On the Morphology of the Equatorial Evening Vortex

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The evening plasma vortex is an important electrodynamic feature of the low-latitude F-region ionosphere. It is the result of a complex thermosphere-ionosphere interaction, and controls the horizontal and vertical transport of ionospheric plasma. More recently, it has been associated with the development of interchange plasma instabilities and equatorial spread F.

Here, we present results of an investigation of the ability of combining readily available thermospheric and ionospheric climatological models (IRI, Scherliess and Fejer (1992) vertical plasma drift model, MSIS, HWM and IGRF) to produce the evening plasma vortex. For that purpose, we followed the two-dimensional formulation of the ionospheric electrodynamics described by Haerendel et al. (1992). They showed that the three-dimensional equations governing ionospheric currents can be simplified to a two dimensional problem. This simplification assumes that the electric potential along magnetic field lines is constant and that electric fields in the equatorial plane map along these field lines. This is a reasonable assumption for the E- and F- regions of the low-latitude ionosphere where the parallel conductivity is several orders of magnitude larger than the perpendicular Pedersen and Hall conductivities. A further simplification is made in our present analysis by neglecting the effects of the integrated meridional current. Previous studies using results from TIE-GCM have shown that the evening plasma vortex can still be reproduced even when the vertical current is neglected.

During this presentation, we will describe our numerical calculation, provide results of the simulation outputs and discuss our results of the two-dimensional plasma flow patterns in the magnetic equatorial plane. The morphology of the vortex is presented for different geophysical conditions. Our results are also compared with measurements of the plasma vortex made by the drift mode of the incoherent scatter radar of the Jicamarca Radio Observatory.