Project Details

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Selection Year: 2006
Program Element: Focused Science Topic

Topic: Storm effects on the global electrodynamics and the middle and low latitude ionosphere

Project Title:
Multi-Instrument Investigation of Inner-Magnetosphere/Ionosphere Disturbances

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Summary:
Strong penetrating and SAPS electric fields perturb and redistribute the cold plasma of the low and mid-latitude ionosphere and plasmasphere during geomagnetic disturbances. The phenomena associated with plasmasphere erosion are a prime example of global M-I coupling and require a multi-technique and multi-disciplinary analysis approach to understand properly. Streaming cold plasma, as seen as storm enhanced density SED plumes, can be used to identify and trace the effects of the perturbation electric fields. At lower latitudes, plasma redistribution and prompt changes in TEC indicate the effects of the disturbance electric fields. A thorough understanding of the mechanisms, causes and effects of these disturbance electric fields are needed to support a predictive capability for these important ionospheric phenomena.

Questions to address:

1) Does the SAPS E field exhibit seasonal or longitude dependencies?

2) What determines the duration and strength of penetration electric field?

4) How do the conjugate E and F-region conductivities influence SAPS formation?

4) How does wave structure in the SAPS/SED channel lead to ionospheric irregularities?

5) What are the causes and characteristics of the redistribution of the equatorial ionosphere in the American sector?

Proposed Method:

1) Use ionospheric TEC observations to study the location, extent, and duration of perturbation electric fields at mid and low latitudes.

2) Combine space and ground-based (GPS) TEC observations, incoherent-scatter radar (ISR) profiles, and DMSP observations to characterize the conditions leading to severe low-latitude ionospheric perturbation.

3) Investigate the relationship of the plasma redistribution to ionospheric irregularities using coherent radar, HF radio scintillation, and passive radar arrays (ISIS).

4) Coordinated ISR experiments (Sondrestrom, Millstone Hill, Arecibo, and Jicamarca) will investigate penetration E fields.

4) Modeling collaboration (RCM and SAMI-II) to address the relationship of the observed features and their evolution to the predicted effects of ring current development and inner magnetospheric shielding.

6) Develop a multi-technique viewpoint of the coupled processes through workshops held at Haystack.

7) Coordinate a distributed working group to investigate storm phenomena using Access Grid and similar remote conferencing techniques.

8) TEC maps and merged datasets made available through the online Madrigal data system.

This research program follows upon the considerable research that the PI institution has already undertaken on problems in this focused research area. The PI institution has organized a CEDAR working group on low-latitude electric field, and has designed and fielded instrumentation arrays (ISIS) to address electric-field structure, with continuous, spatially-distributed observations.

Publication References:

Summary: no summary

Reference: Foster, J. C.; Rideout, W.; Sandel, B.; Forrester, W. T.; Rich, F. J.; (2007), On the relationship of SAPS to storm-enhanced density, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 69, Issue 3, p. 303-313, doi: 10.1016/j.jastp.2006.07.021

Summary: no summary

Reference: Huang, Chao-Song; Foster, John C.; (2007), Correlation of the subauroral polarization streams (SAPS) with the Dst index during severe magnetic storms, Journal of Geophysical Research: Space Physics, Volume 112, Issue A11, CiteID A11302, doi: 10.1029/2007JA012584