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Entropic model and short-term earthquake prediction

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The research deals with the problem of interpreting energy characteristics of seismic events with respect to their time series, be it events preceding a megathrust earthquake (foreshocks) or the sequence of its aftershocks, with the aim of providing short-term prediction of the main shock (time and magnitude) in a certain fault area under observation by means of its active monitoring.

The core of the suggested approach of determining time and magnitude of the megathrust earthquake is establishing active monitoring of the fault area under study on every stage of seismic process development and obtaining precise seismic data non-stop in real-time mode for plotting and processing the time series.

The essence of the suggested method of short-term prediction of the expected earthquake parameters is the technique of extracting certain “energy levels” by analyzing the incoming seismic data. The energy levels are straight lines in the “magnitude/time” diagram of the analyzed seismic event flow. The behavior of the seismic events contains the key information about the behavior the future seismic process in the fault area.

On basis of the detailed data analysis of the peculiarities of the energy characteristics’ behavior of the seismic process related to Altai earthquake (27.09.2003) and the study of a number of regional catalogs of Central Siberia, Kamchatka, South Kuriles, Japan, China and California we found and described a range of prognostic signs that allow determining the time of a strong earthquake 2-3 days before the actual shock with the time precision to 6-12 hours. The precision of magnitude estimation of the expected earthquake depends on the accuracy of its estimation by seismological services (0.1–0.3).

The basic prognostic signs being the basis of the suggested method of analyzing energy levels in time diagrams are “energy wedges” – an intersection of corresponding extreme energy levels. The appearance of an “energy precursor” which is sharp descent of the lowest level a few hours before the expected earthquake is an additional prognostic sign.

To provide a proof of the efficiency of the suggested approach, in the research we analyzed the foreshock process in the fault area of Sumatra earthquake (26.12.2004). The proper “energy wedge”conveying prognostic data regarding the time and magnitude of this destructive earthquake was elicited. The results of the detailed time analysis of the aftershock process energy with the purpose of forecasting the parameters of the most severe seismic events. Energy levels were elicited; geodynamic interpretation of their interaction on basis of thermodynamic (entropic) notions was also given.

The suggested approach to the interpretation of the indicated seismic data could be applicable as a specialized computational technique within the framework of the Global System of active monitoring of the most seismically dangerous areas. It could also be utilized in the seismic system of International Service of Tsunami Warning.