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The technique of processing of radiotechnical and geophysical information about conditions of satellite radio signal propagation for studying lithospheric–ionospheric manifestations

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The appearance of structural ionospheric anomalies and the influence of ionosphere inhomogeneities on radio wave propagation form the unity of an important and topical problem for the study because they are of scientific and practical importance in the field of physics of the upper atmosphere and radio physics. In addition, GNSS data always represents a significant amount of information that must be processed before interpretations could be provided. Often this needs to be done quickly. Therefore, we need a reliable way that allows us to efficiently and quickly process a large volume of satellite data. An investigation has been performed based on a vast volume of data of synchronous measurements, more than 50 million phase measurements readings of satellite radio signals by ground GNSS receives combined into global IGS and UNAVCO networks. Consistently used methods of GPS interferometry, cluster analysis, geophysical analysis, and statistical analysis allow one to distinguish and study inhomogeneous structures of the ionosphere response to seismic activity in the region. Differential program-algorithm methods of satellite radio signal data processing make it possible to distinguish inhomogeneous structures of the ionosphere and to consider characteristics of their distributions over time and space. Variability of the ionosphere is studied using global navigation satellite systems (GNSSs). These systems allow one to determine the total electron content (TEC) [1], i.e., the number of free electrons in a column of unit cross section along the propagation path from the satellite to the receiver in the ionosphere. The dual-frequency method makes it possible to extract from radio signals and study the ionospheric component (TEC units). In this work, identical inhomogeneous ionospheric structures distinguished by radio-interferometry by different cells of GPS receivers are classified using cluster analysis. Results obtained after the use of GPS interferometry and cluster analysis require qualitative and quantitative systematization for understanding their geophysical essence. For this purpose, geophysical analysis with the use of an updated digital model of lithospheric plate boundaries was carried out. Statistical analysis allows one to give quantitative and qualitative final estimates for detected inhomogeneous structures as a response in the ionosphere to seismic activity in the region. The results correspond to the ionosphere response to earthquakes with characteristic wave parameters of the manifestation.

[1] E.L. Afraimovich and N.P. Perevalova, *GPS-monitoring verkhnei atmosfery Zemli* (GPS Monitoring of the Earth’s Upper Atmosphere), Irkutsk: GUNTs RVKh VSNTs SO RAMN, 2006.