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Storm-time observations of TEC, scintillations, and ionospheric irregularity zonal drifts at equatorial and low-latitude regions

M. T. A. H. Muella (1), E. R. de Paula (1), A. P. Cerruti (2), P. M. Kintner (2), I. J. Kantor (1), I. S. Batista (1), C. N. Mitchell (3)

(1) Divisao de Aeronomia, Instituto Nacional de Pesquisas Espaciais, Sao Jose dos Campos-SP, Brazil, 12243-630 (e-mail: mmuella@dae.inpe.br / phone: 55-12-3945-7164), (2) School of Electrical and Computer Engineering, Cornell University, 301 Rhodes Hall, Ithaca - NY, 14853, (3) Department of Electronic and Electrical Engineering, University of Bath, Bath, UK, BA2 7AY

GPS derived total electron content (TEC), amplitude scintillations at the L1 frequency (1.575 GHz) and estimations of the ionospheric irregularity zonal drift velocities at 350 km are coupled and utilized for studying the large disturbance of the mid and low latitude ionosphere in the South-American longitude sector. Three events of intense geomagnetic storms occurred in the actual declining phase of the solar cycle were analyzed in this investigation. Using a time-dependent inversion algorithm 2-D images are created to study specific relationships between the three geophysical quantities (TEC, scintillation and zonal velocities) measured by ground-based GPS receivers. It is revealed from the 2-D images that the equatorial ionization anomaly (EIA) expanded to much higher latitudes, and the observed large variations in the temporal and spatial evolution of the electron density affected the behavior and dynamics of the irregularities. The coupling of the neutral atmosphere and the ionosphere is also investigated using TIE-GCM neutral wind model results. The model is used to investigate the north-south symmetry/asymmetry conditions in the ionization distribution of the equatorial anomaly produced by a meridional/transequatorial wind and its effect to the development and evolution of the scintillations associated to the ionospheric irregularities. In this work we present some relevant aspects of the ionospheric dynamics and the thermosphere-ionosphere coupling system, which are some of the most important topics of study during the occurrence of geomagnetic storms.