Geophysical Research Abstracts
Vol. 15, EGU2013-13494, 2013
EGU General Assembly 2013

Investigation of the Ionospheric Fluctuations Caused by Space Weather Effects Using GNSS TEC Measurements

Irk Shagimuratov (1), Andrzej Krankowski (2), Iurii Cherniak (1), Ivan Ephishov (1), Irina Zakharenkova (1), and Galina Yakimova (1)

(1) WD IZMIRAN, Kaliningrad, Russian Federation (shagimuratov@mail.ru), (2) Geodynamics Research Laboratory, University of Warmia and Mazury, Olsztyn, Poland

It is known that GPS radio signals passing through the ionosphere suffer varying degrees of rapid variations of their amplitude and phase - signal scintillations. The scintillations are caused by the presence of wide range of scale size irregularities in the ionosphere. It is very important to estimate scintillation and phase fluctuation effects on GNSS navigation system (GPS/GLONASS) performance and consequently on the precession of the obtained position. Effects of the ionospheric irregularities on the GPS signals can be evaluated by measurements of the differential phase time rate of dual frequency GPS signals. GPS observations carried out at the Arctic IGS (International GNSS Service) stations were used to study the development of TEC fluctuations in the high latitude ionosphere. Standard GPS measurements with 30s sampling rate allow the detection of middle- and large-scale ionospheric irregularities.

For detection of ionospheric fluctuations the rate of TEC (ROT, in the unit of TECU/min) at 1 min interval was used. The temporal occurrence of TEC fluctuations is clearly observed in time variations in the dual frequency carrier phase along satellite passes. As a measure of the fluctuation activity level the Rate of TEC Index (ROTI) based on standard deviation of ROT was also used. ROTI was estimated in 10-minute interval.

These techniques and IGS data were used to study the occurrence of TEC fluctuations at the northern latitude ionosphere for selected geomagnetic storms occurred at the end of 23rd and beginning of new 24th solar cycles. Results demonstrate that fluctuation activity of GPS signals in the high latitude ionosphere is depended on geomagnetic conditions. Intensity of fluctuations essentially increases during geomagnetic storms. The strongest TEC fluctuations occurred as short time rate of TEC enhancements of a factor of 2-5 relative to the quiet time.

During geomagnetic disturbed conditions strong phase fluctuations can register at latitudes low than 65º. GPS observations of the Northern hemisphere were used as a raw data for mapping the irregularities over the North Pole. These maps illustrate the spatial structure of the ionospheric irregularities, so called irregularity oval which position is correlated with the auroral oval. During geomagnetic storms the intensity of the irregularities essentially increases and their location expands toward equator.

The study showed that observations of GNSS signal fluctuations activity in the high-latitudinal ionosphere can provide monitoring of the space weather dynamics.

This work was supported by the RAS Presidium Program N 22.