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The detection of the ionospheric irregularities by GNSS signal and the incoherent scatter radio measurements

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The high-latitude ionosphere has a very complicated structure and high dynamics. The ionospheric irregularities can produce scintillations of radio waves that occur predominantly in the ionosphere F-layer. The strong fluctuations can influence on the performance of the different space communication and navigation radio systems. The fluctuations of GPS/GLONASS signals are caused by the ionospheric irregularities with spatial dimensions more than 10 km. These structures can be detected by high potential incoherent scatter radars. It was proposed and carried out at the beginning of June 2012 experiment for a detailed study of the nature of the ionospheric irregularities, influencing on GPS/GLONASS signals parameters, by incoherent scatter and trans-ionospheric radio measurements simultaneously. The EISCAT facilities position provides the unique opportunity to study the ionospheric irregularities' parameters associated with TEC fluctuations and GPS/GLONASS signals scintillations. The EISCAT heating facility provides unique possibility to generate the artificial ionospheric irregularities and to estimate the impact factor of these irregularities on GPS/GLONASS signals transionospheric propagation.
In order to detect the ionosphere irregularities it is used the IS radar measurements (electron density and plasma temperatures profiles) and simultaneously registered on EISCAT site amplitude and phase fluctuations in GPS/GLONASS signals by use of the Javad multi-constellation GPS/GLONASS receiver with high samples rate (100 Hz) and special scintillation GPS receiver PolaRxS PRO that dedicated to ionospheric monitoring and space weather applications and provides TEC and S4 scintillation index measurements. The low frequency fluctuations can be directly measured due to the electron density changes along the radio ray path between a GPS/GLONASS satellite and a ground-based receiver on EISCAT site. The raw data (under scintillating conditions) obtained by use of the high samples rate GPS/GLONASS receiver are processed in order to derive the scintillation parameters. The practical aspect of this investigation is a detailed study of nature and impact level of the ionospheric irregularities that can influence on the GPS/GLONASS performance especially at high latitudes and during geomagnetically disturbed period and to obtain new knowledge that may improve the reliability of the global navigation systems in Arctic and Antarctic regions.

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