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Granular flows simulation and application to the case of Montage Pelée flank collapse and associated tsunami waves.

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Volcano flank collapses are recurrent processes part of the evolution of a volcanic edifice. For volcanic islands, the deposits of these events can flow into the ocean and therefore can trigger tsunamis. The most important deposits of such events have been recognized, extending to several tens of kilometers away from the coastline, such as in Hawaii, La reunion Island or the Lesser Antilles.

Currently, the dynamics of the avalanches and their deposits remains unclear as the monitoring is difficult in real time and there is a lack of observation concerning submarine dynamics and its modeling. Do they occurred in a single event involving volumes of several tens of km^3 or in a handful of events involving smaller volumes? Understanding the dynamics of such event is a key factor in assessing the risks associated with them and to be able to simulate tsunami waves that could be generated by the avalanches flowing into the sea.

The numerical modeling of subaerial debris avalanches has been significantly developing since the pioneered work of Savage and Hutter and a great number of studies investigated volcano flank collapse and associated debris avalanches with numerical simulations using different numerical models to reproduce specific debris avalanches events.

As more than half of the landslides show a slide length larger than around 20 times of the slide thickness, many models are using depth averaged equations to simulate the landslide's motion.

However, concerning the submarine part of these avalanches, the models have been poorly developed as the physical processes involved (granular–fluid interaction, dilatancy effects, etc.) and their description within the thin-layer depth-averaged approximation are still challenging. Also, the description of the topography in such models is often not accurate enough with oversimplified projection of gravity terms or thin-layer approximation applied in the horizontal/ vertical reference frame. As a result, there is no model that is currently accounting for both the granular and fluid interaction and the topography effects.

We will approach these questions first by comparing experimental data to simulation of these experiments for both the granular collapse and the water free surface evolution. In a second part the numerical models are used to simulate past flank collapse event of la Montagne Pelée to try to assess the dynamics of the flow and the generated associated waves. To do so, we propose to combine two, an accurate dry granular flow model (SHALTOP) and a submarine avalanche model (HYSEA), to better assess the set up and emplacement of the deposits for different scenarii as well as simulating the associated waves.

This double approach by validating the numerical models with experimental data to assess and quantify the limits of these models before testing them on field data and generate the wave associated to the collapse events is a great way to better understand the set up and dynamics of volcanic flank collapse and participate in the risk assessment of the tsunami waves that could be associated to such events.