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Study of the Ionosphere Irregularities Caused by Space Weather Activity on the Base of GNSS Measurements.

Abstract:
The study of ionospheric density gradients and irregularities distribution is not essential in fundamental ionosphere-magnetosphere coupling investigations in terms of plasma conductivity that play a major role as well as very important for practical aspects related with trans-ionospheric radio wave propagation conditions. The ionosphere delay is the biggest error source for satellite navigation systems. The GNSS signal fading due to electron density gradients and irregularities in the ionosphere raise a concern about the operational availability of navigation systems. The intensity of such irregularities on high and mid latitudes essentially rises during space weather events.

Existing permanent GNSS networks provides opportunities to estimate the overall levels of ionospheric density gradients and irregularities as well as to study them spatial and temporal evolutions. The our methodology based on rate of GPS TEC estimates, ROTI index and mapping techniques allows to estimate day to day irregularities patterns in geomagnetic coordinates. By processing of data from more than 700 permanent GNSS station (in the Northern Hemisphere) per day it was obtained that the occurrence and magnitude of TEC fluctuations, measured using GNSS networks, increase dramatically during space weather events. The irregularities oval expands considerably equatorward with simultaneous increase of the fluctuation intensity.

The results of observations and analysis for specific space weather events of new solar cycle will be presented and discussed. The study, modeling and prediction of the ionospheric irregularities at midlatitudes and subauroral regions is actual from practical view task because a lot of GNSS positioning users are situated in this area. The statistical analysis of data from the permanent GNSS network together with space weather indices allows to develop approaches for the empirical modeling of the ionospheric irregularities especially for the Northern Hemisphere. With ROTI index maps it was determined the irregularities oval border and averaging parameter – semi-hemisphere fluctuation index. It was investigated the correlation dependences between Kp geomagnetic index and parameters that characterized the ionosphere irregularities activity for period of 2010 – 2014 years.

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