to bring the community together to identify specific global-scale ionosphere-thermosphere questions that can be addressed by specific distributed, networked instrumentation, and include them in a roadmap to understanding system science.

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