Project Details

ROSES ID: NNH06ZDA001N
Selection Year: 2007
Program Element: Focused Science Topic

Topic: Effects of Ionospheric-Magnetospheric Plasma Redistribution on Storms

Project Title:
Storm-Time Plasma Redistribution Processes and Consequences

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Summary:
Objectives:

We propose to establish how ionospheric plasma expansion into the magnetosphere during storms changes as a result of storm energy flows, and how this expansion influences the dynamics and coupling of the magnetosphere and ionosphere. Emphasis will be on the plasma and geomagnetic field conditions of the inner magnetosphere, as distorted by the ring current, with the evolution of the ionospheric conductance, temperature and densities. Measures of success include the identification of principal mechanistic features and quantitative assessment of their impacts over the range of storm-time conditions and their solar wind and IMF drivers.

Our specific objectives are to:

i) assimilate published observations into a developing model;

ii) assess and simulate the entry and circulation of solar wind plasmas.

iii) specify and forecast plasmasheet and ring current composition, energy and spatial distribution;

iv) assess the impacts of storm-time redistribution on magnetosphere-ionosphere coupling.

Methods and Techniques:

The proposed funding will support a team effort including theoretical analysis, assimilation of observational results including empirical-statistical models based on both space borne and ground based data sets, and global modeling of the ionosphere and magnetosphere. We will investigate the ionospheric processes relevant to its expansion into the magnetosphere, and the influence of specific physical phenomena, using published ionospheric models. We will investigate the consequences and impacts of magnetospheric intake of gas and plasma from all sources. We will use all relevant data sets from of the Heliophysics Great Observatory to determine the dynamic local response of the source regions to solar wind influences. Empirical specifications will improve and validate ionosphere-thermosphere, neutral solar wind, and heliospheric gas models, leading the way toward the integration of such models within global circulation models of geospace and its response to the heliosphere.

Significance:

Large-scale redistribution and restructuring of the ionosphere by storm-induced currents and electric fields produces massive ion flows into the magnetosphere. An enhanced polar wind, heavy-ion auroral wind from the low-altitude cusp and auroral regions, and convective entrainment of an eroding plasmasphere are all consequences of large-scale ionospheric changes that are especially prevalent during intense storms. Entrained ionospheric plasmas populate the plasmasheet and ring current, modify magnetospheric convection and current systems, and, thereby couple back into ionospheric plasma electrodynamics. Quantitative understanding of the effects of storm-time ionospheric restructuring on the magnetosphere, and how this feedback evolves with time, is essential to develop forecast-quality models of near-Earth space weather.

Publication References:

Summary: no summary

Reference: Moore, T. E.; Fok, M.-C.; Delcourt, D. C.; Slinker, S. P.; Fedder, J. A.; (2008), Plasma plume circulation and impact in an MHD substorm, Journal of Geophysical Research: Space Physics, Volume 113, Issue A6, CiteID A06219, doi: 10.1029/2008JA013050