INVESTIGATIONS INTO IONOSPHERE-PLASMASPHERE COUPLING DURING A SEVERE MAGNETIC STORM OVER SOUTH AFRICA

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Abstract:

Ionospheric disturbances during the magnetic storm of the 7-9 November 2004 were analysed using electron density profiles and total electron content (TEC) information derived from a dense network of GPS receivers over South Africa. In addition, the F-layer peak parameters from the three South African ionosondes were included in the analysis. The ionosondes are located at Grahamstown (Eastern Cape, 33.30°S, 26.50°E), Louisvale (Northern Cape, 28.51°S, 21.24°E) and Madimbo (Limpopo, 22.39°S, 30.88°E). Data sampling rates for the GPS receivers and ionosondes were thirty seconds and thirty minutes respectively. The ionospheric parameters foF2, and hmF2 as well as ITEC (TEC resulting from ionosonde measurements) were compared with the equivalent parameters derived from full ionospheric tomographic inversion obtained by means of the MIDAS programme. Results from the inversion technique are compared with the results obtained from the ionosonde measurements.

The daytime ionosphere responds dramatically to the additional x-ray and EUV input present during a magnetic storm, by an abrupt increase in TEC due to the increased ionization. Resulting TEC maps provide snapshots of TEC perturbations, revealing the geographic location of storm- enhanced density (SED) and plumes with increased TEC associated with the depletion of the outer plasmasphere. TEC, measured by satellite signals from a 20200 km altitude, include contributions from the plasmasphere. By comparing ionospheric parameters obtained from ionosondes and tomography, insight is gained into plasmasphere-ionosphere coupling.

The aim of this paper is two-fold. Firstly, in a quest to verify the usefulness of the GPS receiver network in South Africa for ionospheric characterisation GPS derived ionospheric electron density and TEC distributions are confirmed by data obtained from the ionosonde network. The results from this analysis alone would be of interest to the ionospheric modelling community as the implications for GPS-derived ionospheric mapping have recently been discovered. Secondly, the association between the ionosphere and the plasmasphere is investigated by considering spatial and dynamic variations in TEC. The results presented in this paper will be of interest to both the ionospheric and GPS communities.