THE EUROVOLC CITIZEN-SCIENCE TOOL: COLLECTING VOLCANO OBSERVATIONS FROM EUROPE

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During the European Commission-funded project EUROVOLC[1], our team has created an interactive webpage to collect citizen-science observations of volcanic events, and to visualise, map and download previously collected data.

This was done with two overarching aims: firstly, we believe that such a tool can involve the general public, greatly helping raise awareness on volcanic hazard and risk. Secondly, the information collected could provide valuable evidence for scientific purposes such as mapping of the eruption impact, or evaluation of model performances.In this article, we tell the story of the EUROVOLC citizen science tool (https://eurovolc.bgs.ac.uk/), which built upon existing citizen-science tools, which had been sparsely developed by different institutions across Europe.

Volcanic events: when nature crosses national borders

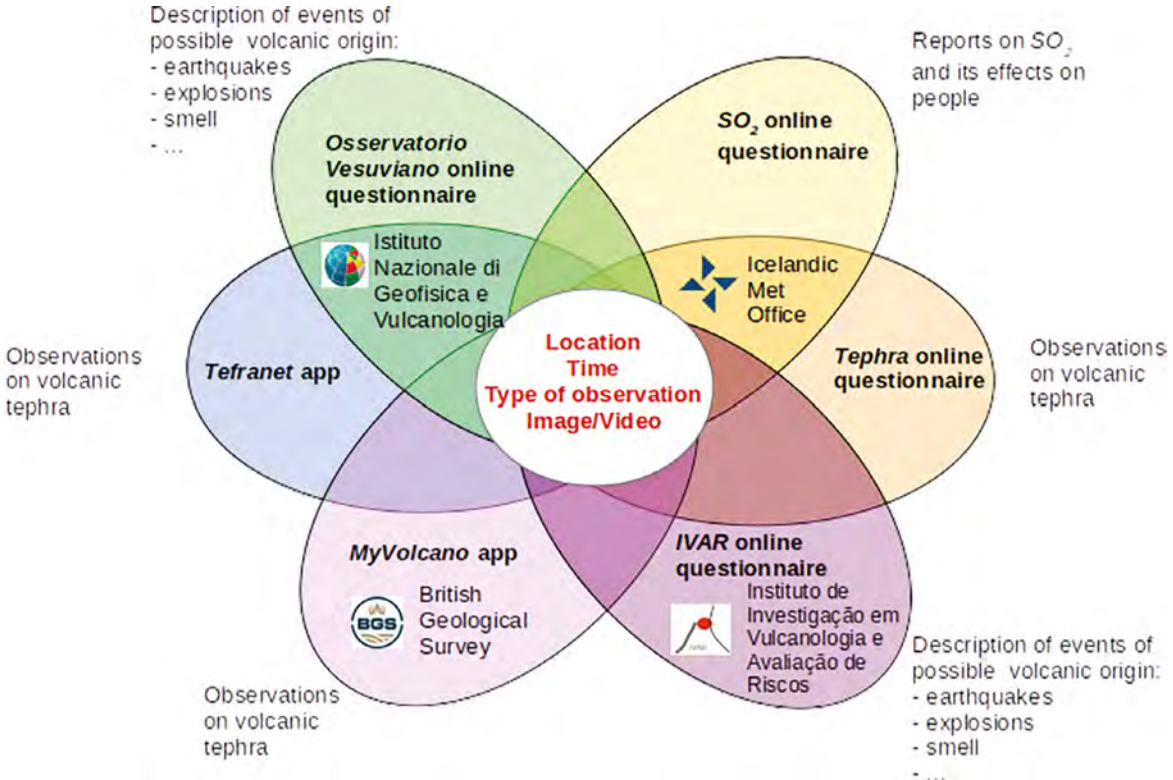
The rapid and unpredictable evolution of volcanic events, such as eruptions or unrest phases, may demand quick access to geo-referenced information on the dispersal of volcanic products, such as irritant or toxic gas species or volcanic ash (technically termed tephra), which can affect inhabited areas across different countries. In Europe, this became evident in the spring of 2010, when the volcanic tephra from the Icelandic volcano Eyjafjallajökull affected much of the continent, in effect one of the most congested airspace in the world, causing a massive disruption of flight connection for weeks across the world.

Citizen science in volcanology

Citizen science is where members of the public partake in collection and/or analysis of data.

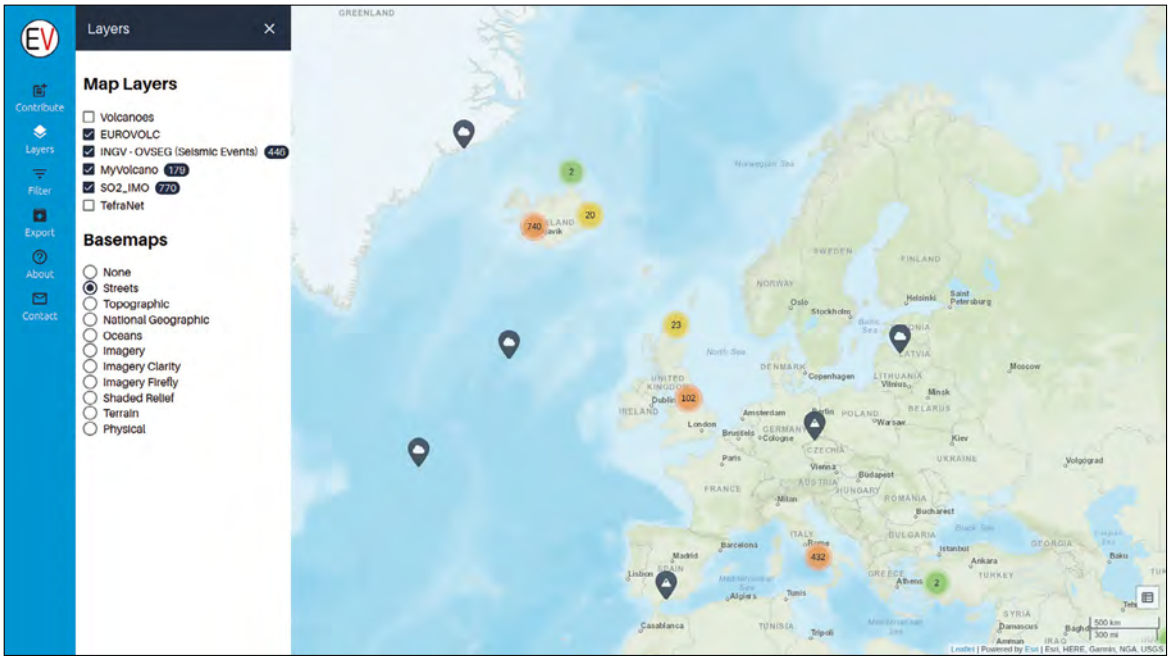
Since the introduction of the internet and smartphones, citizen-sourced observations of volcanic events have become not only possible but also a potentially very valuable tool. Information from people witnessing a volcanic event (*e.g.*, the fallout of volcanic tephra, the sight of a volcanic plume, the smell of volcanic gas, felt earthquakes in a volcanic area, audible explosions) may be collected via user-friendly web pages or apps. Firstly, **this type of information can be useful for assessing, in a qualitative way, the extent and the impact of the volcanic event**. For example, it can identify the spatial extent of volcanic products in a specific event, or it can provide valuable clues to constrain its scale in terms of total erupted mass. Secondly, **it could provide valuable evidence for model benchmarking and calibration**. Finally, **citizen science may represent an effective means to raise awareness on natural risks among citizens** (Mee and Duncan, 2015).

In the recent past, building on the experience from earthquakes, and prompted by the trans-national effects of the Eyjafjallajökull eruption in Iceland, various European research groups have built tools, such ● ● ●



◂ **FIG. 1:** Different existing citizen-science services sparse across Europe before Eurovolc, and the common information they were all already storing (red text)

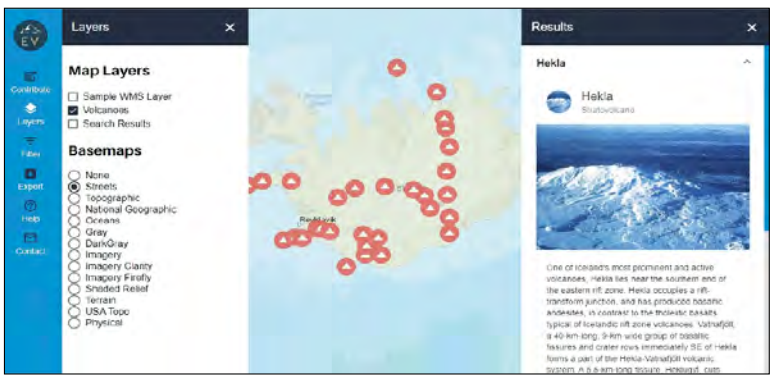
[1] https://eurovolc.eu



▸ **FIG. 2:** page of the EUROVOLC citizen-science tool showing the location and number of observations available in diverse regions

as online questionnaires or apps, for facilitating the collection of data by citizens (Stevenson et al, 2012; 2013). However, at the time of EUROVOLC project, these efforts had been fragmented and sparse across Europe, with different tools developed, or under development (Figure 1):

- the app 'myVolcano' developed by the British Geological Survey in UK (Duncan *et al.*, 2017 and https://www.bgs.ac.uk/myVolcano/)
- two online questionnaires to collect observations on SO_2 and volcanic tephra, respectively, developed by the Icelandic Meteorological Office in Iceland (https://www.vedur.is/skraning_brennisteinsmengun/ and http://skraning.v edur.is/skra/osku/)
- two tools developed by Istituto Nazionale di Geofisica e Vulcanologia in Italy: one online questionnaire set up by Osservatorio Vesuviano in Naples to collect any kind of observations of the activity of Neapolitan volcanoes, and an app 'Tefranet' under development in Osservatorio Etneo in Catania (Andronico et al, 2015) to collect observations of volcanic tephra from Mt Etna in Sicily
- an online questionnaire developed by the Instituto de Investigação em Vulcanologia e Avaliação de Riscos in Portugal to collect observations for Azores volcanoes (http://www.ivar.azores.gov.pt/no-navigation/Paginas/comunicacao-ocorrencias.aspx).



▾ **FIG. 3:** a screenshot of the EUROVOLC citizen-science tool showing also information from the European Catalogue of Volcanoes

EUROVOLC project

The European Network of Observatories and Research Infrastructures for Volcanology (EUROVOLC) project 2018 - 2021 was funded by the European Union. Its main goal was to facilitate communication and integration within the European volcanological community, bringing together the wide range of disciplines necessary for effective volcanic research, and prompting collaborative research among partners, development of best practices, networking between research institutes, volcano observatories, civil protection and Volcanic Ash Advisory Centres, and developing training resources for the public and young researchers.

Among specific objectives of the projects, the development of common procedures and the raising of awareness on volcanic risk among citizens, fuelled the set up of a common citizen science tool to collect, map and make available observations from people witnessing volcanic events at European volcanoes either in continental Europe or overseas territories.

EUROVOLC citizen-science tool

To implement this service, we decided to develop the tool as a web page, adaptive to mobile phone format, for ease of maintenance.

Operatively, the first focus was to run a reconnaissance survey of the different national citizen-science tools already online to look for differences and similarities. Overall, these tools covered diverse volcanic hazards or phenomena, with observations ranging from gas to tephra, earthquakes or explosions, for example. However, some common features were stored by all the tools: the timing (day and hour), the location, a description of the volcanic event, and the possibility to upload pictures or video (Figure 1). Our goal was to merge the large amount of observations already stored and scattered in different databases and make them accessible through a single portal.

Consequently, the basic concepts at the basis of the citizen science tool under development were:

- to be able to collect citizens' new observations of volcanic events from European continental and overseas volcanoes
- to feed it also with the data already collected by national citizen-science tools
- to display and map the collected data
- to allow some user-friendly easy operations through a GUI, such as selecting the types of observations and a specific time window and/or spatial area
- to grant the downloading of the displayed or selected data in csv format for later post-processing by the user.

The feeding from already-existing services required a legal consultation with the legal representatives of the partner institution providing such services, to exclude any potential issue on the visualization and downloading of data from other European tools. This led to discard, at least for present times, the data from the web questionnaire for the Azores volcanoes, as the data collected by that tool are not open.

Further, in order to be able to search and visualize observations from other European tools, the EUROVOLC citizen science tool populates and updates monthly its internal database, fetching the observations once a month from the other tools' differently-structured databases.

The developed webpage is now available at https://eurovolc.bgs.ac.uk/ (Figure 2).

The tool integrates information from the European Catalogue of Volcanoes, another service provided by EUROVOLC project to the scientific community and to citizens, to show the location of volcanoes in the visualized maps (Figure 3). ■

About the Authors

The authors are a group of scientists from 5 different research institutions and volcano observatories in 4 different European countries. They have collaborated in EUROVOLC project on the task related to the use of citizen science in volcanology.

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