Estimations of Maximum Tsunami Wave Heights for Turkish coast under Possible Catastrophic Earthquakes in Black Sea Basin

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Extended Abstract

The numerical simulation of tsunami in the Black Sea basin, including evaluation of tsunami and seismic danger of the coasts, is an actual problem of last decades. Actuality of such computations is connected, in particular, with problem of exploitation of sea part of gas-pipeline Russia-Turkey (“Blue Stream” project), connecting territories of these countries on the Black Sea bottom, which should function in conditions of higher seismicity and landslide danger of Russian and Turkish slopes of the Black Sea.

Principal feature of the study, performed in this work, is connected with generation of tsunami waves by kinematic seismic source, considered in frames of keyboard model of earthquake. The dynamics of seismic source was considered with taking into account possible temporal and velocity characteristics of concrete seismic process. By using keyboard model of source, there were considered both kinematic and dynamic models of earthquake sources.

Figure 1: The computation basin of Black sea: I-VI correspond to localization of computed seismic sources; 1-28 is location of virtual tide-gauges.
The numerical simulation was performed for possible catastrophic tsunamis in Black Sea basin for Russian and Turkish coasts. For numerical simulation of surface water waves, induced by underwater earthquake, the system of shallow water nonlinear equations, with taking into account the bottom friction was used. In present paper there are presented data mainly for Turkish coast. There were considered both near-field and far-field seismic sources. The computation was performed for three seismic sources with their localization in north-eastern part of Black Sea and three sources in south-western parts of Black Sea basin. There were considered six scenarios for six seismic sources (see, Fig.1): each source was separated to three keyboard blocks. It was considered vertical component of keyboard block displacements under realization of earthquake. The keyboard blocks are moved in different time moments in vertical direction (up and down). The magnitude of earthquake was proposed to be $M = 7.3$.

Figure 2: The distribution of maximum wave heights along Turkish coast at realization of 6 scenarios (top figures I-VI correspond to number of earthquake source).

In Fig.2, there are presented the histograms of distribution of maximum wave heights at 4m-isobate for these 6 scenarios, respectively. It is well seen that that at magnitude $M = 7.3$, the near-field sources (I), (II) and (III) give values of maximum wave heights at 4m-isobate of the order of 3.5. The re-calculation for a dry beach can give rise of wave height in 1.5-2 times. For far-field sources (IV), (V), and (VI) maximum wave heights are not more than 2.5 m.

The numerical simulation, performed in present work, permits to make estimations of possible consequences from earthquake with moderate force at Turkish coast of the Black sea basin. The considered scenario of movements of keyboard blocks in underwater seismic source performed obtain at least upper estimation of possible result of earthquake at given computed magnitude of earthquake.

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