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ORIGINAL ARTICLE

Response of low latitude ionosphere to the geomagnetic storm of May 30

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Abstract Response of low latitude ionosphere to the geomagnetic storm of May 30, 2005 in the Indian longitude sector has been investigated by using the GPS data recorded at three stations namely, Udaipur, Hyderabad and Bengaluru. The event is noteworthy due to the fact that the Z component of interplanetary magnetic field (IMF Bz) remained southward for about 10 hours, coincident with the local day time for the Indian longitude sector, along with significantly higher values of AE and ASY-H indices. However, we neither found any evidence for the presence of long lasting storm time electric fields nor could we infer episodes of eastward-westward penetration of electric fields under steady southward IMF Bz and unsteady ring current conditions. On the storm day, the maximum enhancement in the total electron content has been found to be about 60%. The ionosonde observations also showed increased critical frequency (foF_2) and the height (h_PF_2) of the F layer. The foF_2 was enhanced by ∼60% which is consistent with the enhancement in total electron content. The slow rise and long duration enhancement of h_PF_2 and foF_2 have been attributed to the upwelling by the meridional neutral winds, caused by continuous energy inputs at higher latitudes. The poleward expansion of the equatorial ionization anomaly has also been observed on May 30. On May 31, the following day of the storm, significantly suppressed anomaly with near absence of its northern crest in the Indian longitude sector, revealed the effect of storm induced disturbance dynamo electric fields.

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1 Introduction

Geomagnetic storms and their effects on ionosphere have been a subject of extensive studies in the past (Schunk and Sojka 1996; Fuller-Rowell et al. 1997; Ho et al. 1998; Sastri et al. 2000). Based on these studies, the impact of the geomagnetic storms on the ionosphere has been classified in terms of positive and negative ionospheric storms (Buonsanto 1999; Zhao et al. 2005; Tsurutani et al. 2004; Dashora and Pandey 2007) wherein enhancement and reduction, respectively of the ionospheric plasma density results. The mechanisms that give rise to the positive ionospheric storms are both electrodynamical (e.g., Fejer 2002; Fejer et al. 2007) and mechanical. Here the mechanical forcing implies the upwelling of the ionospheric plasma caused by the equatorward flow of meridional winds that result from the storm time heating at high latitudes due to the large energy deposition (Kirchengast et al. 1996; Sastri et al. 2000). The upwelled plasma stays at higher altitudes where recombination rates are lower, therefore the plasma survives longer and increased plasma density or a positive ionospheric storm results. During the day, the electrodynamical forcing resulting in positive ionospheric storm arises mainly from the prompt penetration of the eastward electric fields that are generated due to the undershielding condition that follows the southward turning of the IMF Bz (e.g., Fejer 2002 and references therein). These undershielding fields can penetrate to low and equatorial latitudes (e.g., Kikuchi et al. 1996). Since the daytime ambient electric field at the equator is eastward (Matsushita 1969;