



Spatial-temporal distributions of earthquakes of the Kuril Island arc

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The regularity of the spatial-temporal distributions of earthquake (EQ) hypocenters of the Kuril region was regarded in this work. We used the Kuril-Kamchatka catalogue of the seismic events compiled (from ISC and regional catalogues) and supported by Kim and Andreeva [2009]. Catalogue contains data about 30253 events. In this work it was extracted events occurred only in Kuril region with depth $0 \leq H \leq 700$ km.

The analysis was carried out for two events subset simultaneously: with $M_s \geq 4$ for time interval 1980 -2009 (20576 EQ's) and with $M_s \geq 7$ 1910 -2009 (76 EQ's). It was shown that the events with $M_s \geq 4$ are representative for studied region only from 1980 and the events with $M_s \geq 7$ are representative from 1910. The aftershocks were canceled from the list of events. Then the Kuril region was disintegrated into 18 nonoverlapping parts (polygons) with identical sizes.

The speciality application-dependent software was developed in frame of MatLab system for multivariate statistical analysis, which was enable to obtain the four-dimensional (4D) distributions of the number of seismic events and released energy (over polygons, depth, time intervals, and energy levels). This software allows us to extract any prescribed subset from the prepared four-dimensional matrixes and to plot the graphic presentation of the distributions for extracted subsets.

Firstly the analysis of the distributions over depth and polygons for the earthquake number and released energy for the seismic events with $M_s \geq 4$ was carried out for the following magnitude levels: $\{4.0 \leq MS < 5.0; 5.0 \leq MS < 6.0; 6.0 \leq MS < 7.0; 7.0 \leq MS < 7.5; 7.5 \leq MS < 8.0; MS \geq 8.0\}$ and the depth scale: $\{10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 200, 240, 300, 350, 400, 450, 500, 600, 700\}$.

It was shown a clear spatial clustering of events is traced by both polygons and depths. The event crowding was observed near the Shikotan-Iturup-Urup Islands both for crust and for deep events and near Simushir Island for crust events. The most part of the 2D matrix (polygon-depth) remains empty. The great EQ's have tend to decrease the hypocenter depth with increasing of the magnitude of events. The spatial-temporal analysis of the EQ's with $M_s \geq 4$ in six five-year time intervals (TIN) in period 1980-2009 shows cyclical increasing and decreasing of the seismic activity in various TIN and cyclical migration of the activity between South and North Kuril.

The analysis of the EQ's with $M_s \geq 7$ in twenty five-year TIN in period 1910-2009 shows that number of great seismic events were substantially decreased in the last 30 years. The average value of EQ's from 1910 to 1969 was equal to 8 events per one TIN, but from 1975 to 2009 year this value decrease to two events. The distribution of these events over the depth also was substantially varied. The deep and the intermediate EQ's occurred practically in every TIN. But from 1975 it was observed only crust great EQ's. The peaks of seismic activity appeared in 1915-1919, 1955-1969 and 2005-2009, and time intervals between these peaks were approximately equal to 35 years. It was noted also, that near the Onkotan Island do not occur no one great EQ in period 100 years.

We will be able to receive more valid conclusion about spatial-temporal dynamic of great seismic events of the Kuril region when we will have sufficiently long data sequences of seismic observations.