EDGE WAVES LANDSLIDE-GENERATED TSUNAMIS

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1. Introduction

The interest in tsunamis generated by landslides in proximity of the coast, has risen in the last years, due to some devastating events, such as that in Papua New Guinea in 1998 (e.g., Synolakis et al., 2002). Since the tsunami generation is likely to occur in shallow water regions, the interaction between the waves and the sloping sea bottom plays immediately a relevant role. The waves can be refracted by the bathymetry, and trapping mechanisms, like those typical of edge waves, can occur. Trapping phenomena of tsunamis have been observed in nature by measurements (Yamazaki and Cheung, 2011), in analytical (Sammarco and Renzi, 2008) and numerical (Lynett and Liu, 2005) models and in laboratory experiments (Yeh, 1985).

The knowledge of the propagation and trapping mechanisms of the tsunamis generated near the coastline is of special scientific and technical interest. First, the trapping mechanism governs the celerity at which the waves propagate along the coast. Second, trapping phenomena can induce high waves along the coast, also at very large distances from the tsunamigenic source, since the wave energy does not radiate toward the open sea. Third, the effect of the bathymetry can induce the waves to travel around small islands, attacking areas geographically sheltered by the tsunami. Thus in order to provide information to design the Tsunami Early Warning Systems (TEWS), is essential to gain insight on these described phenomena.

In this paper we study the propagation and trapping mechanisms of the tsunamis generated by landslides directly at the coast of an island. We apply the so-called wavenumber-frequency analysis (k-f) to the laboratory experiments described in the work of Di Risio et al. (2009), which investigate the propagation of landslide-generated tsunamis around a conical island. The k-f is a special technique that allows to estimate the energy distribution of a geophysical signal, measured by a spatial array of sensors, in the wavenumber-frequency plane. We use the k-f in order to identify the dispersion relation followed by the waves and, consequently, to estimate the phase and group celerity of the tsunamis.

The k-f has revealed that both complicated trapped modes (i.e. 0th-order and 1st-order edge waves) and free radiating waves occur during the propagation around the island. The flooding phenomena are dominated by the 0th-order edge waves mode, while as the distance from the shoreline increases both trapped and non-trapped modes take place. A detailed description of the properties of the propagating waves will be showed in the Conference.

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