Statistical analysis of the predictive efficiency of ionospheric precursors of earthquakes in the Kamchatka region

Bogdanov V.V., Pavlov A.V.

Institute of cosmophysical research and radio wave propagation FEB RAS, Paratunka, Russia

e-mail: pavlov@ikir.ru

There is a direct relationship between solar activity and processes in the magnetosphere, ionosphere and lithosphere of the Earth. However, there is also a feedback that determines the influence of lithospheric processes in seismically active regions on the physical processes occurring in the upper geospheric shells. In seismically active regions, any anomalous changes in the behavior of the ionospheric parameters that form against the background of a regular daily change in the characteristics of the ionosphere due to the influence of the Sun can provide information about the processes of earthquake preparation. At the same time, each seismically active region is characterized by its own most informative features (anomalies) in the behavior of ionospheric parameters, which can be identified with earthquake precursors.

In the course of vertical radio sounding of the ionosphere at the ionospheric station located in Paratunka, on the eve of the onset of earthquakes in the Kamchatka region, the following ionospheric disturbances were recorded: the excess of the current values of the critical frequency foF2 of the ionospheric layer F2 over the median values during periods of the disturbed state of the magnetosphere, precipitation of charged particles from the radiation belts into the ionosphere (formation of the K-layer), formation of a sporadic Es type r layer, appearance of scattered reflection traces in the ionograms in the F region (F2-spread) against the background of a quiet magnetosphere, stratification of the reflection trace in the ionograms in the F region in frequency and height. For these ionospheric disturbances, a statistical analysis of their predictive effectiveness for earthquakes with magnitude $M \geq 5.0$ that occurred in the Kamchatka region over the time period 2013-2021 was carried out. A method for short-term forecasting of seismic events with a magnitude of $M \geq 5.0$ and an earthquake expectation period of up to several days based on a set of ionospheric parameters that have the best predictive efficiency, is proposed. A retrospective analysis of the prognostic effectiveness of this method showed that the prediction by this method is statistically significant and differs from random guessing.