Geophysical Research Abstracts
Vol. 15, EGU2013-5547-1, 2013
EGU General Assembly 2013

Calculation of initial elevation in tsunami source making use of exact analytical solutions

Kirill A. Sementsov (1) and Mikhail A. Nosov (2)

(1) Faculty of Physics, M.V. Lomonosov Moscow State University, Leninskie Gory, Moscow 119991, Russia. E-mail: sebbest@yandex.ru, (2) Faculty of Physics, M.V. Lomonosov Moscow State University, Leninskie Gory, Moscow 119991, Russia. E-mail: nosov@phys.msu.ru

Strong bottom earthquakes are the most prevailing cause for the rise of tsunamis. As a rule, numerical simulation of tsunamis is based on the equations of hydrodynamics, averaged over the vertical coordinate. As for the description of tsunami generation, an earthquake is considered to instantly cause residual deformations of the ocean bottom. Then, the assumption is made that the displacement of the bottom is simultaneously accompanied by formation at the surface of the ocean of a perturbation (initial elevation), the shape of which is fully similar to the vertical residual deformations of the bottom. The initial elevation thus obtained is then applied as the initial condition in resolving the problem of tsunami propagation. The initial field of flow velocities is assumed to be zero. This traditional approach is not accurate due to at least the following two reasons. First, direct transfer of bottom deformations up to the water surface artificially enriches the spectrum of the tsunami at the expense of unrealistically short waves. Second, the horizontal deformation of a sloping bottom can also contribute significantly to the initial elevation. Improved method of calculation of initial elevation in tsunami source was suggested in [1, 2]. This method takes into account both the "smoothing effect" of water layer and contribution of vertical and horizontal components of bottom deformation. The method requires the solution of 3D Laplace's equation. Numerical solution to the 3D problem is computationally expensive, besides there are some difficulties in specification of a static free-pass condition at ocean-crossing outer borders. Analytic-Numerical Algorithm (ANA) [2] is a good alternative to the numerical solution. ANA is based on the analytical solution to the problem in case of the ocean of constant depth. The first purpose of this study is to verify ANA making use of the newly derived exact analytical solution to the problem in case of inclined flat bottom. The second purpose is an optimization of ANA at the expense of pre-calculation of integrals in the analytical solution. The efficiency of the improved ANA is demonstrated by examples of some recent tsunami sources.

References:
[1] Nosov M. A., Kolesov S. V. (2009), Method of Specification of the Initial Conditions for Numerical Tsunami Modeling, Moscow University Physics Bulletin, 64(2), 208–213.
[2] Nosov M. A., Kolesov S. V. (2011), Optimal Initial Conditions for Simulation of Seismotectonic Tsunamis // Pure and Applied Geophysics, 168(6-7), 1223-1237.