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Numerical simulation of the potential tsunami generated by the BIG'95 debris flow, Northwestern Mediterranean Sea

Olaia Iglesias (1), Galderic Lastras (1), Miquel Canals (1), Maitane Olabarrieta (2), and Mauricio González (2)

(1) GRC Geociències Marines, Universitat de Barcelona, Barcelona, Spain, (2) Instituto de Hidráulica Ambiental, Universidad de Cantabria, Av. de los Castros, Santander, Spain

Based on the characteristics (slope gradient, volume of deposit and estimated downslope velocity) of the BIG'95 debris flow in the Ebro continental margin, and comparing them with those from other tsunamigenic submarine landslides around the world, it appears that this event, occurred ca. 11,500 cal yr BP, could have triggered a tsunami. A published conceptual and numerical model of the BIG'95 debris flow, and the application of the COrnell Multigrid COupled Tsunami model (COMCOT), indicate the tsunamigenic potential of this mass movement. The tsunami numerical simulation has been carried out considering a present day scenario, i.e. with current sea level. Required as an input to the model, we have reconstructed the seafloor variation during landsliding, as well as the bathymetry previous to the landslide occurrence, in agreement with the conceptual and numerical model of Lastras et al. (2005), taking also into account all available multibeam bathymetry and high-resolution seismic profiles. COMCOT is a modelling package capable of simulating the entire lifespan of a tsunami, from its generation to propagation and run-up/run-down in coastal regions. The result of running the model for the BIG'95 debris flow scenario depict a sensible tsunami that would have hit the surrounding shores. The dipole wave generated consists of a trough over the source area of the slide and a crest over the depositional area. Maximum amplitudes follow the main sliding direction. The trough corresponds to the back-going wave, directed towards the Iberian Peninsula, while the crest is the out-going wave, directed towards the Balearic Promontory. The nearest shores are not the first ones to be hit by the tsunami, as the arrival time to coastlines (15 min to Eivissa Island, 20 min to Mallorca Island, and 45 min to the Iberian Peninsula shores) reflects the asymmetric bathymetry of the Catalano-Balearic Sea. The tsunami thus generated experiences a significant shoaling effect caused by the wide continental shelf of the Ebro margin off mainland Spain, which delays notably the arrival time to the Iberian shores. The wave directed towards the Balearic Islands travels longer over deep water till it meets a narrower shelf, which allows its rapid advance. The maximum propagation velocity occurs over the Valencia Channel, which is the axial valley and deepest part of the Valencia Trough. This study case illustrates the control of the submarine topography on the propagation of a landslide-generated tsunami and on its arrival time and impacts on the shorelines surrounding the source area.