LANDSLIDE-GENERATED TSUNAMIS: A NUMERICAL ANALYSIS OF THE NEAR-FIELD

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INTRODUCTION

There are coastal areas which are particularly prone to landslide-generated tsunami risk. The destructive effects caused by the impulsive waves, generated by landslide sources, can be strongly magnified by the characteristics of the so-called "confined geometries" (e.g. bays, reservoirs, lakes, volcanic islands, fjords, etc.). Complicated physical phenomena (e.g. trapping mechanisms, edge waves, wave runup, etc.) take place as a consequence of the interaction between the generated waves and the local bathymetry and control the tsunami propagation and interaction with the coast, often causing devastating consequences. Many past events of landslide-generated tsunamis testify this reality (e.g. Lituya Bay, Alaska, Fritz et al., 2009; Stromboli Island, Italy, Tinti et al., 2005; Anak Krakatau, Indonesia, Grilli et al., 2019).

To reduce and mitigate the tsunami risk a proper comprehension, and modelling, of such complicated phenomena is crucial. Landslide-generated tsunamis have been largely studied by exploiting experimental, analytical and numerical modelling. Experimental tests are often time and money consuming, especially if 3D models are considered. Large facilities, as well as complicated experimental configurations and sophisticated measurement systems (e.g. Romano et al. 2016), are often needed. Furthermore, not always it is possible to explore in detail the influence of all the involved parameters, in particular those related to the landslide triggering mechanisms and rheology, that have a considerable influence on the wave characteristics in the so-called "near-field".

To this end, numerical modelling can provide a valuable assistance. The new tools offered by the Computational Fluid Dynamics (CFD) methods represent a valuable means for shedding light on the unresolved aspects. In particular, the 3D CFD modelling techniques appear to be crucial as far as the tsunami characteristics in the near-field, induced by landslide sources, are concerned. Indeed, the accurate reproduction of the energy transfer between the landslide and the water is essential to model the tsunami generation and propagation mechanisms, allowing to explore a large variety of landslide triggering mechanisms and rheology.

In this paper we present a numerical study of the landslide-generated tsunamis in the near-field. A new numerical method for modelling tsunamis generated by solid and impermeable landslides in OpenFOAM® (Romano et al., 2020) has been applied (Figure 1). The method, based on the Overset mesh technique and the porous media approach (Lara et al., 2012), has been used to carry out a parametric analysis aimed at investigating the tsunami characteristics in the near-field as a function of different landslide triggering mechanisms. New results and physical considerations will be shown at the Conference.

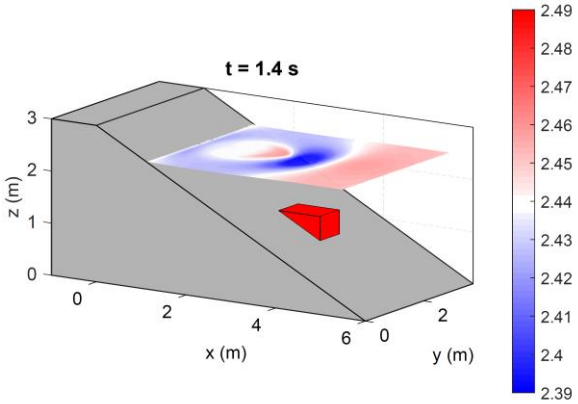

Figure 1 - Free surface elevation in the near-field at a given time instant after the landslide model release.

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