LANDSLIDE TSUNAMI HAZARD ASSESSMENT: A NUMERICAL MODEL FOR THE SIMULATION OF MULTIPLE LANDSLIDE-INDUCED TSUNAMIS SCENARIOS IN A MONTE CARLO FRAMEWORK

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Submarine landslides can pose serious tsunami hazard to coastal communities. However, performing a comprehensive landslide tsunami hazard assessment for a given area is in general difficult in view of the large uncertainties associated with tsunamigenic source parameters. These are often known only approximately, on the basis of estimates of the landslide geometry, slide material properties, and kinematics.

Here, we present an efficient model to perform such hazard analyses, based on solving the linear mild-slope equation with a time-dependent source term representing the seafloor motion as detailed in Iorio et al. (2021). This approach allows carrying out many computations, for a large number of landslide scenarios, in a Monte Carlo (MC) approach framework, at a reduced computational cost compared to other available methods, while still providing physically accurate simulations of most landslide tsunami generation and propagation.

To further speed-up the MC simulations, a database of elementary solutions is first developed, for many landslide sources of unit amplitude motion over a small seafloor area within the possible landslide footprint (rectangular areas in Fig 1). For each unit source, the resulting tsunami elevations are computed with the model at many save points of interest $P(x_p,y_p)$. In the MC simulations, a large number of landslide scenarios are defined by randomly selecting slide parameters within their statistical distributions and then simulated for their specific bottom motion using a linear combination of the pre-computed unit sources. Hence, each resulting tsunami impact is quickly computed at the save points by linear superposition.

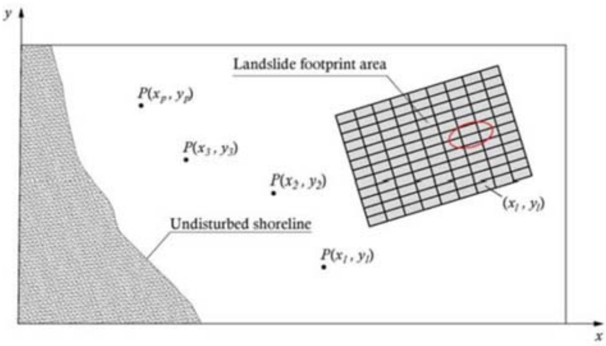

Figure 1 - Sketch of elementary solution method. Decomposition of the underwater landslide motion area (shaded in gray) into rectangular sub-areas (black rectangles); save points onshore P $(xp,\ yp)$; landslide initial footprint on the seafloor (elliptical red contour).

The model and the procedure were validated using the results of a couple of physical model experiments: the tsunamis generated along a straight coastline by a submerged landslide studied by Enet and Grilli (2007) and the case of subaerial landslides around a circular shoreline island by Di Risio et al. (2009). Details can be found in Iorio et al. (2021).

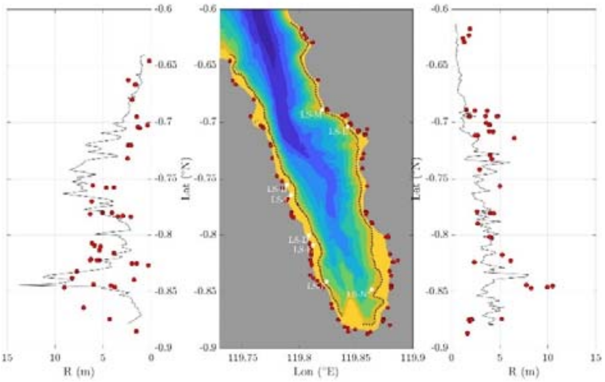

Figure 2 – Comparison of runups (red dots) measured in Palu Bay during the field surveys with those computed starting from model results at 100 bathymetric contour.

Here, the novel numerical method is applied to an actual case study: the multiple landslide tsunamigenic event that occurred in Palu Bay in 2018 (see overview and simulations in Schambach et al., 2021). Fig. 2 shows the comparison between model results and field measurements of tsunami runup. The agreement between both is reasonable, particularly since the contribution of the coseismic tsunami generated by the earthquake is missing.

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