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Hydrodynamics of Tsunami Waves

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The last giant tsunamis occurred in the Indian Ocean on 26th December 2004 and in the Pacific Ocean on 27th February 2010 draw attention to this natural phenomenon. The given course of lectures (3 lectures) deals with the 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 nonlinear solitary waves (solitons) are discussed. The practical usage of the tsunami modeling for the tsunami forecasting and tsunami risk evaluation is described. The results of the numerical simulations of the several global tsunamis including the Indian Ocean tsunamis induced by the catastrophic Krakatau eruption in 1883 and the strongest North Sumatra earthquake in 2004 are given.