Project Details

ROSES ID: NNH13ZDA001N
Selection Year: 2013
Program Element: Targeted Science Team

Topic: Thermospheric wind dynamics during geomagnetic storms and their influence on the coupled magnetosphere-ionosphere-thermosphere system

Project Title:
A LWS Targeted Investigation on Thermospheric Dynamics During Geomagnetic Storms

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Summary:
We propose to undertake an integrated data analysis and numerical modeling of thermospheric dynamics in response to solar and magnetospheric energy inputs during geomagnetic storms. More specifically, we will address three science questions: (1) What are the temporal and spatial scales of thermospheric variations for various solar wind and magnetospheric energy inputs? (2) What is the influence of storm-time winds on the ionosphere? (3) What is the influence of storm-time winds on the plasmasphere?

We will use the neutral wind and density measurements from the CHAMP and GRACE satellites, global TEC data from COSMIC and the ground-based GPS network, together with electric field and plasma measurements from the C/NOFS satellite, to determine the spatial and temporal scales of thermospheric and ionospheric disturbances in response to various solar and magnetospheric energy inputs. Measurements of NO inferred radiation from the TIMED/SABER and the O/N2 column density ratio from TIMED/GUVI will also aid the data-model intercomparison. The assimilative mapping of ionospheric electrodynamics (AMIE) procedure will be used to specify magnetospheric energy dissipation into the high-latitude ionosphere and thermosphere by synthesizing various ground- and space-based observations. Numerical simulations based on the NCAR Thermosphere-Ionosphere-Mesosphere-Electrodynamics General Circulation Model (TIMEGCM) will be used to characterize the neutral winds and their role in producing thermospheric and ionospheric disturbances. Furthermore, the coupled TIMEGCM-SAMI3 model will be used to investigate the plasmaspheric effects by neutral winds. Knowledge gained from such a systematic data-model investigation is critical to a better understanding of the underlying physical/chemical/dynamical processes that control the overall storm-time thermospheric dynamics.

The proposed study directly addresses the Focus Science Topic (FST) 1.3.1(d) on Thermospheric wind dynamics during geomagnetic storms and their influence on the coupled magnetosphere-ionosphere-thermosphere system . The proposal is highly relevant to NASA s Strategic Goals to Open the Frontier to space Environment prediction and to Understand the nature of our home in space (see Science Plan for NASA s Science Mission Directorate 2007-2013). More specifically, it deals with some specific research focus areas of the Heliophysics Division: Determine changes in the Earth s magnetosphere and ionosphere; Understand and characterize space weather effects on and within planetary environments. The National Research Council s 2013-2022 Decadal Survey report has called out Determine the dynamics and coupling of Earth s magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs as one of the top science goals for the next decade, and our proposed investigation is fully in line with this high-priority science objective.

Publication References:

Summary: no summary

Reference: Lu, G.; Hagan, M. E.; Häusler, K.; Doornbos, E.; Bruinsma, S.; Anderson, B. J.; Korth, H.; (2014), Global ionospheric and thermospheric response to the 5 April 2010 geomagnetic storm: An integrated data-model investigation, Journal of Geophysical Research: Space Physics, Volume 119, Issue 12, pp, doi: 10.1002/2014JA020555

Summary: no summary

Reference: Häusler, K.; Hagan, M. E.; Forbes, J. M.; Zhang, X.; Doornbos, E.; Bruinsma, S.; Lu, G.; (2015), Intraannual variability of tides in the thermosphere from model simulations and in situ satellite observations, Journal of Geophysical Research: Space Physics, Volume 120, Issue 1, pp. 751-765, doi: 10.1002/2014JA020579