



**European Network of  
Observatories and Research Infrastructure for Volcanology**

**Deliverable Report**

**D20.1 Report on the WP20 VA service during the project**

Work Package:	<i>VIRTUAL ACCESS TO EPOS VO-TCS</i>	
Work Package number:	<i>20</i>	
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## 1. Summary

The deliverable summarizes the activity in the WP20 and the use of the relevant Virtual Access service during the project, as well as the periodic reporting on the feed-back from questionnaires issued to the board of external users specifically selected to assess the service of the WP.

## 2. Introduction/objectives

The objective of WP20 is to provide and promote access to the EPOS “Volcano Observations” Thematic Core Service (VO-TCS) data to the EUROVOLC community, and implement new products and services produced inside the EPOS and EUROVOLC projects. This goal is achieved by creating a customized e-infrastructure: the “VO-TCS Gateway”. During the lifecycle of the project, the structure of the “VO-TCS Gateway” has been designed and developed.

This tool takes inspiration from the experience gained in the volcanological observatories/research institutions and the results obtained in the European Supersite projects (FUTUREVOLC and MED-SUV).

Since volcanological data are intrinsically heterogeneous, Virtual Access (VA) in WP20 is also used to uniform the complexity of the VO-TCS data discovery and access data, by using common standard interfaces developed by each single European provider.

Concerning the objectives of the WP20, their main activities can be summarized as follow:

- give access to data, data products and services already existing in the EPOS “Volcano Observations” Thematic Core Service (VO-TCS);
- implement data and services developed within Networking Activities and Joint Research Work packages of EUROVOLC;
- create a tool for trans-national access for the Transnational accesses’ second call of the project.

## 3. Activities

### 3.1 Activity 1 - Access to VO-TCS data and services [INGV, IMO, IPGP, UCA OPGC]

The first activity planned is *Access to VO-TCS data and services*.

The main goal of this activity is one of the main objective of the WP, i.e., to give access to data, data products and services (DDSS) existing in the EPOS VO-TCS Gateway. This task is strictly connected to Work Package 6 goals: in particular Subtask 6.1.1. which to define the list of the DDSSs that were not still implemented within the EPOS-IP project, according to the roadmap for service implementation in the Volcano Observations TCS

(VO-TCS). In collaboration with WP20, task 6.1.1, collected information about each DDSSS, concerning its organization, storage, standardized structures, format, the presence of associated metadata and the existence of a structured services for their distribution. Further details are provided in EUROVOLC Deliverable report D6.1.

Web services list. Some of them are also available in EPOS GUI

ID	Category	Name	Institution	Endpoint	Web
001	Seismological data	Velocity Seismic Waveforms	INGV, IPGP	<a href="https://www.orfeus-eu.org/data/eida/">https://www.orfeus-eu.org/data/eida/</a> , <a href="http://ws.resif.fr/fdsnws/dataselect/1/query">http://ws.resif.fr/fdsnws/dataselect/1/query</a>	
002	Seismological data	Acceleration /Accelerometer waveforms	INGV, IPGP	<a href="https://www.orfeus-eu.org/data/eida/">https://www.orfeus-eu.org/data/eida/</a> , <a href="http://ws.resif.fr/fdsnws/dataselect/1/query">http://ws.resif.fr/fdsnws/dataselect/1/query</a>	
003	Geodetic data	GNSS raw data (Rinex Data)	IMO, INGV, IPGP	<a href="https://api.vedur.is/epos/v1/gps/station">https://api.vedur.is/epos/v1/gps/station</a> , <a href="http://medsuv_portal.ct.ingv.it:8080/ingvsac/gpsapi/site/search">http://medsuv_portal.ct.ingv.it:8080/ingvsac/gpsapi/site/search</a>	<a href="https://docs.vedur.is/api/epos/v1/GNSS/get_gps_station">https://docs.vedur.is/api/epos/v1/GNSS/get_gps_station</a>
031	Volcanological-Petrological	Reports on volcanic activity	IMO	<a href="https://api.vedur.is/epos/v1/volcanoes/products/reports">https://api.vedur.is/epos/v1/volcanoes/products/reports</a>	<a href="https://docs.vedur.is/api/epos/v1/Volcanoes/get_volcanoes_prodi">https://docs.vedur.is/api/epos/v1/Volcanoes/get_volcanoes_prodi</a>
032	Volcanological-Petrological	Aviation colour codes for volcanoes	IMO	<a href="https://api.vedur.is/epos/v1/volcanoes/products/aviation_color_codes">https://api.vedur.is/epos/v1/volcanoes/products/aviation_color_codes</a>	<a href="https://docs.vedur.is/api/epos/v1/Volcanoes/get_volcanoes_prodi">https://docs.vedur.is/api/epos/v1/Volcanoes/get_volcanoes_prodi</a>
036	Volcanological-Petrological	Chemical analysis and physical	INGV, OPGC	<a href="http://193.206.223.51:8081/rest/bulk-rock">http://193.206.223.51:8081/rest/bulk-rock</a>	<a href="http://tsd.ct.ingv.it/tsdws/VolcanicCatalogs/1995-2015/">http://tsd.ct.ingv.it/tsdws/VolcanicCatalogs/1995-2015/</a>

Figure 1: First draft of the VO-TCS Gateway Service List.

Following this work, it became clear to the WP20 participants/developers that the list of services needed to be updated, following the EPOS-IP lifetime and remarks, so a revised structure was necessary.

The first step was to transfer existing data and service from different Research Infrastructures and Projects (MEDSUV, FUTUREVOLC, EPOS, EUROVOLC) to the new structure called *VO-TCS gateway* (<http://vo-tcs.ct.ingv.it>), which consist of different sections:

- *Service List* as result of EPOS existing services and Eurovolc products,
- *Software List*, implemented within the WP12 (see Task2),
- *Data Providers*, a direct connection to data providers web portals,
- *Eurovolc TNA* (see Task3) portal developed within the Eurovolc project
- *EDUBOX*, that represents all EUROVOLC project outputs (references, tutorials, video, etc) for dissemination objective (WP3 NA 1.3).

The activity 1 is also involved in the development of the Gateway guideline, in progress at the moment. The complete guide has not been finalized by the time this is written but will be released by the WP20 at month 46.



Figure 2: Home Page of the Gateway.

The VO-TCS Gateway new sitemap makes it easier for users to navigate the site, like a real map; it also provides an overview of the available content, with indications of the resources present and the path to reach them (see Figure 3).

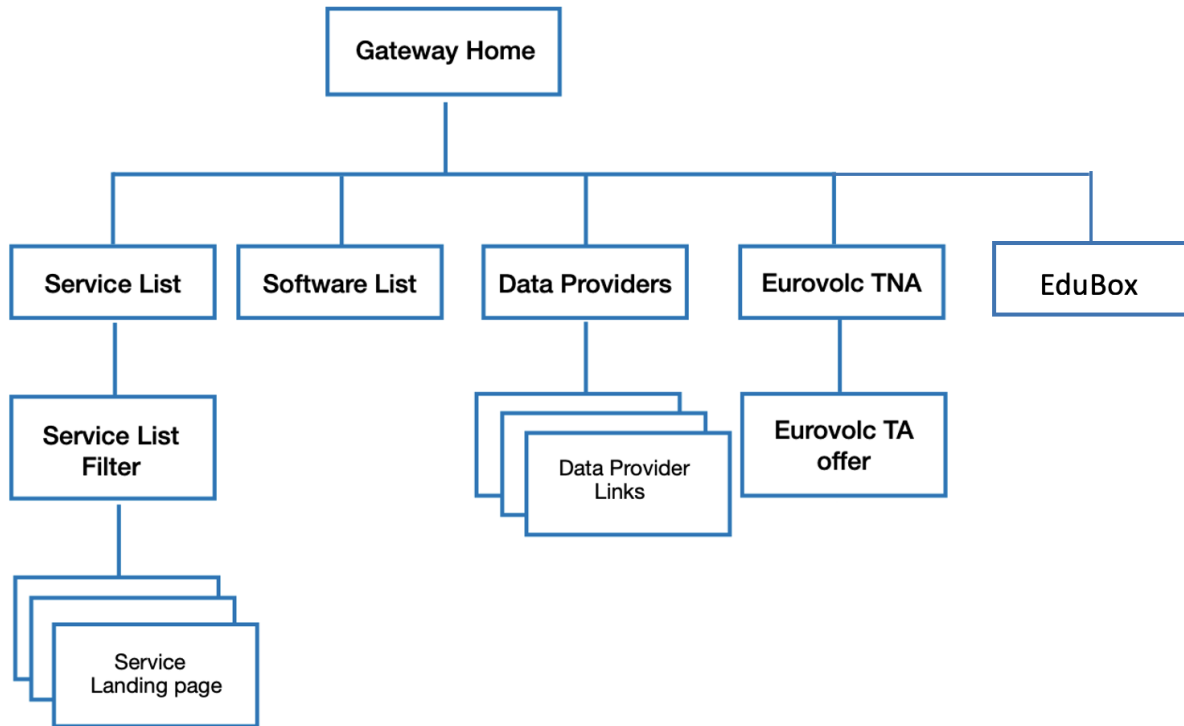


Figure 3: VO-TCS Gateway sitemap.

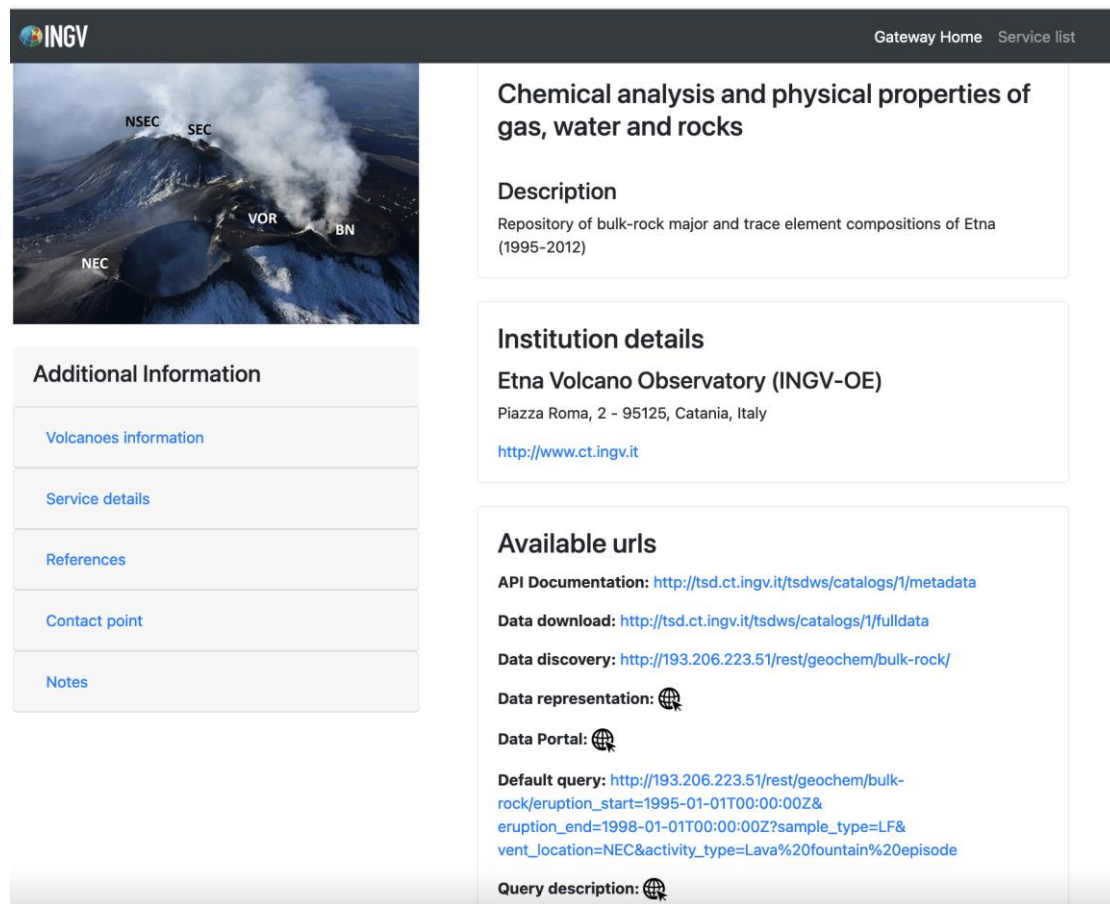
The information on web services is structured by using a landing page, accessible via specific link that provides details for each service.

This page includes the principal information of the proposed service, a small description about the service itself, the provided data and (if it exists) and a list of references.

## WEB SERVICE - landing page

General information
<b>Web service name:</b> Chemical analysis and physical properties of gas, water and rocks
<b>Category:</b> Volcanological-petrological
<b>Epos_id:</b> DDSS-WP11-036
<b>Description:</b> Catalog name: "bulk rocks analysis of Etna from 1995 to 2015". Type of sample: "LF" means lava flow sample; "PY" means pyroclast sample. Date of eruption : it's the date when the sample has been erupted. Type of activity: it's the description of the activity that produced the sample. Information is provided by IIV and INGV internal reports. Analytical Techniques: "ICP-OES" means "Inductively Coupled Plasma Optical Emission Spectroscopy"; "ICP-MS" means "Inductively Coupled Plasma Mass Spectrometry". Institution: INGV.
<b>References:</b> DOI: "10.1007/s00445-006-0083-4", 2007, Title: "Petrologic evidence of a complex plumbing system feeding the July-August 2001 eruption of Mt Etna, Sicily, Italy." Authors: Corsaro R. A. , Miraglia L. , Pompilio M., Bulletin of Volcanology, 69, 401-421. DOI: "10.1007/s00445-009-0264-z", 2009, Title: "Petrology of lavas from 2004-05 eruption of Mt. Etna, Italy: inferences on the dynamics of magma in the central conduits plumbing system." Authors: Corsaro R.A., Civetta L., Di Renzo, V. Miraglia L., Bulletin of Volcanology, 71, 7, 781-793. DOI: "10.1007/s00445-011-0467-y", 2011, Title: " Lava fountains during the episodic eruption of South-East Crater (Mt. Etna), 2000: insights into magma-gas dynamics within the shallow volcano plumbing system." Authors: Andronico D. , Corsaro R.A., Bulletin of Volcanology, 73, 9, 1165-1178. DOI: "10.1016/j.jvolgeores.2012.02.010", 2013, Title: "Relationship between petrologic processes in the plumbing system of Mt. Etna and the dynamics of the eastern flank from 1995 to 2005." Authors: Corsaro, R.A., V. Di Renzo, , S. Distefano, L. Miraglia, L. Civetta, Journal of Volcanology and Geothermal Research, 251, 75-89. DOI: "http://dx.doi.org/10.1016/j.jvolgeores.2014.02.009", 2014, Title: "The transition from summit to flank activity at Mt. Etna, Sicily (Italy): Inferences from the petrology of products erupted in 2007?" Authors: Corsaro R.A, Miraglia L., Journal of Volcanology and Geothermal Research, 275, 51-60.
<b>Documentation:</b> <a href="#">documentation link</a>

Figure 4: Example of general information section details.






**INGV** Gateway Home Service list

**Chemical analysis and physical properties of gas, water and rocks**

**Description**  
Repository of bulk-rock major and trace element compositions of Etna (1995-2012)

**Institution details**  
**Etna Volcano Observatory (INGV-OE)**  
Piazza Roma, 2 - 95125, Catania, Italy  
<http://www.ct.ingv.it>

**Available urls**  
**API Documentation:** <http://tsd.ct.ingv.it/tsdws/catalogs/1/metadata>  
**Data download:** <http://tsd.ct.ingv.it/tsdws/catalogs/1/fulldata>  
**Data discovery:** <http://193.206.223.51/rest/geochem/bulk-rock/>  
**Data representation:**   
**Data Portal:**   
**Default query:** [http://193.206.223.51/rest/geochem/bulk-rock/eruption\\_start=1995-01-01T00:00:00Z&eruption\\_end=1998-01-01T00:00:00Z?sample\\_type=LF&vent\\_location=NEC&activity\\_type=Lava%20fountain%20episode](http://193.206.223.51/rest/geochem/bulk-rock/eruption_start=1995-01-01T00:00:00Z&eruption_end=1998-01-01T00:00:00Z?sample_type=LF&vent_location=NEC&activity_type=Lava%20fountain%20episode)  
**Query description:** 

**Additional Information**  
[Volcanoes information](#)  
[Service details](#)  
[References](#)  
[Contact point](#)  
[Notes](#)

Figure 5: Landing Page for the INGV Bulk Rock service.

Moreover, this section contains the *documentation link*, a specific page that redirects to the service documentation page. It is very important for EPOS metadata documentations and it can also be used by machine readable tools. It reports the query description which provides operational information on how to query the service or the features notes section, which specifies the characteristics of the provided data.

To simplify the input process for each single Landing Page, a custom form page has been created only for administrative purposes: VO-TCS data providers can fill in all necessary information that will be discovered at the end of the process by the users.

Overall, the service list section allows a generic user to choose between the categories of web services (e.g. satellite data, geodetic data, etc.), but it is possible to organize the discovery of services based on the specific type of data provided by each individual institution.

The members of the VO-TCS Tech team had different roles in the Activity 1. INGV IT staff (Danilo Reitano, Lucia Cacciola) were in charge of the development of the Data Portal infrastructure. The other members (A. Geyer Traver (CSIC), Yannick Guehenneux (OPGC), Davíð Steinar Guðjónsson (IMO), Arnaud Lemarchand, Jean-Marie Saurel (IPGP)) i) verified the Data Portal ii) provided all necessary information to fill the Landing Pages for each service iii) validated the web pages with particular care of providers' landing pages.

A special thanks is due to Eng. Salvatore Mangiagli (INGV – Etna Volcano Observatory) that built the OS server and installed the CSS framework.

### 3.2 Activity 2 - Implementing EUROVOLC Data and Services

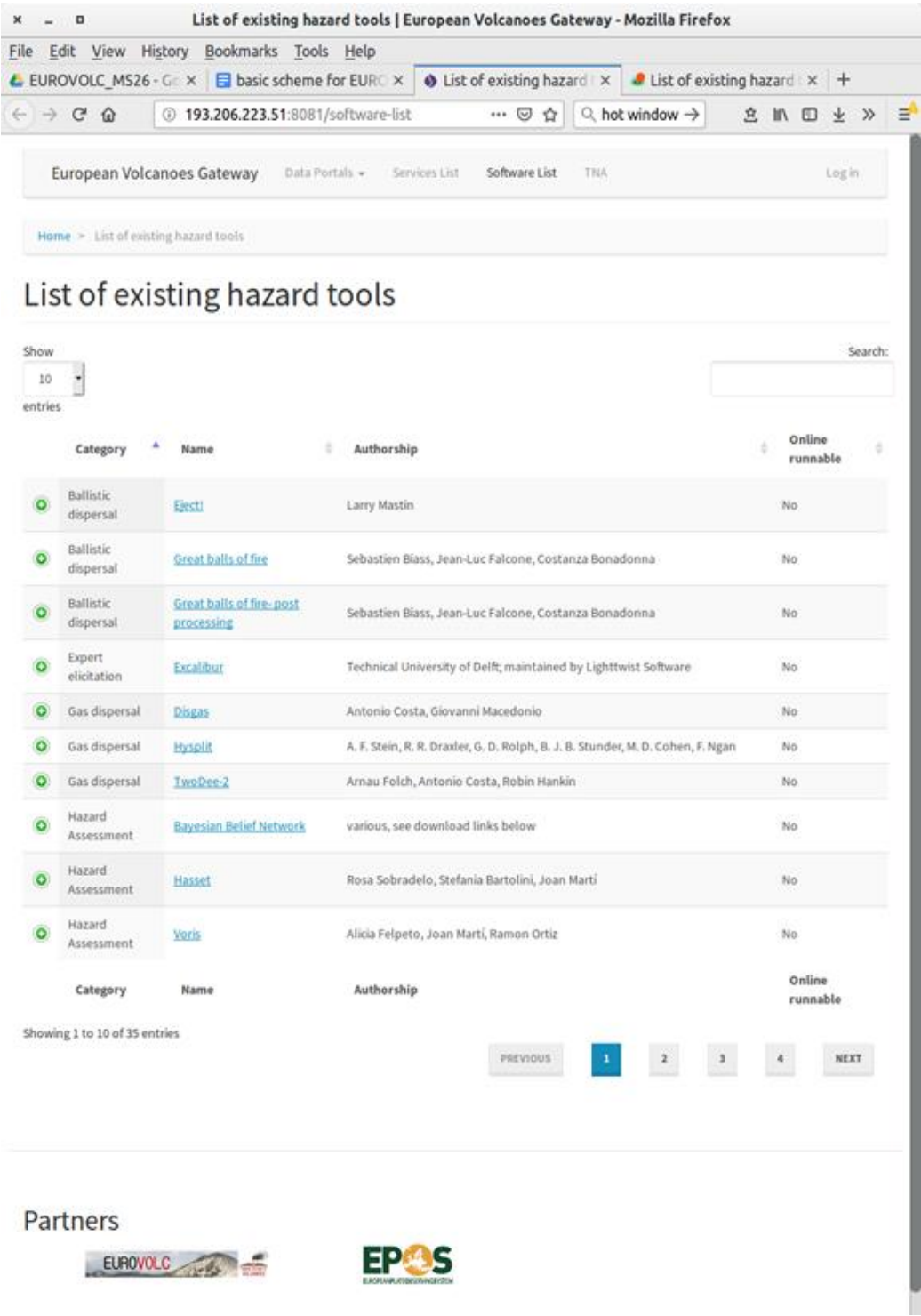
The first activity within this task is related to the implementation of a dynamic catalogue of Existing hazard tools. This work has been done in collaboration with Work Package 12 (Task 12.1: *Expanding on the work of previous projects on quantitative volcanic hazard assessment*) and focused on creating the on-line catalogue as result of the WP12 survey on the [pre-existing tools for volcanic hazard assessment](#). Following the suggestions and requirements of the WP12 team group, this activity created a dedicated tool with the goal to promote software and let the user discover their features, according to the structure of the Gateway described in the previous section. Because hazard tool software's versions are continuously modified/updated, the main idea (and also the main effort in planning the system) is to develop an interactive tool, a “web catalogue”, very simple to use and easy to upgrade. Experts, but also common users, can find details even if they do not know proper keywords: a power free search Area (see Figures 6-7, right side) can be used to search, filter, and also to group needed information and allow to discover metadata in a very intuitive way.

What is reported below is detailed in the WP12-JR4.2: *Exploitation of tools for hazard assessment risk and management* documentation and can be found in WP12 technical report in the EUROVOLC 3<sup>rd</sup> Periodic report and EUROVOLC Final reports. For technical point of view, details are provided in WP20 Technical Reports in EUROVOLC 1<sup>st</sup> and 2<sup>nd</sup> Periodic Reports.

The main information are presented into a dynamic Web table organizer by first:

- a) Category;
- b) Name;
- c) Authorship;
- d) On line runnable.





European Volcanoes Gateway | Data Portals | Services List | Software List | TNA | Log in

Home > List of existing hazard tools

## List of existing hazard tools

Show: 10 entries

Search:

Category	Name	Authorship	Online runnable
Ballistic dispersal	<a href="#">Ejecta</a>	Larry Mastin	No
Ballistic dispersal	<a href="#">Great balls of fire</a>	Sebastien Biass, Jean-Luc Falcone, Costanza Bonadonna	No
Ballistic dispersal	<a href="#">Great balls of fire-post processing</a>	Sebastien Biass, Jean-Luc Falcone, Costanza Bonadonna	No
Expert elicitation	<a href="#">Excalibur</a>	Technical University of Delft, maintained by Lighttwist Software	No
Gas dispersal	<a href="#">Disgas</a>	Antonio Costa, Giovanni Macedonio	No
Gas dispersal	<a href="#">Hysplit</a>	A. F. Stein, R. R. Draxler, G. D. Rolph, B. J. B. Stunder, M. D. Cohen, F. Ngan	No
Gas dispersal	<a href="#">TwoDee-2</a>	Arnau Folch, Antonio Costa, Robin Hankin	No
Hazard Assessment	<a href="#">Bayesian Belief Network</a>	various, see download links below	No
Hazard Assessment	<a href="#">Hasset</a>	Rosa Sobradelo, Stefania Bartolini, Joan Martí	No
Hazard Assessment	<a href="#">Voris</a>	Alicia Felpeto, Joan Martí, Ramon Ortiz	No

Showing 1 to 10 of 35 entries

PREVIOUS 1 2 3 4 NEXT

### Partners






Figure 6: List of existing hazard tools. A search bar can be used to filter results.

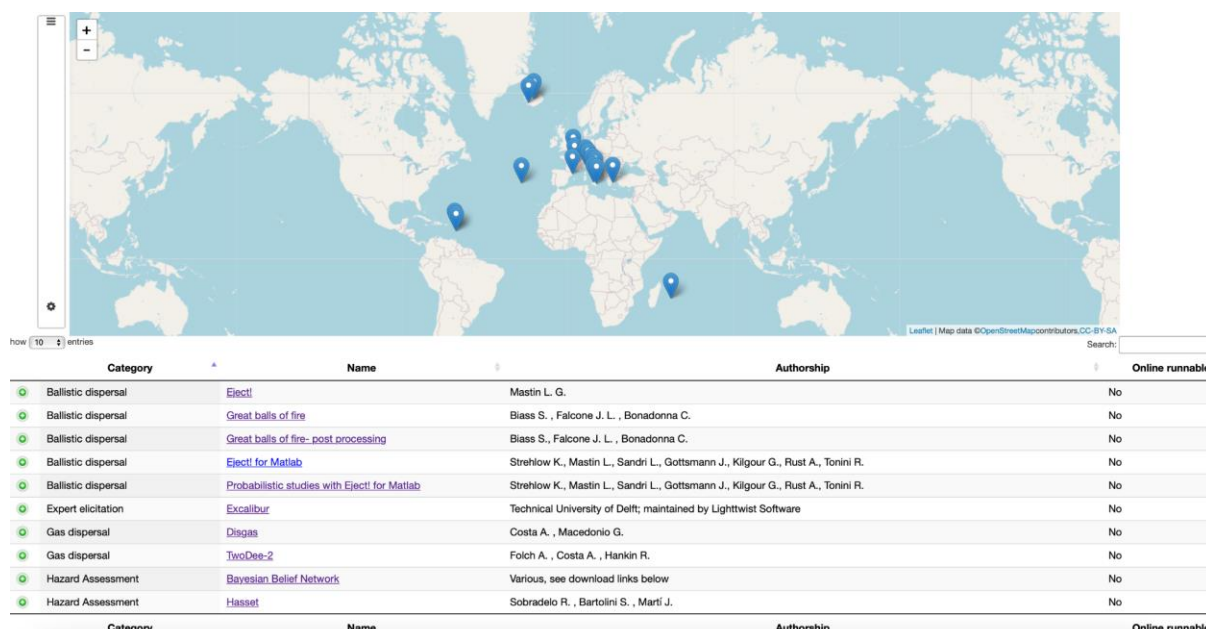


Figure 7: Searchable catalogue of pre-existing hazard tools implemented in the first draft and the actual VO-TCS Gateway.

Once the User has filtered the list, by using the +/- buttons he/she can access additional details concerning the description, the download URL and also a subset list of references (see Figure 8).

## List of existing hazard tools

Show  entries

Search:

Category	Name	Authorship	Online runnable
Ballistic dispersal	<a href="#">Eject!</a>	Larry Mastin	no
Ballistic dispersal	<a href="#">Great balls of fire</a>	Sebastien Blass, Jean-Luc Falcone, Costanza Bonadonna	no

**Description:** Great Balls of Fire (GBF) is an approach for the probabilistic hazard assessment of volcanic ballistic projectiles (VBP). It contains a model describing ballistic trajectories of VBPs accounting for a variable drag coefficient and topography and is designed to model large numbers of VBPs stochastically. Associated functions come with the GBF code to post-process model outputs into a comprehensive probabilistic hazard assessment for VBP impacts. Outcomes include probability maps to exceed given thresholds of kinetic energies at impact, hazard curves and probabilistic isoenergy maps. Probabilities are calculated either on equally-sized pixels or zones of interest. GBF can be downloaded as a suit of software for modeling the hazard posed by VBPs.

**Implementation and requirements:** GBF is executed on the Java virtual machine (version 8). It is then compatible with any OS which supports Java, notably GNU/Linux, Apple MacOSX and MS Windows. The computation is mainly CPU intensive, as each bomb trajectory is computed independently. Thus, only a limited amount of memory is required even for large simulations (1GB should be enough). Multicore CPU or multiprocessor machines will however greatly speed up the computation. The only external requirement is the Java Virtual Machine (JVM) version 8. A suitable version can be downloaded at Oracle website.

**Download:** <https://github.com/UnigeSPC/gbf>

**References:** <https://www.sciencedirect.com/science/article/pii/S0177027316301317>

Ballistic dispersal	<a href="#">Great balls of fire- post processing</a>	Sebastien Blass, Jean-Luc Falcone, Costanza Bonadonna	No
Expert elicitation	<a href="#">Excalibur</a>	Technical University of Delft; maintained by Lighttwist Software	No
Gas dispersal	<a href="#">Disgas</a>	Antonio Costa, Giovanni Macedonio	No
Gas dispersal	<a href="#">Hysol8</a>	A. F. Stein, R. R. Draxler, G. D. Rolph, B. J. B. Stunder, M. D. Cohen, F. Nigan	No
Gas dispersal	<a href="#">TwoDec-2</a>	Arnau Folch, Antonio Costa, Robin Hankin	No

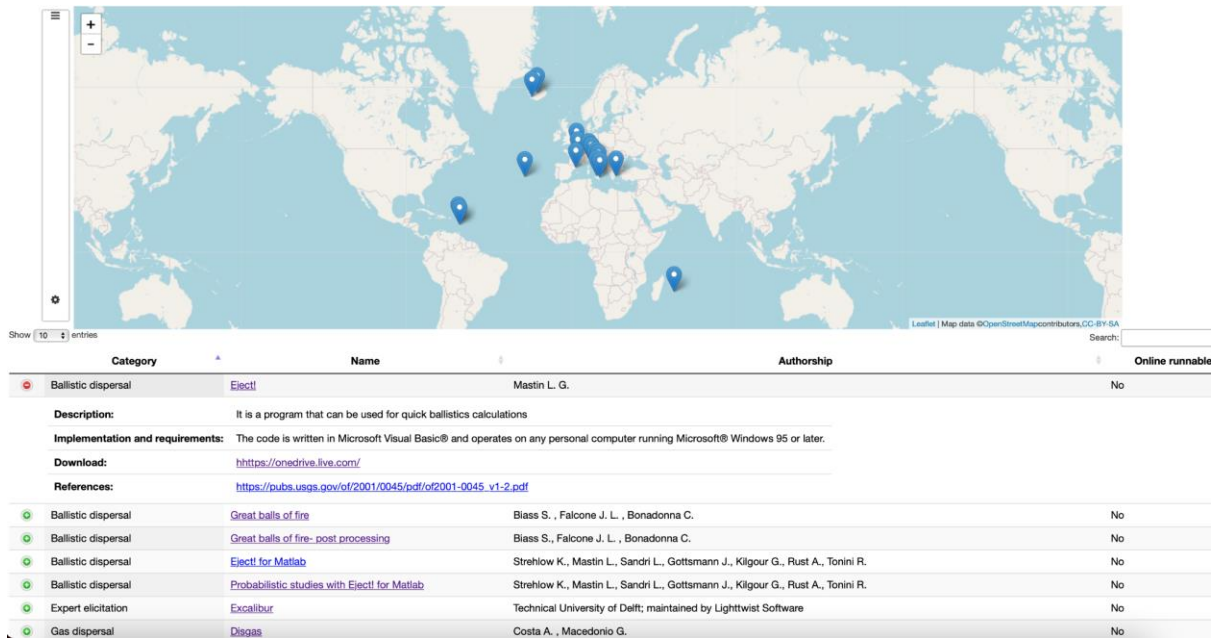


Figure 8: How to select details from the main Web page (the old and new one).

It is important to point out that this work has been completed within the first year of the project; only minor upgrades and a general maintenance have been conducted in the second part of it.

### 3.3 Activity 3 - Trans-national Access: EUROVOLC second call [INGV]

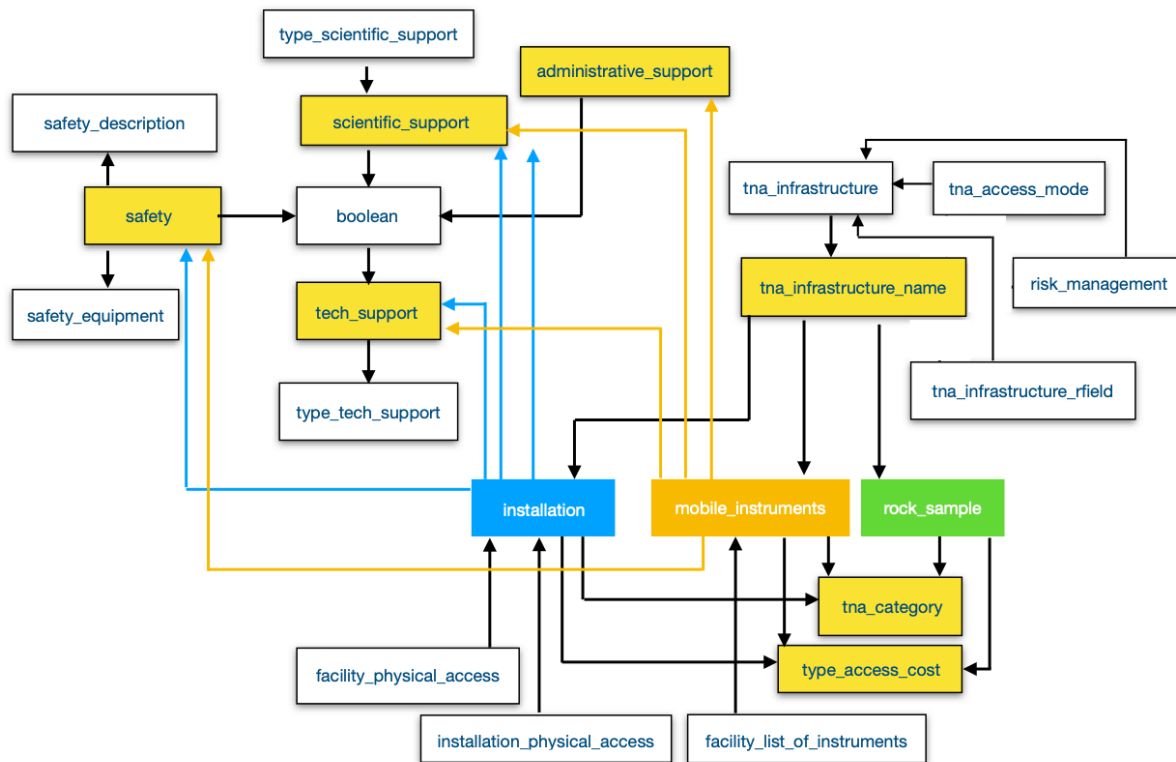
After the first call of Trans-national Access (TA) in EUROVOLC, discussions commenced about the possibility to create a tool, able to manage the TA calls, starting from the second one. To carry this out, a group of experts was asked to provide a solution in terms of minimum requirements needed to characterize a TA offer and to develop its main sections. At the end of this phase it was decided to share a survey to all partners to revise this product and contribute to improve it. This output (in form of excel sheets) was delivered to the WP20 IT team (in particular to INGV) that started to plan and build a Web based solution.

#### 3.3.1 Description of the system

Many hypothesis were considered during the IT planning phase. At the end, the proposed infrastructure is based on an interactive Web portal solution, that uses a relational database and the tool will be part of the EUROVOLC VO-TCS Gateway.

The infrastructure is composed of a *back end*, based on a Linux server that provides all necessary services and controls and a *front end*, created from scratch to build all connections and calls to the relational “MySQL” database. The database structure has

been built up and it manages all tables, views to query data information. A simplified schema has been reported in Figure 9.



The Trans-national Access Web portal main page is composed of four main parts:

1. TA Offers
2. Request Form
3. TNA Guidelines
4. F.A.Q.

The **first part** shows the Trans-national Access available offers. By entering the web page, a generic user can find a map which represents the existing infrastructures that are proposing TA Offers; by clicking each marker, it is possible to access to their geographical location and look at the related Institution (Figure 10). The list below represents each single offer and shows four main keywords: the Category name, the name of the proposing Institution's infrastructure, the name of the single facility and at last, the Institution's country. The catalogue consists of three different categories:

- Access to Mobile Instruments

Figure 9: Overall simplified schema of the TA database.

- Access to Volcano Observatories and Volcano Research Institutions
- Provision of Rock Samples

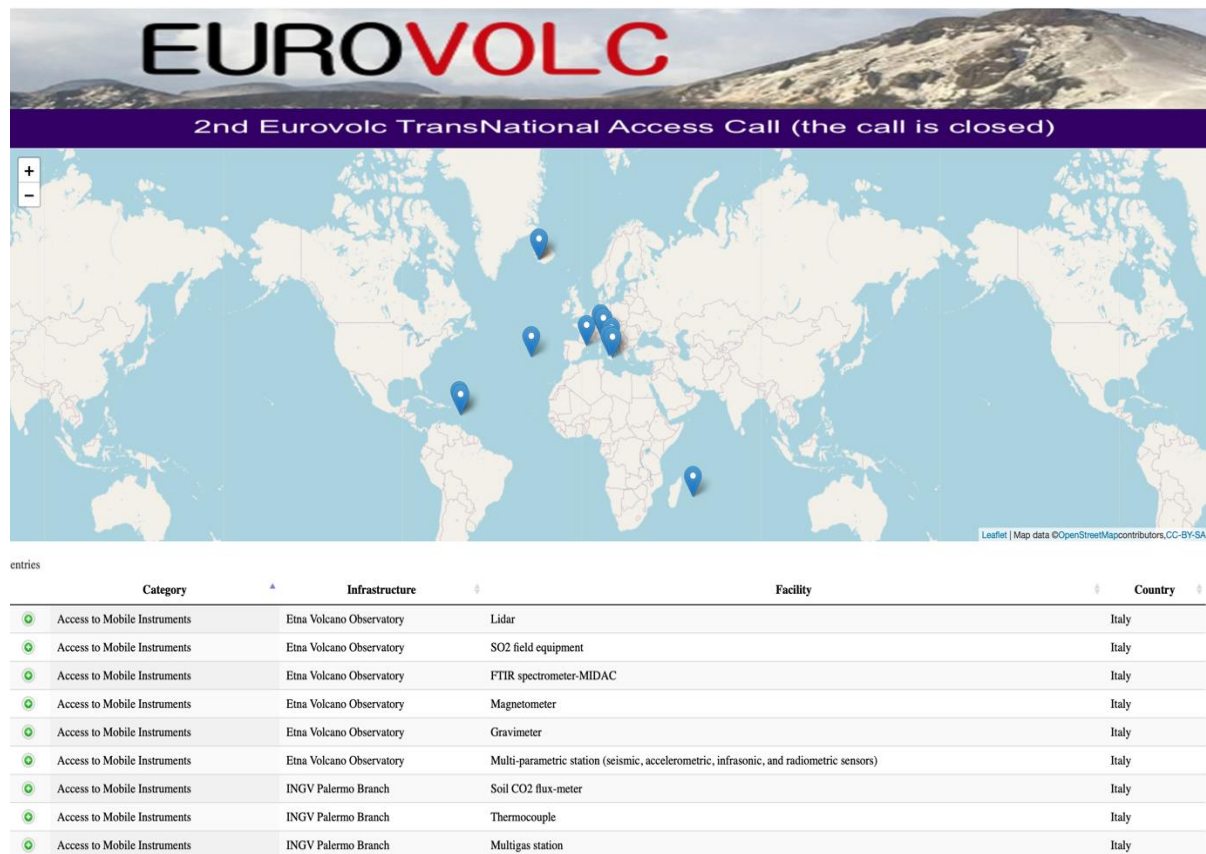


Figure 10:TA Offers page: A map and the related table show all the TA Offers of the second Call.

Once the user has filtered the list, by using the +/- buttons he/she can access additional details (see Figure 11).



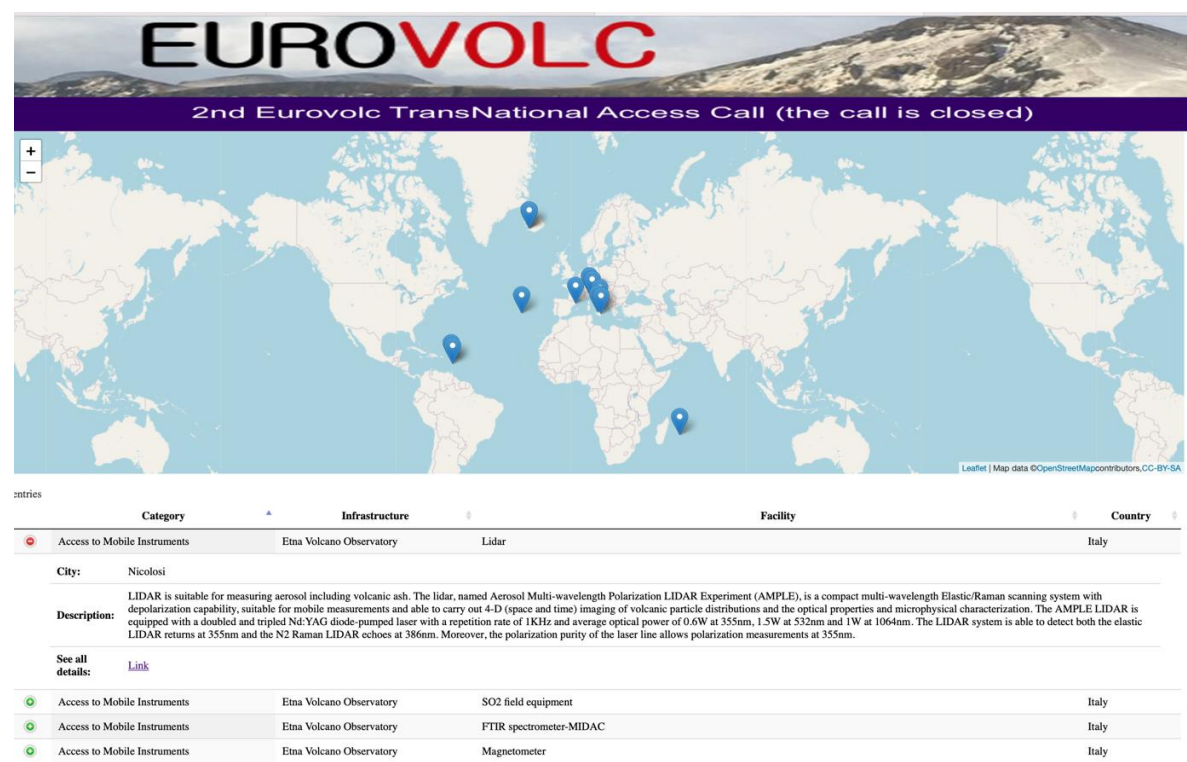


Figure 11: Click on the +/- button to access to details.

By clicking on the Link, in the section “See all details”, a new page is loaded. The new page (Figure 12) is made by using an *accordion* style that helps the user to enter (by choosing each title) all features that compose a single offer. So many entries are necessary to describe all different features and following experts’ suggestions, the whole page is divided into different sections.

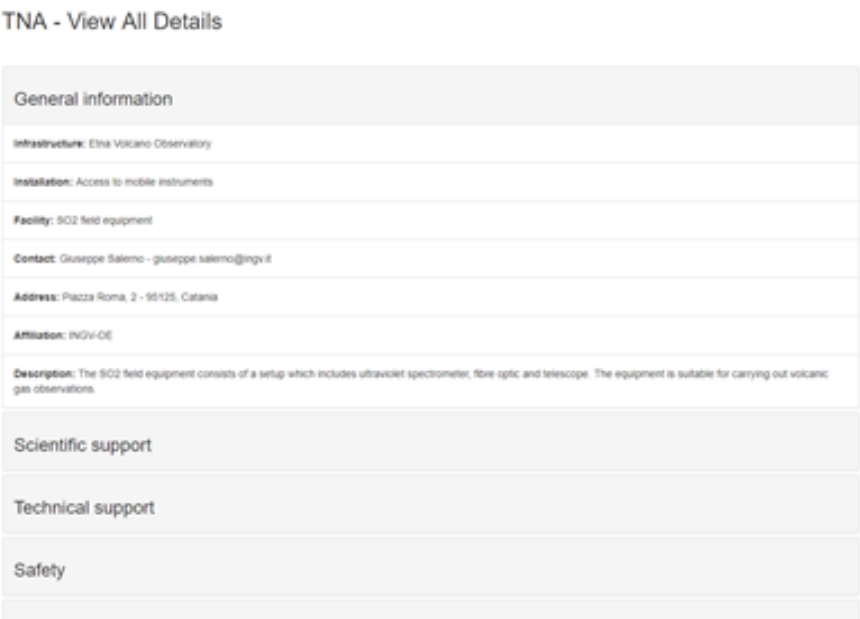


Figure 12: Report on all details that characterize a single TA Offer.

In particular, the main sections are:

- General information
- Scientific support
- Technical support
- Safety
- Administrative support
- Access modalities
- Financial support
- Risk management

Each section contains fields (mandatory or optional) each provider has compiled during the preparation phase of the TA Call. All of them are loaded into the TA database. When a user wants to access the details, an “*on the fly*” response query is created by the system, and the code build the results shown in Figure 12.

The **second part** is dedicated to the **Request Form**. Furthermore, this section is built with custom code that guides the user into the compilation of the form. The form is divided into three different sections: the first contains general information about the project, the principal investigator and team members and the second is made to request attached files (e.g. a CV of the principal investigator).

In order to combine offers and requests, the **third part** proposes the existing infrastructures. The database query and visualizes only the facilities related to the chosen infrastructure and the related financial combination as they have been compiled by the provider. The user can also review a draft proposal to modify it before the final submission, that is, instead, locked. For this reason, the user is requested to login into the portal, so the system can recognize user’s identity and retrieve his/her form data submission from the database (Figures 13–14).

Project title and Team information

**Project title**  
Provide here the title given to your project <150 characters max>

**Project acronym**  
Provide here the acronym given to your project. <20 characters max>

**Proposed Project period:**

**Starting date**  
mm/dd/yyyy

**Ending date**  
mm/dd/yyyy

**Principal Investigator**

First Name	
Middle Name	
Last Name	

Figure 13: A detail of the first part of the Request Form.

Figure 14 shows the page related to the requested accesses by using the Infrastructure, the Category and Facility. Once the Infrastructure name is chosen the system shows the related offers with important details concerning the facilities and the number of offered accesses.

### Form TA - Part B

Choose the Infrastructure

-- Please select an option --
Select

Select	Infrastructure name	Installation	Facility/Equipment name	Accesses / unit of access offered
<input type="checkbox"/>	Agencia Estatal Consejo Superior de Investigaciones Cientificas	Physical access to on-site modelling resources	COMSOL Multiphysics simulations (termofluid dynamic processes)	15 accesses / 1 working day
<input type="checkbox"/>	Agencia Estatal Consejo Superior de Investigaciones Cientificas	Physical access to on-site hazard assessment tools	VOLCANBOX (code)	15 accesses / 1 working day

Requested number of accesses (please pay attention to use the access unit referred above)
0

Describe briefly the reason why you chose this facility and why it will be best carried out on it
<500 characters, included spaces>

Are you providing another submission for a different infrastructure?
☐ Yes ☒ No

If Yes, please fill the following field for each form
<150 characters, included spaces>

Estimated project costs

By completing this Application form, the user team agrees with the terms and conditions for Transnational Access within the EUROVOLC project (see Eligibility Criteria and User's Obligations in the [Call web page](#)). Finally, before pressing submit, the applicant is required to indicate his/her approval of EUROVOLC's privacy statement regarding the treatment, use and management of personal data, and EUROVOLC's statement of data access and data management. Note that the submission is successful after clicking on the Submit button below. For any problems, please send an email to [danilo.reitano@ingv.it](mailto:danilo.reitano@ingv.it)

Approval
☒ I, the applicant, accept EUROVOLC's Policy of the Data Access & Management and Treatment of personal data

Submit

Figure 14: Part B of the Request Form: choice of the infrastructure and related facilities.

The **last part** (the *FAQ* section) reports some questions and answers regarding the main features of the Portal and also a guide to fill the Request Form.



### 3.4 Activity 4 - The EDUBOX section

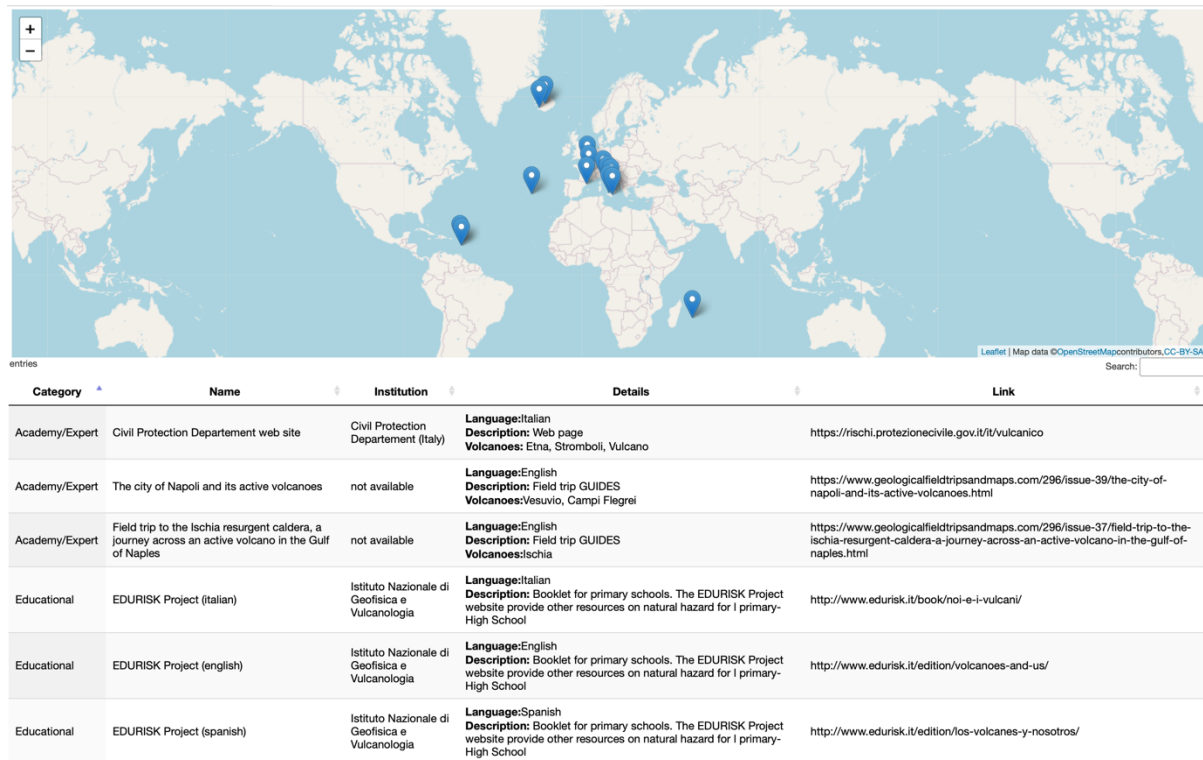


Fig 3.15 EduBox section

Last available section is represented by EDUBOX, a special storage area and a customized database that demonstrates the work done within WP3 - Subtask 3.2.3: *Developing of outreach resources on volcanoes* [Task lead INGV, other participants IMO; UNIGE; UI; CVISA; ICP; CSIC; IPGP].

The aim of this subtask is to develop the *EUROVOLC Outreach Box (EDUBOX)* based on the shared material uploaded on intranet EUROVOLC platform Basecamp and surveyed in WP3 Deliverable report D3.2. The initial work for the WP20 team concerns the definition of the technical structure of the database and of the framework where the EDUBOX will be available.

From a technical point of view, the EDUBOX section is built by using the same structure available for the other sections. In particular, the proposed documentation refers to three main categories:

- Resource for *General Public*, outreach material for the general public;
- Resource for *Educational*; material for educational activities (primary school to university level);
- Resource for *Academy/Expert*.

Other details and related documentation can be found in the EUROVOLC Deliverable report D3.5 released by WP3 at the end of the project.

#### 4. Criticalities

From a technical point of view, building a specific Data Portal for the European volcanological community is a big challenge in terms of requested effort. Different actions are necessary to design, develop and deploy the IT e-infrastructure: Activity 1, in particular, needed much more effort in terms of P/M and partners' contribution.

The design and development of the IT structure was in charge of INGV so, in order to update the Gateway features, the strategy was to ask the other Partners to:

- contribute to collect information about services, sharing all information and eventually fill the form to complete the landing pages;
- expose all available details for each product/service;
- populate the Gateway with existing/new services (EPOS and EUROVOLC products);
- work to create active links between the Gateway and the EUROVOLC products (i.e. the European Catalogue of Volcanoes (ECV) and EDUBOX).

These actions represented an initial criticality for the WP20 team, because the harmonization process was simultaneously carried out in the EPOS e-infrastructure.

At the end the Gateway contains both EPOS and not-EPOS datasets, exposed using tailored Landing Pages.

#### 5. Conclusions

Integrated research on Earth science processes are intrinsically multidisciplinary, so covering a multitude of heterogeneous datasets collected by EUROVOLC data providers was one of the main goals of the project and, in this framework, WP20 has represented the aim to promote efforts for sustainability purposes. The European Plate Observing System (EPOS) establishes a sustainable and long-term access to solid Earth science data and services integrating diverse European Research Infrastructures under a common federated framework. The VO-TCS has the responsibility to coordinate the volcanological community in EPOS and the EUROVOLC project can really contribute to enrich data and services that will be active even at the end of the project itself. Although many criticisms have been highlighted during the project lifetime, great results have been achieved by the EUROVOLC community, most of them shared within the volcanological community and available for different kinds of stakeholders. Moreover, the Data portal follows the *open access* paradigm and the choice of landing pages to discover data and service details will also guide non-expert users within Earth Science. A detailed introduction and overview of the EPOS Volcano Observations services and the Gateway has recently been published in *Annals of Geophysics* (Puglisi et al., 2022).

## 6. References

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