Geophysical Research Abstracts
Vol. 18, EGU2016-2702, 2016
EGU General Assembly 2016

Modeling tsunami of cosmogenic and landslide origin on the basis of Navier-Stokes equations

Andrey Kozelkov (1,2), Andrey Kurkin (2), Efim Pelinovsky (2,3)

(1) Russian Federal Nuclear Center, All-Russian Research Institute of Experimental Physics, Sarov, Russia (askozelkov@mail.ru), (2) Nizhny Novgorod State Technical University n.a. R.E. Alekseev, Nizhny Novgorod, Russia (aakurkin@gmail.com), (3) Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod, Russia (pelinovsky@hydro.appl.sci-nnov.ru)

An approach to the modeling of the landslide and meteoritic origin tsunami, based on the Navier-Stokes equations for multiphase flows with a free surface, is presented. Description of the system's numerical integration, based on a fully implicit connection of velocity and pressure, is done. The connection of the continuity equation and the equations of conservation of momentum is based on account of the implicit terms of the pressure gradient and mass flow. Basic formulas for discretization of equations and the form of the coefficients, which are summarized in general associated matrix, are performed. Basic steps of the computational procedure are described. The results of proposed method's verification to the problems with experimental data (the problem of the dam collapse, a hydraulic jump and a falling of a box in the water) are presented.

Results of the numerical modeling of possible hydrodynamic disturbances in the lake Chebarkul, Russia, caused by the fall of a meteorite in 2013, are presented. The numerical experiments are performed both with and without account of the lake's ice cover. Dimensions of the ice cover disruption are evaluated. Dimensions of the observable ice-hole in the place of the meteorite fall are shown to be in good agreement with the theoretical predictions and the preliminary estimations. In addition, results of the numerical investigation of the influence of angle of the body's entry into the water on the characteristics of the resulting waves in the near field are presented. Dimensions of the perturbation and the regularities of changes in the parameters of the source are studied. It is shown that the greatest change in characteristics of the source occurs most rapidly in the vicinity of the angle of incidence of 20 degrees to the horizontal.

The source as a separate phase representing Newtonian fluid with its density and viscosity and the surface is separated from the water and air phase is used to simulate landslide. The results of the calculation of the full-scale landslide tsunami experiment are presented. They demonstrate the possibility of using the provided simulation technology for all stages of the landslide type tsunami - education, distribution and reel. To be able to calculate tsunami propagation in large water areas the parallel algorithm implementation of the technology is proposed. It is based on an algebraic multigrid method. The results of the comparison with the non-linear dispersion theory by the example of the historical tsunamis of volcanic origin are presented. They showed quite good agreement.