

UNION CIVIL PROTECTION MECHANISM

Directorate General for European Civil Protection and Humanitarian Aid Operations

**PREVENTION AND PREPARADNESS PROJECTS IN CIVIL PROTECTION
AND MARINE POLLUTION**



Grant Agreement Number	826292
Proposal Title/Acronym	EUROPEAN VOLCANO EARLY WARNING SYSTEM (EVE)

D7-TECHNICALS REPORTS AND PAPERS

2019

Giudicepietro, F., Calvari, S., Alparone, S., Bianco, F., Bonaccorso, A., Bruno, V., Caputo, T., Cristaldi, A., D'Auria, L., De Cesare, W., Di Lieto, B., Esposito, A.M., Gambino, S., Inguaggiato, S., Macedonio, G., Martini, M., Mattia, M., Orazi, M., Paonita, A., Peluso, R., Privitera, E., Romano, P., Scarpato, G., Tramelli, A., Vita, F. (2019). Integration of ground-based remote-sensing and in situ multidisciplinary monitoring data to analyze the eruptive activity of Stromboli volcano in 2017-2018, *Remote Sens.*, 11, 1813, doi:10.3390/rs11151813.

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (monitoring data for short term analysis of Stromboli eruption 2017). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

Giudicepietro, G., Chiodini, G., Caliro, S., De Cesare, W., Esposito, A.M., Galluzzo, D., Lo Bascio, D., Macedonio, G., Orazi, M., Ricciolino, P., Vandemeulebrouck J. (2019). Insight into Campi Flegrei caldera unrest through seismic tremor measurements at Pisciarelli fumarolic field, *Geochem. Geophys. Geosyst.*, 20(11), 5544-5555, doi:10.1029/2019GC008610.

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (monitoring data for short term analysis of Campi Flegrei caldera current unrest). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

Martí Molist, J., Hoskuldsson, A., Scaillet, B., Macedonio, G., Brum, A., & Bachellery, P., & (2019). EVE: The European Volcano Early Warning System. *Geophysical Research Abstracts*, 21: EGU2019-6013. https://digital.csic.es/bitstream/10261/203087/1/Marti_EGU2019-6013.pdf

Fully financed by the EVE project. Related directly to WPs 2 (actions 2.2) as it consisted in the presentation of the project to the Scientific Community.

Martí, J., Hoskuldsson, A., Scaillet, B., Bachellery, P., Macedonio, G., Brum, A., EVE: the European Volcano Early Warning System, IUGG General Assembly 2019, Montréal, Canada, 8-18 July, 2019, Poster. Presentation number: U02p-423.

Fully financed by the EVE project. Related directly to WPs 2 (actions 2.2) as it consisted in the presentation of the project to the Scientific Community

2020

Martí, J., Zafrilla, S., Andújar, J., Jiménez-Mejías, M., Scaillet, B., Pedrazzi, D., . . . Scaillet, S. (2020). Controls of magma chamber zonation on eruption dynamics and deposits stratigraphy: The case of El Palomar fallout succession (Tenerife, Canary Islands). *Journal of Volcanology and Geothermal Research*, 399, 106908. <https://doi.org/10.1016/j.jvolgeores.2020.106908>

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (petrological approach to the preeruptive conditions of felsic magmas). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint the time taken to prepare a new eruption in central phonolitic volcanoes such Teide and Vesuvius.

Bardeglinu, I., Cioni, R., & Scaillet, B. (2020). Experimental constraints on pre-eruption conditions of the 1631 Vesuvius eruption. *Journal of Volcanology and Geothermal Research*, 406, 107076. <https://doi.org/10.1016/j.jvolgeores.2020.107076>

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (petrological approach to the preeruptive conditions of felsic magmas). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint the time taken to prepare a new eruption in central phonolitic volcanoes such Teide and Vesuvius

Giudicepietro, F., López, C., Macedonio, G., Alparone, S., Bianco, F., Calvari, S., De Cesare, W., Delle Donne, D., Di Lieto, B., Esposito, A.M., Orazi, M., Peluso, R., Privitera, E., Romano, P., Scarpato, G., Tramelli, A. (2020). Geophysical precursors of the July-August 2019 paroxysmal eruptive phase and their implications for Stromboli volcano (Italy) monitoring, *Scientific Reports*, 10:10296, doi:10.1038/s41598-020-67220-1

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (monitoring data for short term analysis of Stromboli 2019 eruption). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

2021

Giudicepietro, F., Chiodini, G., Avino, R., Brandi, G., Caliro, S., De Cesare, W., Galluzzo, D., Esposito, A., La Rocca, A., Lo Bascio, D., Obrizzo, F., Pinto, S., Ricciolino, P., Siniscalchi, A., Tramelli, A., Vandemeulebrouck, J., Macedonio, G. (2021). Tracking episodes of seismicity and gas transport in Campi Flegrei caldera trough seismic, geophysical and geochemical measurements, *Seism. Res. Lett.*, 92(2A), 965-975, doi:10.1785/0220200223.

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (monitoring data for short term analysis of Campi Flegrei caldera current unrest). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

Giudicepietro, F., Esposito, A.M., Spina, L., Cannata, A., Morgavi, D., Layer, L., Macedonio, G. (2021). Clustering of experimental seismo-acoustic events using Self Organizing Maps (SOM), *Front. Earth Sci.*, 8:581742, doi:10.3389/feart.2020.581742.

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (theoretical approach to the use of monitoring data for short term analysis in active volcanoes). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

Giudicepietro, F., Ricciolino, P., Bianco, F., Caliro, S., Cubellis, E., D'Auria, L., De Cesare, W., De Martino, P., Esposito, A.M., Galluzzo, D., Macedonio, G., Lo Bascio, D., Orazi, M., Pappalardo, L., Peluso, R., Scarpato, G., Tramelli, A., Chiodini, G. (2021). Campi Flegrei, Vesuvius and Ischia seismicity in the context of the Neapolitan volcanic area, *Front. Earth Sci.*, 9, 662113, doi:10.3389/feart.2021.662113.

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (monitoring data for short term analysis of Neapolitan volcanic area). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

Jiménez-Mejías, M., Andújar, J., Scaillet, B., & Casillas, R. (2021). Experimental determination of H₂O and CO₂ solubilities of mafic alkaline magmas from Canary Islands. *Comptes Rendus. Geoscience*, 353(S2), 1-26. <https://doi.org/10.5802/crgeos.84>

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (petrological approach to the preeruptive conditions of mafic magmas). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint the time taken to prepare a new basaltic eruption

Jiménez-Mejías, M., Andújar, J., Scaillet, B., & Casillas, R. (2021). Supplementary Material: Experimental determination of H₂O and CO₂ solubilities of mafic alkaline magmas from Canary Islands. *Comptes Rendus. Geoscience*, 353(S2), 1-26. <https://doi.org/10.5802/crgeos.84>

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (petrological approach to the preeruptive conditions of mafic magmas). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint the time taken to prepare a new basaltic eruption

2022

Rosi, M., Acocella, V., Cioni, R., Bianco, F., Costa, A., De Martino, P., Giordano, G., & Inguaggiato, S. (2022). Defining the Pre-Eruptive States of Active Volcanoes for Improving Eruption Forecasting. *Frontiers in Earth Science*, vol. 10, 795700, <https://doi.org/10.3389/feart.2022.795700>

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (definition of pre-eruption unrest stages at Campi Flegrei caldera and Vesuvius volcanoes). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for the declaration of a volcano alert

Submitted

Martí, J., Becerril, L. Rodríguez, A. How long-term hazard assessment may help to anticipate volcanic eruptions: the case of La Palma eruption 2021 (Canary Islands). *Journal of Volcanology and Geothermal Research*, (submitted).

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (application of the EVE tools for long and short term hazard assessment at the La Palma 2021 eruption). It demonstrates the utility of the EVE project in anticipating volcanic eruptions.

Pous, J., Martí, J. Romero-Ruiz, I., Seillé, H., Muñoz, G., Monteiro Santos, F., Heise, W., Geyer, A., Martín-Luis, C. Imaging the interior of large volcanic systems: A 2 magnetotelluric approach to Tenerife (Canary Islands). *Nature Geosciences*, (submitted).

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 4 (provides data on the internal structure of active central volcanoes). Reference for the Volcano Early Warning System (VEWS), as it provides inputs for understanding the causes of unrest.

Tadini, A. (AC), Harris, A. Morin, J.,...Zafrilla, Z. (34/34). “Structured elicitation of expert judgement in real-time eruption scenarios: an exercise for Piton de la Fournaise volcano, La Réunion island”. *Volcanica*. (submitted)

Study financed in part by the EVE project. Related directly to WPs 2 (actions 2.3) and 5 (application of the EVE tools for long and short term hazard assessment at Piton de la Fournaise volcano). It demonstrates the utility of the EVE project in anticipating volcanic eruptions.

In preparation

Martí, J., Hoskuldsson, A., Scaillet, B., Macedonio, G., Brum, A., Bachellery, P., Martínez-Sepúlveda, M. Zafrilla, S. EVE: the European Volcano Early Warning System. *Journal of Volcanology and Geothermal Research* (in preparation, to be submitted to *Journal of Volcanology and Geothermal Research*)

Fully financed by the EVE project. Presentation of the VEWS for European volcanoes, the main product of the EVE project.

Bulletin of Volcanology Special Issue: Low intensity basalt eruptions: the 2021 Fagradalsfjall eruption, SW-Iceland”

Coordinating editors: **Thor Thordarson** (torvth@hi.is) and **Freysteinn Sigmundsson** (fs@hi.is)

This special volume of Bulletin of Volcanology will contain two contributions by members of the EVE consortium showing the application of the EVE tools for long and short term hazard assessment at at the Reykjanes peninsula 2021 eruption. It demonstrates the utility of the EVE project in anticipating volcanic eruptions.

Martí, J., Martínez-Sepúlveda, M., Zafrilla, S. VOLCANBOX: a systematic methodology and e-tools set to conduct long- and short-term volcanic hazard assessment. *Environmental Modelling and Software* (*in preparation*, to be submitted to *Environmental Modelling and Software*).

Fully financed by the EVE project. Presentation of the main components of Volcanbox platform constructed as part of the EVE project

Martínez-Sepúlveda, M., Martí, J., Zafrilla, S. VOLCANBOX: a software platform for Volcanic Hazard Assessment. *Journal of Computational Science or Computers and Geosciences*. (*in preparation*, to be submitted to *Journal of Computational Science or Computers and Geosciences*).

Fully financed by the EVE project. Presentation of the technical (programming) details of Volcanbox platform constructed as part of the EVE project

Martínez-Sepúlveda, M., Martí, J., Zafrilla, S. Implementing data models for volcanic hazard assessment: the VOLCANBOX software platform. *Computer Standards and Interfaces* (*in preparation*, to be submitted to *Computer Standards and Interfaces*).

Fully financed by the EVE project. Presentation of the technical (programming) details regarding the implementation of the database into the Volcanbox platform constructed as part of the EVE project

PhD THESIS in preparation

- “Experimental and analytical constraints on magma degassing processes of Tenerife, Canary Islands” PhD student: María Jiménez Mejías. Universidad de La Laguna. PhD Directors: Juan Andújar Fernández and Ramón Casillas Ruiz. In preparation (starting date: september 2017). *PhD Thesis financed in part by the EVE project. Related directly 5 (petrological approach to the preeruptive conditions of mafic and felsic magmas). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint the time taken to prepare a new eruption*

Brief summary: This study is aimed at providing tight constraints about the plumbing system, volatile contents and degassing paths of the different magmatic compositions that characterize the recent volcanism (≤ 10 ka) of Tenerife island by combining detailed petrological and geochemical data with the study of mineral hosted melt inclusions, for which an H₂O and CO₂ solubility model has been developed.

- “Modeling the eruptive and pre-eruptive dynamics on Teide-Pico Viejo volcanic complex (Tenerife, Canary islands)” PhD student: Olaya Dorado García. Departament de Mineralogia, Petrologia i Geologia Aplicada, Facultat de Ciències de la Terra, Universitat de Barcelona. PhD Directors: Joan Martí and Adelina Geyer. In preparation (starting date: september 2019).
- *PhD Thesis financed in part by the EVE project. Related directly to WP5 (petrological approach to the preeruptive conditions of Teide volcano). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint the time taken to prepare a new eruption in Teide volcano*

Brief summary: The objective of the thesis is the elaboration of a conceptual model of the magmatic system of Teide-Pico Viejo volcanic complex. Through fieldwork, petrology and geochemistry, and its integration with the geophysical information available on the island of Tenerife, the aim is to interpret the area of origin of the magmas, their ascent and evolution

through the lithosphere, the processes of magmatic evolution within the magma reservoirs, and their relationship with the eruptive processes, as well as the eruptive recurrence through the dating of different eruptions of Holocene age.

- “Multi-hazard assessment and risk management in volcanic islands”. PhD student: Marta López-Saavedra. Departamento de Geodinámica, Facultat de Ciències de la Terra, Universitat de Barcelona. PhD Directors: Joan Martí and Dario Pedrazzi. In preparation (starting date: september de 2020)
- *PhD Thesis financed in part by the EVE project. Related to WP5 and WP6 (long and short term analysis of multihazard extreme events occurred on Tenerife). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint extreme scenarios for volcanic events*

Brief summary: The PhD thesis focuses on multi-hazard assessment and risk management on volcanic islands. Main work consists of analysing how the multi-hazard concept is integrated into national and international policies, as well as conducting long-term multi-hazard assessments considering cascading effects. With Tenerife (Canary Islands) as a study scenario, I analyse both the consequences of past extreme events that the island has experienced in case they were to happen again in the future, as well as the impact of non-extreme but frequent events that have occurred on Tenerife and how they have been managed in order to propose improvements in local, regional and global risk reduction policies

- "Evaluación del riesgo volcánico en el volcán Irazú, Costa Rica". PhD student: Daniela Campos Duran. Departamento de Geodinámica, Facultat de Ciències de la Terra, Universitat de Barcelona. PhD Director: Joan Martí Molist. In preparation (starting date: september de 2019)
- *PhD Thesis financed in part by the EVE project. Related to WP5 and WP6 (long and short term analysis of volcanic hazards at Irazú volcan, Costa Rica). Reference for the Volcano Early Warning System (VEWS), as it provides inputs to constraint eruption scenarios for a particular volcano, and extends the application of EVE tools beyond European volcanoes*

Brief summary: Longterm hazard assessment, definition of risk managing protocols and vulnerability analysis, at Irazu volcano, one of the most active volcanoes in Costa Rica, using methodology, protocols and e-tools included in VOLCANBOX.

- “Computing applications for Volcanic Hazard Assessment” PhD student: Marc Martínez Sepúlveda. Universitat Politècnica de Catalunya. PhD Director: Joan Martí Molist. In preparation (starting date: february 2021).
PhD Thesis totally financed by the EVE project. Related to the whole project it describes the technical aspects of the Volcanbox and of the Volcano Early Warning System (VEWS)

Brief summary: This PhD Thesis details the computational process followed to organise and implement the Volcanbox multiplatform computer application. This includes the definition of its internal architecture, the preparation and writing of the corresponding codes, the development of a Geographic Information System visualiser, the integration and redefinition of all the tools developed in the VeTOOLS project (VERDI, QVAST, VARIS, HASSET), the integration of the different simulation models for volcanic and associated hazards (lavas, pdc, fallout, ballistic, lahars, debris avalanches, tsunamis, peak ground acceleration), the integration of tools for semi-quantitative risk analysis, and, finally, the integration of the Early Warning System (EVE project). In addition to this work, the thesis also will describe the main problems encountered during the whole process and the computational solutions applied to solve them.

