Project Details

ROSES ID: NNH10ZDA001N
Selection Year: 2011
Program Element: Focused Science Topic

Topic: Low-To Mid-Latitude Ionospheric Irregularities and Turbulence

Project Title:
Investigation of the low-latitude electrodynamics and seeding conditions of plasma structures by utilizing multi-instrument observations

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Summary:
We propose to conduct multi-instrument observations of the low-latitude ionosphere to address two fundamental areas of thermosphere-ionosphere-magnetosphere coupling physics: (1) to understand the control that the atmosphere and its dynamics have on the day-to-day variability and the longitudinal dependence of the low-latitude electrodynamics and the large-scale structuring, and (2) to investigate regionally the main seeding conditions for equatorial plasma bubbles and scintillation activities in Africa and South America. The physical mechanisms that cause large-scale density irregularities and scintillations at the equatorial regions are not yet fully understood. Especially, the longitudinal variability of bubble occurrence is still an outstanding question. This is evident in satellite observations that show very unique and more intense equatorial anomaly structures and scintillation activity in the African region than any other regions. In addition, recent measurements of TEC depletions over South America have revealed that usually they occur in patches extending for 100s of km, but quite often they occupy the whole continent.

Therefore, to address the above fundamental problems, data from several different ground- and space-based instruments will be utilized. Pairs of magnetometers in the American and African sectors will be used to estimate vertical drifts. Data from Ion Velocity Meter (IVM) and Vector Electric Field Instrument (VEFI) instruments on board C/NOFS will also provide vertical drifts at different altitudes. Simultaneously, ACE satellite data will help understand the role of the penetration electric field, for processes governing equatorial ionospheric electrodynamics during storm conditions. GPS receivers on the ground and in space (LEO satellites) will resolve space-time ambiguity and will be able to track the evolution of equatorial ionospheric irregularities. New ionosondes recently installed in the African and South American equatorial and anomaly peak regions will provide bottomside densities, drifts near sunset times and the meridional winds. The PLP sensor on C/NOFS and the density instrument on DMSP will give information about the maximum penetration altitude of plasma bubbles.

This 4-year proposal aims to use this instrumentation to quantify the effect that the upper thermosphere in the form of propagating migrating/non-migrating tides and planetary waves, originated in the troposphere, have on the ionospheric dynamics and on the development and decay of plasma bubbles. This investigation aims to relate the day-to-day variability of F-region dynamics to the variability of the inputs from below. This complete specification of the driving winds will allow us to calculate plasma drifts for longitudes and times that do not have direct plasma drift measurements. During disturbed conditions, the more complete assessment of the thermospheric inputs in two continents (e.g. disturbed dynamo effect) will make it possible to single out effects due to prompt penetration electric fields. We will also utilize the capability of existent GPS receivers and ionosondes in Africa and South America to observe gravity waves (GW) and study their seeding conditions in these two continents.

By adopting an observational strategy rich in instrumental diversity and a scientific initiative that seeks the primary causes of the day-to-day variability and the longitudinal dependence of the occurrence of the plasma bubbles, we will be addressing the focused science topic (a) Low- to Mid-Latitude Ionospheric Irregularities and Turbulence.

Publication References:

no references