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Physics and characterisation of tsunami hazards

Efim Pelinovsky

Department of Nonlinear Geophysical Processes, Institute of Applied Physics and Department of Applied Mathematics, Nizhny Novgorod State Technical University, Nizhny Novgorod, Russia; International Tsunami Commission

The giant tsunamis occurred in the last decade (2004 Indian Ocean, 2010 Chile, 2011 Japan) draw attention to this natural phenomenon. The given course of lectures deals with the basic physics of the tsunami wave propagation from the source to the coast. Briefly, the geographical distribution of the tsunamis is described and physical mechanisms of their origin are discussed. Simplified robust formulas for the source parameters (dimension and height) are given for tsunamis of different origin. It is shown that the shallow-water theory is an adequate model to describe the tsunamis of the seismic origin; meanwhile for the tsunamis of the landslide or explosion (volcanoes, asteroid impact) origin various theories (from linear dispersive to nonlinear shallow-water equations) can be applied. The applicability of the existing theories to describe the tsunami wave propagation, refraction, transformation and climbing on the coast is demonstrated. Nonlinear-dispersive effects including the role of the solitons are discussed. The practical usage of the tsunami modeling for the tsunami forecasting and tsunami risk evaluation is described. Results of numerical simulations of several huge tsunamis are presented. Special attention is given to evaluate the tsunami hazard for the Black Sea.