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Comparative study of the 3D tsunami simulations performed with the use of different approaches to the reconstruction of the bottom movement

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Information on the earthquake source mechanism (Centroid Moment Tensor) becomes publicly available in a few minutes after the earthquake (for example, https://earthquake.usgs.gov/earthquakes or http://geofon.gfz-potsdam.de/eqinfo). Using this information, we can calculate the ocean bottom displacement in the earthquake area [Leonard, 2010; Okada, 1985] and then use this displacement as an input data for hydrodynamic simulation of the tsunami waves. Let us call this type of input data - Type 1. Somewhat later (and sometimes much later), than CMT, more detailed information on the rupture fault structure (Finite Fault Model) becomes available. According to Finite Fault Model, the rupture fault in the earthquake source consists of a certain number of segments characterized by their dip and strike angles. Each segment consists of a finite number of rectangular subfaults, for each of which a displacement vector, an activation time and a rise time are specified. By applying Okada's formulas to each subfault and using the principle of superposition, we can calculate the ocean bottom displacement in the earthquake area and also use it as an input data for tsunami simulations. Let us call this type of input data - Type 2. However, based on the Finite Fault Model, we are able to create a third type of input data (Type 3). To do this, it is necessary to take into account the displacement start time (subfault activation time) and the displacement duration (subfault rise time) of each subfault and consider the dynamics of the rupture process. In this case, we will be able to reconstruct not only the coseismic bottom displacement in the earthquake source (Type 2), but also describe the dynamics of the coseismic bottom displacement formation in the tsunami source (Type 3).

This paper compares the tsunami simulation results performed with the of different types of input data (Type 1, Type 2 and Type 3). We performed calculations for a number of large earthquakes at the beginning of the 21st century. We took all the earthquake source information from the USGS catalog (https://earthquake.usgs.gov/earthquakes). The bottom deformations of all three types were calculated using the ffaultdisp code (http://ocean.phys.msu.ru/projects/ffaultdisp/). Tsunami modeling was carried out using a combined 2D / 3D CPTM model [Nosov, Kolesov, 2019;

Sementsov et al., 2019]. The simulation results are compared with each other as well as with the DART ocean bottom observatories records.

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