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Map of Pseudo-F-statistics of seismic noise parameters as an indicator of current seismic danger in Japan

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The problem of estimate of current seismic danger based on monitoring of seismic noise properties from broadband seismic network F-net in Japan (84 stations) is considered. Variations of the following seismic noise parameters are analyzed: multifractal singularity spectrum support width, generalized Hurst exponent, minimum Hölder-Lipschitz exponent and minimum normalized entropy of squared orthogonal wavelet coefficients. These parameters are estimated within adjacent time windows of the length 1 day for seismic noise waveforms from each station. Calculating daily median values of these parameters by all stations provides 4-dimensional time series which describes integral properties of the seismic noise in the region covered by the network.

Cluster analysis is applied to the sequence of clouds of 4-dimensional vectors within moving time window of the length 365 days with mutual shift 3 days starting from the beginning of 1997 up to the current time. The purpose of the cluster analysis is to find the best number of clusters (BNC) from probe numbers which are varying from 1 up to the maximum value 40. The BNC is found from the maximum of pseudo-F-statistics (PFS). A 2D map could be created which presents dependence of PFS on the tested probe number of clusters and the right-hand end of moving time window which is rather similar to usual spectral time-frequency diagrams. In the paper [1] it was shown that the BNC before Tohoku mega-earthquake on March 11, 2011, has strongly chaotic regime with jumps from minimum up to maximum values in the time interval 1 year before the event and this time intervals was characterized by high PFS values.

The PFS-map is proposed as the method for extracting time intervals with high current seismic danger. The next danger time interval after Tohoku mega-EQ began at the end of 2012 and was finished at the middle of 2013. Starting from middle of 2015 the high PFS values and chaotic regime of BNC variations were returned. This could be interpreted as the increasing of the danger of the next mega-EQ in Japan in the region of Nankai Trough [1] at the first half of 2016.

References

1. Lyubushin, A., 2013. How soon would the next mega-earthquake occur in Japan? // Natural Science, 5 (8A1), 1-7.
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