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Estimation of tsunami source parameters by foreshock process monitoring of tsunamigeneous earthquake

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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. Position of the expected tsunami source is identified by the position the foreshocks in the seismically active area under study.

The time and magnitude of the megathrust tsunamigeneous earthquake is 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 earthquakes. 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. Thus the time and intensity of the tsunami are estimated in advance. The area of the potential tsunami source is characterized by the position of the analyzed foreshocks, which is essential for the efficient tsunami modeling and tsunami danger estimation.

The presented method was utilized for the analysis for 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 made a detailed analysis of time - space distribution of the foreshock sequence in December 26^{th} 2004

Sumatra earthquake fault area, over the period of 2003-2004. A diagram of foreshock process development in magnitude-time coordinates for the seismic events in the area 2–8º NL with hypocenter depths up to 50 km was plotted. For determining the time of the expected megathrust earthquake the prognostic wedge has been extracted which appears 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 26^{th} 2004. The possible magnitude estimation has also been presented. Then the basic parameters of the expected tsunami (time of occurrence, intensity and source position) are estimated.

The suggested approach could be employed in the global monitoring service of disastrous earthquakes and tsunamis that is presently being established.