Project Details

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Selection Year: 2010
Program Element: Focused Science Topic

Topic: Determine the Behavior of the Plasmasphere and its Influence on the Ionosphere and Magnetosphere

Project Title:
The Role of Currents and Conductance in Controlling Plasmasphere Dynamics

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Summary:
JUSTIFICATION: The objective of the LWS TR&T Focused Science Topic we are proposing to is to "Determine the Behavior of the Plasmasphere and its Influence on the Ionosphere and Magnetosphere". With this proposal we seek to understand how currents and ionospheric conductance work together to produce the large-scale electric fields of the ionosphere and magnetosphere that control plasmasphere dynamics. The pressure gradients in the storm-time ring current and near-Earth plasmasheet are in force balance with the region-2 current system. Its closure through the ionospheric conductance to the region-1 field-aligned current (FAC) system is associated with a complicated and globally varying electric potential pattern in the ionosphere that is mapped out along field lines to the magnetosphere to affect the transport and dynamics of the plasmasphere. Known examples include the over and under shielding effects from the ring current, and the stretched dusk side plasmaspheric plumes and undulations due to the enhanced electric field associated with the sub-auroral polarization streams (SAPS) in the ionospheric trough region.

OBJECTIVE: To determine how currents and ionospheric conductance control plasmasphere dynamics in the presence of varying convection.
METHODOLOGY:
1. Select IMAGE/EUV observations of the plasmasphere displaying dynamical behavior, such as onset of sunward convection surges, formation of tails, drainage plumes, shoulders and undulations. This will be done in conjunction with the FST team.
2. Determine spatial and temporal correlations with solar wind parameters, global ring current distribution, FAC patterns, auroral and sub-auroral conductance, and ionospheric flows, by using data from IMAGE/HENA, IMAGE/FUV, Iridium and ground radars.
3. Determine the physical mechanisms and their relative roles in controlling plasmasphere dynamics by modeling the plasmasphere, ring current and its coupling to the ionosphere using the Comprehensive Ring Current Model (CRCM) and the Dynamic Global Core Plasma Model (DGCPM), or any plasmasphere model from the FST Team other than DGCPM. The CRCM uses a self-consistent electric field to update the convection and can use data-derived conductances. The model will be validated against global measurements of the plasmasphere and ring current. In order to understand the relative roles of the physical mechanisms we will perform model experiments where either quantities are kept constant or turned off.

RELEVANCE TO FST: We determine the factors and mechanisms that control the dynamics of plasmasphere, and in particular how the ring current and its coupling to the ionosphere affect the plasmasphere. Understanding these controlling factors is required to achieve a predictive understanding of plasmasphere behavior.

CONTRIBUTIONS: We provide a quantitative view of how the plasmasphere evolves during the course of a geomagnetic storm and its relation to the solar wind, ring current, FACs and ionospheric conductance. The goal is to summarize the findings in statistical study, such as a superposed epoch analysis, but we recognize that this may be done at the FST Team level. In addition, we provide global plasmasphere, ring current proton and O+ distributions, auroral conductance and FAC patterns for the selected events.
We also provide validated model runs of selected events, where the dynamical electric field is one of the outputs of the model.
METRICS: The completion and quantification of relations between plasmaspheric dynamics and the factors above signify success of the observation study. The success of the modeling study is graded by how well the model can reproduce the results from the observational study and by how well we can determine, and thereby understand, the relative roles of the physical mechanisms controlling plasmasphere dynamics.

Publication References:

no references