

The physical background and GPS TEC processing technology for identification of ionospheric anomalies forming over seismically active zones and leading to GNSS signals degradation

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The recent extended studies have demonstrated that the low latitude ionosphere is very sensitive to the anomalous electric fields generated during the most last stage of the strong earthquake preparation (few days before the seismic shock). We can mention three main types of large scale (from several hundred up to several thousand km) forming over the seismically active zones: formation of positive/negative deviation of GPS TEC from undisturbed state, modification of the shape of equatorial anomaly (crests movement, changes of crest-to-trough relation, anomaly deformation), spread-F effect due to formation of plasma bubbles. Other characteristic features of seismo-ionospheric anomalies are the magnetically conjugated effect (anomaly appears also over the area magnetically conjugated to the impended epicentral area) and longitudinal effect (asymmetry in zonal direction to the position of impending epicenter) (S. A. Pulinets, *International Journal of Geophysics*, doi:10.1155/2012/131842, 2012).

The physical mechanism of the observed anomalies was revealed in (S. A. Pulinets and D.V. Davidenko, *Advances in Space Research*, **53**, 2014, pp. 709-723), and modeled with the use of the first principle ionospheric model (M.V. Klimenko et al., *Advances in Space Research*, **48**, 2011, pp. 488-499). The pure effect of formation of the anomalous zonal electric field was demonstrated in (K. M. Ryu et al., *J. Geophys. Res.*, **119**, 2014, doi:10.1002/2014JA020613). The possible mechanism of plasma bubbles formation before earthquake was proposed in (C L. Kuo et al., *J. Geophys. Res.*, **116**, 2011, Article ID A10317).

The special techniques for automatic detection of seismo-ionospheric anomalies were developed which will be demonstrated in the present paper. These techniques permit also to distinguish the seismically induced anomalies from those initiated by solar and geomagnetic activity. Seismo-ionospheric anomalies could be revealed also even during the geomagnetic storm.