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GNSS monitoring of the ionospheric irregularities over the Northern Hemisphere for Space Weather applications

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Passing through the ionosphere GNSS radio signals are subjected to rapid variations of their amplitude and phase and, from the other side, they can be used to reveal the strong ionosphere fluctuation events. Currently, there is a demand to increase the precision and reliability of GNSS positioning by taking into account of the ionosphere's variatiability, both regular and irregular. The regular behavior of the ionosphere is effectively studied with use of the global ionospheric maps (GIMs TEC) produced by IGS community. Also several research groups have developed techniques for creation the ionospheric irregularities maps. Such maps can be useful for space weather monitoring, radioastronomy and navigation by combining them with global ionospheric TEC maps.
Our investigation is based on the classical approach when Rate of TEC (ROT) is detrended rate of line-of-sight TEC change and ROTI – index calculated on 5 min interval with 30 sec sampling rate (Pi et al, 1997). There are processed observations of more than 800 permanent stations which available from IGS, UNAVCO and EUREF networks. For analysis there is produced the daily map of the ROTI index as a function of geomagnetic local time on the grid with 2 deg x 2 deg resolution. The value in every cell is calculated by averaging of all ROTI values cover by cell area and it is proportional to the fluctuation event probability in the current sector. The ROTI maps, constructed by such way, allow to estimate the overall fluctuation activity and auroral oval evolutions. It is presented few case studies that illustrated ability of ROTI maps to represent changes of midlatitude, subauroral and auroral ionospheric structures during space weather events during the years of 2011-2013.