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How the choice between nodal planes affects the estimate of tsunami hazard of an earthquake

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Usually tsunami warning is issued if a submarine earthquake is registered of magnitude exceeding a threshold, the value of which varies depending on the region where the earthquake took place and on the earthquake depth. Being simple and fast this approach is characterized by quite a low accuracy in the tsunami run-up heights estimate. The forecast accuracy can be improved if, instead of magnitude, we use the potential energy of the initial elevation in the tsunami source, calculated taking into account the earthquake focal mechanism. Automatic system for estimate of tsunami hazard using focal mechanism (Tsunami Observer, <http://ocean.phys.msu.ru/projects/tsunami-observer/>) was recently developed and implemented. Focal mechanisms derived from analysis of the recorded seismic waveforms has two possible solutions, i.e. two nodal planes. Short after an earthquake it is not possible to determine automatically which of the nodal planes is in fact the fault plane.

The main purpose of this study is to reveal a difference in estimates of the potential energy of the initial elevation obtained making use of the first (NP1) and the second (NP2) nodal planes. All earthquake data including focal mechanism solutions were extracted from the Bulletin of the International Seismological Centre. Totally we processed nearly 6000 earthquakes $M_w > 6$ occurred within the time period 1976 – 2019. All calculations were performed by means of the Tsunami Observer system. It was established that the potential energy calculated with use of NP1 (E_{NP1}) and NP2 (E_{NP2}) datasets can vary more than an order. However for overwhelming majority of seismic events (96.3%) the difference does not exceed two times, for significant number of events (74.1%) the difference does not exceed 1.2 times. In our presentation, we shall provide detailed description of calculation methods we use and the distribution of the ratio E_{NP1}/E_{NP2} . Also we shall discuss the influence of the focal depth and magnitude on the ratio E_{NP1}/E_{NP2} .

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