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Day-time variations of foE and foF2 connected to earthquakes

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In the present work, disturbances of the characteristic frequencies foE and foF2 of the ionosphere are studied to find out if they may be considered as possible earthquake precursors. These frequencies are proportional to the square root of the maximal electron density in the E- and F-layer of the ionosphere, respectively. The statistical analysis of the frequencies foE and foF2 is performed using data of the vertical sounding radar station Tashkent (latitude $\varphi = 41.3^o$ N, longitude $\lambda = 69.6^o$ E), obtained from 1964 until 1996 every hour. Experimental observations averaged over mid-day hours from 11 till 17 h LT are considered on the background of seasonal, geomagnetic, 11-years and 27-days Solar variations. Special normalized parameters E and F are introduced, which represent the almost seasonal-independent part of foE and foF2. Days with higher Solar (Wolf number > 100) and geomagnetic ($\Sigma Kp > 25$) disturbances are excluded from the analysis. It is shown that, for the whole data massive, that means considering all days studied, no correlations between the normalized parameters of the E- and F-layer are found (correlation coefficient 0.05). Further, the superimposed epoches method is used to determine the temporal dependence of the parameters of the E- and F-layers. It is found that the normalized parameters of both layers increase one day before the earthquakes, and then decrease before the seismic shock. The decrease is obtained for earthquakes occurring at distances smaller than 1500 km from the ionospheric radar station and having a depth of the epicenter not larger than 60 km. The increase of foE occurs for earthquakes with magnitudes $M > 4.5$, and the increase of foF2 is obtained for events with $M > 5$. The reliability of the effect is larger than 95 %. Possible physical processes causing the phenomenon are discussed.