



Volcanolo Observations

Thematic Core Service – **VO-TCS**

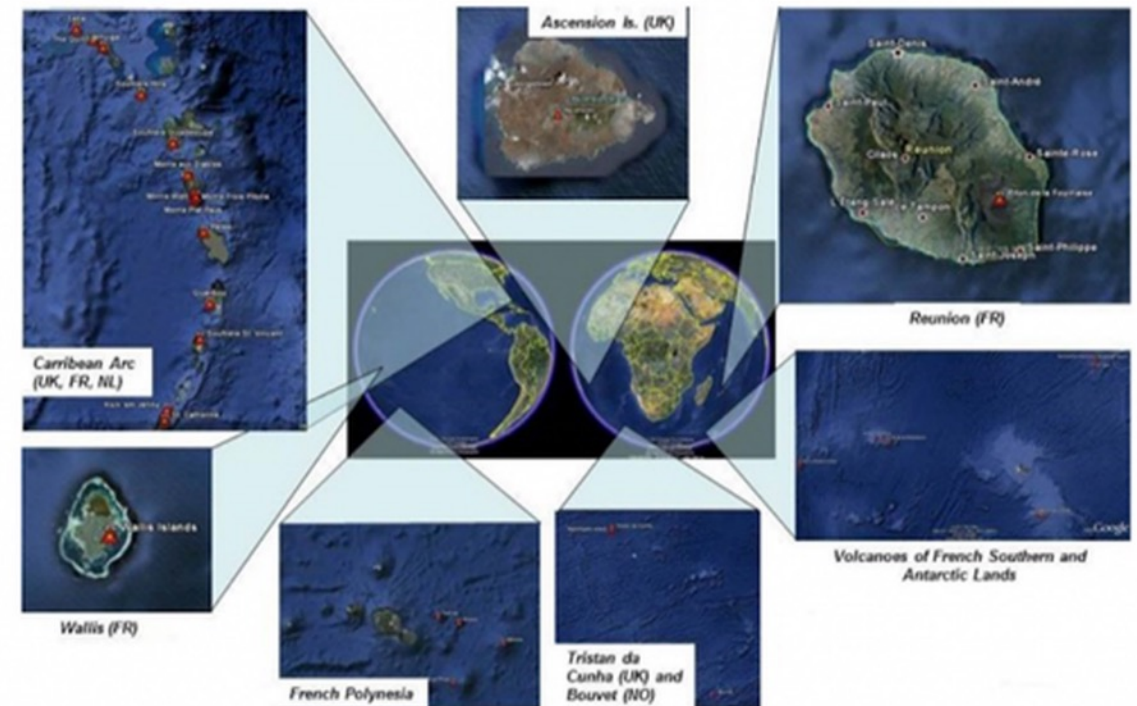
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1) IMO, Iceland; 2) INGV, Italy; 3) CSIC, Spain; 4) OPGC, France; 5) IPGP, France; 6) HSGME, Greece



1. Objectives of the volcanological community

- To share data, products and best practices in monitoring and research methods to promote the application of the **Open Science** paradigm in volcanology
- To facilitate access to volcano observatories, laboratories and computational facilities in order to strengthen the **European volcanology community**





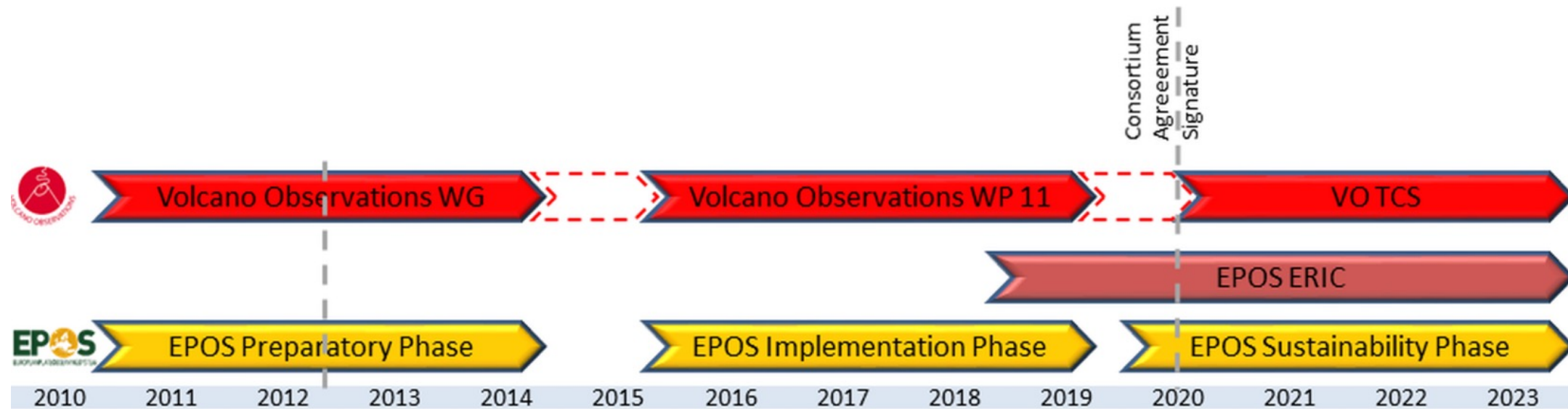
1. Mission of the VO-TCS



The **overall mission of** the **VO-TCS** is to:

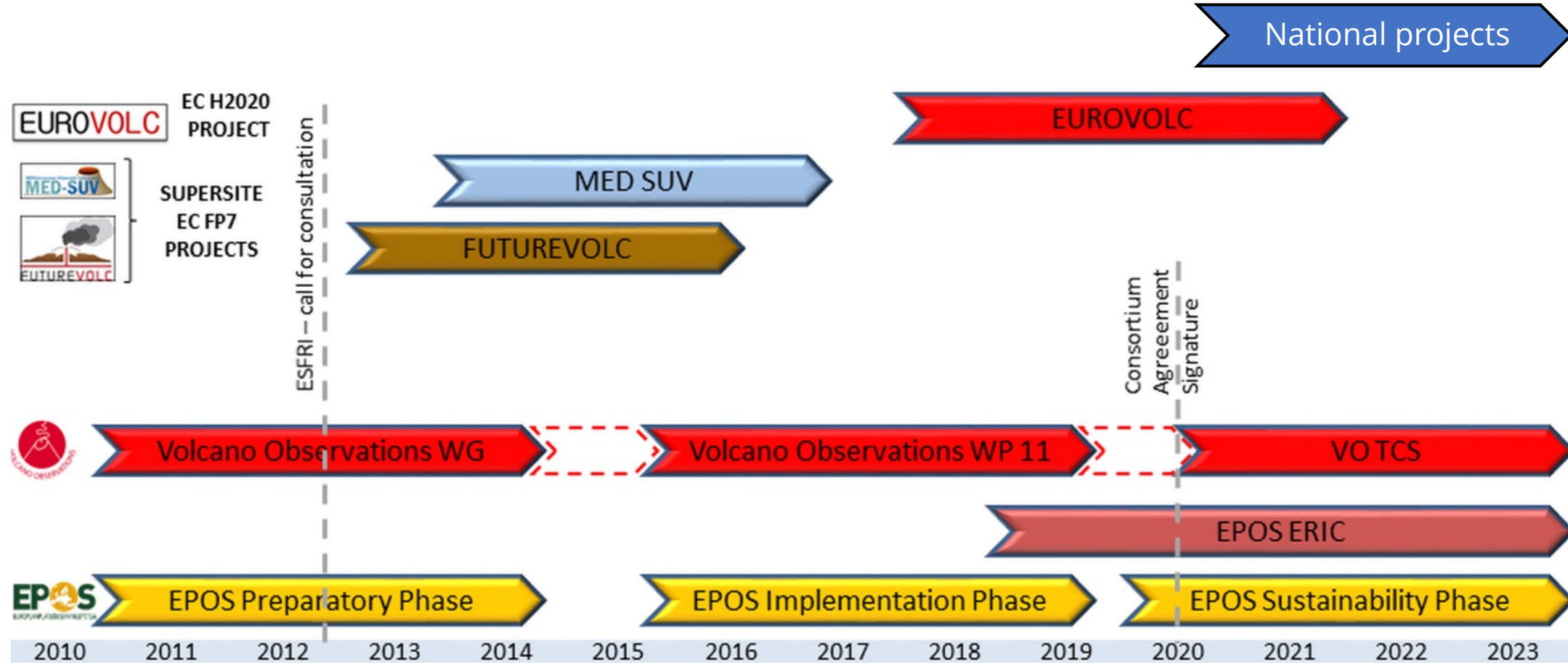
- provide **coordination** between the European Volcano Observatories (VO) and Volcano Research Institutions (VRI)
- implement **interoperable services**
- provide **long-term sustainable access** to Volcanological Data, Products and Services related to volcanic areas monitored and/or studied by the European VOs and VRIs
- promote **standardization** and **good practices** through EPOS

2. Timeline of activities



Participation in the EPOS build-up provided additional opportunities to further design and implement the European volcanological infrastructure

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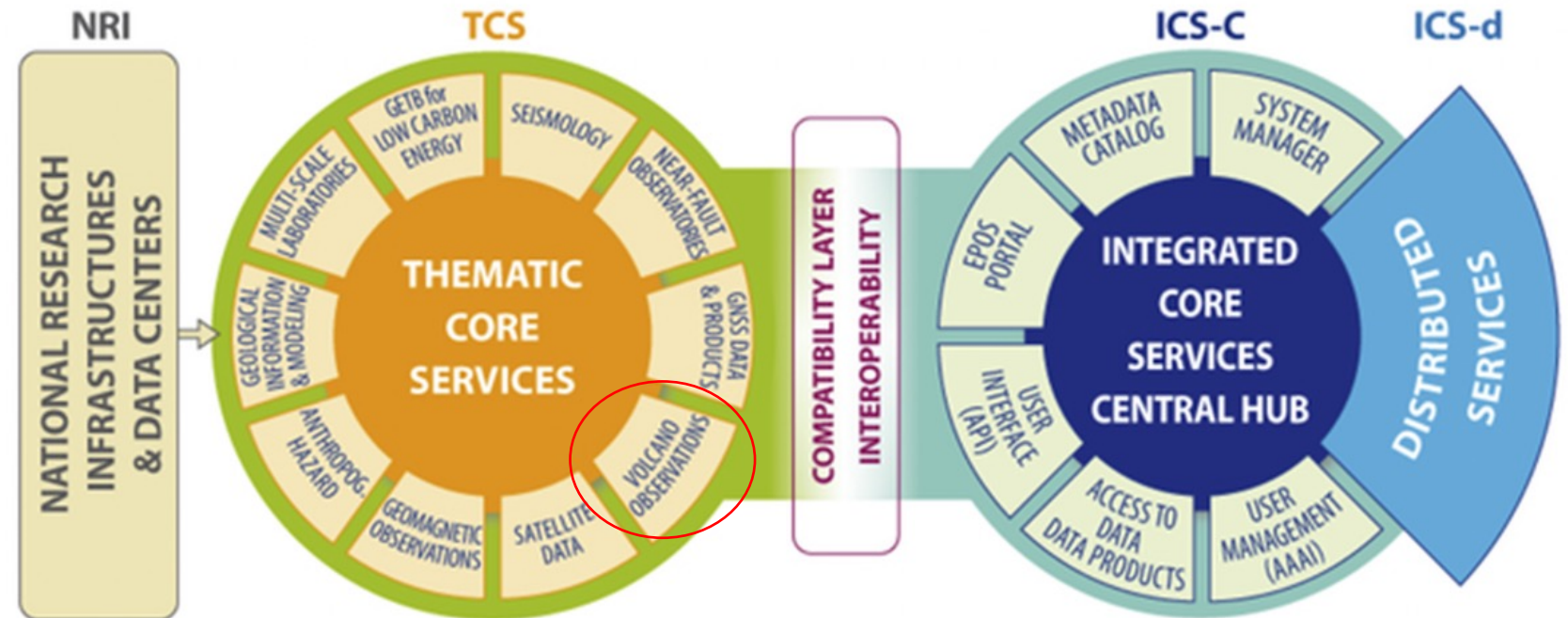


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3. Structure and functional architecture of EPOS: TCS and ICS

The EPOS architecture is composed of three connected technical and structural elements:

1. National Research Infrastructures (**NRI**)
2. Thematic Core Services (**TCS**)
3. Integrated Core Services (**ICS**)

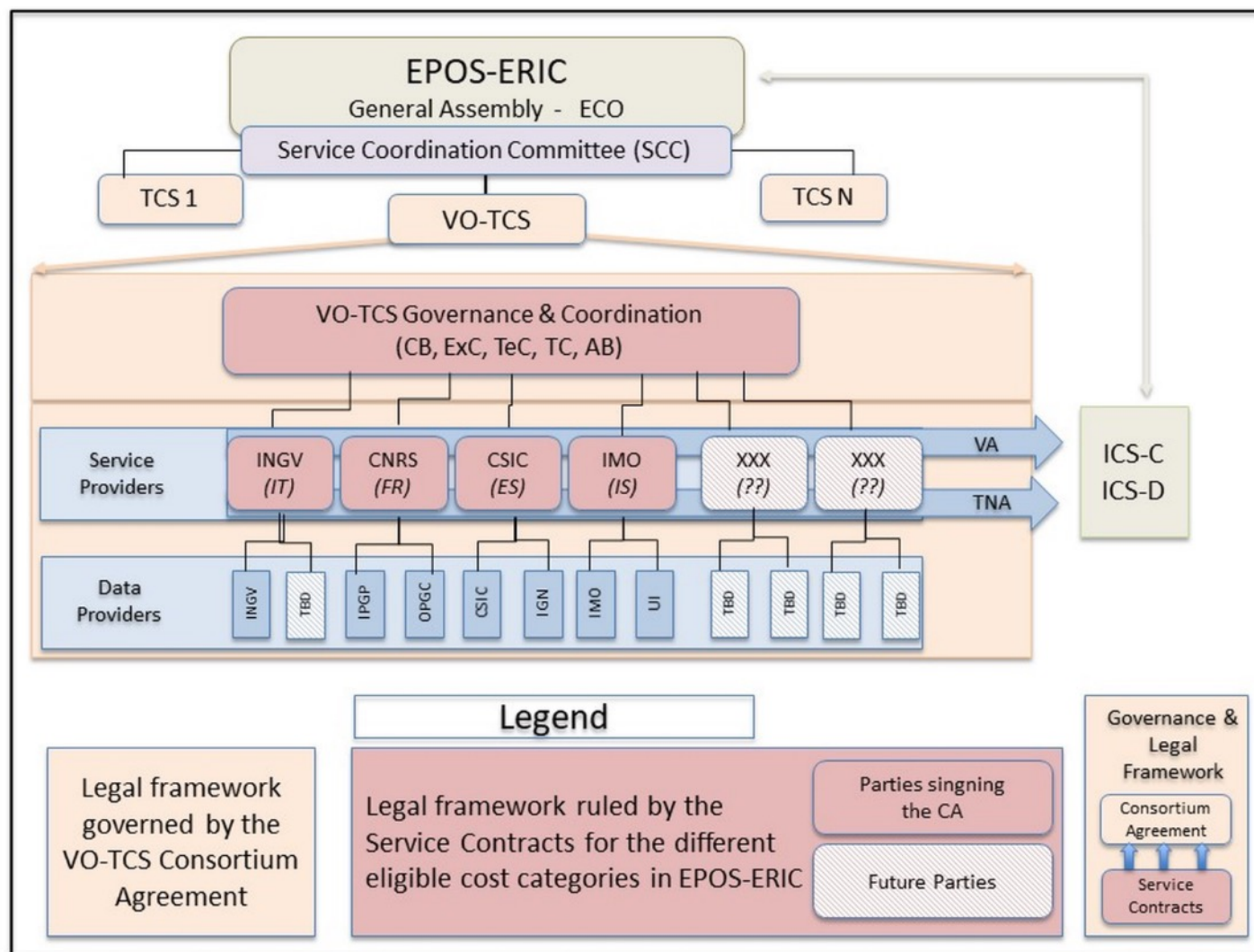


Volcano Observations Thematic Core Service = **VO-TCS**

3. Structure and Governance of the VO-TCS

General architecture of the VO-TCS (pink box)

- The *top* level refers to management, or **Governance**
- The *middle* level refers to the **technical management of the services** (Virtual Access and Trans-National Access services) – all **managed by the Service Providers**
- The *lowest* level refers to the **sources of the data and products (VO-DDSS) available from the Data providers and coordinated by National Consortia** or institute

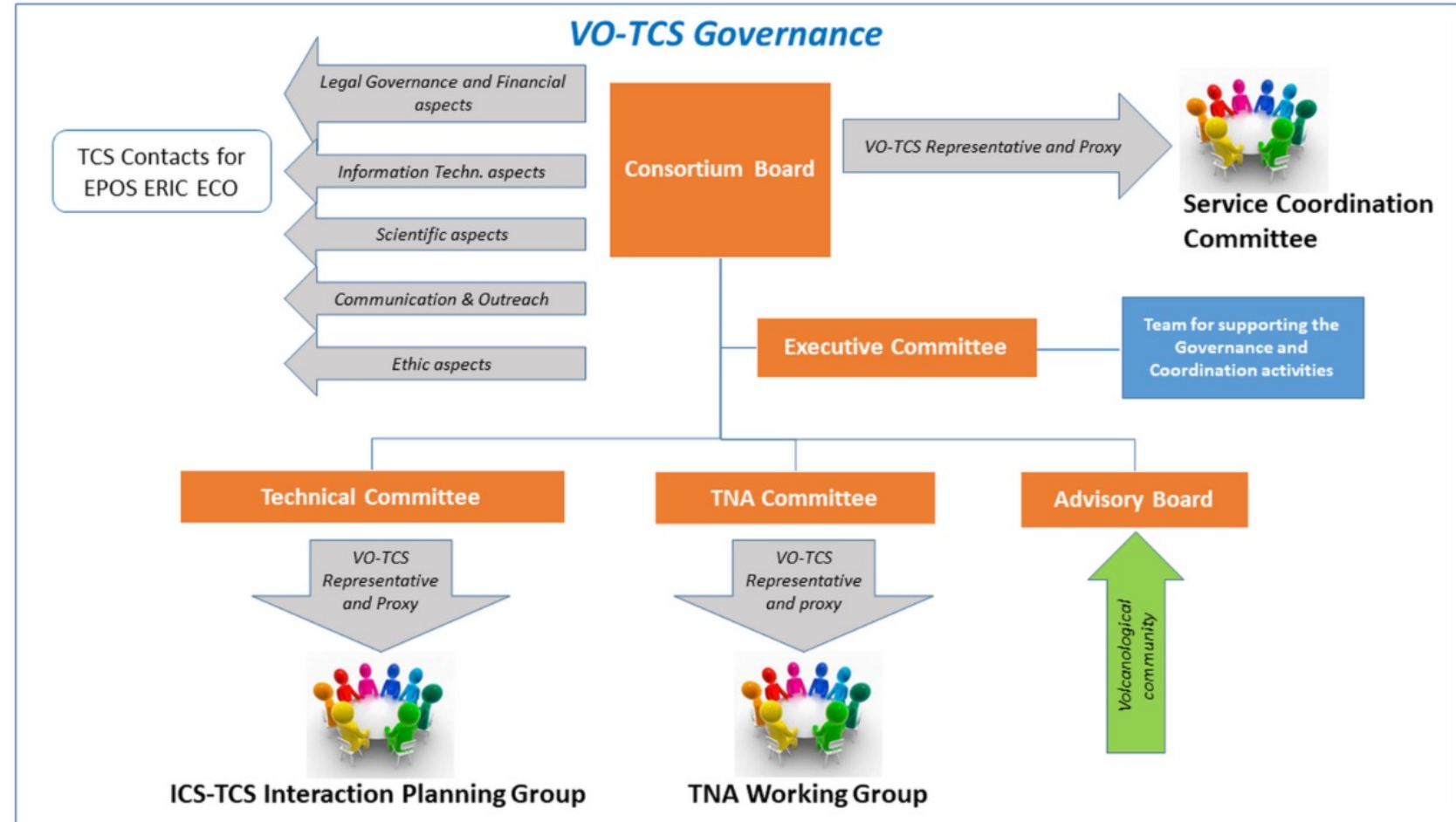




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3. Structure and Governance of the VO-TCS

- **Consortium board (CB):** Decision-making body
- **Executive Committee (ExC):** Supervisory body for execution and implementation of TCS activities and CB decisions
- **Technical Committee (TeC):** provides technical support and cooperates with ICS
- **Transnational access Committee (TC):** management of TNA activities
- **Advisory Board (AB):** supports the community building; is composed of representatives of the stakeholder community

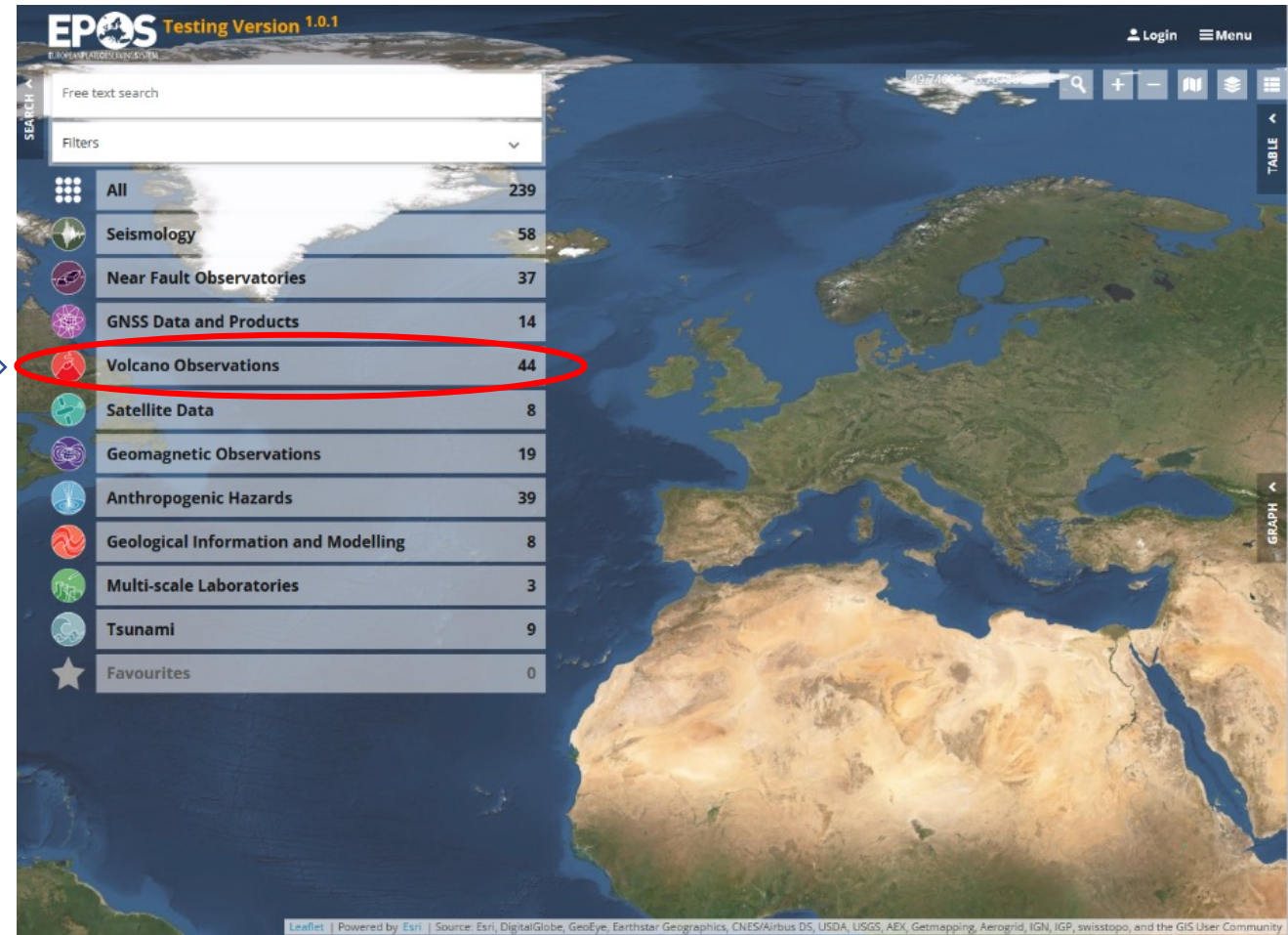
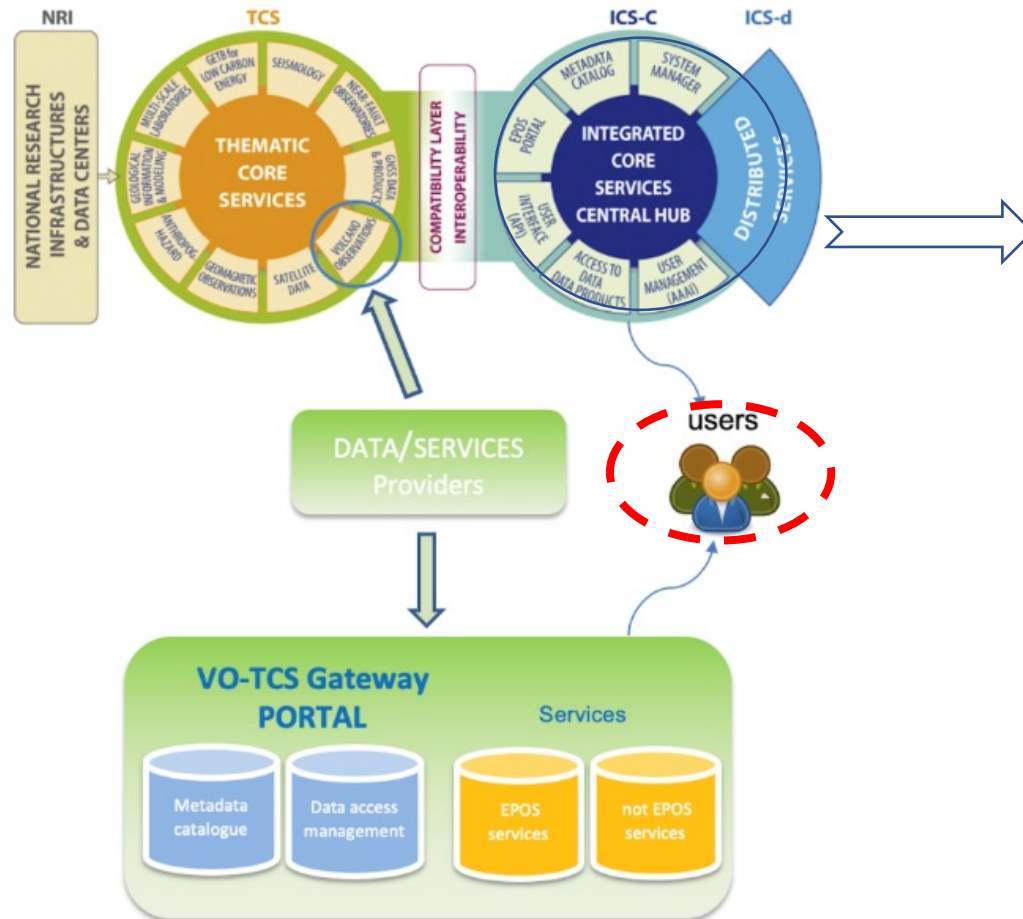




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4. The VO-TCS Services

EPOS Data Portal to be officially launched in January 2023



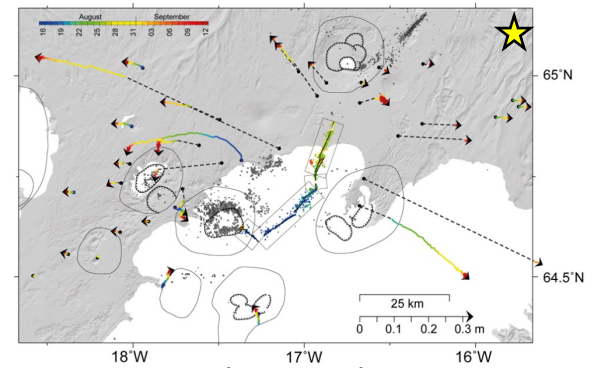
4. The VO-TCS Services

- **Access** to volcanological facilities:
 - **Virtual** i.e., through informatics networks
 - **Physical (or Remote)**, i.e. through the use of on-site observatories, laboratories, etc.
- To guarantee the **sustainability** the services they must follow the FAIR principle and 4 main aspects must also be validated :
 1. Technical, i.e., standardization and harmonization of data and metadata, interoperability with ICS, continuity of the provisions
 2. Governance, i.e., clear definition of roles and responsibilities in the service management, both at national and European level
 3. Legal, i.e., compliance with Open Access policies
 4. Financial, i.e., adoption of the EPOS funding model and a suitable strategy for future funding provisions
- The **main issue** of the implementation of the infrastructure concerns the **management of the intrinsic heterogeneity** of the volcanological services

4. The VO-TCS Services

Seismological and Geodetic Data

...ongoing work, first implementations

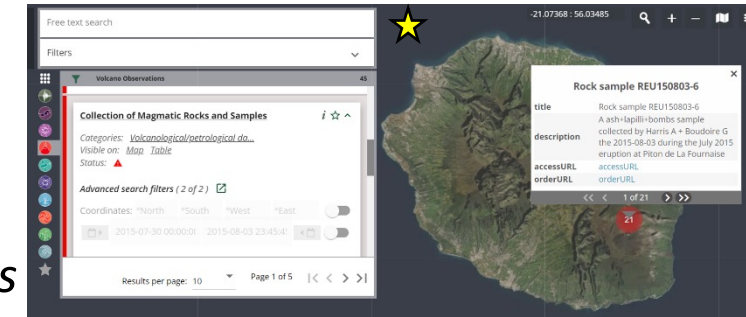


[Bárdarbunga 2014; Sigmundsson et al., Nature 2015]

DDSS Name	CSIC	IMO	INGV	IPGP	OPGC	HSGME
Velocity seismic waveforms		Eastern, Northern and Western volcanic zones	Etna, Stromboli, Vulcano, Campi Flegrei, Vesuvio	Mayotte, Montagne Pelée, Piton de la Fournaise, Soufrière de Guadeloupe,		Santorini
Acceleration /Accelerometer waveforms			Etna, Stromboli, Vulcano, Campi Flegrei, Vesuvio	Montagne Pelée, Soufrière de Guadeloupe,		
GNSS raw data (Rinex Data-15s)		★ Eastern, Northern and Western volcanic zones	Etna, Stromboli, Vulcano, Campi Flegrei, Vesuvio	Mayotte, Montagne Pelée, Piton de la Fournaise, Soufrière de Guadeloupe,		
Tiltmeter				Mayotte, Montagne Pelée, Piton de la Fournaise, Soufrière de Guadeloupe,		
Tide gauge				Soufrière de Guadeloupe		
Station information		Eastern, Northern and Western volcanic zones				

4. The VO-TCS Services

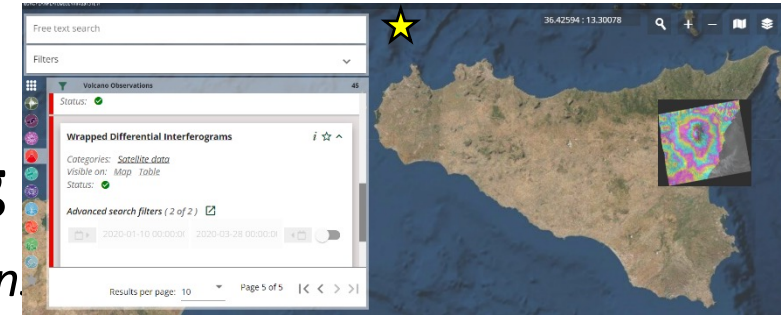
Petrological, geochemical and volcanological
data and products *...ongoing work, first implementations*




DDSS Name	CSIC	IMO	INGV	IPGP	OPGC	HSGME
Collections of magmatic rocks					Piton de la Fournaise★	
Reports on volcanic activity		All volcanoes in Iceland	Etna	Mayotte, Montagne Pelée, Piton de la Fournaise, Soufrière de Guadeloupe,		
Aviation colour codes for volcanoes		All volcanoes in Iceland	Etna	Mayotte, Montagne Pelée, Piton de la Fournaise, Soufrière de Guadeloupe,		
Catalogue of eruptions		Bárðarbunga, Eyjafjallajökull, Grímsvötn, Hekla, Katla				
Chemical analysis and physical properties of gas, water and rocks			Etna		Piton de la Fournaise	

4. The VO-TCS Services

Ground-based and Satellite Remote Sensing
data and products *...ongoing work, first implementation.*



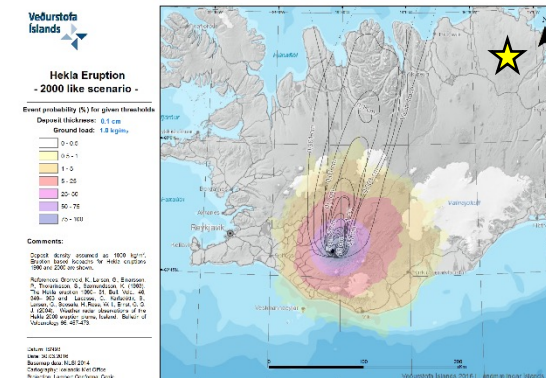
DDSS Name	CSIC	IMO	INGV	IPGP	OPGC	HSGME
Ground-based radar data		Grímsvötn, Eyjafjallajökull				
Ground-based visible and thermal / IR camera		Bárðarbunga				
Ground-based doppler radar near-source eruptive parameters					Etna	
Ground-based UV scanner spectra		Bárðarbunga				
Volcanic Plume (Ash + SO ₂)					Active volcanoes between -70° and 70° of latitude and longitude	
Thermal anomaly (lava flow)					Active volcanoes between -70° and 70° of latitude and longitude	
Wrapped Differential Interferograms (Phase and Amplitude)			Etna 		Piton de la Fournaise	
InSAR lava flow maps					Piton de la Fournaise	
Ground-based Doppler radar spectra					Etna	



4. The VO-TCS Services

Geohazard and Modeling products and services

...ongoing work, first implementations



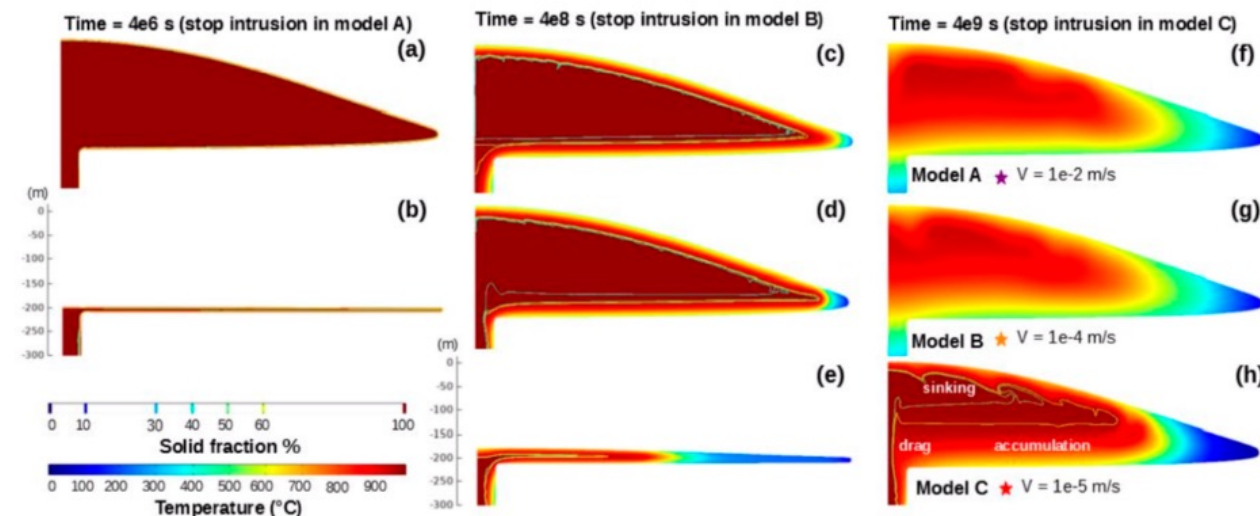
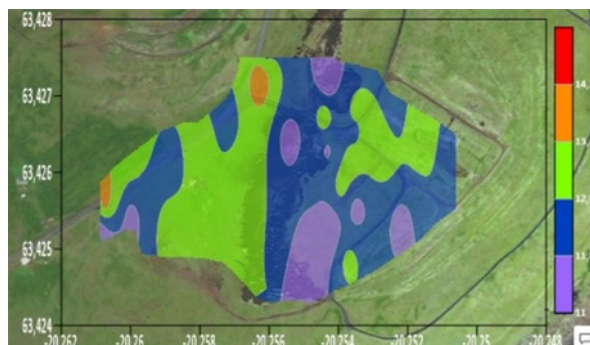
DDSS Name	CSIC	IMO	INGV	IPGP	OPGC	HSGME
SO2 concentration probabilistic hazard maps		Bárðarbunga				
Spatial probability analysis/maps	San Miguel, Lanzarote Island, El Hierro island, Deception Island, La Garrotxa Volcanic Field					
Lava flow invasion hazard maps	Lanzarote island, El Hierro island, Deception Island, La Garrotxa Volcanic Field					
Tephra fallout hazard maps for explosive	Lanzarote island	★ Hekla, Katla				
PDCs hazard maps	El Hierro, Deception Island, La Garrotxa Volcanic Field					
Probabilistic volcanic hazard assessment (maps)	Lanzarote island, El Hierro island, Deception Island, La Garrotxa Volcanic Field					
Effects on health and recommendations for response to SO2 from volcanic eruptions		All volcanoes in Iceland				
Daily ash/gas forecasting maps		Dependent on the daily runs				
Software catalogue for petrological to geophysical modelling			√			



4. The VO-TCS TNA Services

Physical or Remote access to the volcanological facilities:

- *Observatories*
- *Laboratories*
- *Pool of instruments*
- *Computational facilities*





5. Concluding Remarks

- The **establishment of the VO-TCS in 2020** is the result of a long history, which started in 2010 within the EPOS pan-European infrastructure for Solid Earth Science
- The **overall aim** of the VO-TCS is to foster **adoption of the Open Science paradigm in volcanology** and facilitate **access to volcano observatories, laboratories and computational facilities** in order to strengthen the European volcanology community
- The **first 44 services** will be **operational at the end of 2022** and many more will be implemented in the coming years
- The **VO-TCS wishes to cooperate with other international initiatives** (e.g. WoVodat) to **create a global infrastructure** for providing data, products and services to the volcanological community

Reference: G. Puglisi et al., 2022. The integrated multidisciplinary European volcano infrastructure: from conception to implementation, *Annals of Geophysics* (in press)