

Investigation of the vertical slope of MSTID phase fronts from GNSS data

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The paper deals with the property of the mid-latitude MSTIDs with small intensities, $\Delta N/N \sim 10-20\%$, using the GNSS transionospheric sounding method. A dense network of GNSS receivers located in European part of Russia (more than 150 receivers) was used. Two-dimensional maps of TEC perturbations for three satellites were constructed, which revealed the influence of line-of-sight (LOS) viewing angle on amplitudes of TEC perturbations. Three satellites, R03, R18 (GLONASS satellites) and G18 (GPS satellite) were simultaneously observed on 21 September 2016. The signatures of MSTID (band structures on TEC perturbation maps) were observed for two satellites R03, G18 with similar LOS at this time, but satellite R18 LOS don't allow us to observe band structures (see figure 1). The proposed approach made it possible to create a method to assess the vertical slope of MSTIDs by GNSS data. We obtain the MSTIDs vertical slopes distribution (sloping forward/ sloping backward) in two latitudinal regions (see figure 2). The daily variations of MSTIDs propagation directions have been studied as well. It was found that summer nighttime MSTIDs over Samara (~ 55° N, 50° E) have the typical southwestern directions of propagation and sloping forward phase fronts, while near Krasnodar (~ 45° N, 38.5° E) the MSTIDs observed with northwestern propagation directions and with sloping backward phase fronts. We do not propose the exact mechanism of their formation in this paper, however, we note that sloping backward phase fronts of MSTIDs couldn't be formed by the AGWs with sources in the troposphere. We suppose that this plasma fluctuations may be caused by MEF/MMF and amplified by NMPBE in ~ 45° N latitudes, which moves poleward because of ambipolar diffusion.



Figure 1. Two-dimensional TEC perturbation maps reconstructed from data of satellites GLONASS (R03, R18) and GPS (G18)



Figure 2. Occurence rate of MSTIDs with sloping forward and sloping backward phase fronts at two latitude regions (~ 45° N,~ 55° N). Areas of the image with certain vertical slope are labeled and marked by dotted lines.

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