Project Details

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

Topic: Investigate the Global Distribution, Sources and Effects of Large Electron Density Gradients at Middle and Low Latitudes

Project Title:
Ionospheric Dynamics Associated with Large-Scale Density Gradients

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Summary:
We propose to utilize satellite observations, ground TEC measurements, and simple computational modeling to investigate the role of ExB drifts and neutral winds in the generation and evolution of electron density gradients at middle to low latitudes in the F region. The appearance of significant density gradients in the region produce large signal fades and loss of control tracking loops in GPS systems and thus the importance of recognizing under what conditions such degradation might appear is of great value. At middle latitudes the interaction between magnetospheric energy inputs, solar radiative inputs, and planetary rotation critically determines the dynamics of the plasma and large-scale spatial gradients in the ion density can result from vastly different dynamic histories of the plasma in neighboring regions. Thus the relevance of this investigation extends beyond the societal impacts of compromised communication and navigation systems to the more fundamental of NASA's strategic goals to understand the Sun and its effects on Earth and specifically how the near space environment responds to changes in the interplanetary medium produced by the Sun.

We will identify electron density gradients using two different techniques. Examination of a global distribution of total electron content derived from ground-based TEC measurements will provide a global perspective within the wide and variable spatial and universal time ranges of the available data. Latitude and longitude (local time) profiles of the ionospheric electron density, from the DMSP and ROCSAT satellites respectively, will provide a much higher spatial resolution but in a more limited spatial and universal time range. Together these two data sources provide many opportunities to identify plasma density gradients. In addition, the satellite data provide a detailed description of the dynamics of the plasma associated with the density gradients. From this data set we will establish the differences in the dynamics associated with regions of low and high density and how the transitions between the regions behave.

An ionospheric model, driven by ExB drift and neutral wind inputs can be used to conduct parameter studies to establish the relationships between these drivers and field-aligned plasma motions. Since these field-aligned perpendicular motions can be directly measured it is possible to infer the differences in neutral winds and ExB drifts that are associated with regions of low and high density. In this way the conditions for formation of large-scale gradients can be specified.

Publication References:

no references