



First Results on impact of St. Patricks day storm on GPS precise positioning in equatorial and low latitudes

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Abstract:

A severe geomagnetic storm that occurred on 17-18 March 2015 has produced dramatic effects on Ionosphere in terms of variation in total electron content (TEC) and Scintillations in Indian longitude sector. Various studies from India have emphasized upon abnormal and anomalous deviations in ionospheric delay. However, so far, no study has reported the effects of sharp gradients in TEC on positioning using GPS signals. This paper presents a robust analysis including estimation of precise point position (PPP) using dual frequency GPS signals in L1 and L2 bands. PPP approach has been applied using ionosphere-free and ionosphere combinations to obtain the effect of ionospheric delay on PPP during the geomagnetic storm. RAIM algorithm has been utilized for epoch wise solution estimate while the precise orbit from SP3 files are obtained from IGS analysis centers. A range domain Kalman filter has also been developed to smooth the 30 sec sampled code pseudo-range using carrier phase data. The results are shown for static PPP solution from 5 GPS receiver stations from Indian sector which are located along 79-80 E longitude sectors. Static PPP solution for quiet days of month of March 2015 is averaged to exhibit day-to-day variability in effect of ionospheric delay on horizontal positioning. Also, we show the results from PPP technique by applying ionospheric corrections using model based TEC and observed TEC from over each station. Thus, we not only present the results that provide PPP solution without ionospheric correction but also exhibit the effect of incorrect ionospheric corrections by some of the ionospheric models as applied to single frequency receivers. The ionospheric plasma depletions produced in Indian sector after 20:00 IST in Indian sector have caused sharp fluctuations in PPP solution whereas, the ionospheric electric fields of storm origin played major role in changing ionospheric daytime delays on 18 March 2015. Results for 5 other moderate storms of solar cycle 24 have also been prepared to compare the effect of severity

of the storms and their impact on static PPP positioning from Indian sector. The results form a basis of need for better ionospheric models that could minimize the effect of line of sight ionospheric delays for single frequency users during space weather events. The results highlight the importance of network based studies of ionosphere to understand the latitudinal and longitudinal variations in equatorial and low latitudes.