Geophysical Research Abstracts
Vol. 20, EGU2018-18885, 2018
EGU General Assembly 2018

Modelling and numerical simulations of tsunami waves generated by landslides at Stromboli volcano (Aeolian islands, Italy)

Mattia de' Michieli Vitturi (1), Tomaso Esposti Ongaro (1), Alessandro Fornaciai (1), Matteo Cerminara (1), Luca Nannipieri (1), Masismiliano Favalli (1), Jorge Macías (2), Manuel J. Castro (2), Sergio Ortega (2), and José M. González-Vida (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Pisa, Italy, (2) EDANYA group, University of Málaga, Spain

The 2002 eruptive activity at Stromboli volcano drove, on December 30th, two major flank failures, one aerial and one submarine, along the Sciara del Fuoco scar, which triggered tsunami waves that spread around the island of Stromboli, with maximum run-up above 10 m, and in the neighboring islands, extending their own influence up to the coasts of northern Sicily, Calabria, and Campania. We present here a modeling, aimed at identifying the optimal modeling approach for tsunami hazard assessment and early warning in a volcanic context where 1) the source conditions are difficult to predict, to observe and to model; 2) the tsunamigenic source is close to the shoreline; 3) the bathymetry is extremely steep and irregular. To this aim, several models, at different levels of approximation and accuracy, have been compared: the NHWAVE three-dimensional non-hydrostatic model in sigma-coordinates (Ma and Kirby, Ocean Modelling, 2012) and the HySEA family of geophysical codes (e.g., Macías et al., Marine Geology, 2015) based on either single layer, two-layer (landslide and sea) stratified systems or multilayer shallow water models (https://edanya.uma.es/hysea/).
Models results have been compared for the maximum wave run-up, the invasion maps at the Stromboli village, and the waveform sampled at four proximal sites (two of them corresponding to the locations of the monitoring gauges offshore the Sciara del Fuoco). Both a rigid a deformable (granular) submarine landslide models, with volumes ranging from 6 to 20 millions of cubic meters, have been used to trigger the water waves. On one hand, the invasion maps at the Stromboli village are quite comparable between hydrostatic and non-hydrostatic models, the differences being likely associated with the need of accounting for wave-breaking effects in non-hydrostatic models. On the other hand, as expected, preliminary results indicate strong differences between the waveforms produced by models considered. In addition, some difficulties arise due to modeling of shoaling effects (associated with the steep bathymetry). We show that the use of non-hydrostatic, second-order accurate models, coupled with a multilayer approach, allows a better description of the waveforms, and thus a comparison with those recorded at the proximal gauges installed at Stromboli. We finally show that non-hydrostatic models such as Multilayer-HySEA, solved on accelerated GPU architectures, also display the optimal trade-off between accuracy and computational requirements, at least for what concerns the proximal wave field of landslide-generated tsunamis.