EFFECT OF INTENSE GEOMAGNETIC STORMS ON LOW LATITUDE IONOSPHERE DURING ASCENDING PHASE OF SOLAR CYCLE 24

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Summary. In the present study, results pertaining to the effect of intense geomagnetic storms on the low latitude ionosphere during the ascending phase of solar cycle 24 are presented. The dual frequency signals from GPS satellites have been analyzed to retrieve the total electron contents (TEC) recorded at Varanasi (Geographic latitude 25^0, 16′ N, longitude 82^0, 59′ E, Geomagnetic latitude 16°, 08′ N) which is situated near the equatorial ionization anomaly (EIA) crest region and an equatorial station Bangalore (Geographic latitude 13^0, 12′ N, longitude 77^0, 30′ E, Geomagnetic latitude 04°, 48′ N) in India during the period from 2011-2015.

1 INTRODUCTION

Geomagnetic storms are temporary disturbances in the Earth's magnetic field caused by either Coronal Mass Ejections (CMEs) or solar flares [1]. Geomagnetic storms produce large and rapid changes in magnetospheric convection. As a result, the direct prompt penetration of dawn-dusk electric field to equatorial and low-latitude ionosphere modulate the current and the field in the region. The perturbation in field affects the distribution of ionospheric plasma. During the day time prompt penetration electric field (PPEF) is eastward and enhances the dynamic electric field which enhances vertical drift lifting the plasma to higher altitudes [2]. At these altitudes, the production to loss ratio is greater. This results into enhanced electron density in the dayside sector. Thus PPEF is associated with huge enhancement in total electron content (TEC) in dayside sector [3] and depletion in TEC in night side sector [4]. The disturbance dynamo electric field (DDEF) from geomagnetic storm is westward in dayside and decreases the dynamo electric field, reducing vertical drift and causing depletion of TEC in dayside sector and suppression of EIA. The observed increases or decreases in the ionospheric F region electron densities and TEC are respectively referred as positive and negative storm effects [5].

In this study four intense class geomagnetic storms have been selected to study perturbation in the ionosphere over a station Varanasi situated near the EIA crest region and an equatorial station during the ascending phase of solar cycle 24. The storms were occurred on 26 September 2011 (Dst_{min} = -118 nT), 15 July 2012 (Dst_{min} = -118 nT), 19 February 2014 (Dst_{min} = -118 nT) and 20 December 2015 (Dst_{min} = -118 nT).

2 EXERIMENTAL SETUP AND DATA

The GPS is a satellite-based navigation system widely used for navigation, relative positioning and time transfer. The slant total electron content along the line of sight is estimated from GPS observation data recorded in RINEX format with a time resolution of 30 s which is easily converted into vertical total electron content (VTEC) using the method discussed elsewhere [6]. The hourly Dst-index is taken from the website: http://swdcwww.kugi.kyto-u.ac.jp. The z-component of interplanetary magnetic field (IMF) Bz in GSM (Geocentric Solar Magnetospheric) coordinates and solar wind velocity in GSE coordinates have been taken from the Omni website (https://omniweb.gsfc.nasa.gov).

3 EFFECT OF GEOMAGENTIC STORMS

To study the effect of geomagnetic storms on VTEC, we have analyzed GPS data recorded at Varanasi during ascending phase of solar cycle 24 from 2007 - 2015. In this period total fourteen intense geomagnetic storms occurred. Out of 14, four most intense storms occurred on 26 September 2011, 15 July 2012, 19 February 2014 and 20 December 2015 have been selected for detailed study.

4 CONCLUSIONS

In this study, we have presented the effect of intense geomagnetic storms on the variation of TEC at a low latitude station, Varanasi situated near the EIA region occurred during the ascending phase of the solar cycle 24. During four selected intense geomagnetic storms occurred on 26 September 2011, 15 July 2012, 19 February 2014 and 20 December 2015 during 2010-2015 geomagnetic storms, ionospheric TEC is found to increase as well as decrease. Storm induced electric field responsible for electro dynamical drift as well as storm induced mechanical effect from neutral wind have been used to explain the observed results.

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