

Project Details

ROSES ID: NNH18ZDA001N

Selection Year: 2018

Program Element: Focused Science Topic

Topic: Mid-latitude and Equatorial Dynamics of the Ionosphere-Thermosphere System

Project Title:

Response of the Ionosphere and Thermosphere to Geomagnetic Storms in the Mid to Low Latitudes

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Summary:

The purpose of the proposed research is to understand how energy is transferred from the high-latitudes to mid and low latitudes during geomagnetic storms and how this energy impacts the ionospheric structure and the occurrence of radiowave scintillation. It will address FST #1, namely Mid-latitude and Equatorial Dynamics of the Ionosphere-Thermosphere System. In particular, the research will focus on the generation and propagation of acoustic gravity waves (AGWs) produced in the auroral region and the associated traveling atmospheric and ionospheric disturbances (TADs/TIDs), their impact on ionospheric structure in the mid and low latitude, and their impact on the generation of the ionospheric bubbles responsible for ionospheric scintillation. We will use ionospheric data from the C/NOFS and DMSP satellites, thermospheric data from the CHAMP, GRACE, and GOCE satellites, a globally distributed set of TEC measurements from ground-based GPS receivers, along with the Global Ionosphere Thermosphere Model (GITM). With the given set of measurements, we will cover nearly the entire realm of interest of the thermosphere/ionosphere system, although other datasets such as ionosonde networks, radars, and imagers will be considered.

The presence of TIDs and their characteristics (wavelength, propagation speed, orientation, etc.) will be determined by the GPS measurements. The DMSP and C/NOFS data will be used as a complement to the GPS measurements and will also be used to determine the TID characteristics, filling in where the GPS measurements are not available. The CHAMP, GRACE, and GOCE thermospheric data will, in the same way, be used to determine the characteristics of the TADs associated with the TIDs. Finally, GITM simulations, bounded by the measured thermospheric and ionospheric parameters will be used to tie the measurements together and provide a global picture of the propagation and structure of the TADs/TIDs and the response of the ionosphere. The high latitude inputs to the GITM model will be bounded by the DMSP ion drifts, responsible for Joule heating, and precipitating particle responsible for particle heating.

With the given set of measurements, we will cover nearly the entire realm of interest of the thermosphere/ionosphere system.

Specific questions to be addressed are:

- 1) How is the propagation and structure of TADs/TIDs dependent on longitude?
- 2) What are the effects of TIDs on the generation of the ionospheric bubbles responsible for radiowave scintillation, what are the important associated TID characteristics (wavelength, speed, orientation, etc.) and what is the impact of longitude (geomagnetic field orientation)?
- 3) What is the impact of geomagnetic activity and TADs/TIDs on ionospheric structure in the mid and low latitudes and how does the response of the ionosphere in these regions depend on longitude?

These questions clearly address the questions and goals of the FST "Ion-Neutral Interactions in the Topside Ionosphere". In particular, the following science questions listed in the solicitation:

" What is the mid-, low-, and equatorial latitude structure of plasma density, particularly during geomagnetically active periods, and how does the magnetic field longitudinal orientation and magnitude affect it?

" What is the role of TIDs and TADs?

" How does the coupling between lower atmosphere and ionosphere (possibly source for non-migrating tides and localized gravity wave activity) contribute and affect TEC and scintillation?

The proposed study clearly addresses the type of investigations sought, using historical, ongoing and future observations from space and ground instrumentation in combination with a physics based model, and addressing several of the required science questions.

Publication References:

no references