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Tsunami risk estimation in systems of early tsunami warning

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The research presents a description of the method of tsunami source parameters' estimation on basis of forecasting time and magnitude of the expected megathrust tsunamigeneous earthquake. The time and magnitude, in their turn, are determined by the foreshock process monitoring. The position of the expected tsunami source is identified by the position of the foreshocks in the fault area of the earthquake. The time and magnitude of the megathrust tsunamigeneous earthquake are predicted by extracting the so-called prognostic wedge by means of forming envelopes – straight lines in the "magnitude-time" diagram of the foreshock process development which characterize the intensification of low energy earthquakes in the area under observation and the slack in high energy seismic events.

The time of the expected tsunamigeneous earthquake is determined by the point of intersection of the aforesaid lines. The appearance of an "energy precursor" which is sharp descent of the registered magnitude level a few hours before the main shock is an additional prognostic sign. The magnitude of the main shock is determined by the difference in the values of the extreme magnitudes in the foreshock process. The area of the potential tsunami source is characterized by the position of the analyzed foreshocks, which is essential for the efficient tsunami modelling and tsunami risk estimation.

The presented method was implemented in the analysis of the foreshock sequence of a range of tsunamigeneous earthquake fault areas near Kamchatka, South Kuriles, Japan, Indonesia, and was highly effective. In our research we carried out a detailed analysis of time - space distribution of the foreshock sequence in December 26th 2004 Sumatra earthquake fault area, over the period of 2003-2004. For determining the time of the expected megathrust earthquake the prognostic wedge was extracted which appeared to be the development (intensification) of the low energy earthquakes in the studied area and the slack in the high energy earthquakes in the period from September 2003 till December 26th 2004. The possible magnitude estimation was also presented. Then the basic parameters of the expected tsunami (time of occurrence, intensity and source position) were estimated.

The suggested approach could be employed in the global monitoring service of disastrous earthquakes and is an essential part of early warning systems on tsunamis.

Keywords: Tsunamigeneous earthquake; foreshock process monitoring; tsunami source; tsunami modeling; tsunami risk estimation; early warning systems.