ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences in Earth sciences

Agent-based evacuation model for a future eruption of La Fossa volcano, Vulcano island, Sicily

Contact persons

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Context

Amongst available risk reduction measures to natural hazards, evacuations are amongst the last resort to prevent loss of life, for instance in the context of wildfires and tsunamis. Efficient evacuation plans need to be developed and tested long before the occurrence of natural hazards and require i) the estimation of the spatiotemporal properties of the hazard(s), ii) the properties of the evacuation network (e.g., pedestrian vs motorized evacuations), iii) the knowledge of the population to be evacuated and iv) a model sufficiently flexible to dynamically parametrize interactions between these aspects. One class of such dynamic models are called *Agent-based Models* (or ABMs), which is a bottom-up computational simulation model based on individual movements (agents) within spatially and temporally explicit environment (volcanic activity in an island). Such simulation model, when parameterized with real-world data, can serve as important decision-making tools during emergencies such as evacuation planning.

Vulcano, in Sicily, is a ~20 km^2 island formed by active volcanoes. The last eruption of La Fossa volcano occurred in 1888-1890, but an episode of unrest in 2021-2022 outlined the need to update emergency plans for future eruptions. Although ~1'200 residents permanently live on the island, peaks of tourism during summer months can result in more than 20'000 people daily. Accurate emergency plans require to account for this dynamic evolution of exposure in time when developing evacuation strategies.

Aims and Methods

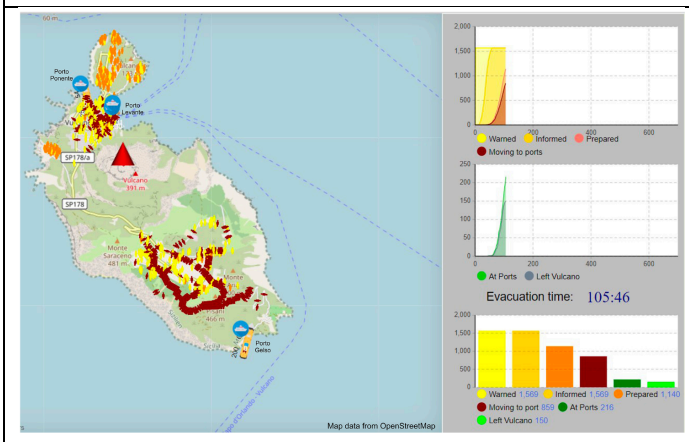
This project aims at developing an ABM evacuation model for the island of Vulcano. Using open-source tools (e.g., *GAMA or NetLogo*), the objectives of the project are to:

1. Evaluate previous efforts and develop an ABM evacuation model for Vulcano island based on real-world evacuation data.
2. Explore various scenarios using the above-mentioned ABM model (e.g., pedestrian, motorized or mixed evacuations; staged vs simultaneous).
3. Explore how the evolution of volcanic hazards in space and time would affect evacuation efficiencies.

This project will introduce the student to ABM models, to the physical modeling of natural hazards and provide a knowledge of disaster risk reduction of natural hazards, exploring such aspects as physical and systemic vulnerability. This project is a collaboration between the Department of Earth Sciences (Sébastien Biass, Costanza Bonadonna), the Institute for Environmental Sciences (Takuya Iwamura) and the Centre Universitaire d'Informatique (Jean-Luc Falcone).

References

- *Bonadonna C, Asgary A, Romerio F, et al (2022) Assessing the effectiveness and the economic impact of evacuation: the case of the island of Vulcano, Italy. Nat Hazards Earth Syst Sci 22:1083–1108. https://doi.org/10.5194/nhess-22-1083-2022*
- *Selva J, Bonadonna C, Branca S, et al (2020) Multiple hazards and paths to eruptions: A review of the volcanic system of Vulcano (Aeolian Islands, Italy). Earth-Science Reviews 207:103186. https://doi.org/10.1016/j.earscirev.2020.103186*
- *Gillet O, Daudé É, Saval A, et al (2023) Modeling staged and simultaneous evacuation during a volcanic crisis of La Soufrière of Guadeloupe (France). SIMULATION. https://doi.org/10.1177/00375497231209998*



Website

- https://www.unige.ch/sciences/terre/en/groups/physical-volcanology-and-geological-risk/welcome/
- https://www.unige.ch/sciences/terre/CERG-C/
- https://cerg-c.github.io

Prerequiste

An interest in disaster risk reduction and scientific programming is required.

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