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## European Plate Observing System (EPOS) - update

Sylvain Grellet

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## European Plate Observing System (EPOS) - update

113th OGC Technical Committee

Toulouse, France

S.Grellet – BRGM

19 November 2019

# Agenda

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- EPOS Overview
- Thematic Core Service 'tour de table'
- ICS - TCS exchange
- What next ?

# EPOS Overview



- **European Plate Observing System**

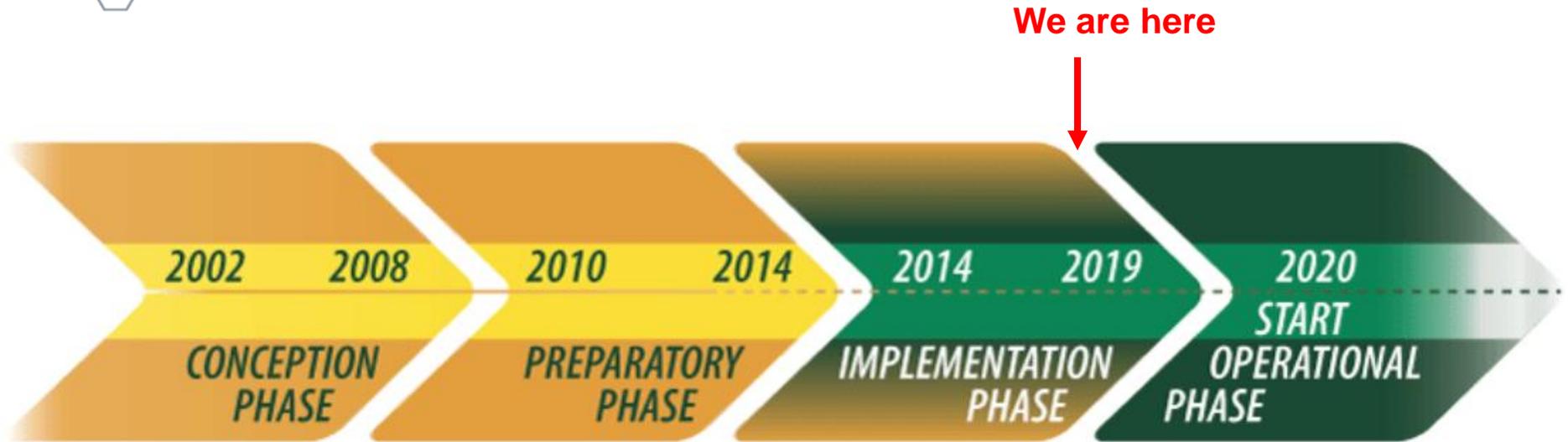
- [www.epos-eu.org](http://www.epos-eu.org)
- European research infrastructure on solid earth science
- Integrates the existing and future advanced European facilities into a single, distributed, sustainable infrastructure



Several PetaBytes of solid Earth Science data will be available

Several thousands of users expected to access the infrastructure

# EPOS Overview



- A Research Infrastructure

- = Part of EU ESFRI Roadmap (like CERN Large Hadron Collider, Square Kilometer Array, European contribution to the international Argo Programme, ...)

- = Long term sustainability

- <> a one time project

# EPOS Overview



Research  
Communities  
producing  
Data & Services  
...

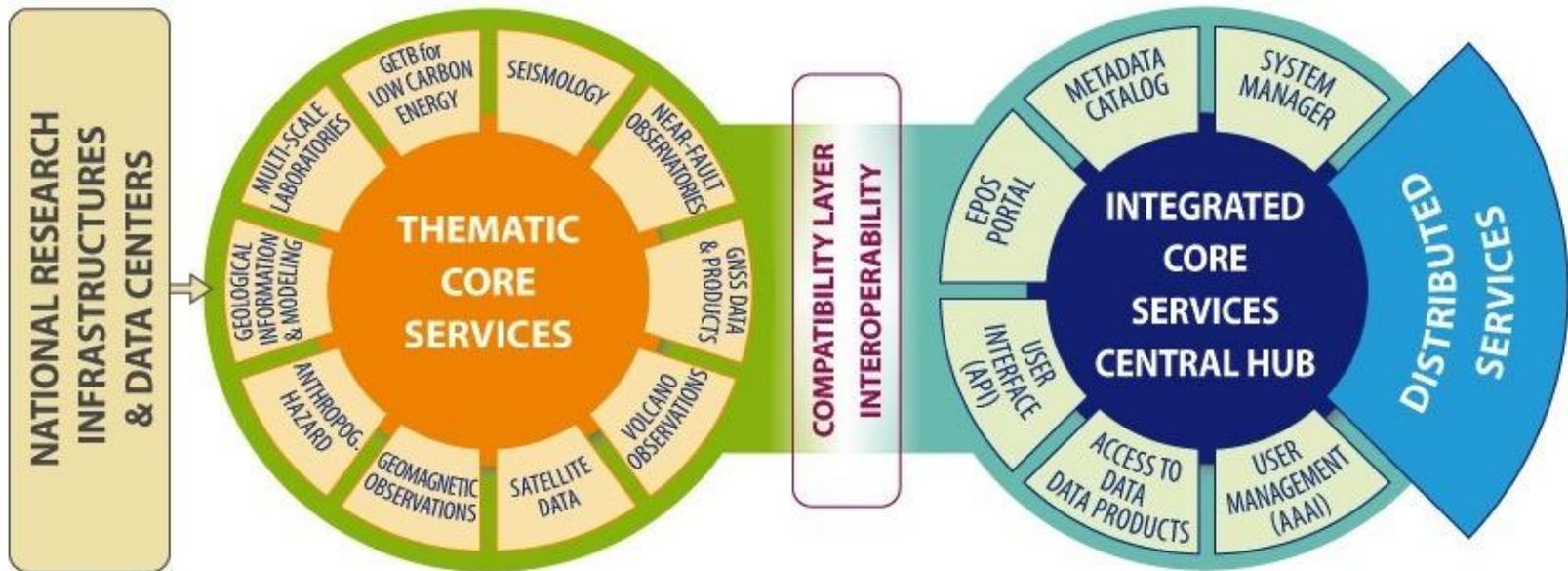
agreeing on how to  
share those  
(semantics, APIs,  
portals, ...)...

declaring it  
using the  
same semantics  
...

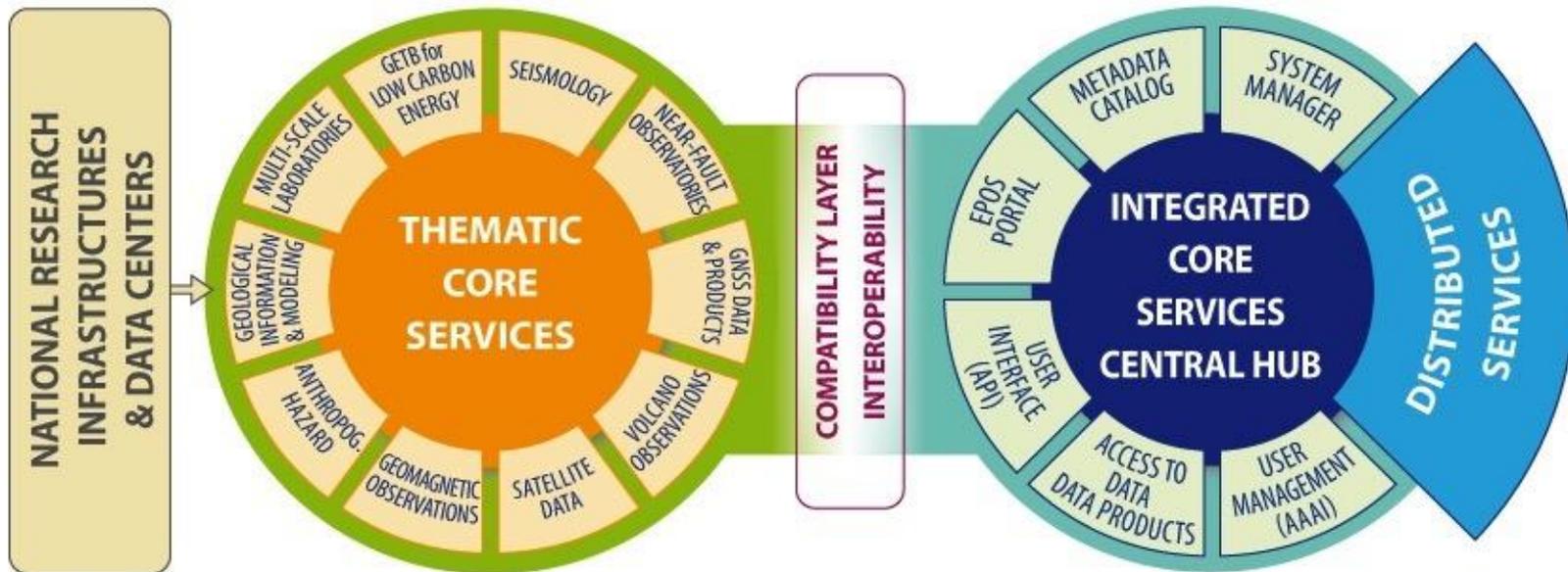
into EPOS  
central hub  
...

for the  
outer world  
to search.

# EPOS Overview



# EPOS Overview



Data generation  
Data collection  
Responsible  
of sustainability  
and operation

Data curation  
Metadata  
Registration  
Community Services  
Standardization

Interoperability  
Brokering



Metadata registry  
Processing  
Aggregation  
Integrated analyses  
Visualization

# EPOS Overview



EPOS ICS

Help Login

SEARCH  
WORKSPACE  
PROCESSING

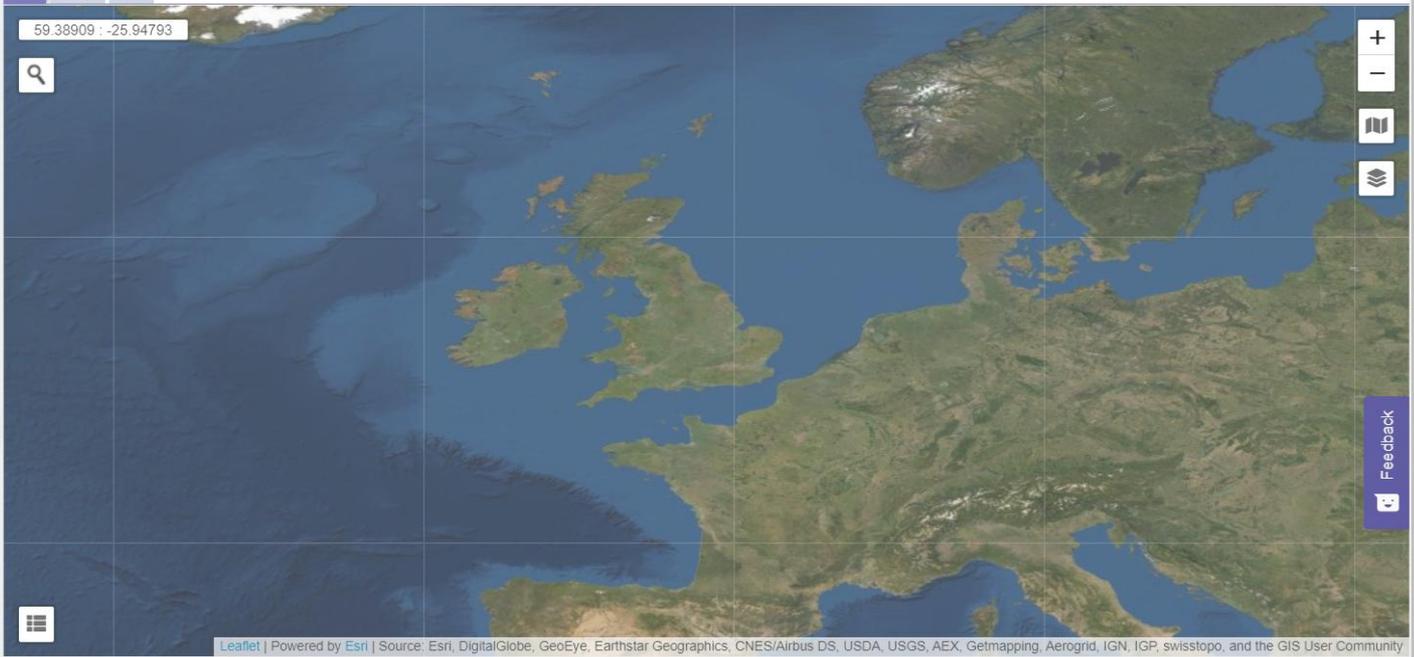
°North (°N) °South (°S) °East (°E) °West (°W) YYYY-MM-DD HH:mm:ss YYYY-MM-DD HH:mm:ss

Advanced Search

Results (215)

- Anthropogenic Hazard Observations (41)
- Geology (8)
- Geoelectromagnetism (19)
- Geo-energy Test Beds (0)
- Geodesy (13)
- Multi-scale Laboratory Data (0)
- Near Fault Observations (37)
- Satellite Observations (8)
- Seismology (45)
- Volcano Observations (44)

Map Graph Data



Leaflet | Powered by Esri | Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Selected Items (0)

Clear

Details Configuration

Console

Please Select a Service.

# EPOS Overview



**EPOS ICS** ? Login

°North (°N) °South (°S) °East (°E) °West (°W) | YYYY-MM-DD HH:mm:ss | YYYY-MM-DD HH:mm:ss

**SEARCH** **Advanced Search** Map Graph Data

**Results (215)**

- Anthropogenic Hazard Observations (41)
- Geology (8)
- Geoelectromagnetism (19)
- Geo-energy Test Beds (0)
- Geodesy (13)
- Multi-scale Laboratory Data (0)
- Near Fault Observations (37)
- Satellite Observations (8)
- Seismology (45)
- Volcano Observations (44)
- Seismic data (4)
  - Waveforms (4)
    - Seismic Waveforms Santorini
    - Seismic Stations Santorini
    - Seismic station
    - Seismic waveform
- Geodetic data (10)
  - GNSS raw data Iceland
  - Waveforms metadata Santorini

**Selected Items (3)** Clear

- Geological Map 1:1,000,000 (OneGeology-Europe layer)
- List of episodes
- Seismic event data collected at the European-Mediterranean Seismological Centre

**Map** 60.64615 : 37.40944 + - ? Feedback

Leaflet | Powered by Esri | Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

**Details** **Configuration** Console

Name	European Database of Seismogenic Faults - WFS vectorial data - Subductions
Description	The standard OGC WFS web service providing the European Database of Seismogenic Faults (EDSF) data related to subduction

# Thematic Core Service 'tour de table'





## Status of Validated Services

### Waveform services

EIDA – fdsnws for station information & waveform data	fully functional
ODC - waveform quality service	fully functional
RRSM & ESM – strong motion parameter data services	fully functional
waveform modeling - modeling platform	fully functional

### Seismological products

EMSC – fdsnws for event information	fully functional
web services for other products	fully functional
event information portal (website)	fully functional
AHEAD – fdsnws for event information	fully functional
wms/wfs type event information	fully functional
interactive portal (website)	fully functional
AVIOS – site characterization modeling service	fully functional

### Hazard and risk services

EFEHR – interactive hazard platform	fully functional
EDSF – active fault data (platform, wms/wfs)	fully functional
RISK – exposure data web platform	fully functional



**Status of Services under implementation/envisioned**

**Waveform services**

mobile pool services & coordination platform	partially implemented - community discussion
ongoing	
OBS data integration services	partially implemented – community discussion ongoing
waveform modeling – future services	partially implemented – community discussion ongoing

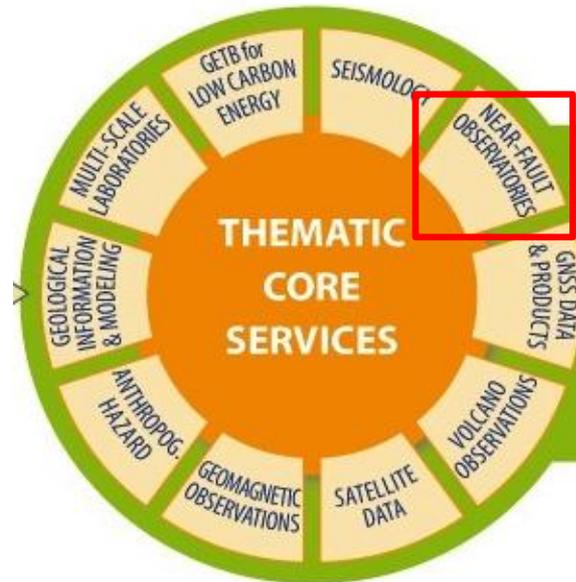
**Seismological products**

European Shakemap Service (joint EPOS Seismology service)	under discussion
macroseismic data integration (ESC working group)	under discussion

**Hazard and risk services**

EFEHR – hazard data web services	under implementation – Q4/2019
EGSIM – ground shaking model service	under implementation – Q4/2019
EGD – geotechnical site characterization	under implementation – Q1/2020
BSM – strong motion data from buildings	under development – jointly with SERA
RISK – vulnerability losses	under development
EFSM20 – fault-source model for ESHM20	under implementation – April 2020

# Thematic Core Service 'tour de table'



<https://www.epos-ip.org/tcs/near-fault-observatories>



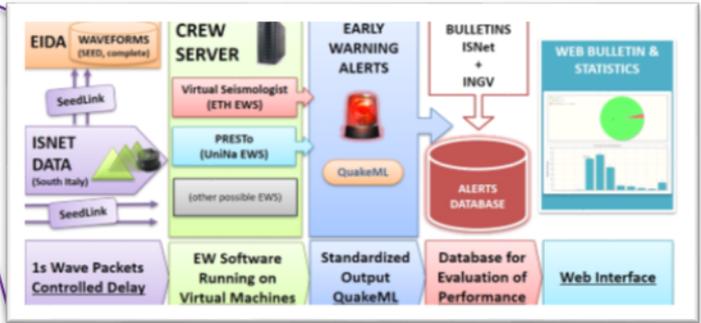
## Status of Validated Services

DDSS	Category	Data - Product	Platform
WP09-DDSS-001	Seismological data	Velocimetric Waveforms Continuous	EIDA
WP09-DDSS-001b	Seismological data	Seismic Station Information	EIDA (VN) – FRIDGE - ICS
WP09-DDSS-002	Seismological data	Accelerometric waveforms Continuous	EIDA
WP09-DDSS-006	Seismological data	Earthquakes parameters	FRIDGE - ICS
WP09-DDSS-009	Seismological data	$V_p/V_s$ (Time series)	FRIDGE
WP09-DDSS-029	Seismological data	Historical EQ Catalogue	FRIDGE - AHEAD
WP09-DDSS-004	Geophysical data	Infrasound waveforms	EIDA
WP09-DDSS-004b	Geophysical data	Infrasound station info	EIDA – FRIDGE - ICS
WP09-DDSS-024	Geochemical data	Radon Decay Counts	FRIDGE - ICS
WP09-DDSS-035	Geophysical data	Strainmeter (water level, pressure)	EIDA
WP09-DDSS-035b	Geophysical data	Strainmeter Station info	EIDA – FRIDGE - ICS
WP09-DDSS-024b	Geochemical data	Radon Station info	FRIDGE - ICS
WP09-DDSS-025	Geochemical data	Meteo parameters	FRIDGE - ICS
WP09-DDSS-028	Geochemical data	CO2 dynamic concentration	FRIDGE - ICS
WP09-DDSS-028b	Geochemical data	CO2 station info	FRIDGE - ICS
WP09-DDSS-034	Data services	FRIDGE - NFO Federated specific data gateway and VL	FRIDGE
WP09-DDSS-037	Geodetic data	GNSS Site and Station information	FRIDGE – GLASS (VN)



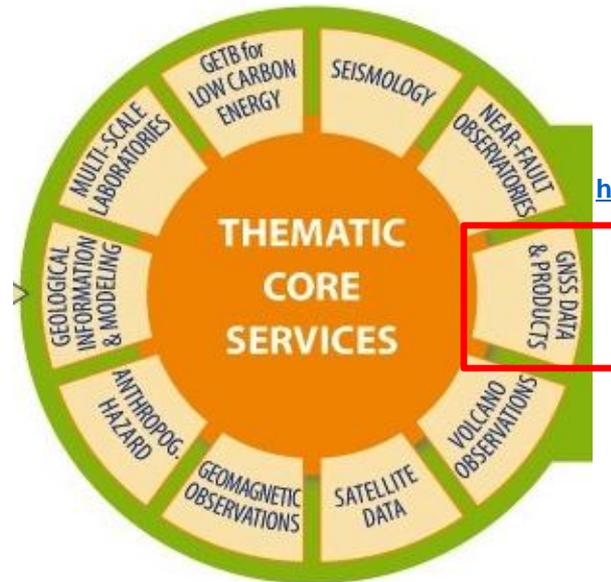
## Status of Services under implementation/envisioned

DDSS ID	Data type	Description	PLATFORM
WP09-DDSS-033	<b>Data Services</b>	<b>CREW - EU Testing Centre for Early Warning &amp; Source Characterization</b>	<b>CREW</b>
WP09-DDSS-013	Geodetic data	GNSS Daily Data (30 second)	GLASS
WP09-DDSS-037	Geodetic data	GNSS Site and Station information	GLASS – FRIDGE - ICS
WP09-DDSS-039	Geodetic data	GNSS coordinate time-series (PPP, DD)	GLASS
WP09-DDSS-040	Geodetic data	GNSS velocity fields (PPP, DD)	GLASS
WP09-DDSS-003	Seismological data	OBS waveforms	EIDA
WP09-DDSS-007	Seismological data	Focal mechanisms	FRIDGE - ICS
WP09-DDSS-011	Seismological data	Velocity and Attenuation Models	FRIDGE - ICS
WP09-DDSS-012	Seismological data	Site Characterisation	FRIDGE
WP09-DDSS-010	Seismological data	Repeaters and Multiplets catalogue	FRIDGE
WP09-DDSS-018	Satellite data	InSAR LOS Displacement Time series	FRIDGE
WP09-DDSS-019	Geodetic data	Strain rate time series	FRIDGE - ICS
WP09-DDSS-027	Geochemical data	Gas chemistry near the fault	FRIDGE - ICS
WP09-DDSS-031	Geology	Geological maps	FRIDGE - ICS
WP09-DDSS-034b	TNA	Trans National Access	ICS
WP09-DDSS-041	Seismological data	b-value time series	FRIDGE
WP09-DDSS-042	Seismological data	Network detection(space/time)	FRIDGE
WP09-DDSS-043	Geochemical data	Total gas pressure in well water	FRIDGE
WP09-DDSS-044	Geochemical data	Ground water temperature	FRIDGE
WP09-DDSS-045	Geochemical data	Spring or well water chemistry	FRIDGE
WP09-DDSS-046	Geochemical data	Ground water level	FRIDGE
WP09-DDSS-047	Geochemical data	Ions (+/-)	FRIDGE
WP09-DDSS-048	Geochemical data	CH4 methane concentration	FRIDGE - ICS
WP09-DDSS-049	Geochemical data	water chemistry	FRIDGE - ICS
WP09-DDSS-050	Geochemical data	Multiple band Fluorescence	FRIDGE - ICS
WP09-DDSS-051	Geology	Seismogenic Fault	FRIDGE – ICS - AHEAD
WP09-DDSS-052	Geodetic data	GNSS Real-Time Data (high-rate)	FRIDGE



CREW is a testing facility that compares methodologies and software for real-time monitoring of faulting processes; specifically, the testing facility is at the present dedicated to Earthquake Early Warning (EEW)

# Thematic Core Service 'tour de table'



<https://www.epos-ip.org/tcs/gnss-data-and-products>



The screenshot displays the EPOS web application interface. At the top, there is a search bar with a magnifying glass icon and a coordinate input field showing "26.2191 : -29.24975". Below the search bar, there are tabs for "Map", "Graph", and "Data". The main content area is a map of Europe with numerous green circular markers representing GNSS stations. On the left side, there is a sidebar with the following sections:

- Advanced Search**
- Results (215)**
- Geodesy (13)**
- Data (3)**
  - Stations with RINEX data
  - List RINEX Files search parameters
  - GET RINEX Files
- Products (10)**
- Selected Items (0)**

At the bottom of the interface, there is a table with the following columns:

Name	Stations with GNSS Products
------	-----------------------------

- **GNSS Data & Products (some still in progress) already discoverable at ICS Portal**
- **Collaboration with other TCS (Near Fault Observatories & Volcanology) also implemented to host their GNSS data**



## Status of Validated Services

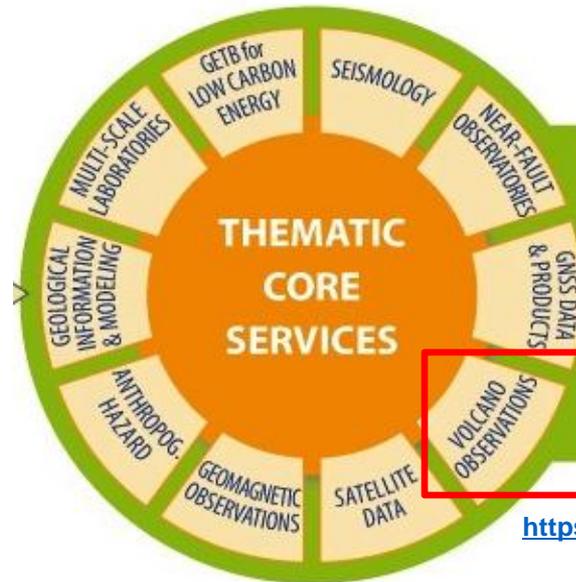
Software provision		
WP10-SP-011	M&O of GLASS software	yes
WP10-SP-013	M&O of GLASS tools	yes
WP10-SP-014	M&O of GLASS webservices	yes

Data Dissemination	Val.	
WP10-SP-003	Metadata Management for GNSS Sites	yes
WP10-SP-004	M&O of GNSS Data Gateway	yes
WP10-SP-005	Long-term Data Quality Monitoring	almost

Product Dissemination		
WP10-SP-006	M&O of GNSS Products Gateway; Internal validation of GNSS-derived products	yes
WP10-SP-007	Daily solutions for EPOS stations using PPP approach; Velocity Field from Combined EPOS	yes
WP10-SP-008	Daily solutions for EPOS stations using DD approach; Velocity field from Combined EPOS	yes
WP10-SP-009	Daily Combined time-series solutions using EPOS DD and PPP solutions	yes
WP10-SP-010	Strain rates derived from velocity fields	almost

EUREF		
WP10-SP-015	EUREF Permanent Network Central Bureau	yes
WP10-SP-016	Maintenance of EUREF Pan-European Repositories	yes
WP10-SP-017	Maintenance of EUREF Pan-European Repositories	yes
WP10-SP-018	Weekly Combined Solutions of EUREF stations	yes
WP10-SP-019	EUREF Reference Frame Products	yes
WP10-SP-020	Velocity Field from Combined EPOS EUREF Densified Solutions	yes

# Thematic Core Service 'tour de table'

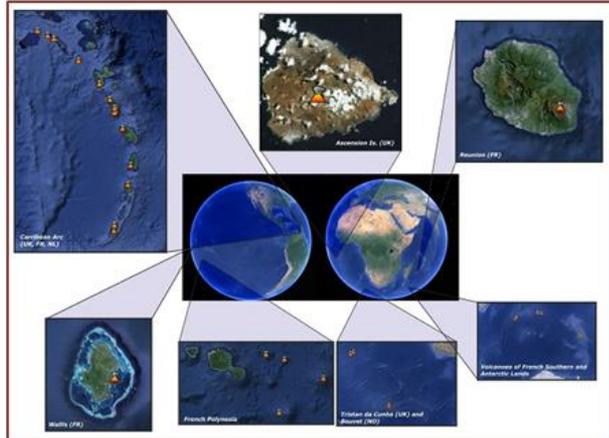


<https://www.epos-ip.org/tcs/volcano-observations>



## VO-TCS mission:

- to provide coordination between the European Volcano Observatories (VOs) and Volcano Research Institutions (VRIs),
- to implement interoperable services,
- to provide long term sustainable access to the VO-DDSSs, and
- to promote best practices through EPOS.



*Worldwide distribution of "European" volcanoes*

*Layered structure of the VO-TCS*



The **VO-TCS Gateway**, in synergy with the EC EUROVOLC project, will have an important role in making the services of VO-TCS (and all volcanological community) interoperable with ICS.



## Status of Validated Services

Name – web-service title	Service Provider
Velocity Seismic Waveforms	INGV, IPGP, IMO
Chemical analysis and physical properties of gas, water and rocks	INGV, OPGC
Thermal anomaly (lava flow)	OPGC
Wrapped Differential Interferograms	INGV, OPGC

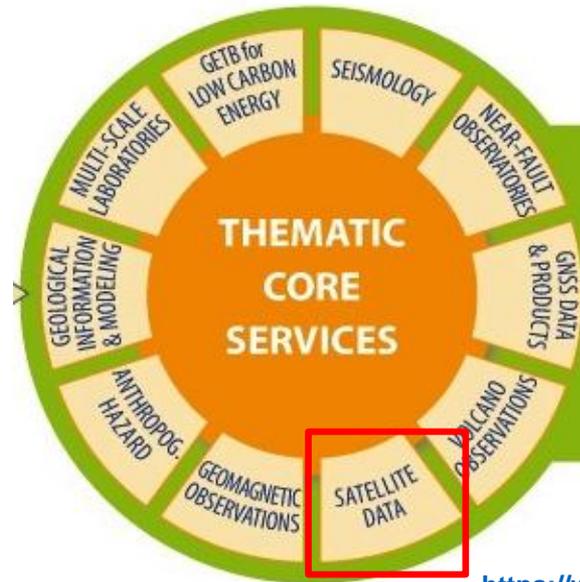
Category	DDSS Name	Access
Seismological data	Velocity seismic waveforms	Open
Volcanological /petrological	Reports on volcanic activity	Open
Volcanological /petrological	Aviation colour codes for volcanoes	Open
Geohazards	SO2 concentration probabilistic hazard maps	Open
Geohazards	Tephra fallout hazard maps for explosive volcanoes	Embargoed
Geohazards	Effects on health and recommendations for response to SO2	Open
Geohazards	Daily ash/gas forecasting maps	Open
Data services	Station information (GPS)	Open
Seismological data	Velocity seismic waveforms	Open
Seismological data	Acceleration /Accelerometer waveforms	Open
Geodetic data	GNSS raw data (Rinex Data- 15s)	Open
Geochemical /petrological	Chemical analysis and physical properties of gas, water and rocks	Open
Satellite data	Wrapped Differential Interferograms (Phase and Amplitude)	Open
Seismological data	Velocity seismic waveforms	Open
Seismological data	Acceleration /Accelerometer waveforms	Open
Ground-based remote sensing data&pro	Ground-based doppler radar near-source eruptive parameters	Open
Geochemical /petrological	Chemical analysis and physical properties of gas, water and rocks	Open
Satellite data	Volcanic Plume (Ash + SO2)	Open
Satellite data	Thermal anomaly (lava flow)	Open
Satellite data	Wrapped Differential Interferograms (Phase and Amplitude)	Open



## Status of Validated Services

Category	DDSS Name	Access
Geohazards	Spatial probability analysis/maps	Open
Geohazards	Lava flow invasion hazard maps	Open
Geohazards	Tephra fallout hazard maps for explosive volcanoes	Open
Geohazards	PDCs hazard maps (EH;GVF; Deception)	Open
Geohazards	Probabilistic volcanic hazard assessment (maps)	Open
Geodetic data	GNSS raw data (Rinex Data- 15s)	Open
Ground-based remote sensing data	Ground-based radar data	Open
Ground-based remote sensing data	Ground-based visible and thermal / IR camera	Open
Ground-based remote sensing data	Ground-based UV scanner spectra	Open
Volcanological /petrological	Catalogue of eruptions	Open
Volcanological /petrological	Reports on volcanic activity	Open
Volcanological /petrological	Reports on volcanic activity	Open
Rock sample properties	Collections of magmatic rocks	Restricted
Satellite data	InSAR lava flow maps	Open/ Registered
Ground-based remote sensing data	Ground-based Doppler radar spectra	Open

# Thematic Core Service 'tour de table'



<https://www.epos-ip.org/tcs/satellite-data>



**A unique interface for TCS metadata, API and AAI**

**Metadata: ISO 19115(-2) & OGC 10-157r3**

**Data Product discovery: OpenSearch (CEOS OpenSearch BP)**

**Data Product retrieval: HTTPS**



## **TCS Access Rules**

**Products freely discoverable/Metadata freely accessible**

**Registered users can access and manage products**

**CC-BY and CC-BY-NC licences will be applied**





## Status of Validated Services

### Validated **Static** Map Data Product

Data Product	Radar	Geo	Priority	Data Org.	Metadata	Format
Wrapped Differential Interferograms	✓	✓	High	2D raster	ISO 19115	geotiff
Spatial coherence	✓	✓	High	2D raster	ISO 19115	geotiff
Unwrapped Differential Interferograms	✓	✓	High	2D raster	ISO 19115	geotiff
Map of LOS vector (NEU coefficient)	✓	✓	High	2D raster	ISO 19115	geotiff
Interferogram Atmospheric Phase Screen	✓		High	2D raster	ISO 19115	geotiff
DEM in radar geometry	✓		High	2D raster	ISO 19115	geotiff
Lookup table from radar coordinates to ground coordinates	✓		High	2D raster	ISO 19115	geotiff

### Validated **Multitemporal** Data Product

Data Product	Radar	Geo	Priority	Data Org.	Metadata	Format
LOS Displacement Time Series	✓	✓	High	Table / 3D	ISO 19115	CSV / SHP / geotiff
Temporal Coherence (Quality of measure)	✓	✓	High	Table / 2D	ISO 19115	CSV / geotiff
Average Scatterer Elevation (Topography)		✓	High	Table / 2D	ISO 19115	CSV / geotiff
Mean LOS velocity		✓	High	Table / 2D	ISO 19115	CSV / geotiff



**Status of Services under implementation/envisioned**

### Level 2 Data Product ready at TCS level

Data Products	Priority	Data Org.	Metadata	Format
Model Parameters	Medium	Table	ISO 19115	CSV
Modelled LOS Displacement	Medium	Table	ISO 19115	CSV
Inversion Statistical Analysis	Medium	2D raster (Image)	ISO 19115	JPG, PNG, etc

### Level 1 services ready at TCS level

Services	Priority	Metadata	API
EPOSAR Sentinel-1 Processing on demand (L1)	High	ISO 19115	WPS 1.0
EPOSAR ERS-ENVISAT Processing on demand (L1)	High	ISO 19115	WPS 1.0

### Level 1 radar services under implementation

Data Product	Radar	Geo	Priority	Data Org.	Metadata	Format
Network misclosure (Quality of times series inversion)	✓		High	2D raster	ISO 19115	geotiff
Stack of coregistered Interferograms	✓		High	3D raster	ISO 19115	geotiff



**Status of Services under implementation/envisioned**

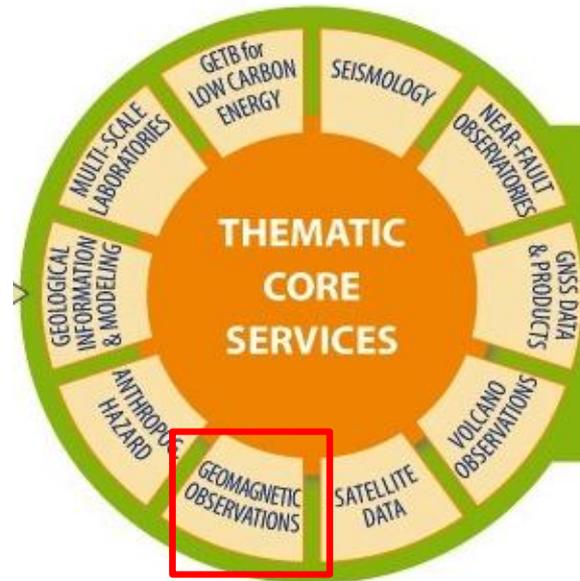
**Level 2/3 data products under implementation**

Data Products	Priority	Data Org.	Metadata	Format
3-D Displacement maps	Medium	2D / Table	TBD	geotiff / CSV
3-D Displacement Time Series	Medium	2D / Table	TBD	geotiff / CSV
Strain Rate Maps	Medium	2D raster	TBD	TBD
Stress field computation and Visualization	Medium	2D / Table	TBD	geotiff / CSV
Seismic Hazard Maps	Medium	2D raster	TBD	TBD

**On-demand Services under implementation**

Services	Priority	Metadata	API
GDM-SAR processing on demand	High	ISO 19115	WPS 1.0
GDM-SAR visualization	High	ISO 19115	WPS 1.0
GDM-optical processing	Medium	TBD	WPS 1.0
Displacement Analytical Modelling - Displacement Maps (L2)	Medium	TBD	WPS 1.0
Displacement Analytical Modelling - Displacement Time Series (L2)	Medium	TBD	WPS 1.0
Modelling toolbox with User Interface	Medium	TBD	Custom web interface
Data fusion (InSAR , GNSS,...) to obtain 3D displacement maps	Medium	TBD	Custom web interface
Joint Displacement and Gravity data Modeling	Medium	TBD	Custom web interface

# Thematic Core Service 'tour de table'



<https://www.epos-ip.org/tcs/geomagnetic-observations>



Status of Validated Services

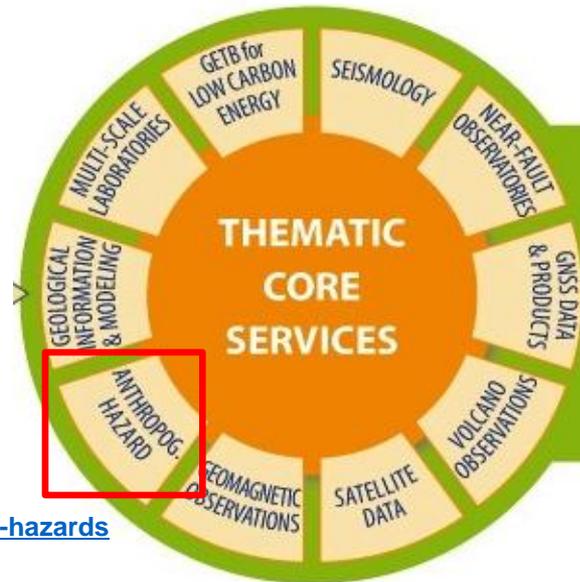
Magnetic observatory data (World Data Centre - WDC Edinburgh & INTERMAGNET)
Variometer data (IMAGE + Baltic extensions)
Geomagnetic indices (ISGI)
Geomagnetic events (EO & ESGI)
Electrojet indices (IMAGE)
Global magnetic models (IGRF and WMM)



**Status of Services under  
implementation/envisioned**

Magnetic survey data
Magnetotelluric time series
Substorm events (IMAGE)
Magnetotelluric transfer functions
Lithospheric conductivity models

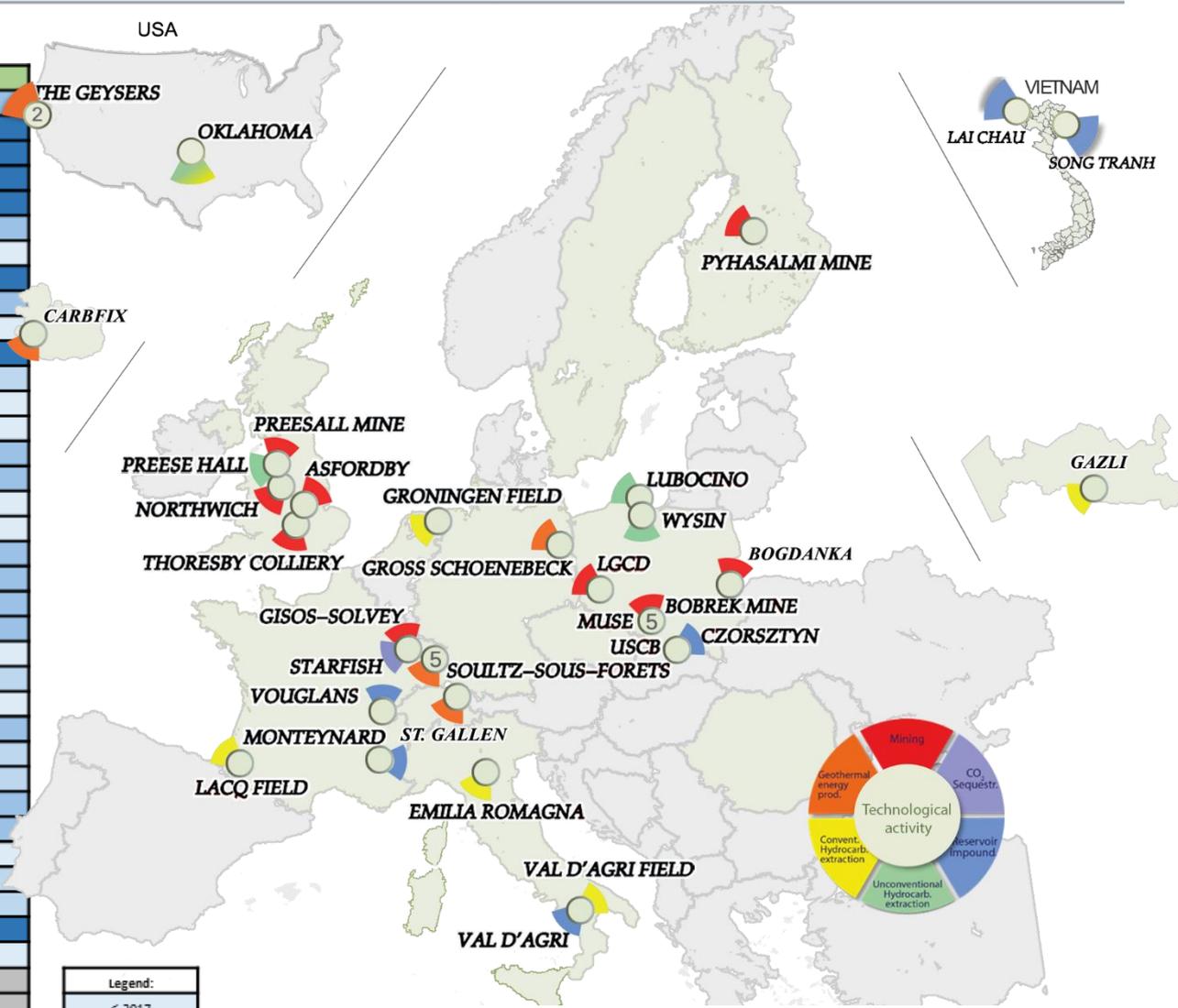
# Thematic Core Service 'tour de table'



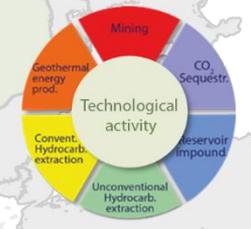
<https://www.epos-ip.org/tcs/anthropogenic-hazards>



EPISODE	Published
1993 Soultz-sous-Forêts Stimulation	Oct-18
2000 Soultz-sous-Forêts Stimulation	Apr-19
2003 Soultz-sous-Forêts Stimulation	Apr-19
2004 Soultz-sous-Forêts Stimulation	Aug-19
2005 Soultz-sous-Forêts Stimulation	Aug-19
ASFORDBY	Dec-18
BOBREK MINE	IS-EPOS
BOGDANKA	Mar-19
CARBFIX	Jul-18
CZORSZTYN	IS-EPOS
GAZLI	Mar-19
GISOS-CERVILLE	Nov-17
GRONINGEN FIELD	Jul-16
GROSS SCHOENEBECK	IS-EPOS
LACQ GAS FIELD	Sep-18
LAI CHAU	Oct-18
LGCD	IS-EPOS
LUBOCINO	Jul-16
MONTEYNARD	Aug-18
NORTHWICH	Dec-18
OKLAHOMA	May-18
PREESALL MINE	Dec-18
PREESE HALL	Jul-16
PYHASALMI MINE	Nov-17
SONG TRANH	IS-EPOS
ST. GALLEN	Jul-18
STARFISH	Nov-17
THE GEYSERS Prati 9 and Prati 29 cluster	Jul-17
THE GEYSERS	May-18
THORESBY COLLIERY	Dec-18
USCB	IS-EPOS
VAL D'AGRI FIELD	Nov-17
VAL D'AGRI	Nov-17
VOUGLANS	Mar-19
WYSIN	Jul-16
COTTON VALLEY	
EMILIA ROMAGNA	
MUSE1 KWK Piast Ziemowit	
MUSE1 KWK Ruda Bielszowice	
MUSE1 Regional Polygon	
MUSE2 KWK ROW Rydułtowy	



Legend:
< 2017
2017
2018
2019
not published





EPOS ICS
Login

North (°N) South (°S) East (°E) West (°W)
YYYY-MM-DD HH:mm:ss

**Advanced Search**

**Results (212)**

- Anthropogenic Hazard Observations (41)
- Services (2)
  - List of episodes
  - List of applications
- Episodes (39)
  - Reservoir impoundment (6)
    - Episode CZORSZTYN: shallow water reservoir - dataset
    - Episode SONG TRANH: deep water reservoir - dataset
    - Episode MONTEYNARD: water reservoir - dataset
    - Episode VAL D'AGRI: water reservoir - dataset
    - Episode LAI CHAU: water reservoir - dataset
    - Episode VOUGLANS: water reservoir - dataset
  - Geothermal energy production (10)
  - Underground mining (10)
  - Conventional hydrocarbon extraction (5)
  - Underground gas storage (1)
    - Episode STARFISH: underground gas storage - dataset
  - Wastewater injection (2)
  - Unconventional hydrocarbon extraction (4)
    - Episode PREESE HALL: Shale Gas - dataset
    - Episode OKLAHOMA: conventional and unconventional hydrocarbon extraction and wastewater injection - dataset
    - Episode LUBOCINO: Shale Gas - dataset
    - Episode WYSIN: Shale Gas - dataset
  - CO2 sequestration (1)
    - Episode CARBFIX: geothermal energy production and CCS - dataset
  - ... (8)

Map Graph Data
82.96913 ; -53.50525

**LAI CHAU: water reservoir**

owner: Institute of Geophysics Vietnam Academy of Science and Technology, Vietnam and Institute of Geophysics Polish Academy of Sciences (IG PAS), Poland

country: Vietnam

code: LAI\_CHAU

name: LAI CHAU: water reservoir

type: episode

shortName: LAI CHAU

region: Lai Chau Province

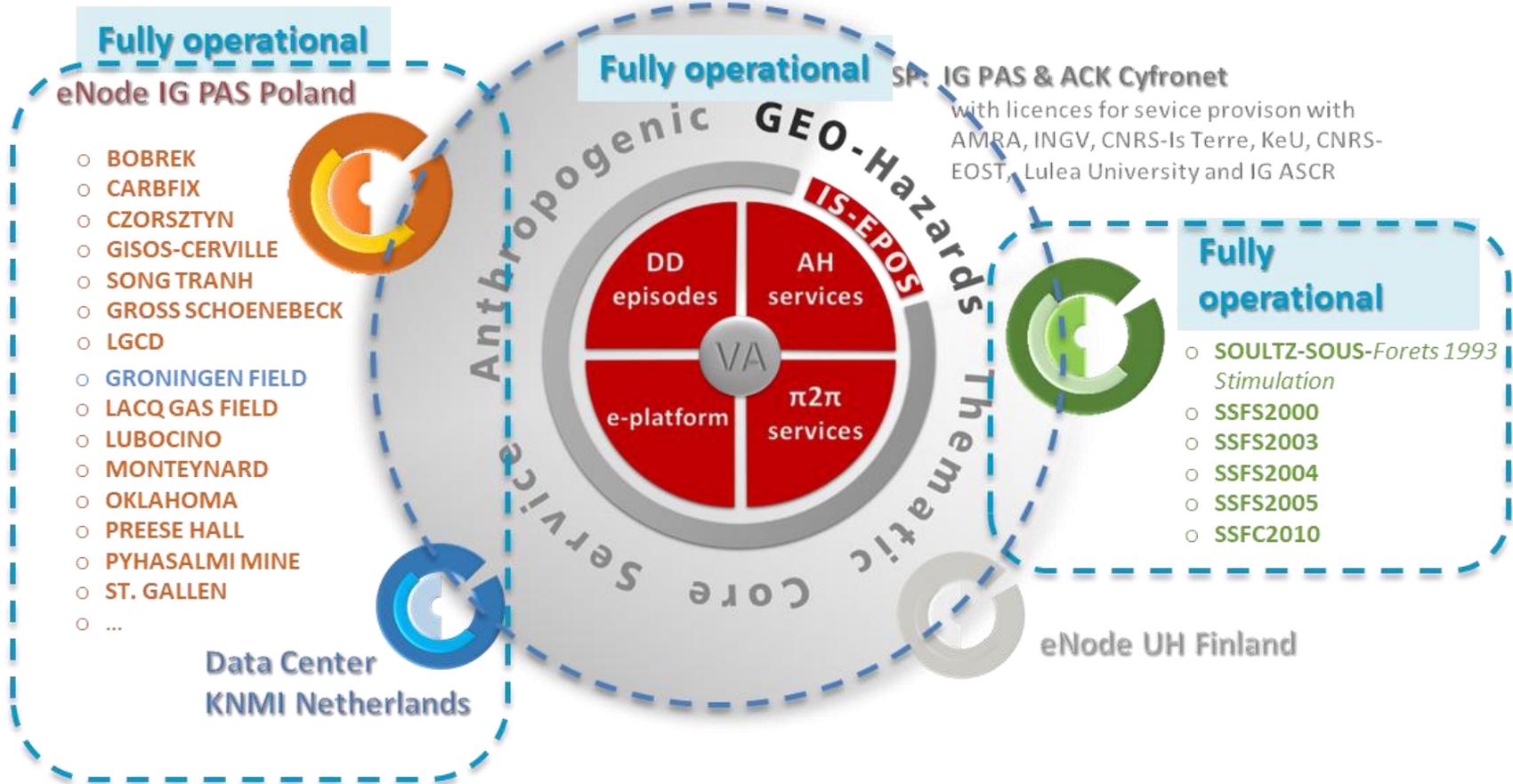
impactingFactors: [reservoir impoundment]

Details Configuration
Console

Name	List of episodes
Description	The IS-EPOS Platform integrates research infrastructure of EPOS TCS AH ( <a href="https://tcs.ah-epos.eu/">https://tcs.ah-epos.eu/</a> ). It provides access to Episodes, which are collections of time-correlated geophysical, technological and other relevant geodata, relating comprehensively anthropogenic seismicity to its industrial cause.
Spatial Coverage	<i>Unspecified</i>
Temporal Coverage	1956-06-01T11:06:00+00:00 - <i>unspecified</i>
Digital Object Identifier	<a href="https://doi.org/10.1007/s11600-018-0209-z">https://doi.org/10.1007/s11600-018-0209-z</a>
Service Provider	Institute of Geophysics, Polish Academy of Sciences
Service Description	Virtual access to IS-EPOS Platform (multiservice)



Status of Validated Services

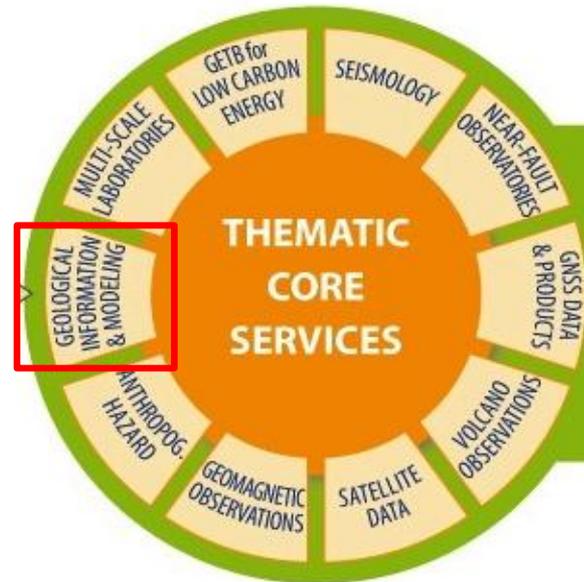




## Status of Services under implementation/envisioned

1. GSS2: Moment tensor (single) – step 4;
2. GSS2: Moment tensor (double couple) – step 4;
3. GSS2: Moment tensor (shear-tensile crack inventor) – step 4;
4. GSS3: Location of emergent - sustained signals – step 5;
5. GSS4: Tracking changes in the elastic parameters – step 2;
6. GMS3: Stress and strain changes induced by fluid injection and temperature change driven by geothermy injection – step 4 ;
7. QIS1 Seismicity patterns tested mean field patterns - Superposed epoch analysis for Magnitudinal aftershocks – step 4;
8. QIS1 Seismicity patterns tested mean field patterns - Superposed epoch analysis for georesource field aftershocks – step 4;
9. QIS1 Seismicity patterns tested mean field patterns - Superposed epoch analysis for seasonal pattern – step 4;
10. QIS2 seismicity patterns tested against reshuffled catalogues – step 4;
11. A Template-Matching based Detection Algorithm – step 4;
12. Modelling uncertainties and interval estimation of hazard parameters – step 1;
13. Estimate of maximum possible magnitude from induced deformation – step 4;
14. Ground Motion Prediction Equations – step 4;
15. Merger – step 4.

# Thematic Core Service 'tour de table'



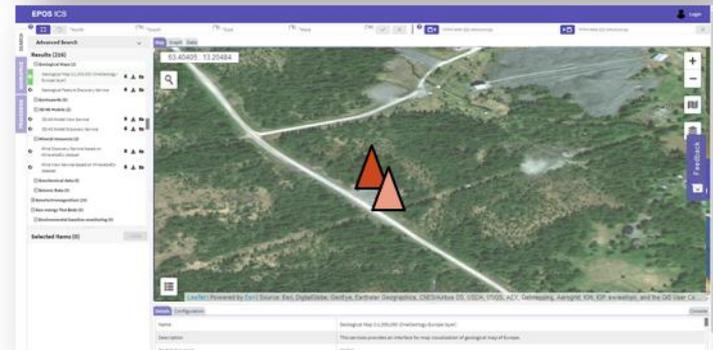
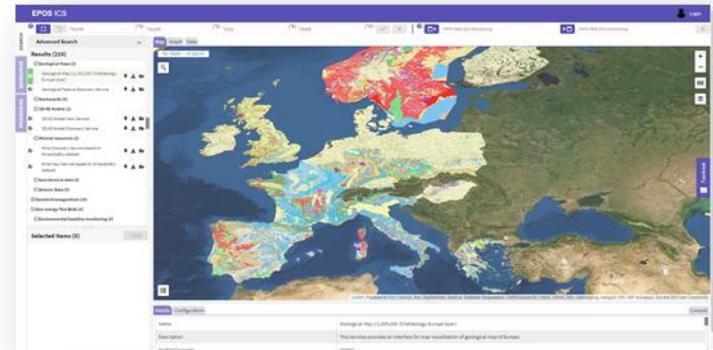
<https://www.epos-ip.org/tcs/geological-information-and-modeling>



Status of Validated Services

8 sets of pan-European services offered to the EPOS platform: 5 sets are operational

- Boreholes
  - Borehole View Service
  - Borehole Discovery Service
- Geologic Maps
  - Geologic Map 1/1,000,000 View Service
  - Geologic Feature Discovery Service
- 3D/4D Models
  - 3D/4D Models View Service
  - 3D/4D Models Discovery Service
- Mineral resources
  - Mine Discovery Service
  - Mine View Service
- Data & service cataloguing
  - WP15 catalogue service





Status of Validated Services

Presently, the TCS-ICS interoperability offers an access to dataset & service discovery (without deep semantics)  
 => From the BoreholeIndex entry point, navigate through all borehole-related features (ex.: logs) and display them using the borehole visualisation tool libraries developed by TCS Geological Information & Modeling  
 => Apply this linked data mechanism to all “Geological Information and Modeling” datasets

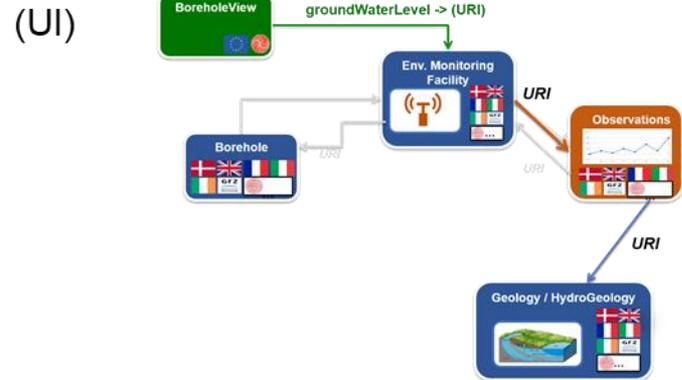




Status of Services under implementation/envisioned

- Geohazards (Ground deformation) Under Implementation (UI)
- Geohazards: Active faults inventories / Landslides Envisioned (E)
- Active seismic data (onshore/offshore) (UI)
- Rock sample properties: Borehole rock sample analysis (UI)
- Georesource occurrence data (UI)
- Geochemical Data (E)
- Geological Maps (E)  
1:500,000-250,000 / 1:100,000-50,000 (stratigraphic, lithological, faults, bedrock, superficial)

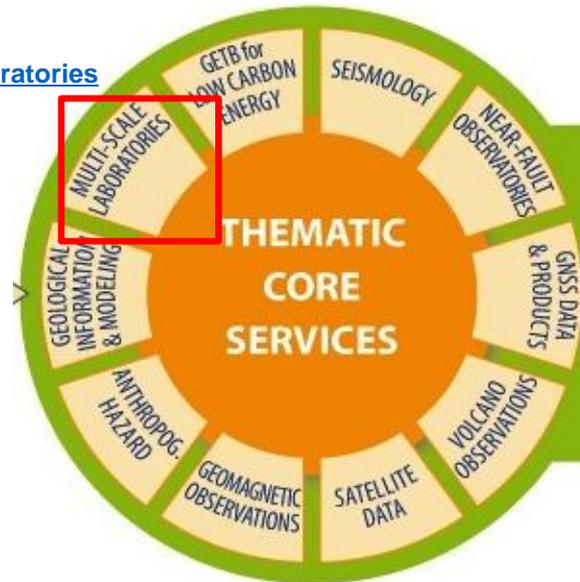
- Boreholes Data Index (UI)
  - Detailed data (depth, contractor, equipment...)
  - Geophysical logs
  - Geological description
  - Groundwater level
  - Rock Geochemistry
  - Pore Gas Chemistry
  - Geotechnical Information
  - Visualisation tool (logs...)



# Thematic Core Service 'tour de table'

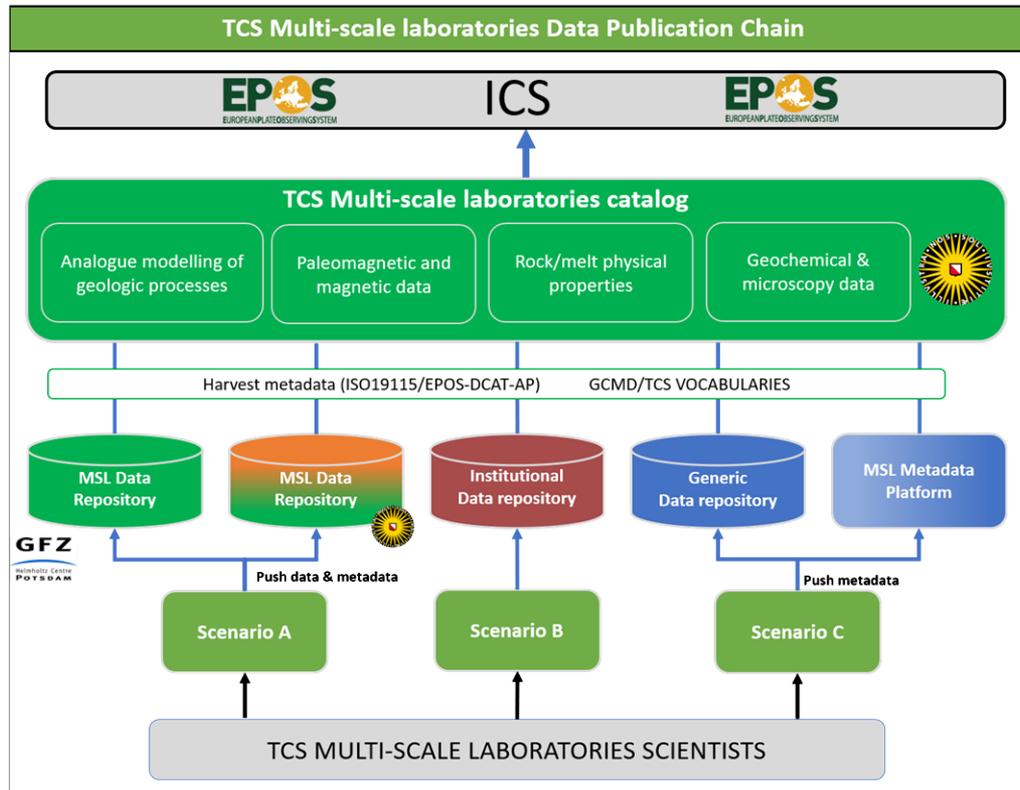


<https://www.epos-ip.org/tcs/multi-scale-laboratories>





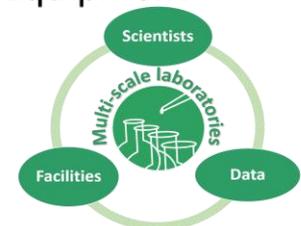
Status of Validated Services



New scenario for exchanging actualized and full download information

EPOS-wide brokering tool for TransNational Access (TNA) workflow support: Equipment information and model for implementation are already available (and used!)

Retrieval of actualized facility information from TCS Portal service





## Status of Validated Services

**Transnational Access to the TCS Multi-scale laboratories facilities**

The third call for TNA to EPOS Multi-scale laboratories facilities has closed.

As part of the EPOS Trans-National Access activities, the TCS Multi-scale laboratories is offering access to 38 facilities across Europe.

Access to European solid Earth Science facilities (analogue modelling facilities, rock/melt experimental facilities, paleomagnetism facilities and analytical & microscopy facilities) will be available as physical access or remote service (sample analysis).

**The 3<sup>rd</sup> TNA call was open from February 25<sup>th</sup>, 2019, to April 21<sup>st</sup>, 2019.**

During this period, proposals can be submitted at any time.

Projects accepted under this call **started as early as May 13<sup>th</sup>, 2019** and must be **completed by December 31<sup>st</sup>, 2019**.

Please note that the type of access (physical access/remote service) and the type of financial support for users (lab costs, financial support for user travel and accommodation) varies for different facilities and installations, which is specified in the tables listing the lab facilities available for TNA.

We advise potential users to contact the facility before submitting a proposal for TNA to discuss availability and terms for access.

**APPLY HERE**

**LIST OF FACILITIES AND ACCESS PROVIDED**

The e-mail addresses of the contact persons and the planned number of days/samples and user support available at each facility as part of the EPOS Multi-scale laboratories TNA is given in the tables accessible using the links below:

**Utrecht University**

**Paleomagnetic Laboratory Fort Hoofddijk (Utrecht University, The Netherlands)**

The research of the Fort Hoofddijk Paleomagnetic Laboratory cover nearly all fields of paleomagnetism. An important expertise of the research group is building high resolution... read more

Followers: 0 Datasets: 2

Type	Research field	Facility Name	RI Name
laboratory	Paleomagnetism	Paleomagnetic Laboratory Fort Hoofddijk	Utrecht University

**Latitude** 52.0880573

**Longitude** 5.1702548

**Website** [Link](#)

**Services**

- [Go to data publications from this lab \(MSL TCS catalogue portal\)](#)
- [Retrieve data publications from this lab](#)
- [More facility information](#)
- [More information about TNA possibilities at this lab](#)

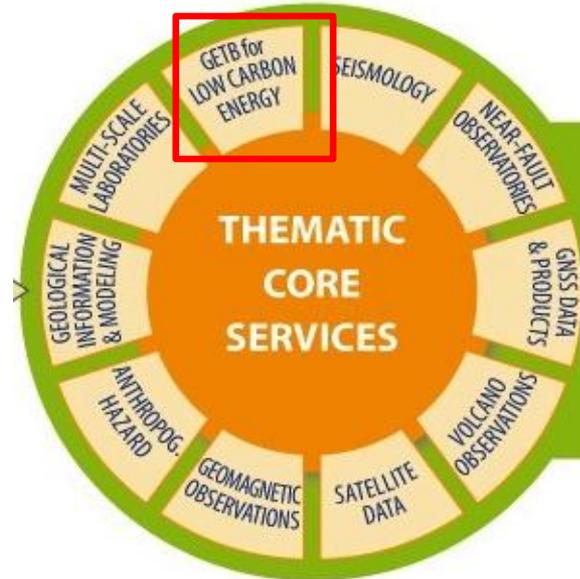
**Equipments** (10) +

**Measurements** (7) +

# Thematic Core Service 'tour de table'

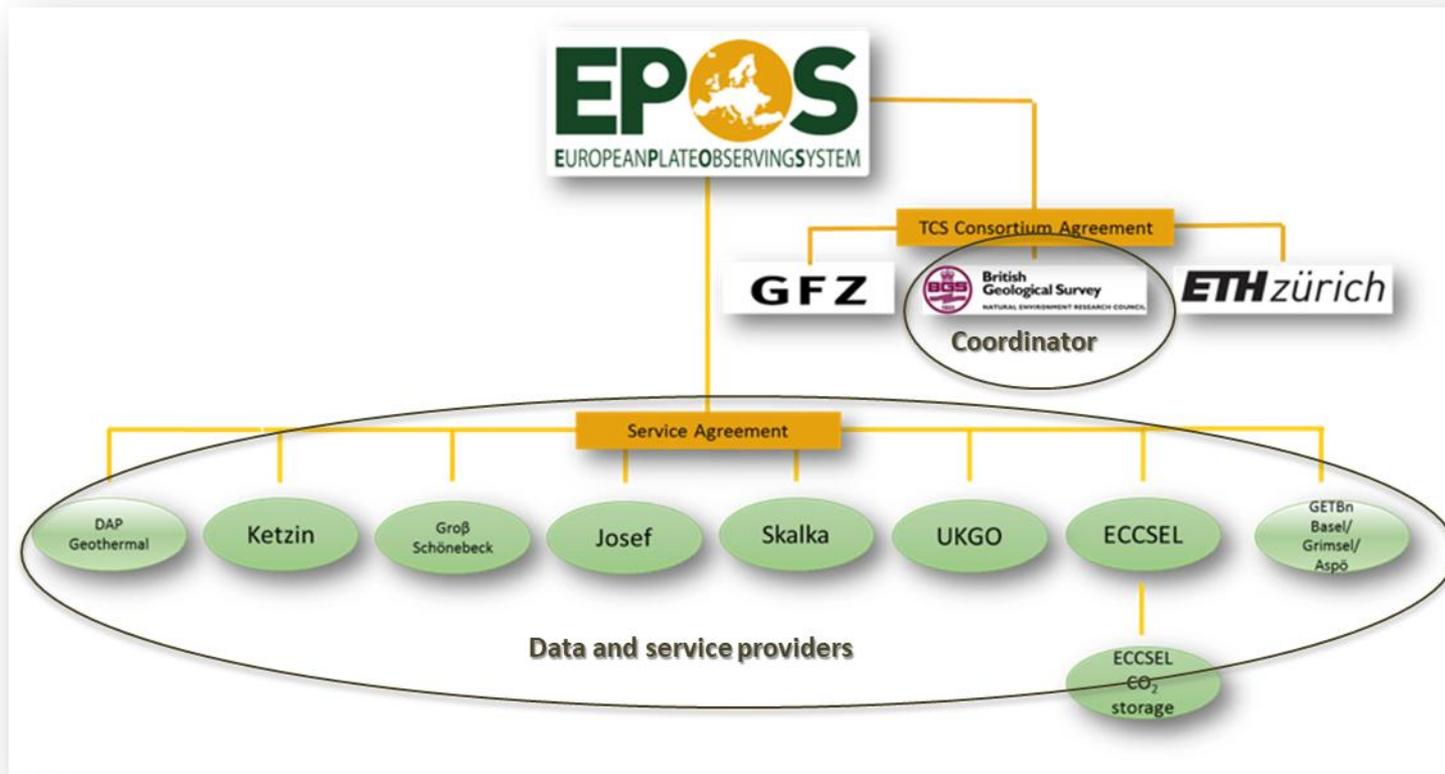


<https://www.epos-ip.org/tcs/geo-energy-test-beds-low-carbon-energy>

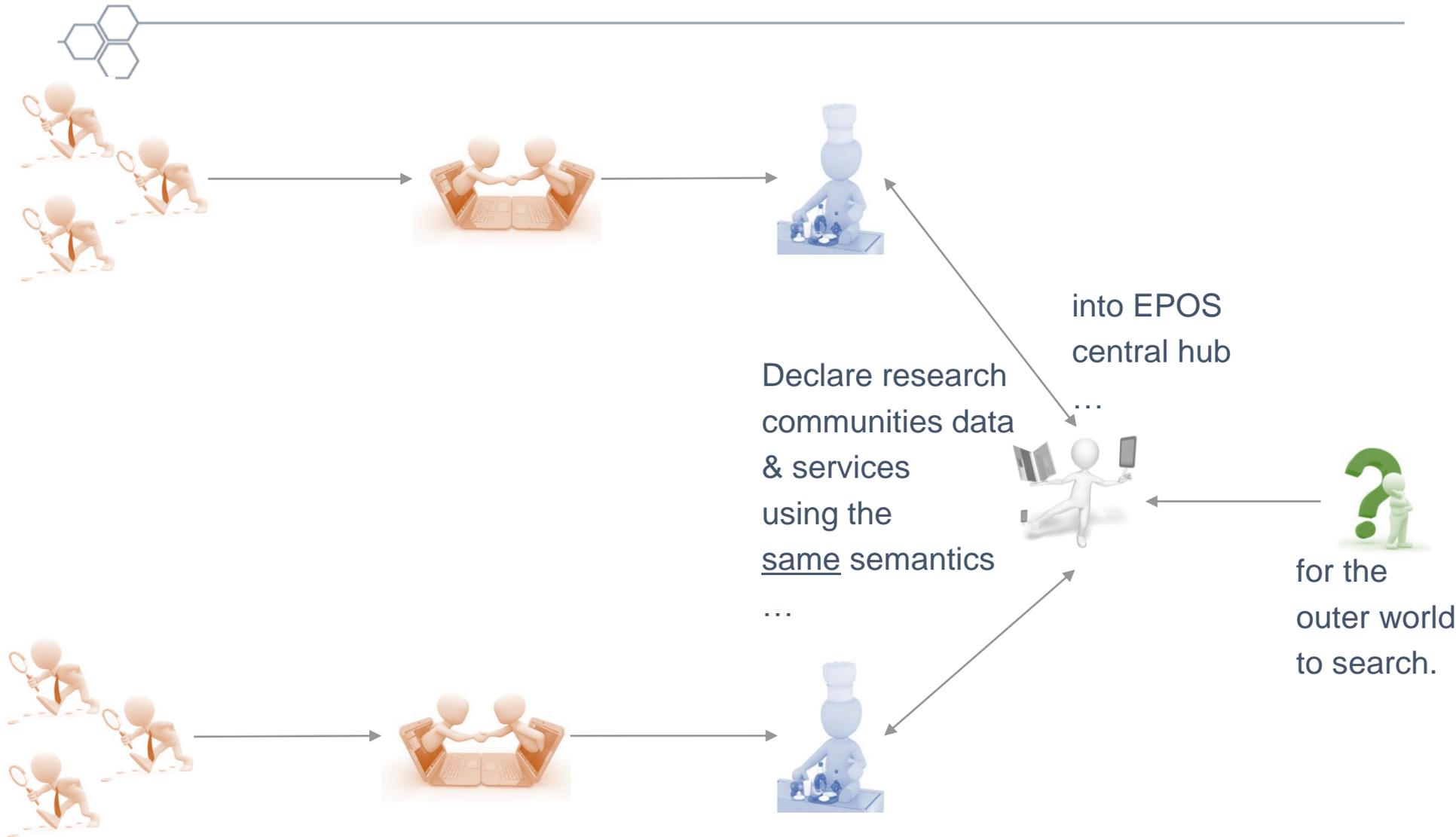




Name	Sub-domain Description
Oil & Gas	Conventional and non-conventional oil&gas recovery
Deep underground laboratories	Deep labs for R&D on rock mechanics, geoenergy applications, georesources, earthquake physics
Geothermal	Deep geothermal energy, both hydro- and petro-thermal
Storage	Geological storage of gas or carbon
Shale	Shale gas
Repository	R&D facilities for deep geological repository of nuclear waste
Mining	Deep mining



# ICS – TCS compatibility layer

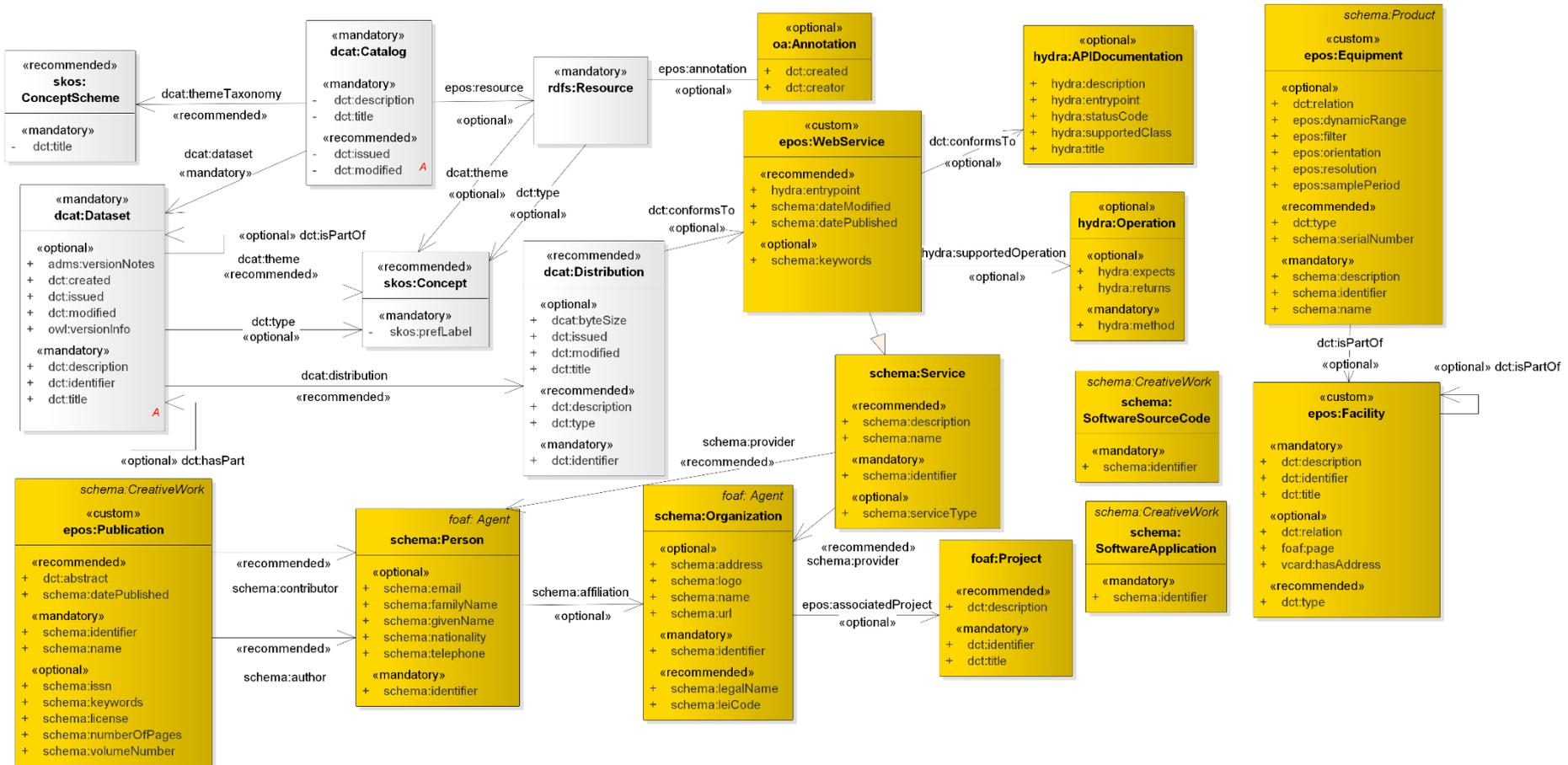


# ICS – TCS compatibility layer



- Each dataset, service, organization described using
  - EPOS\_DCAT\_AP: DCAT 1.4 (2014), hydra, schema, ...

class EPOS-DCAT-AP-Simplified



# What next ?



- System in operational mode
  - ⇒ more data and services available -> automatize their declaration and discovery
  - ⇒ more interoperability between within and across communities
- More
  - Shared semantics & linked data
    - Facility, equipment
    - Observation -> O&M
    - Shared domain objects
  - Machine2machine discovery -> OGC APIs and semantics
  - Python notebook for manipulating data sets in the GUI
  - TimeSeries CovJSON -> more O&M compliant serialization
  - GeoJSON for features

# What next ?



- Federation of ESFRI projects in the EU Open Science Cloud (EOSC)



**“The Earth is our Lab”  
Europe’s Environmental  
Research Infrastructures**

# What next ?

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- Federation of ESFRI projects in the EU Open Science Cloud (EOSC)

⇒ Is EPOS FAIR ?



# Thank you



on behalf of all the communities mentioned

