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Numerical modeling of landslide generated tsunamis in the bay of Biscay

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Tsunami hazard in metropolitan France is poorly known. The TANDEM (Tsunamis in northern AtlaNtic : Definition of Effects by Modeling) project is a French initiative to draw lessons from the 2011 catastrophic tsunami in Japan on French coastlines, in order to provide guidance for risk assessment on the nuclear facilities in the area.
This project is aimed at adapting numerical methods of tsunami hazard assessment against the outstanding observation database of the 2011 tsunami, in order to apply these validated methods to the definition of the tsunami hazard for the French Atlantic and Channel coastlines.
Landslide induced tsunami hazard in the Bay of Biscay France (NE Atlantic ocean) is poorly known. Investigation on the continental slope of the Bay show the existence of numerous landslide scars, but no real risk assessment studies were made to determine the potential tsunami hazard from those landslide. This work focuses on tsunami induced by landslides, and aims to assess the threat using numerical simulation.
We assumes that the landslide has a fluid-like behaviour and applies shallow water/thin layer approximations to both aspect. The similarity of the resulting equations of momentum and mass conservation enables to use a single Godunov-like numerical scheme for both parts of the model. The model results are then carried into a multigrid dispersive model in order to get better estimation of the water height near the coast. This second model uses the Boussinesq equations for larger scale grids and the Saint-Venant equations near the coast, and is resolved using a Crank-Nicholson scheme.
The first study zone is located in the Cap Breton canyon region in the south of the Bay. Investigation is carried out to identify scenarios that could have caused paleo-tsunamis, with a special interest on a large scar off the canyon($\sim$70 km3). 4 scenarios of varying volumes (from 17 to 70 km3) and depth are carried into the model and the result show maximum water heights of up to 10 metres in the direct neighbourhoods of the landslide and 1 to 2 metres in the North of the bay depending of the volume of the slide.
Southwest of the scar, a large slope exhibits several pockmarks that could indicate a lower soils resistance and thus higher landslide hazard. Two scenarios are carried with the same failure area and different thickness (100 m and 30 m for volumes of 24 km3 and 6 km3 respectively) are carried and also show maximum water heights that varies with the volume of the slide.
The second study zone is the continental slope of the Bay of Biscay, where smaller landslides are more frequent. Several smaller scenarios (from 1 km3 to 0.06 km3) are investigated thorough the slope in order to determine the potential water height from those landslides. Results show that those scenarios produce lower maximum water heights than the previous studies but that the impact is similar in the North of the bay of Biscay.
Those studies allows to highlight higher threat zones on the coast of France, especially the North of the bay that would be similarly impacted from many of the scenarios used in this study. Smaller landslide with smaller recurrence periods would have the same impact than southern huge 20+ km3 landslide.