Modeling of tsunami generation by submarine and subaerial landslides

Isaak V. Fine[1], Evgueni A. Kulikov[2], Richard E. Thomson[3], and Alexander B. Rabinovich[2]

[1]***Heat and Mass Transfer Institute, Minsk, Belarus***
[2]***Tsunami Center, Shirshov Institute of Oceanology, Moscow, Russia***
[3]***Institute of Ocean Sciences, Sidney, British Columbia, Canada***

Abstract. Recent catastrophic tsunami events at Flores Island (1992), Skagway (1994), Papua New Guinea (1998), and Turkey (1999) have significantly increased an interest in landslides and slide-generated tsunamis. Numerical modeling of tsunamis caused by submarine slides and slumps is a much more complicated problem than simulation of seismic-generated tsunamis. The duration of the slide deformation and propagation is sufficiently long that it affects the characteristics of the surface waves. As a consequence, the coupling between the slide body and the surface waves must be taken into account. The landslide itself changes significantly during its movement, causing it to modify the surface waves it has generated. An efficient viscous slide shallow-water model accounting for all these effects was elaborated by Jiang and LeBlond (1994). We modified and generalized the JLB94 model to include arbitrary bottom topography and (what is most important) to incorporate consideration of the subaerial part of the slides. Theoretical investigations and laboratory modeling demonstrate that subaerial slides are much more efficient tsunami generators than purely submarine slides. Subaerial slides or slumps displace a considerable volume of water at high speed as they slide into the water from the foreslope. The main problem in the numerical modeling of subaerial slides is that the "wet" and "dry" areas change during the slide/wave motions, so we have variable boundaries between these areas. We have overcome this problem, and will provide several numerical experiments to examine the influence on tsunami generation of various slide parameters: slope angle, water depth, slide density, kinematic viscosity, size and orientation of the source area, relative size of the subaerial portion, etc. The model was used to simulate actual tsunamis for realistic bathymetry and coastline geometry, in particular the 1966 and 1994 tsunamis in Skagway Harbor, Alaska. We also used this model to assess the potential risk of landslide-generated tsunamis for certain areas along the coast of British Columbia having extensive zones of unstable sediment deposits.

[1]Heat and Mass Transfer Institute, P.Brovki 15, Minsk, Belarus (fine@itmo.by)
[2]Tsunami Center, Shirshov Institute of Oceanology, 36 Nakhimovsky Prospect, Moscow 117851, Russia (kulikov@korolev.net.ru, abr@iki.rssi.ru)
[3]Institute of Ocean Sciences, 9860 West Saanich Road, Sidney, BC V8L 4B2, Canada (ThomsonR@pac.dfo-mpo.gc.ca)