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OBSERVATION OF THE HIGH-LATITUDE IONOSPHERIC IRREGULARITIES: METHODOLOGY AND SERVICE

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Observation and analysis of the ionospheric irregularities at the high latitudes using GPS measurements represent very actual task for both scientific point of view and Global Navigation Satellite Systems (GNSS) applications, as the occurrence of the ionospheric irregularities can impact a variety of communication and navigation systems. In this work we describe methodology and service for continuous generation of high-resolution maps of the ionospheric irregularities. To observe the high-latitude ionospheric irregularities, data collected from three ground-based GPS networks of the Northern Hemisphere are processed and analyzed (Fig. 1a). Here we used GPS-based parameters ROT (rate of total electron content (TEC) change) and ROTI (index of ROT) to study the occurrence of TEC fluctuations [Pi et al. 1997].
For representation of the high-latitude irregularities spatial evolutions and estimation of their linkage with the Earth's magnetosphere (due to strong connections between the Earth's magnetic field and the ionosphere) we analyze the diurnal ROTI polar maps. Here, ROTI behavior is represented as a function of a magnetic local time (MLT) and corrected magnetic latitude (MLAT) for a specific day. Resulted polar map is a daily map with the grid of 2° × 2° spatial and 00-24 MLT time frames. Maps show binned and averaged ROTI data within the magnetic latitude range of 50° - 90°.
The ROTI maps allow us to estimate the overall fluctuation activity and auroral oval evolutions, in general, the ROTI values are corresponded to the probability of the GPS signals phase fluctuations. We analyze the dependence of the GPS-detected ionospheric irregularities on the auroral activity indices, such as Dst index, the auroral electrojet (AE) and the planetary geomagnetic Kp indices. We demonstrate 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 TEC fluctuation intensity (Fig. 1b-c).
The indices and maps, based on TEC changes, can be effective and very perspective indicator of the presence of irregularities in the high-latitude and midlatitude ionosphere. We expect the high potential of the proposed products; however, it is the just tool and great work should be done on data processing, statistical analysis, comparative or/and joint investigations with other ionosphere-magnetosphere measurements.

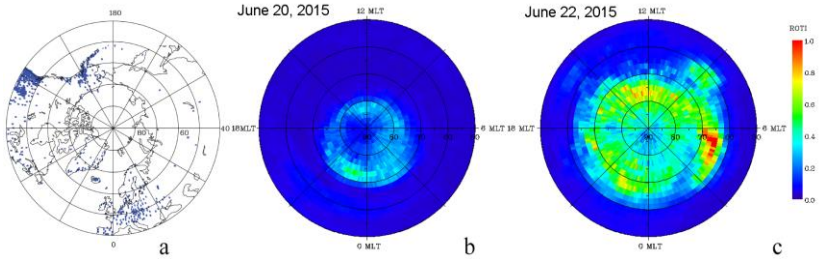

Figure 1. Map with geographical location of the processed GNSS stations (a), ROTI maps for quiet (b) and disturbed (c) geomagnetic conditions.

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