DIRECT RESPONSE TO PROMPT PENETRATION ELECTRIC FIELD IN LOW LATITUDE IONOSPHERE AND COMPLEX INTERPLAY OF TIDS AND FOUNTAIN EFFECT

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The response of the equatorial and low latitude ionosphere to a major geomagnetic storm that occurred on May 15, 2005 has been analyzed and presented. The results are the first from the Indian zone in terms of (i) GPS derived total electron content (TEC) variations following the storm (ii) Direct low latitude electrodynamic response to penetration of high latitude convection electric field (iii) effect of storm induced travelling atmospheric disturbances (TIDs) on GPS-TEC in equatorial ionization anomaly (EIA) zone.
Data set consisting of TEC obtained from GPS measurements, Ionosonde data, New Delhi (Geog. Lat. 28.42 N, Geog. Long. 77.21), ground based magnetometers in equatorial and low latitude stations and solar wind data obtained from Advanced Composition Explorer (ACE) has been used in the present study. Two GPS receivers located at Udaipur (Geog. Lat. 24.73 N, Geog. Long. 73.73 E) and Hyderabad (Geog. Lat.17.33 N, Geog. Long. 78.47 E) have been used. Storm induced features in vertical TEC (VTEC) have been obtained comparing them with the mean VTEC of quiet days. Variations in solar wind parameters as obtained from ACE and in the SYM-H index indicate that the storm commenced on May 15, 2005 at 0239 UT. The main phase of the storm commenced at 0600 UT on 15 May with sudden southward turning of the Z-component of interplanetary magnetic field (IMF-Bz) and subsequent decrease in SYM-H index. The dawn-to-dusk convection electric field of high latitude origin penetrated to low and equatorial latitudes simultaneously as corroborated by the magnetometer data from the Indian zone. Subsequent northward turning of the IMF-Bz and the penetration of the dusk-to-dawn electric field over the dip equator is also discernible. Response of the low latitude ionosphere for this storm may be characterized in terms of (i) enhanced background level of VTEC as compared to the mean VTEC, (ii) peaks in VTEC and foF2 within two hours of prompt penetration of electric field and (iii) wave-like modulations in VTEC and sudden enhancement in hmF2 within 4-5 hours in to the storm. These features have been explained in terms of the modified fountain effect, local low latitude electrodynamic response to penetration electric field and the TIDs, respectively. The study reveals a strong positive ionospheric storm in the Indian zone on May 15, 2005. Consequences of such major ionospheric storms on the systems that use satellite based navigation solutions, in low latitudes are also discussed.

Geomagnetic storm, low latitude ionosphere, disturbance electric fields, TADs

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