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Ionospheric Effects of Geomagnetic Storms on GNSS based Systems

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It is known that ionosphere is the effective indicator of the space weather state. Severe ionospheric perturbations can seriously degrade the performance of Global Navigation Satellite Systems (GNSS). During geomagnetic storms the ionospheric gradients are essentially increased in compare with quiet conditions. Strong ionospheric gradients can caused the deterioration of GPS positioning. In the given report it is presented the analysis of ionospheric effects during summer (July 2004) and winter (November 2004) geomagnetic storms on the base of GPS TEC maps over Europe.

Dramatic changes in TEC distribution during storms were attributed by large intensity (Dst>200nT) as well as long duration of these storms. The effects were associated with particle precipitation, dynamics of auroral oval and the main ionospheric trough. During both storms the ionospheric gradients were essentially increased on middle latitudes. This effect was caused by migration of the main ionospheric trough to lower latitudes, it was detected on 55°N latitude in summer and lower than 50°N in winter events.

Short-term positive TEC perturbations were found during recovery phase of storms against the general depressions of TEC which were observed in day-time and strictly marked at lower latitudes. The perturbations were associated with standing Poincare waves in the atmosphere. It was revealed the essential increase of TEC fluctuation intensity during storms. Significant TEC fluctuations were registered even at middle latitudes. These fluctuations led to the loss lock of GPS signals at high latitude stations.