Report of Transnational Access Projects

(Note: the information here will be publicly disclosed in the Geo-INQUIRE website, do not include sensitive information)

Project ID: C1_TA2-541-1_2

Principal investigator: Simone Correia Aguiar, https://ivar.uac.pt/investigadores/69

Project team (if applicable): Maria Margarida Ramalho, Adriano Pimentel, Jose Pacheco (University of Azores)

Project title: Long-term Probabilistic Volcanic Hazard Assessment of the North Atlantic–European Region: application to tephra hazard from the Azores

Project acronym: TEPHRAZOR

Hosting installation: PVHA@INGV, TA2-541-1, INGV; PVHA@SCIS, TA2-541-2, CSIC, Galielo100, CINECA

Hosting team: Laura Sandri, Beatriz Martinez, Antonio Costa, Irene Molinari (INGV); Arnau Folch, Leonardo Mingari, Alejandra Guerrero, Eva Hernandez (CSIC); Piero Lanucara (CINECA)

Period of access: 3 – 28 March 2025

Report of activities:

The TEPHRAZOR project aims to develop the first long-term probabilistic volcanic hazard assessment (PVHA) for tephra fallout and airborne ash generated by explosive eruptions at the central volcanoes of São Miguel Island, Azores, taking advantage of the high-performance computing (HPC) capabilities provided by the Geo-INQUIRE Transnational Access. The probabilistic approach, based on the Bayesian event tree (BET) method, will allow the generation of long-term hazard maps for different volcanic scenarios, including tephra fallout (load) and ash concentration at specific flight levels, and to evaluate the associated uncertainty.

During the project, the PI learned to implement the Fall3D dispersal model within an HPC based workflow for generating simulations designed to capture a full range of eruptive and atmospheric variability that influences tephra transport and deposition. A detailed set of eruptive scenarios were defined for VEI 3, 4, and 5 events, and eruptive parameters were sampled from probability density

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functions. To account for variability in meteorological conditions, 30 years of ERA5 reanalysis data were incorporated into the simulations. For the probabilistic hazard calculations, tephra footprints are being produced for each simulation and month, considering two different computational domains: a high-resolution grid to assess tephra load and impact on São Miguel Island, and a large-scale domain to evaluate the airborne ash concentration, arrival times, and atmospheric persistence affecting Europe.

Overall, the project aims to provide the foundations for a new generation of long-term volcanic hazard assessments for the Azores, particularly for São Miguel Island, and for the North Atlantic–European airspace, offering a more robust framework than ever before.

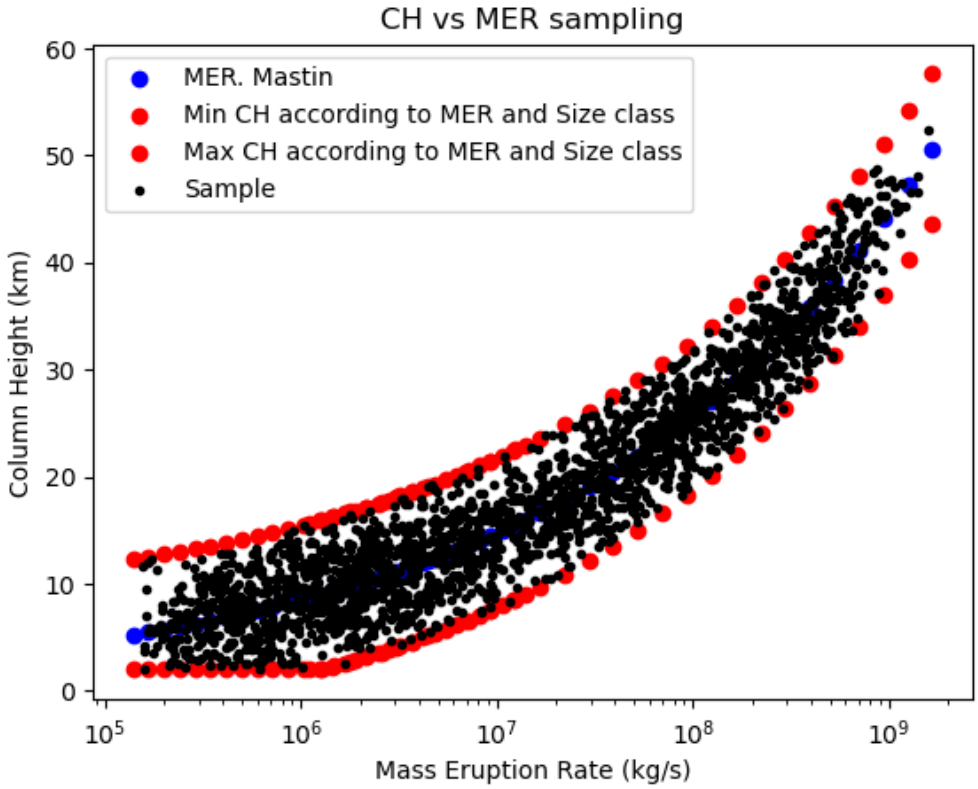

Figure 1 - Example of the sampled points in the MER-Hcol space considering all size classes.

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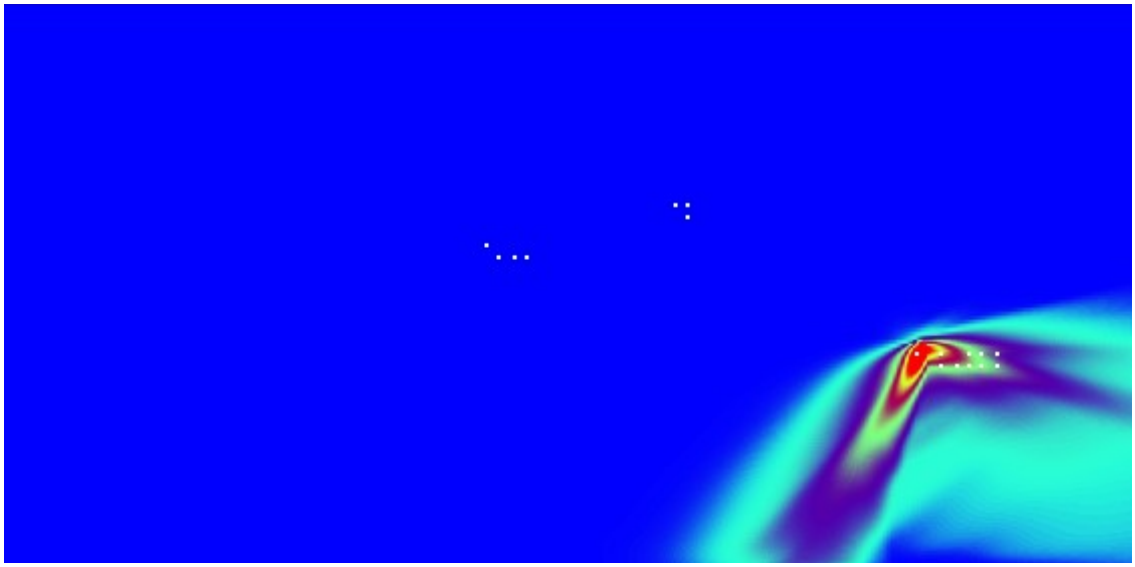

Figure 3 - Example of a footprint generated for the small-scale domain in November, showing the expected maximum tephra load if an eruption occurs in the Azores. The white dots represent the coastline.

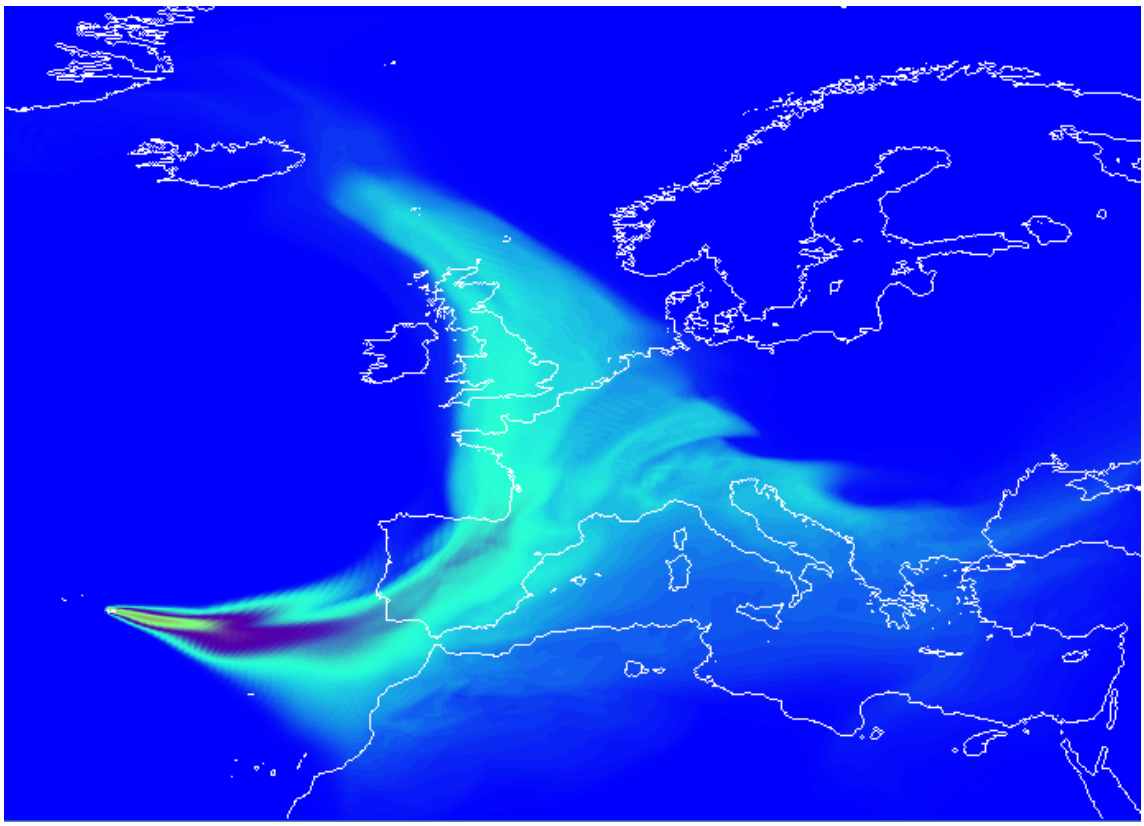

Figure 3 - Example of a footprint generated for the large-scale domain in November, showing the expected maximum amount of tephra in the atmosphere at the lowest altitude level considered after an eruption occurs in the Azores.

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Project outcomes:

All the simulations performed are now fully accessible, under CC-BY-4.0 license, in the Simulation Data Lake at https://doi.org/10.82554/sdl-282.281

Abstract submitted to EGU 2026: Simone Aguiar et al., *A showcase of HPC workflow for long-term Probabilistic Volcanic Hazard Assessment: the case of tephra hazard from three active volcanoes in the Azores*, **EGU26-14476**, Submitted to Session NH2.1

Note: Data, products, software and publications resulting from TA activities must be publicly accessible under a CC-BY 4.0, GPLv3 or equivalent open license. No embargos beyond June 2026 are allowed. They must cite Geo-INQUIRE as the source of funding. Minimal citation: *"Geo-INQUIRE is funded by the European Union (GA 101058518)"*.