2022 Workshop: Cross-scale in M-I-T processes: data & model

Long title
Cross-scale electrodynamics in M-I-T processes: data analysis and modeling
Conveners
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Description

High-resolution network observations by distributed sensors have revealed the existence of strong localized and transient structures between a few 10s and a few 100s km size and several minute durations. Those are referred to as meso-scale structures and have indicated to have potential substantial impacts on the ionosphere-thermosphere (I-T) system. Small size (<~10 km) dynamics including turbulence are also recognized as a critical component for Global Navigation Satellite System (GNSS) signal scintillation, conductance, and energy dissipation. The multi-scale (large, meso, small) nature is ubiquitous in the global ionosphere including the cusp, polar cap, auroral oval, mid latitudes, and equatorial regions. For example, flows and precipitation imposed by the magnetosphere at high latitudes tend to be more intense at meso-scale than at large-scale, and neutral wind has been shown to have strong responses to such meso-scale energy input. Localized fast flows and density structures travel across regions as flow channels and waves, giving rise to coupling across latitude and longitudes. Meso-scale structures are also important sources of energy that cascades down to small-scale structures and forms density irregularities.

Coupling over multiple scales is a critical challenge since observational and modeling methodologies for bridging different scales do not presently exist. This workshop solicits presentations on a wide range of coupling processes in the I-T system from global to local processes both through empirical and physics-based

models in the growing M-I-T observational system, data assimilation, and machine learning to effectively connect the individual resources.

Agenda

1. 13:30-13:35, Yue Deng, Introduction
2. 13:35-13:45, Sneha Yadav, Association of Equatorward Extending Streamers with Ground Magnetic Perturbations and Geosynchronous Injections
3. 13:45-13:55, Christine Gabrielse (given by Larry Lyons), Precipitating Energy Flux, Average Energy, and Hall Auroral Conductance from THEMIS All-Sky-Imagers during Two Substorms: Mesoscale Contributions
4. 13:55-14:05, Wenbin Wang, Global reversal of ionospheric vertical drift in response to a sudden commencement
5. 14:05-14:15, Kike (Enrique) Rojas Villalba, Fluid simulation of Farley-Buneman instabilities: Model description and possible applications to large scale coupling
6. 14:15-14:25, Cheng Sheng, Data-model comparisons of F-region neutral winds during the March 27th, 2014 substorm event
7. 14:25-14:35, Xian Lu, Study of cross-scale interaction during the 2015 St. Patricks' Day Storm using the data-assimilated TIEGCM
8. 14:35-14:45, Hyosub Kil (Teams), Bubble and TID signatures in low and mid latitudes
9. 14:45-14:55, Ryan McGranaghan (Teams), Some thoughts on the state of cross-scale MIT coupling and key questions
10. 14:55-15:30, Discussion

Link to Join the Session Virtually

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Justification

(1) Proposed challenge questions
Our overarching goal is to understand multi-scale coupling processes in the global I-T system. Specifically, we propose to focus on the questions below:
(a) What are quantitative properties of meso-scale and small-scale I-T structures and their relation to magnetosphere driving?
(b) What are their impacts to the large-scale and global I-T system?
(c) How much can we improve physics understanding and reproducibility of multi-scale coupling processes?

(2) How the questions will be addressed
We propose to dedicate one session for discussions with the audience on focused topic. Focused topics will be introduced by a few scene-setting talks, and most of time will be used for open discussions to collect ideas and thoughts to attack the topics and to seek out collaborations.

(3) What resources exist, are planned, or are needed
Growing networks of ground and satellite instruments will be heavily utilized for this activity. Meanwhile, machine learning and data assimilation, and numerical simulations will play critical roles for this study.The proposed activities will be coordinated with GEM (M-I-T coupling FG, precipitation FG, and transition region FG) by bringing their knowledge and holding joint campaigns.

(4) Relevance to CEDAR Strategic Plan
The proposed study meets three of the strategic trusts in the CEDAR Strategic Plan 2011: (1) Encourage and Undertake a Systems Perspective of Geospace, (2) Explore Exchange Processes at Boundaries and Transitions in Geospace, (3) Explore Processes Related to Geospace Evolution.

Related to CEDAR Science Thrusts:
Encourage and undertake a systems perspective of geospace
Explore exchange processes at boundaries and transitions in geospace
Keywords
Multi-scale; dynamics; I-T coupling;