

Project Details

ROSES ID: NNH09ZDA001N

Selection Year: 2010

Program Element: Focused Science Topic

Topic: Plasma Neutral Gas Coupling

Project Title:

Plasma-Neutral Gas Coupling

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Summary:

We propose a four-year program to perform a comprehensive investigation of Plasma- Neutral gas Coupling in the thermosphere-ionosphere system. In this proposal, we explore several science topics that are intimately connected with ion-neutral coupling between the ionosphere and thermosphere. While these phenomena have all been observed, they are unexplained. We use a new coupled model to explore in detail the physics behind the phenomena. The work will involve the development of model postprocessors that will allow us to understand the detailed mechanisms that are at work, and their complex interactions. The lessons learned from this study are expected to have relevance to other plasma systems coupled via neutral-ionized interactions throughout the Heliosphere.

The proposed research addresses three critical scientific questions:

- 1) What are the physical mechanisms that generate the quiet time low latitude dynamo and PRE?
- 2) What is the effect of lower and middle atmosphere disturbances such as sudden stratospheric warmings on the ionospheric electrodynamics?
- 3) What are the ion-neutral coupling processes that generate density depletions in the equatorial ionosphere?

The research will employ an improved first-principles numerical modeling capability of the ionosphere-thermosphere system that has been developed under other NASA funding. This new model has coupled the SAMI3 model of the ionosphere with the TIMEGCM model of the thermosphere. New model postprocessors will be developed, and used together with ground-based radar and C/NOFS satellite data to uncover the detailed mechanisms driving: (a) the ionospheric dynamo and PRE, (b) the effect of sudden stratospheric warmings on the ion-neutral coupling and resulting electrodynamics, and (c) the recently discovered the equatorial dawn density depletions. The data from the C/NOFS satellite, together with ground-based radars will be used to test and validate the findings from the model and the postprocessors.

The proposed study directly addresses key elements of the NASA Living with a Star Focused Science Topic Plasma-Neutral gas Coupling. Specifically the program will investigate the physical issues of plasma-neutral coupling in the ionosphere as we seek to resolve strategically important questions concerning the transition from a weakly ionized plasma with the linkage of the electromagnetic field, and our physical understanding of such systems in the Heliosphere. The aims of this research directly address NASA near- and long-term goals, as outlined in the 2009 Living With a Star Announcement (ROSES 2009), the 2006 NASA Strategic Plan, and the Heliophysics Division Roadmap for Science and Technology: 2005-2035.

The proposed work brings together experts on thermosphere-ionosphere coupling from three different organizations (ASTRA, NRL, and UTD). It combines modeling and data analysis, and provides training for a new postdoc.

Publication References:

Summary: no summary

Reference:

Leake, J. E.; DeVore, C. R.; Thayer, J. P.; Burns, A. G.; Crowley, G.; Gilbert, H. R.; Huba, J. D.; Krall, J.; Linton, M. G.; Lukin, V. S.; Wang, W.; (2014), Ionized Plasma and Neutral Gas Coupling in the Sun's Chromosphere and Earth's Ionosphere/Thermosphere, Space Science Reviews, Volume 184, Issue 1-4, pp. 107-172, doi: 10.1007/s11214-014-0103-1