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Tsunami waves generated by landslides on a plane beach: new three-dimensional experiments

P. De Girolamo (1), G. Bellotti (2), M. Di Risio (3), A. Panizzo (4)

(1) DISAT, Università degli Studi di L'Aquila, L'Aquila, Italy, (2) DSIC, Università degli Studi di Roma Tre, Rome, Italy, (3) Università degli Studi di Roma Tor Vergata, Rome, Italy, (4) DITS, Università degli Studi di Roma "La Sapienza", Rome, Italy.

This paper describes new three dimensional experiments carried out at the LIAM laboratory of the University of L'Aquila (Italy) aimed at reproducing water waves generated by subaerial and underwater landslides sliding along a straight sloping coast. The case under investigation can be considered to be of scientific and practical interest for the following reasons. First, the wave field triggered by the landslide movement is characterized by transient edge waves trapped along the coast and by transient waves freely radiating toward offshore. No experimental studies have been conducted so far in order to estimate the amount of energy that pertains to these two systems of waves. Second, it is not clear what are the edge waves modes that are more likely to be excited depending on the shape and on the movements of the landslide. It is the present Authors' opinion that by using some of the sophisticated analysis techniques recently employed in the coastal engineering field (i.e. the wavelet transform, Panizzo et al., 2002: the Empirical Orthogonal Function decomposition, Panizzo et al., 2005), it is possible to try to answer these questions.

Further objectives of practical interest can be achieved using the experimental results. More specifically these will be used to study simplified techniques for generating in simple and useful wave propagation models the water waves generated by landslides, to develop forecasting formulae for estimation of run-up along the coast (thus extending the research of Lynett & Liu, 2005) and to provide the scientific community with benchmarks for the validation of numerical, analytical and empirical models.

The experiments are carried out in a wave tank 10.8 m long, 5.4 m wide, maximum water depth of 0.8 m. PVC sheets sustained by steel bars represent an impermeable

beach with slope of 1:3. 15 resistance wave gauges are used to measure the surface elevation in the tank. 5 of these are located on a section normal to the undisturbed shoreline at a distance of 1 m from the landslide in order to reconstruct the modal shape of the transient edge waves. 10 run-up gauges measure the movements of the shoreline. The landslide is represented by a rigid fibreglass body of elliptical shape (length 0.8 m, width 0.4 m, maximum height 0.05 m). The slide is equipped with an accelerometer that is used to reconstruct its position in time. The research described in this paper is funded by the Italian Ministry of Research (MIUR, www.tsunamis.it).

References

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