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Towards a probabilistic tsunami hazard analysis for the Gulf of Cadiz

Finn Løvholt (1) and Roger Urgeles (2)

(1) NGI, Computational Geomechanics, Oslo, Norway (finn.lovholt@ngi.no), (2) Institut de Ciències del Mar (CSIC), Barcelona, Spain (urgeles@icm.csic.es)

Landslides and volcanic flank collapses constitute a significant portion of all known tsunami sources, and they are less constrained geographically than earthquakes as they are not tied to large fault zones. While landslides have mostly produced local tsunamis historically, prehistoric evidence show that landslides can also produce ocean wide tsunamis. Because the landslide induced tsunami probability is more difficult to quantify than the one induced by earthquakes, our understanding of the landslide tsunami hazard is less understood. To improve our understanding and methodologies to deal with this hazard, we here present results and methods for a preliminary landslide probabilistic tsunami hazard assessment (LPTHA) for the Gulf of Cadiz for submerged landslides. The present literature on LPTHA is sparse, and studies have so far been separated into two groups, the first based on observed magnitude frequency distributions (MFD's), the second based on simplified geotechnical slope stability analysis. We argue that the MFD based approach is best suited when a sufficient amount of data covering a wide range of volumes is available, although uncertainties in the dating of the landslides often represent a potential large source of bias. To this end, the relatively rich availability of landslide data in the Gulf of Cadiz makes this area suitable for developing and testing LPTHA models. In the presentation, we will first explore the landslide data and statistics, including different spatial factors such as slope versus volume relationships, faults etc. Examples of how random realizations can be used to distribute tsunami source over the study area will be demonstrated. Furthermore, computational strategies for simulating both the landslide and the tsunami generation in a simplified way will be described. To this end, we use depth averaged viscoplastic landslide model coupled to the numerical tsunami model to represent a set of idealized tsunami sources, which are in turn put into a regional tsunami model for computing the tsunami propagation. We devote attention to discussing the epistemic uncertainty and sensitivity of the landslide input parameters, and how these may affect the hazard assessment. As the full variability of the landslide parameters cannot be endured, we show that there is a considerable challenge related to the multiple landslide parameter variability. Finally, we discuss some logical next steps in the analysis, as well as possible sources of error.