



On E_s -spread effects in the ionosphere connected to earthquakes

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In the present work, in connection with earthquake preparation processes, the E_s -spread phenomenon is studied, which occurs as diffusivity, that means as smearing of the traces of sporadic E_s -layers on ionograms of vertical sounding stations, reflecting the turbulization of the sporadic layers. E_s -spread is mainly observed at night, and its observation probability depends on the season and on the solar activity. In a series of former works, it was found that 1-3 days before an earthquake with magnitude $M > 5.5$, and up to 2 days after such an event, at distances up to 300 km an increase of E_s -spread effects is obtained. But all these former works took into account earthquakes of Central Asia. Here ionospheric effects of earthquakes (more than 40 events) with epicenters situated in the sea are investigated. These earthquakes have magnitudes of $M > 3.5$ and depths of up to 50 km. The analysed E_s -spread data were registered by the ionospheric vertical sounding station Petropavlovsk-Kamchatsky ($\varphi = 53.0^\circ$, $\lambda = 158.7^\circ$) in 2004 at night every 15 minutes. There are considered a few groups of earthquakes classified according to different magnitudes and distances between the epicenters and the sounding station. It is shown that mostly an increase of E_s -spread effects is observed on the day of the seismic eruption. Thereat, for earthquakes with distances from the sounding station $R < 100$ km, the phenomenon is even obtainable for weak earthquakes with $3.5 < M < 4$, and for stronger earthquakes the effect may be observed at larger distances. A correlation of the observation probability of E_s -spread connected to earthquakes with ULF variations of the geomagnetic field of 0.05-0.2 Hz is found.