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Numerical simulation of submarine landslide and generated tsunamis : Application to the Mayotte seismo-volcanic crisis

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Since May 2018, Mayotte island has experienced an important seismic activity linked to the on-going sismo-volcanic crisis. The epicenters of the seismic swarms are located between 5 and 15 km east of Petite Terre for the main swarm, and 25 km east of Petite Terre for the secondary swarm. Although variations in the number of earthquakes and their distribution have been observed since the start of the eruption in early July 2018 [Lemoine A.(2020), Cesca et al.(2020)], a continuous seismicity persists and could generate several earthquakes of magnitudes close to M4 widely felt by the population. This recurrent seismicity could weaken the steep submarine slopes of Mayotte, as highlighted by the high resolution bathymetry data collected during the MAYOBS cruise in May 2019 (Feuillet et al.,submitted) and trigger submarine landslides with associated tsunamis.

To address the hazards associated with such events, we analyzed morphological data to define 8 scenarios of potential submarine slides with volumes ranging from $11{,}25.10^6$ to 800.10^6 m^3 and we simulate the landslide dynamics and generated waves. We use two complementary numerical models: (i) the code HYSEA to simulate the dynamic of the submarine granular flows and the water wave generation, and (ii) the Boussinesq FUNWAVE- TVD model simulate the waves propagation and the inundation on Mayotte. The effect of the time at which the models are coupled is investigated.

The most impacting submarine slide scenarios are located close to Petite Terre at a shallow depth. They can locally generate a sea surface elevation more than a meter in local areas especially at Petite Terre. The various simulations show that parts of the island are particularly sensitive to the risk of tsunamis. Indeed, some scenarios that does not cause significant coastal flooding still seems to cause significant hazards in these exposed areas. The barrier reef around Mayotte has a prominent role in controlling the wave propagation towards the island and therefore reducing the impact on land. It should be noted that the arrival of tsunamis on the coastline is not necessarily preceded by a retreat from the sea and the waves can reach the coasts of Mayotte very quicky (few minutes).

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