



Studies on space weather effects of the GPS signals during the storms of November 2004

P.V.S. Rama Rao (1), S. Gopi Krishna (1), D.S.V.V.D. Prasad (1) and A. Raja Babu (1)

(1) Andhra University

This paper presents the space weather effects of two consecutive geomagnetic storm (8th and 10th November 2004) events on the ionospheric parameters such as $h'F$, foF_2 and TEC as well on the phase slips and associated GPS receiver loss of lock events are described. During the storms of 8th and 10th November 2004, the virtual height of the F-layer ($h'F$) increased significantly (from 250 km to 450 km) at the off equatorial station, Waltair, whereas at the equatorial station Trivandrum an increase in $h'F$ is seen on the pre-noon hours of 10th and 11th November 2004. Similarly increases in foF_2 are seen marginally at both the locations during the entire period of the storm activity. These geomagnetic storms have adversely affected the GPS range delay measurements as inferred from the TEC measurements during these storms. At the EIA crest regions during the storm times of 9th and 10th November 2004, the TEC values increased up to 90 TEC units that correspond to a range delay of 15 metres. Further, the EIA seen from the TEC measurements made along a chain of seven GPS receivers on a common meridian of 77 deg. E has shown significant disturbed structure in the formation of the crest of the anomaly during these storm days.

The number of phase slips detected in GPS receiver observed during the storm times, has increased significantly compared to those on quiet days. Some of these phase slips occurring during the storm times resulted in loss of locks of the GPS receivers owing to rapid phase fluctuations in the receiver due to rapid changes in TEC. During the recovery phase of storm, at 0234 IST of 9th November 2004, the phase slips are observed at all the 18 stations in the Indian region simultaneously resulting in loss of lock of the receivers from the satellite signal on PRN 21. Thus, it is inferred from these studies that the phase slips can occur at all stations in the equatorial and low latitude regions due to the sudden temporal changes produced in the ionospheric electron

density during geomagnetic storm conditions.