Ecole Doctorale des Sciences Fondamentales

Title of the thesis: An experimental approach of tsunamis generated by pyroclastic flows

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Summary :

Pyroclastic flows entering water are likely to generate tsunamis (e.g. Rabaul 1994, Montserrat 1997 and 2003, Stromboli 2019) but the flow dynamics at the impact with water and the parameters controlling wave generation are still poorly understood. In the state of current knowledge, the numerical modeling approach does not make it possible to understand all the physical processes linked to the interactions between pyroclastic flow, air and water. The assessment of this potentially devastating hazard at the local level is not yet possible due to this lack of knowledge and the absence of a physical model.
This PhD subject proposes an experimental approach to the problem. Pyroclastic flow is assimilated to a fluidized granular flow. This gas-particle mixture is stored in a reservoir, then released along a ramp before reaching a 7 m long water channel. The device is equipped with cameras filming at high speed (250-1000 images per second) to follow the evolution of (1) the granular flow on the ramp until its impact with water and then underwater, and (2) the wave formation and propagation.
The experiments consist of characterizing the influence of initial parameters such as flow velocity, density and temperature, particle size distribution, slope, and water height in the channel. The results will be compared with known historical cases, such as Krakatau (1883), Montserrat (1997, 2003) and Stromboli (2019). Understanding the physical processes of generating a tsunami by pyroclastic flow will also improve numerical models and hazard assessment.