EPOS: European Plate Observing System

A long-term plan for the integration of research infrastructures for solid Earth Science in Europe

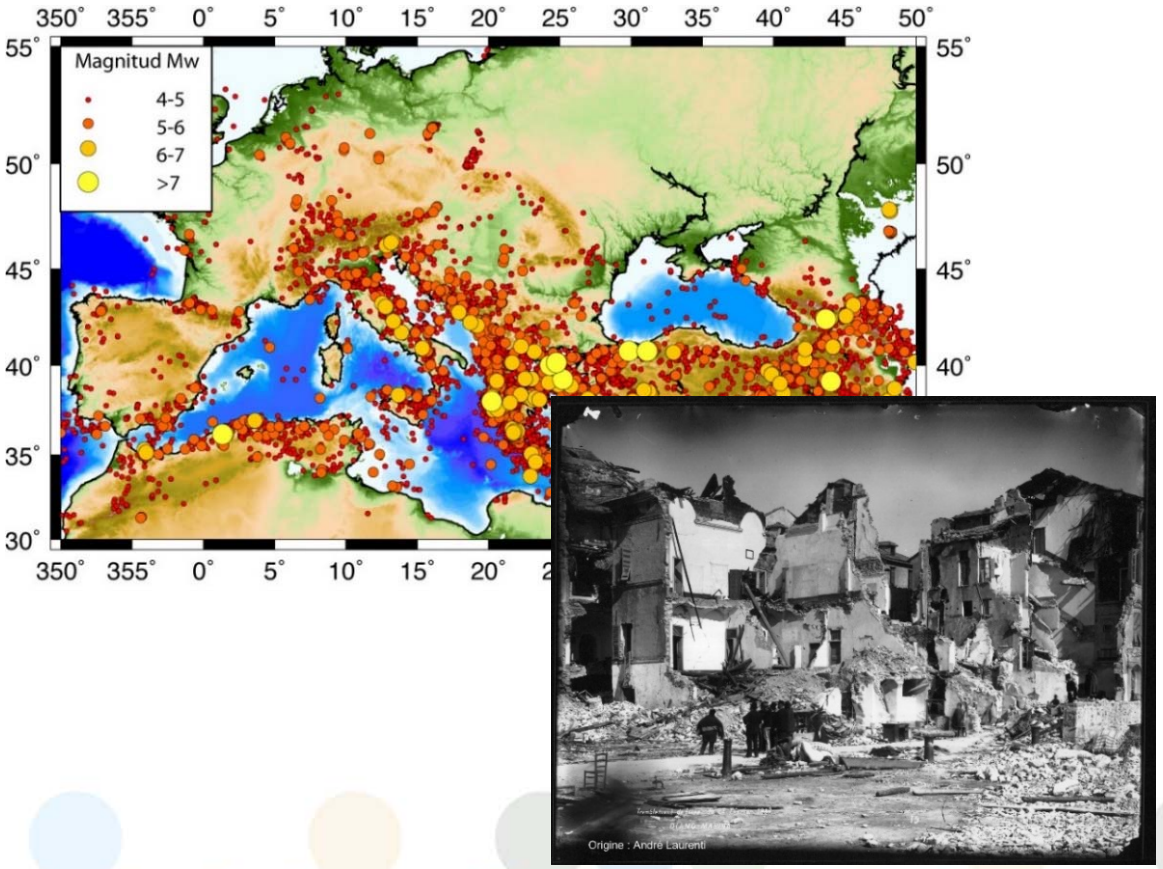
- P. Labazuy
- and the EPOS-France Team

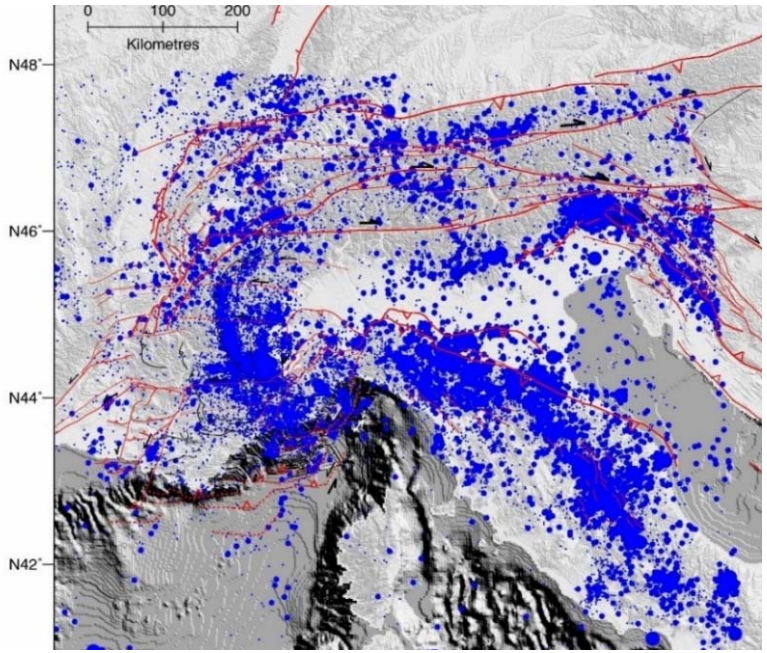
- Laboratoire Magmas et Volcans,
- Observatoire de Physique du Globe de Clermont-Ferrand,
- Université Clermont Auvergne

MDIS - Form@ter 2017
Mesure de la Déformation par Imagerie Spatiale
Clermont-Ferrand, Besse-en-Chandesse, 16-20 Octobre 2017

EPOS European Infrastructure: Objectives?

- Earth observation **to understand the dynamics of the Earth**.
- **Applications to natural hazards in Europe**, characterized by **complex tectonics**, **telluric hazards** - earthquakes, volcanoes, landslides, etc. - and **anthropogenetic hazards**, associated with **high vulnerability**.





Document: I. Manighetti

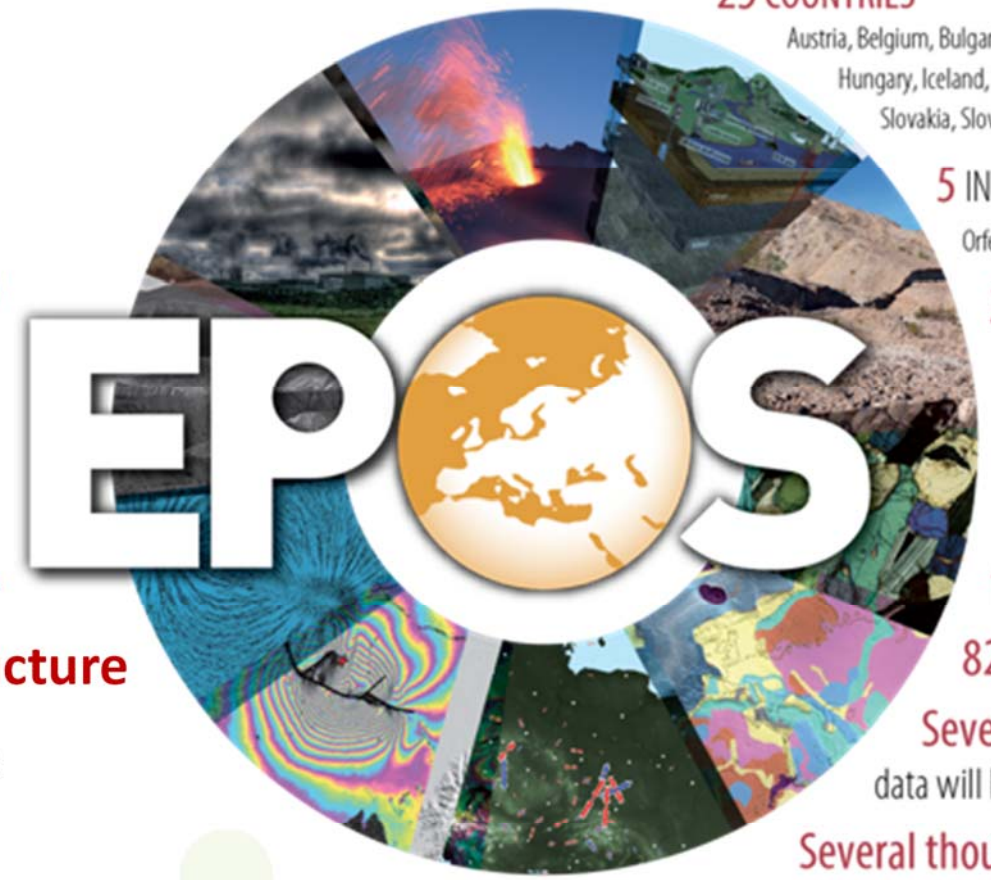
Seismogenic faults (red) and seismicity (blue)

… introducing EPOS

https://www.epos-ip.org/

EPOS is a **long-term plan for the integration** of research infrastructures for solid Earth Science in Europe

EPOS integrates the **existing (and future)** advanced European facilities into **a single, distributed, sustainable infrastructure** taking full advantage of new **e-science opportunities**



25 COUNTRIES

Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Grecee, Hungary, Iceland, Ireland, Italy, The Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom

5 INTERNATIONAL ORGANIZATIONS

Orfeus, EMSC, EUREF, INTERMAGNET, EuroGeoSurveys

256 NATIONAL RESEARCH INFRASTRUCTURES

4939 SEISMIC STATIONS

2272 GPS RECEIVERS

464 TB SEISMIC DATA

118 LABORATORIES

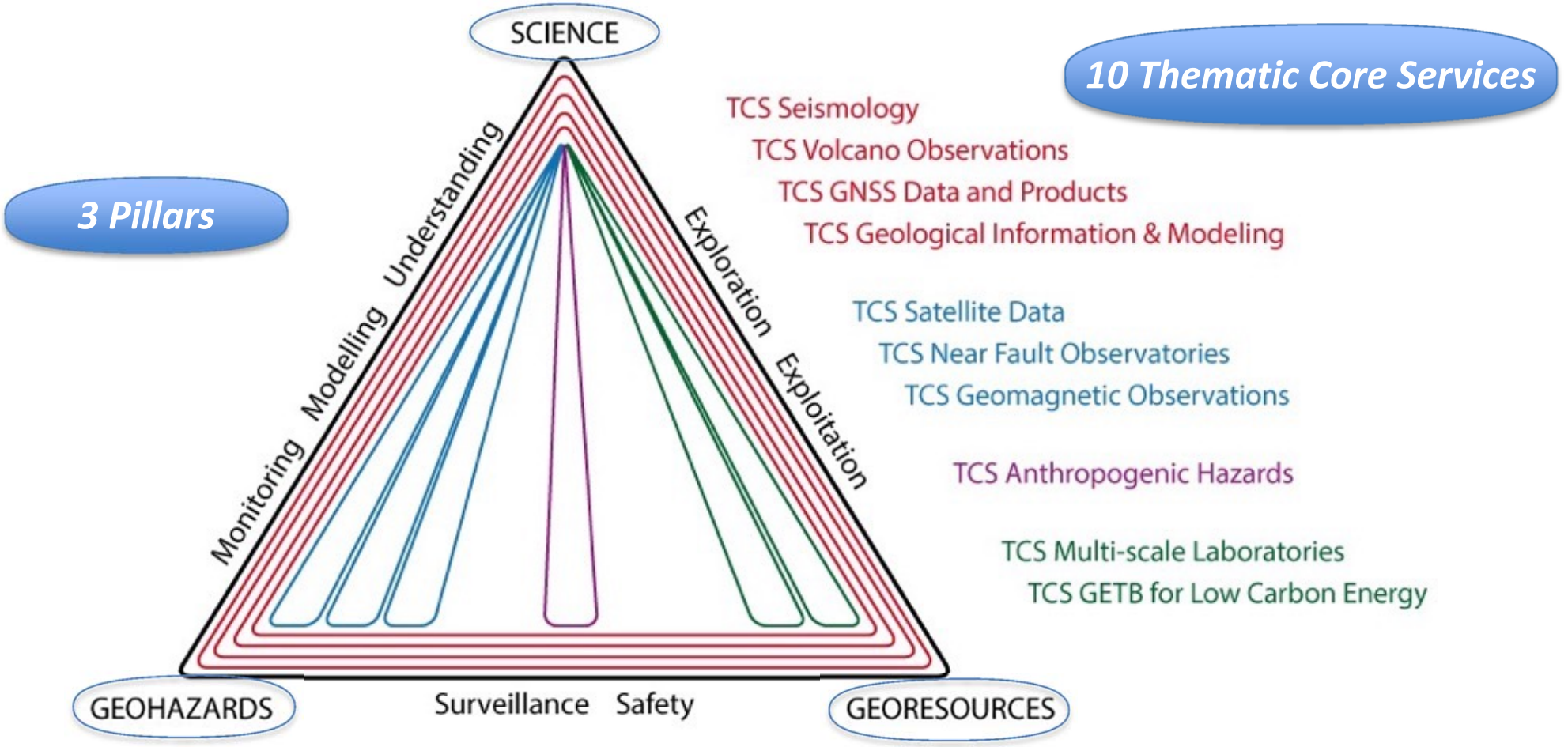
828 INSTRUMENTS

Several PetaBytes of solid Earth Science data will be available

Several thousands of **users** expected to access the infrastructure

EPOS Community

- The range of **communities** participating in EPOS measures its **multidisciplinary** insight and potential impact on the Earth Science community and beyond.



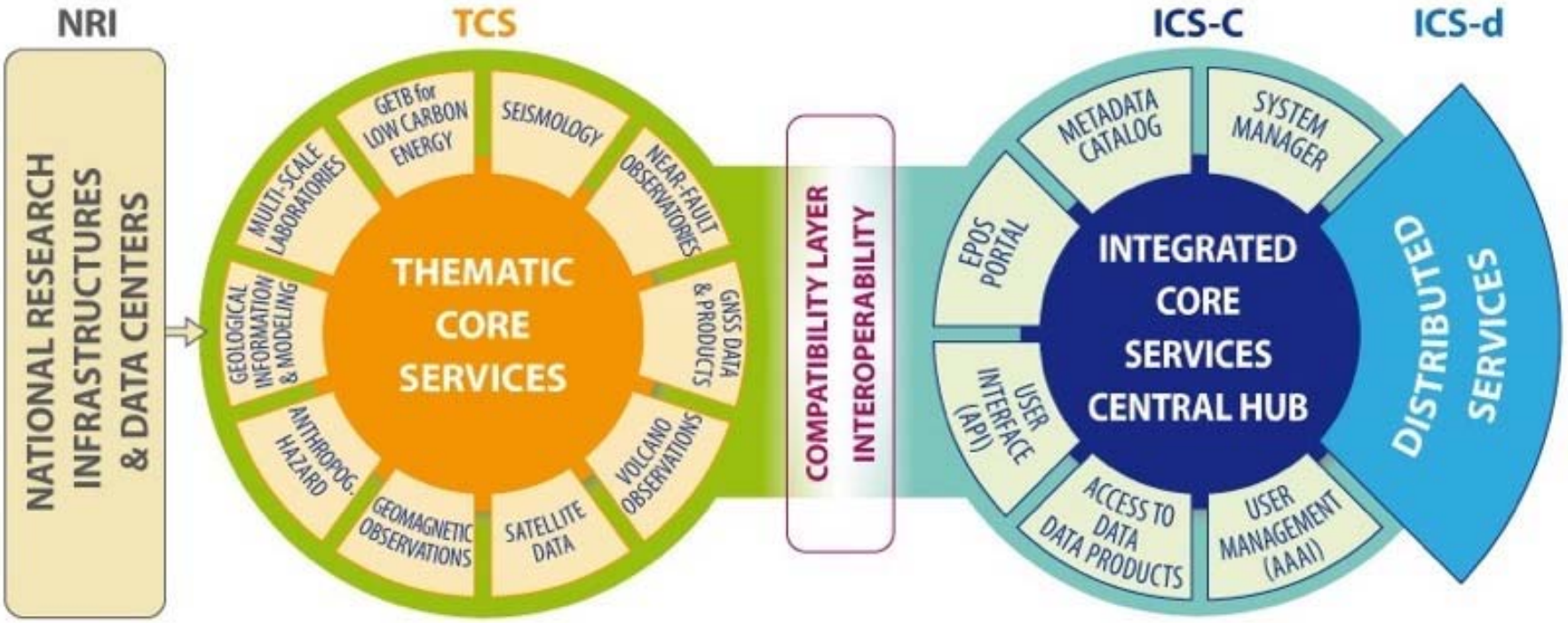
- EPOS aim to **increase the efficiency** of the integrated research infrastructures by **improving and simplifying** the **access (Trans National & Virtual Access - TNA&VA)** to them and the **use** of their data and products

EPOS Concept & Functional Architecture

National Research Infrastructures

Community Layer
Community-specific integration

Integration Layer
Novel e-infrastructure



- **Provide services at national level**
- **Send data to the European thematic data infrastructures**

The governance framework where data and services are provided by communities

Interoperability Layer

Access to multidisciplinary data, products and tools for different stakeholders

EPOS Thematic Core Services 1/2

Seismology	Seismic waveforms (ORFEUS) Seismological products (EMSC) Hazard & risk products (EFEHR) Computational sesmology
Near fault observatories	NFO multidisciplinary data & products Borehole data Virtual laboratory & early warning test beds
GNSS data and products	GNSS primary data & derived products Processing and visualization tools
Satellite data	SAR interferograms Integrated satellite products On-line processing tools
Volcano observations	Multidisciplinary volcanic data & products Hazard products TNA to volcano observations

EPOS Thematic Core Services 2/2

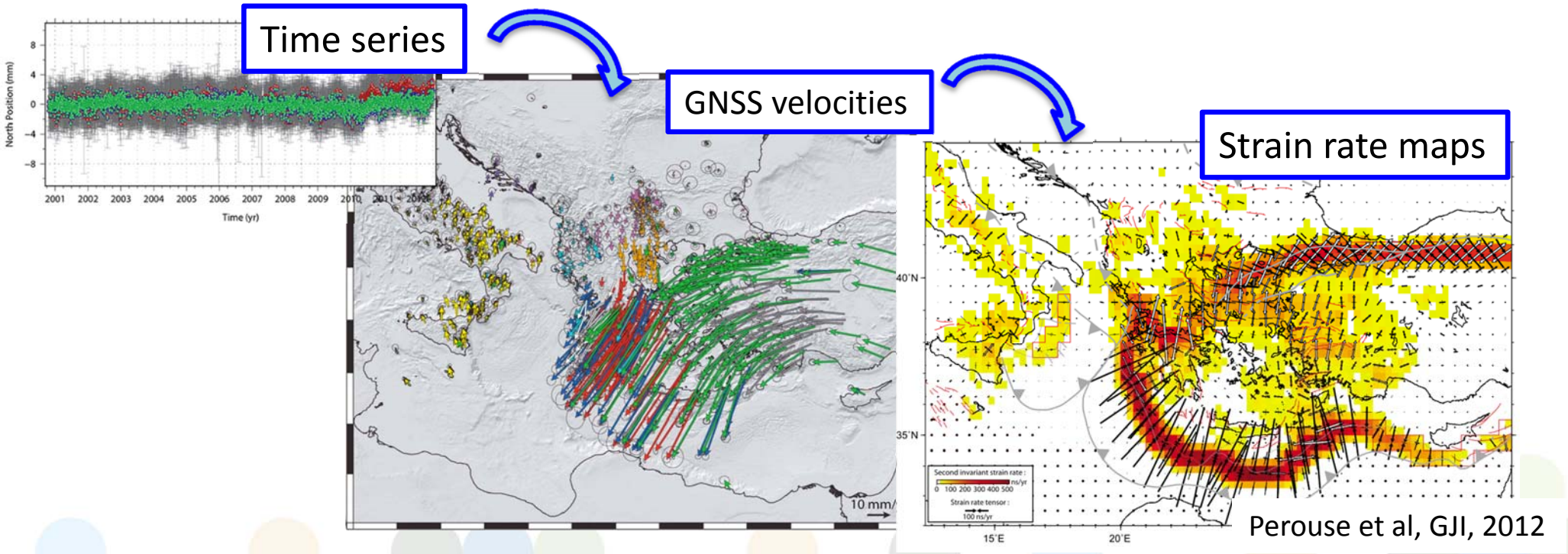
Anthropogenic hazards	Data for AH episodes Multi-hazard simulator - multi-risk assessment AH data visualisation
Geomagnetic observations	Global and regional geomagnetic models Magnetotelluric data
Geological information and modeling	Geological multi-scale data Integrated geological maps Borehole visualization
Multi-scale laboratories	Experimental & analogue data TNA to experimental & micro-analytical facilities
Geo energy test beds for low carbon energy	Geo energy test beds Access to in-situ GETB exsperiments

TCS GNSS Data and Products

Services / Objectives / Users

- Archive and Dissemination of **GNSS data:**
  Rinex files (and associated metadata)
  → geodesists, geophysicists able to process GNSS data

- Archive and Dissemination of **GNSS derived products** :
  Coordinate Time-Series, Velocity Fields, and Strain Rate Maps (and associated metadata)
  → geophysicists: seismology, tectonics, geodynamics, hydrology, surface loading, modelling…

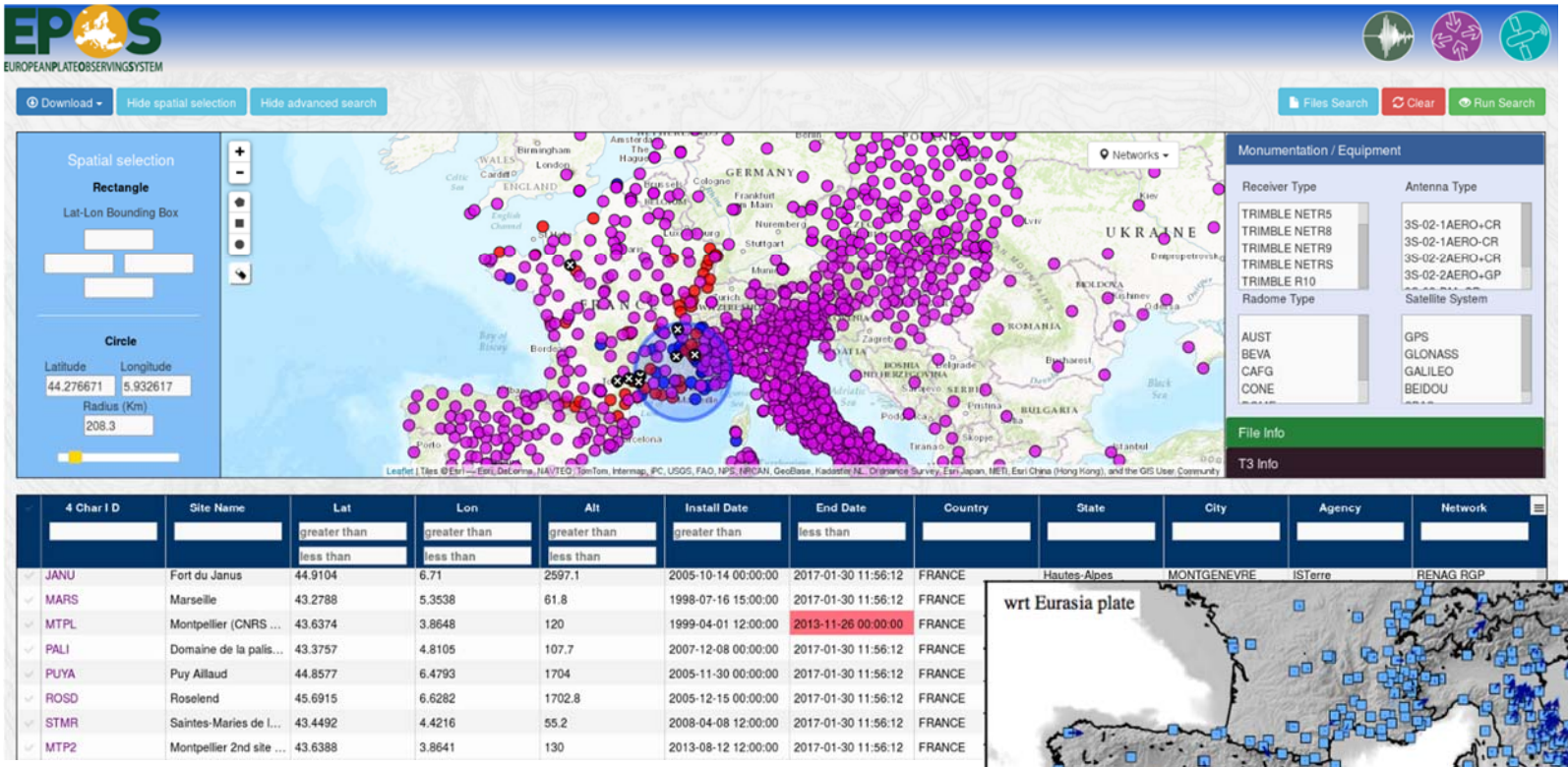


Perouse et al, GJI, 2012

TCS GNSS Data and Products

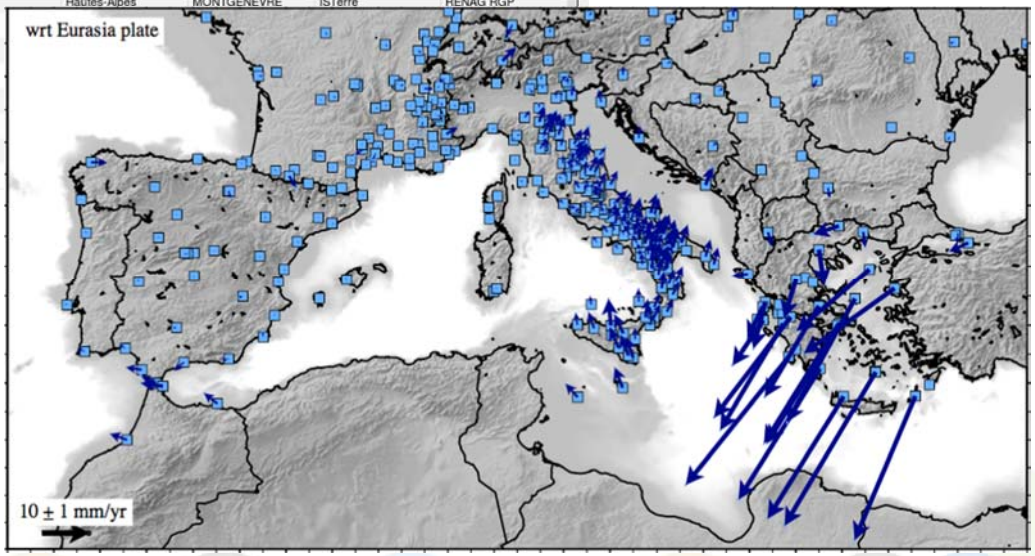
Distribution

Distribution of data (RINEX) and metadata through a portal…



4 Char I D	Site Name	Lat	Lon	Alt	Install Date	End Date	Country	State	City	Agency	Network
		greater than / less than	greater than / less than	greater than / less than	greater than	less than					
JANU	Fort du Janus	44.9104	6.71	2597.1	2005-10-14 00:00:00	2017-01-30 11:56:12	FRANCE	Hautes-Alpes	MONTGENEVRE	ISTerre	RENAG RGP
MARS	Marseille	43.2788	5.3538	61.8	1998-07-16 15:00:00	2017-01-30 11:56:12	FRANCE				
MTPL	Montpellier (CNRS ...	43.6374	3.8648	120	1999-04-01 12:00:00	2013-11-26 00:00:00	FRANCE				
PALI	Domaine de la palis...	43.3757	4.8105	107.7	2007-12-08 00:00:00	2017-01-30 11:56:12	FRANCE				
PUYA	Puy Aillaud	44.8577	6.4793	1704	2005-11-30 00:00:00	2017-01-30 11:56:12	FRANCE				
ROSD	Roselend	45.6915	6.6282	1702.8	2005-12-15 00:00:00	2017-01-30 11:56:12	FRANCE				
STMR	Saintes-Maries de l...	43.4492	4.4216	55.2	2008-04-08 12:00:00	2017-01-30 11:56:12	FRANCE				
MTP2	Montpellier 2nd site ...	43.6388	3.8641	130	2013-08-12 12:00:00	2017-01-30 11:56:12	FRANCE				

… and products
(Daily Solutions, Time series, velocities, strain)



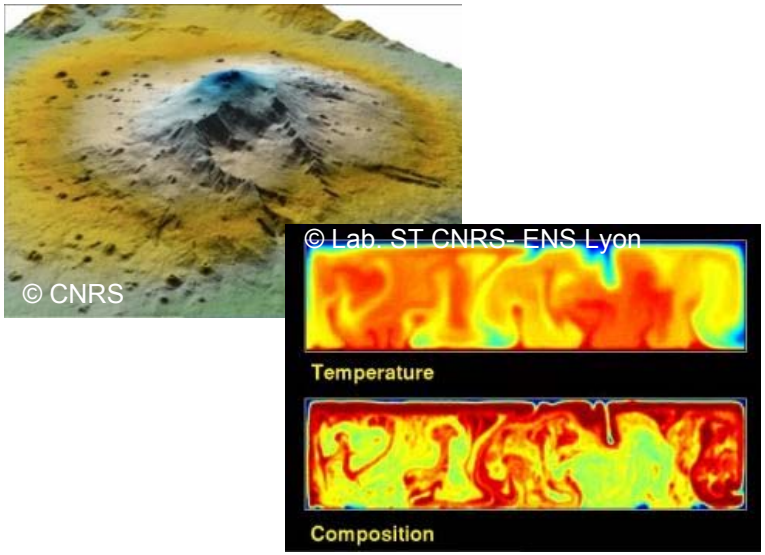
cf A. Déprez et al., EPOS- GNSS: The prototype solution in double difference from CNRS-UGA processing center. MDIS-Formater 2017 Workshop

TCS Satellite Data

Dedicated to the **determination of the Earth surface displacements** through Satellite Radar and Optical data

Leader : **CNR (Italy)**

CNRS (France)
INGV (Italy)
GFZ (Germany)
UoL (UK)
CSIC (Spain)



- TCS partners provide products and services
- Input satellite data come from National and International space agencies

One of the "Satellite Data" TCS objectives is to **broaden the base of national space agencies that actively contribute to the TCS**.

See next talk: M. Diament, The data and services centre for Solid Earth ForM@Ter within the national research infrastructure

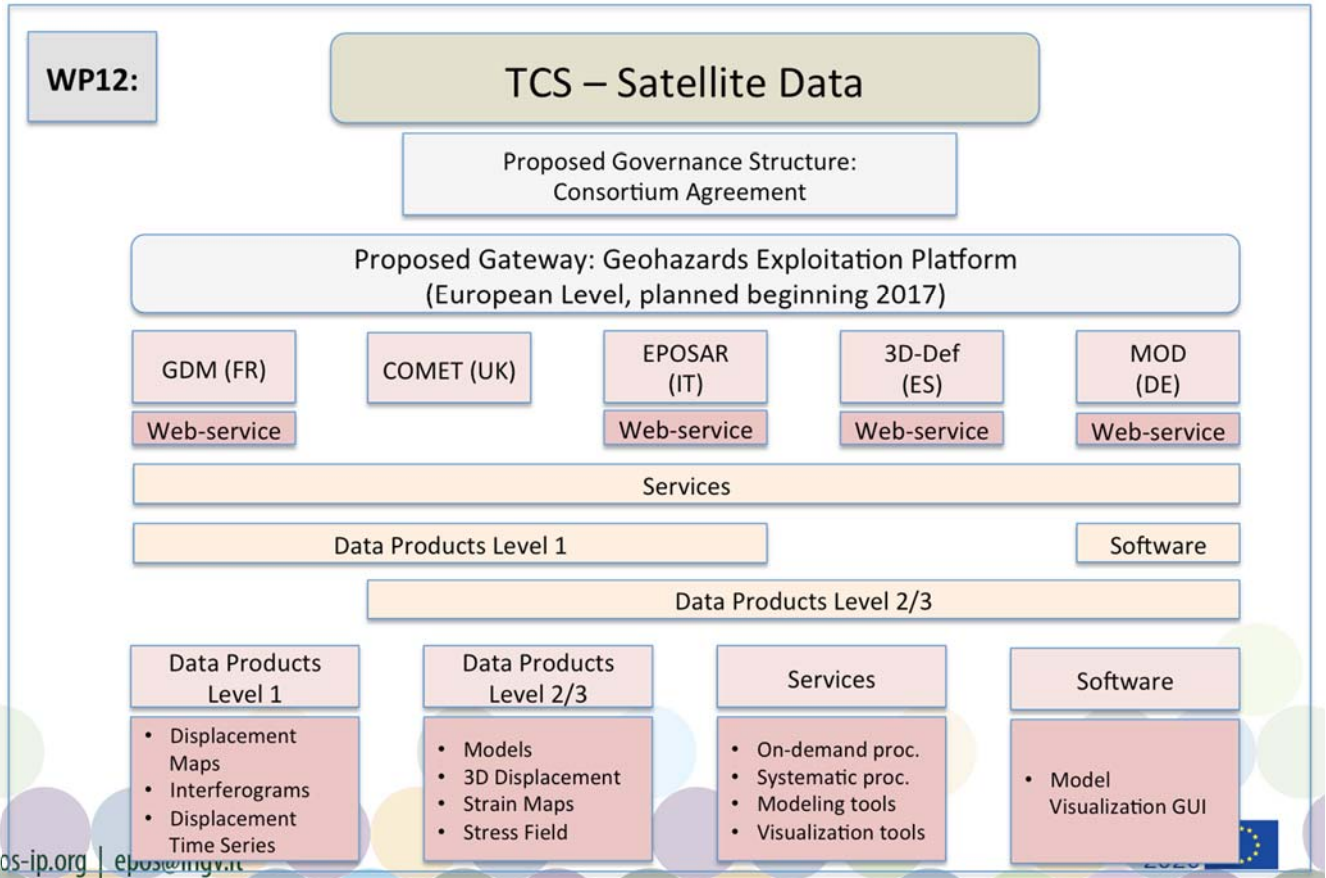
TCS Satellite Data

Services and products

Dedicated to the **determination of the Earth surface displacements** through Satellite Radar and Optical data

- **2 specific functioning modes:**
  - **Continuous**, systematic and periodic generation of products (*ex. the systematic production of updated time series of surface deformation over a given defined area*)
  - **On demand**, users run the tools and process the chosen satellite dataset (*ex. ad hoc generation of a deformation measurements using diachronic satellite observations during a telluric crisis, e.g. a co-seismic terrain motion map*).

- **2 levels:**
  - **"Standard"** (level 1) satellite products/tools: *interferograms, displacements maps, deformation time series.*
  - **Value-added** (level 2/3) satellite products/tools: *3D displacement maps, source mechanisms, fault models…*



ICS - Integrated Core Services

ICS-C

ICS-Central Hub

- Integrates the DDSS* from TCSs and makes sure they are interoperable through a metadata catalogue
- Provides access, searching, visualization and processing tools
- Orchestrates external resources (ICS-D)
- **Hosts** : BGS (UK), BRGM (France) and Geol. Survey of Denmark and Greenland

ICS-D

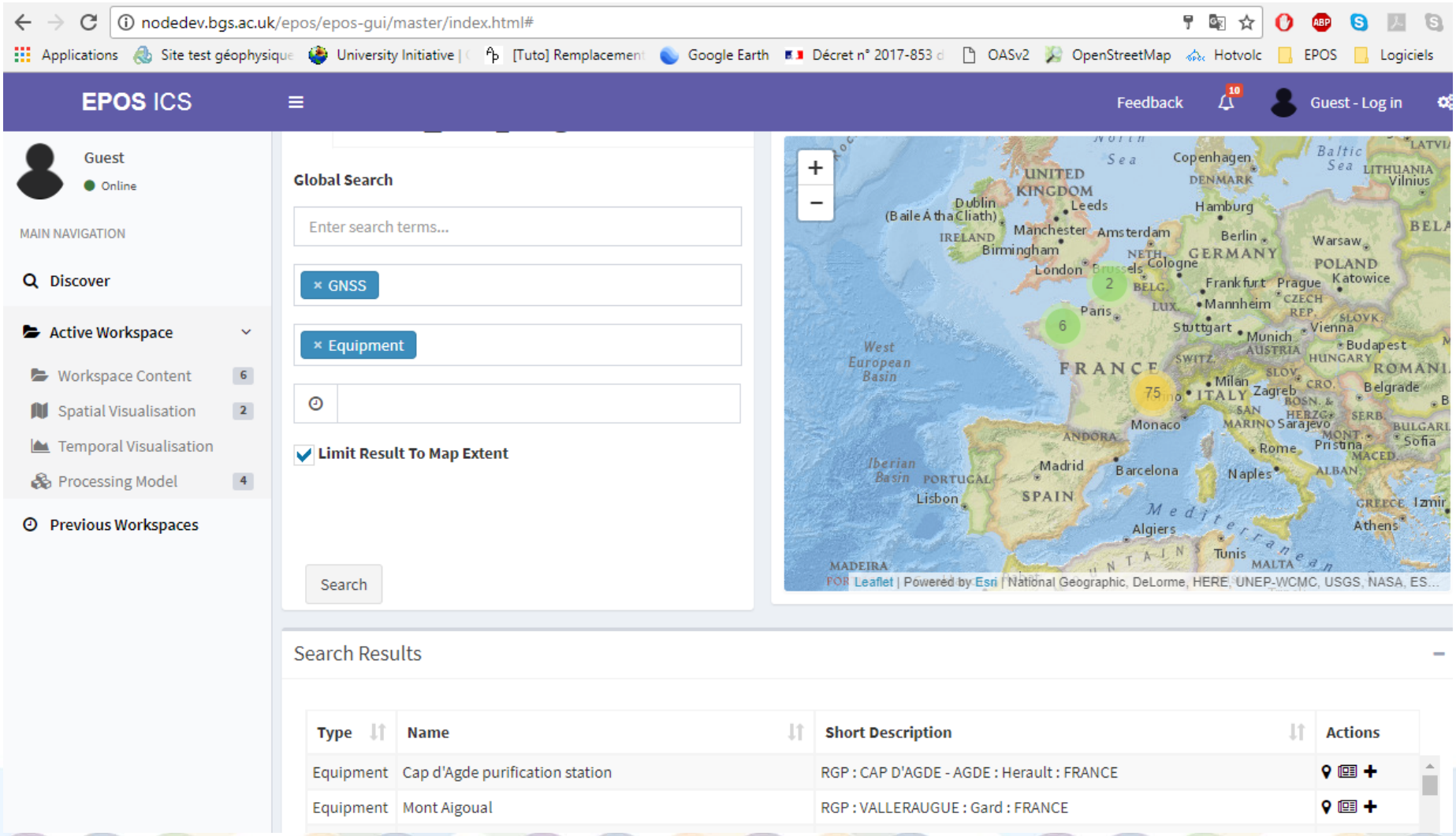
ICS-Distributed services

- Provide IT resources not built by EPOS ICS-C
- Computational resources
- Visualization resources
- Data storage facilities
- Others…

** DDSS: Data, Data Products, Software and Services*

EPOS-ICS GUI (Graphical User Interface)

- **Discover** and **harvest** available Data, Data Products, Software and Services (DDSS)
- Keypoints : **standardized** data and metadata, **direct links** for access and download



Access to Data, Data Products, Softwares, Services

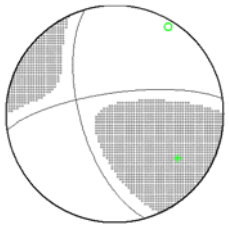
- **Level 0**: raw data, or basic data

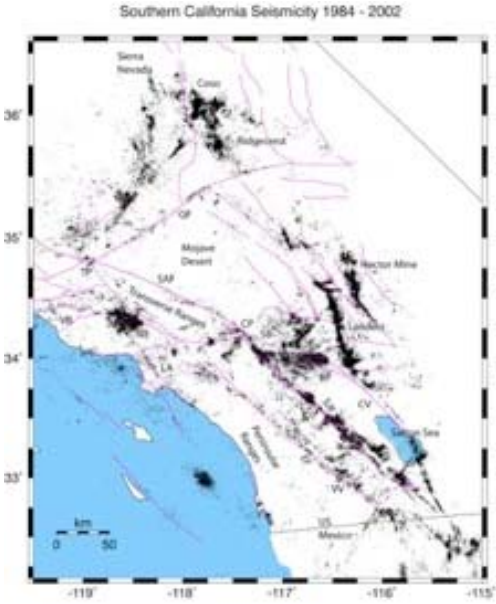
seismograms

Access to Data, Data Products, Softwares, Services

- **Level 0**: raw data, or basic data
- **Level 1**: data products coming from nearly automated procedures

Earthquake locations





Access to Data, Data Products, Softwares, Services

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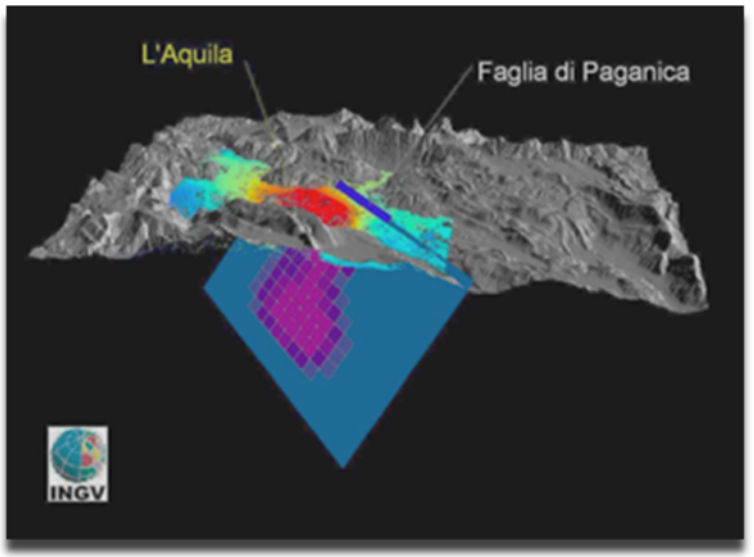

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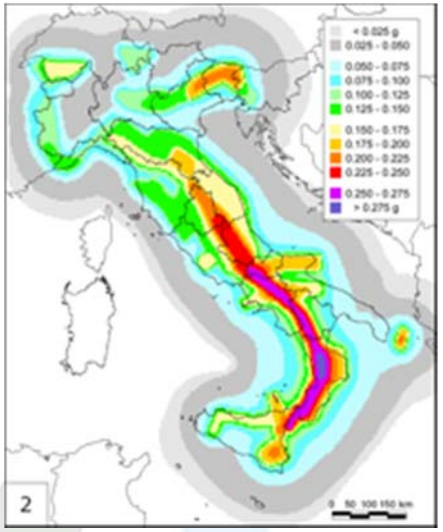

Seismic hazard map

Access to Data, Data Products, Softwares, Services

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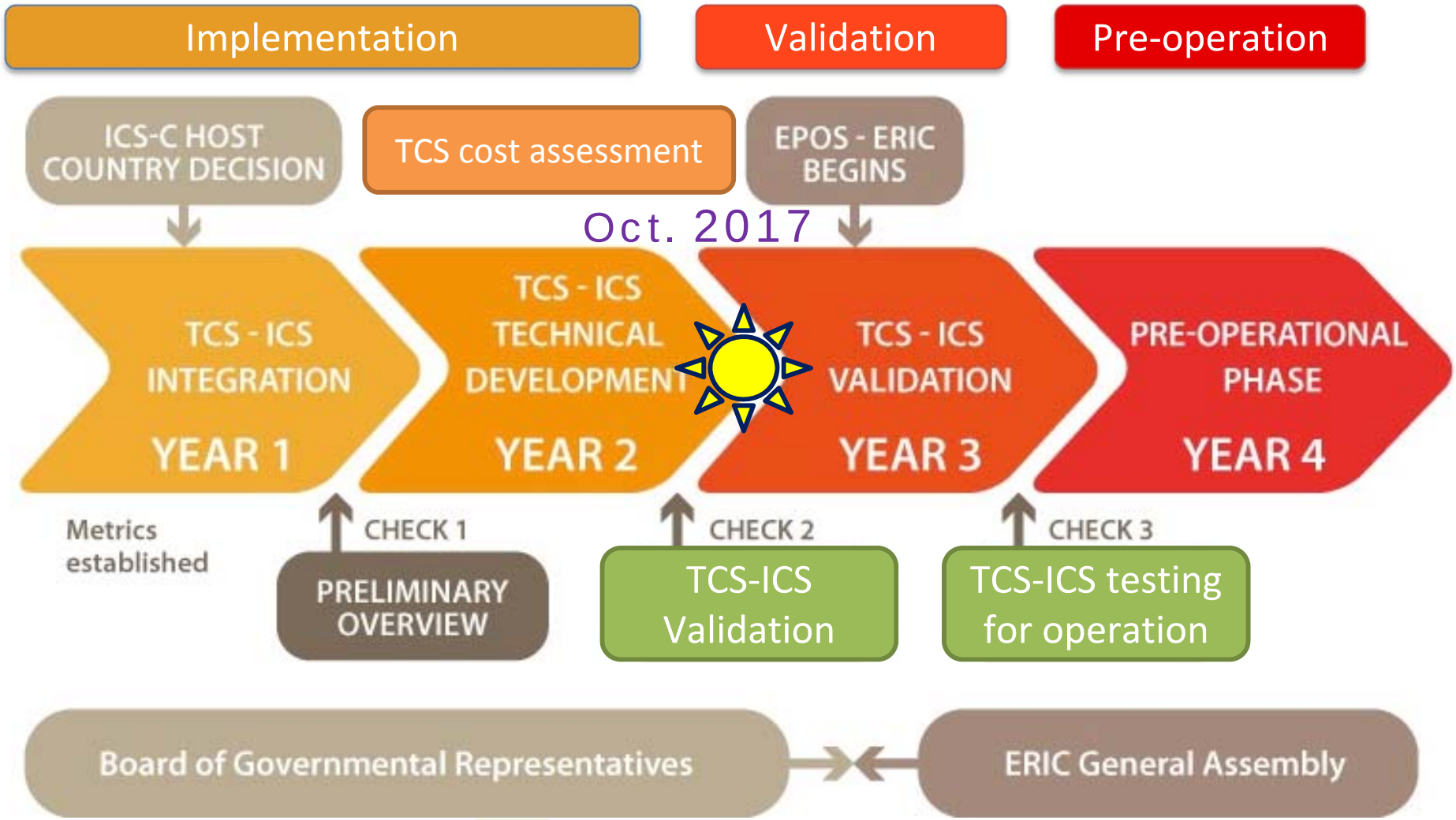
- **Level 4**: Software, IT tools

EPOS Timeline

- Dec. 2008: Inclusion of EPOS in the ESFRI (European Strategic Forum on Research Infrastructures) Roadmap
- 2010-14: Preparatory Phase (EPOS-PP)
- Oct. 2015: Start of the **Implementation phase (EPOS-IP)** – *Funded by the European Commission's Horizon 2020 program (only 3 infrastructures selected among 15 proposals) – About 18.5 M€ (2 M€ for France)*
- By the end of 2017: Starting of EPOS –ERIC (European RI Consortium)
- Oct. 2019: End of EPOS-IP – Start of the **EPOS Operational Phase**

EPOS IP project Timeline



… summing up EPOS

National Research Infrastructures ensure the **competences and resources** for collecting and analysing data and for maintaining national observation systems.

… summing up EPOS

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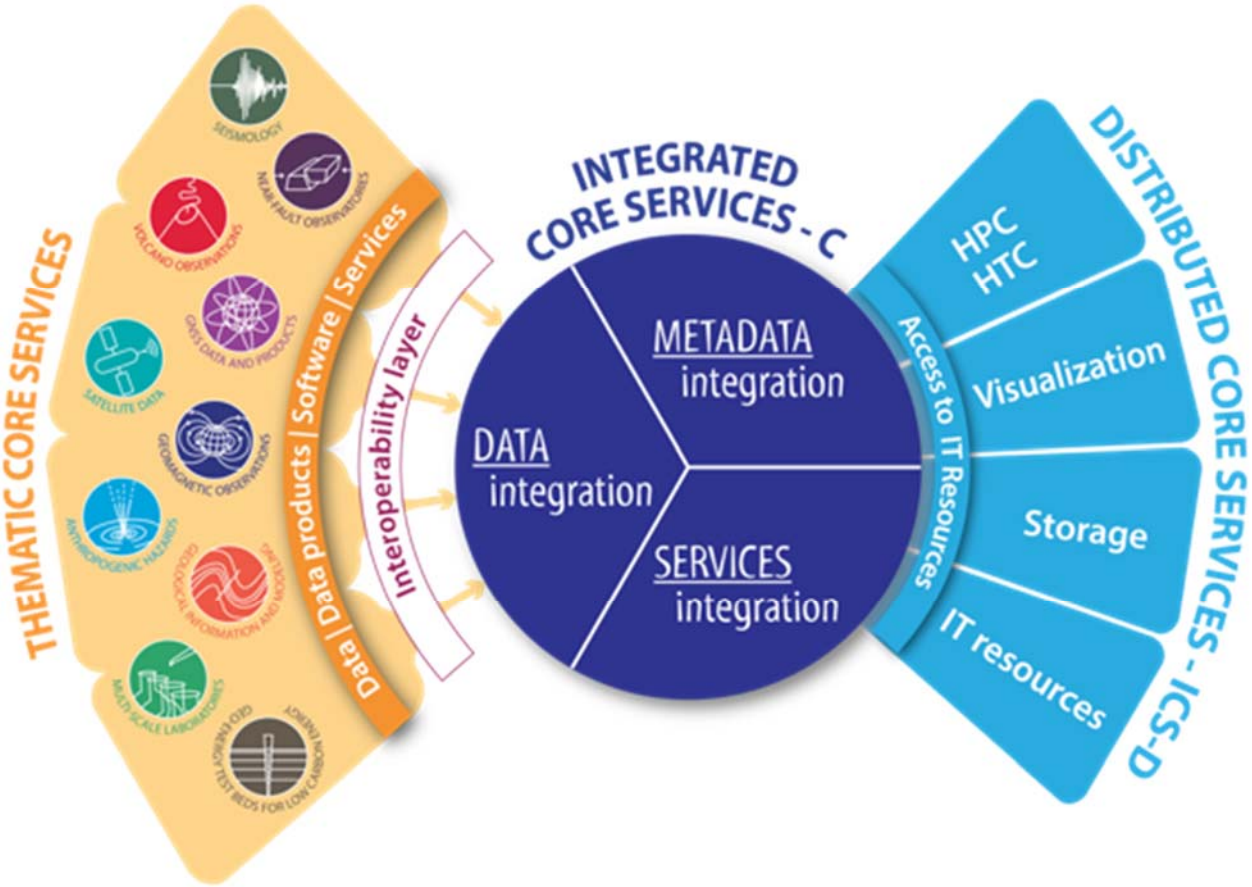
TCS are responsible for **integrating data, metadata and services** from various infrastructures for each discipline.

… summing up EPOS



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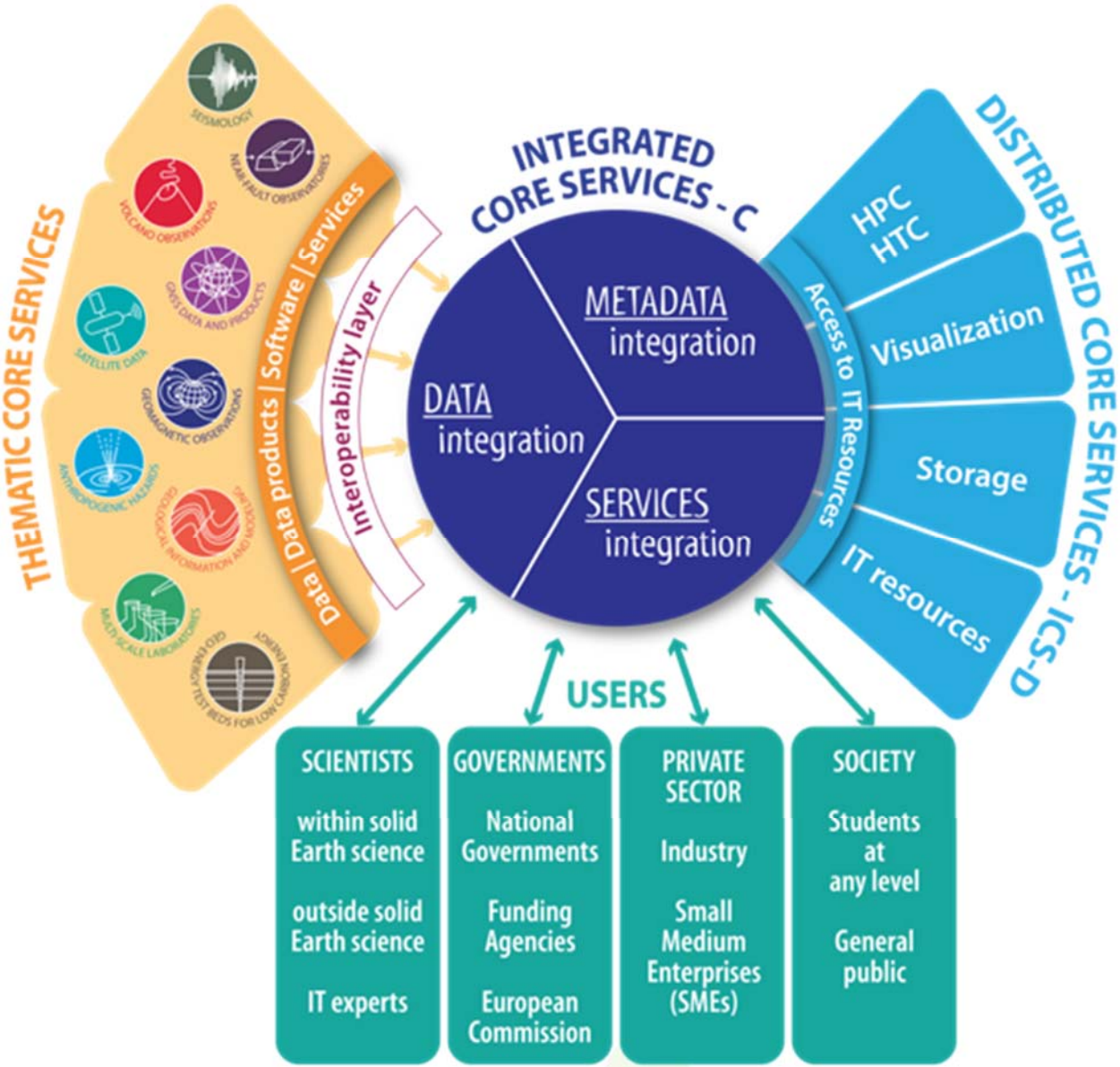
ICS provide a **new interface** that, by adopting data access policies aligned to **Open Science principles**, provides data and products in a **FAIR*** form for users.

****Findable, Accessible, Interoperable, and Re-usable***

… summing up EPOS



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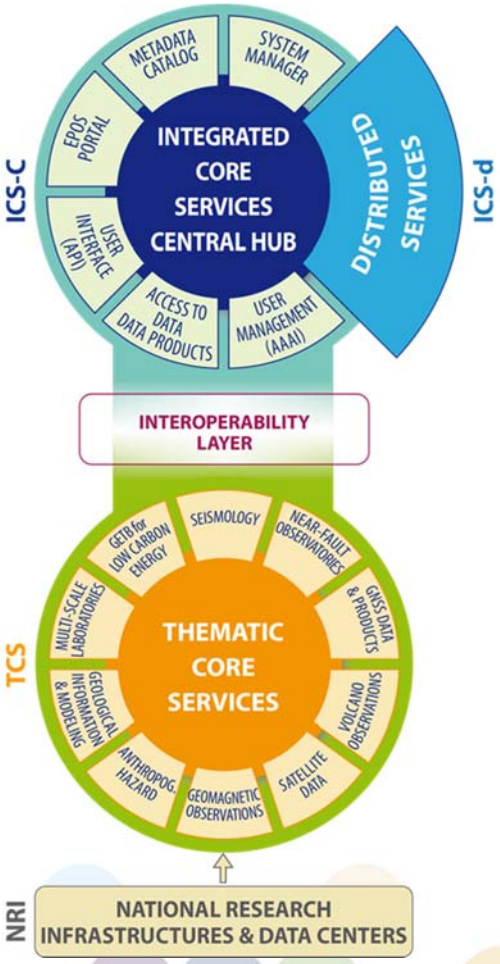
Promote **scientific and technological innovation** for successfully **addressing global major challenges in Earth sciences.**

****Findable, Accessible, Interoperable, and Re-usable***

EPOS: a single, pan-European distributed Research Infrastructures

EPOS is more than a data portal: it will provide not just data but the means to **integrate**, **analyse**, **compare**, **interpret** and **present** data and information about **Solid Earth.**



The **EPOS Integrated Core Services (ICS)**

- will provide **access to multidisciplinary data**, data products, synthetic data from simulations, processing and visualization tools ....
- will serve scientists and stakeholders, young researchers and students (training), professionals and industry

The **EPOS Thematic Core Services (TCS)** will contribute with **mature services** that have already well demonstrated their **effectiveness and relevance** in investigating the physical processes controlling Earth dynamics.

EPOS: a single, pan-European distributed Research Infrastructures