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Traveling wave packets of total electron content disturbances as deduced from global GPS network data

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Abstract

We identified a new class of mid-latitude medium-scale traveling ionospheric disturbances (MS TIDs), viz. traveling wave packets (TWPs) of total electron content (TEC) disturbances. For the first time, the morphology of TWPs is presented for 105 days from the time interval 1998-2001 with a different level of geomagnetic activity, with the number of stations of the global GPS network ranging from 10 to 300. The radio paths used in the analysis total about 700000. These data were obtained using the GLOBDET technology for global detection and monitoring of ionospheric disturbances of natural and technogenic origin from measurements of TEC variations acquired by a global network of receivers of the navigation GPS system. The GLOBDET technology was developed at the ISTP SD RAS. Using the technique of GPS interferometry of TIDs we carried out a detailed analysis of the spatial-temporal properties of TWPs by considering an example of the most conspicuous manifestation of TWPs on October 18, 2001 over California, USA. It was found that TWPs are observed no more than in 0.1-0.4% of all radio paths, most commonly during the daytime in winter and autumn at low geomagnetic activity. TWPs in the time range represent quasi-periodic oscillations of TEC of a length on the order of 1 hour with the oscillation period in the range 10-20 min and the amplitude exceeding the amplitude of "background" TEC fluctuations by one order of magnitude, as a minimum. The radius of spatial correlation of TWPs does not exceed 500–600 km (3–5 wavelengths). The velocity and direction of TWPs correspond to those of mid-latitude medium-scale traveling ionospheric disturbances (MS TIDs) obtained previously from analyzing the phase characteristics of HF radio signals as well as signals from geostationary satellites and discrete cosmic radio sources.