Nonlinear tsunami generation mechanism: basic principles and estimations

M.Nosov, S.Kolesov

Faculty of Physics, M.V.Lomonosov Moscow State University
(nosov@phys.msu.ru/+74959328820)

Traditional view on tsunami generation mechanism is usually linked to a sudden displacement of water by residual bottom deformations during bottom earthquakes. Mathematical description of the tsunami generation assumes the bottom deformation to be an instant process; thus, the bottom displacement duration and, therefore, the bottom velocity are not taken into account. In reality, high-speed bottom motions are certainly accompanied by nonlinear phenomena which can provide an additional contribution to the tsunami wave. Physical model of the nonlinear mechanism is related to energy transfer from “high-frequency” elastic or forced oscillations of water layer to “low-frequency” gravitational waves. Mathematical model is based on the nonlinear Euler equations where we assume all the fluid fields (velocity, pressure, density) to consist of fast-oscillating and time-averaged (slow) terms. Then, the equations are averaged in time. The non-linearity of the Euler equations introduces additional terms in the time-averaged flow equations. These additional terms can be interpreted as external mass force and distributed mass source; we consider them as a non-linear tsunami source. Finally, we estimate such an extra contribution in tsunami energy and amplitude by means of numerical modeling.