UNIVERSITÉ Clermont Auvergne

Chimie – Mathématiques – Physique – Sciences de l'Univers

Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Modelling Volcanogenic Tsunami Run-up Zones and Littoral Evacuation at Volcano Islands

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Summary :

Based on a collaboration between INGV-Pisa, Italian Civil Protection (DPC), the University of Florence (LGS), and LMV/I-SITE, large and small scale evacuation maps have been produced for the populated shore-line area of Stromboli. The maps are based on the warning system operated by LGS where, in the event of a flank collapse, the shoreline needs to be evacuated below a height of 10 m within 4 minutes. While four minutes is the time between the detection of a tsunami due to a landslide on the Sciara del Fuoco, 10 m was the run-up for the December 2002 tsunami which is the event-scenario used by DPC. A unique methodology has been developed at LMV to map fastest escape paths from every door, and beach location, in the vulnerable zone. This involves first carrying out a building and escape route inventory, and then using a GIS to assess the times needed to move from each vulnerable point to the exits of the tsunami run up area (Bonilauri et al., 2021). In collaboration with INGV-Pisa, DPC and LGS, and now also and the Department of Mathematics at UCA, this PhD will now advance this methodology by convolving physical modelling of the process, while extending the study to three other highly vulnerable Aeolian Islands: Lipari, Panarea and Vulcano.

The PhD will focus on physically modelling wave arrival times, heights and run-up, as well as statistically modelling crowd distributions, and will integrate wave arrival probability distributions with crowd density statistics. At all four sites, we will define the full range event scenarios (i.e., wave height and travel time from landslides and/or pyroclastic flow entry into the sea of various sizes) using numerical modelling (cf. Esposti-Ongaro et al. 2021), as well as historical records and interviews. We will then assess the crowd sizes and demographics in the winter and summer populations (as well as during night and various times of day), allowing the spatial and temporal distributions of the crowd to be statistically defined. Merging the two statistical distributions will allow modelling of the final step: best evacuation route and required escape time. Overall, the method will be set up to be of use for any vulnerable volcano island, which tend to be highly populated at the shoreline (e.g., Oahu) and tourist honey pot sites (e.g., White Island).