Geophysical Research Abstracts
Vol. 16, EGU2014-15964, 2014
EGU General Assembly 2014

Tsunami Generation and Propagation by 3D deformable Landslides and Application to Scenarios

Brian C. McFall and Hermann M. Fritz
Georgia Institute of Technology, Civil and Environmental Engineering, Atlanta, United States (bmcfall4@gatech.edu)

Tsunamis generated by landslides and volcano flank collapse account for some of the most catastrophic natural disasters recorded and can be particularly devastative in the near field region due to locally high wave amplitudes and runup. The events of 1958 Lituya Bay, 1963 Vajont reservoir, 1980 Spirit Lake, 2002 Stromboli and 2010 Haiti demonstrate the danger of tsunamis generated by landslides or volcano flank collapses. Unfortunately critical field data from these events is lacking.

Source and runup scenarios based on real world events are physically modeled using generalized Froude similarity in the three dimensional NEES tsunami wave basin at Oregon State University. A novel pneumatic landslide tsunami generator (LTG) was deployed to simulate landslides with varying geometry and kinematics. The bathymetric and topographic scenarios tested with the LTG are the basin-wide propagation and runup, fjord, curved headland fjord and a conical island setting representing a landslide off an island or a volcano flank collapse. The LTG consists of a sliding box filled with 1,350 kg of landslide material which is accelerated by means of four pneumatic pistons down a 2H:1V slope. The landslide is launched from the sliding box and continues to accelerate by gravitational forces up to velocities of 5 m/s. The landslide Froude number at impact with the water is in the range $1 < F < 4$. Two different materials are used to simulate landslides to study the granulometry effects: naturally rounded river gravel and cobble mixtures.

Water surface elevations are recorded by an array of resistance wave gauges. The landslide deformation is measured from above and underwater camera recordings. The landslide deposit is measured on the basin floor with a multiple transducer acoustic array (MTA). Landslide surface reconstruction and kinematics are determined with a stereo particle image velocimetry (PIV) system. Wave runup is recorded with resistance wave gauges along the slope and verified with video image processing.

The measured landslide and wave parameters are compared between the planar hill slope used in various scenarios and the convex hill slope of the conical island. The energy conversion rates from the landslide motion to the wave train is quantified for the planar and convex hill slopes. The wave runup data on the opposing headland is analyzed and evaluated with wave theories. A method to predict the maximum wave runup on an opposing headland using nondimensional landslide, water body and bathymetric parameters is derived. The measured landslide and tsunami data serve to validate and advance three-dimensional numerical landslide tsunami prediction models.