Integrating European Research Infrastructures for solid Earth Science

EPOS Seismology
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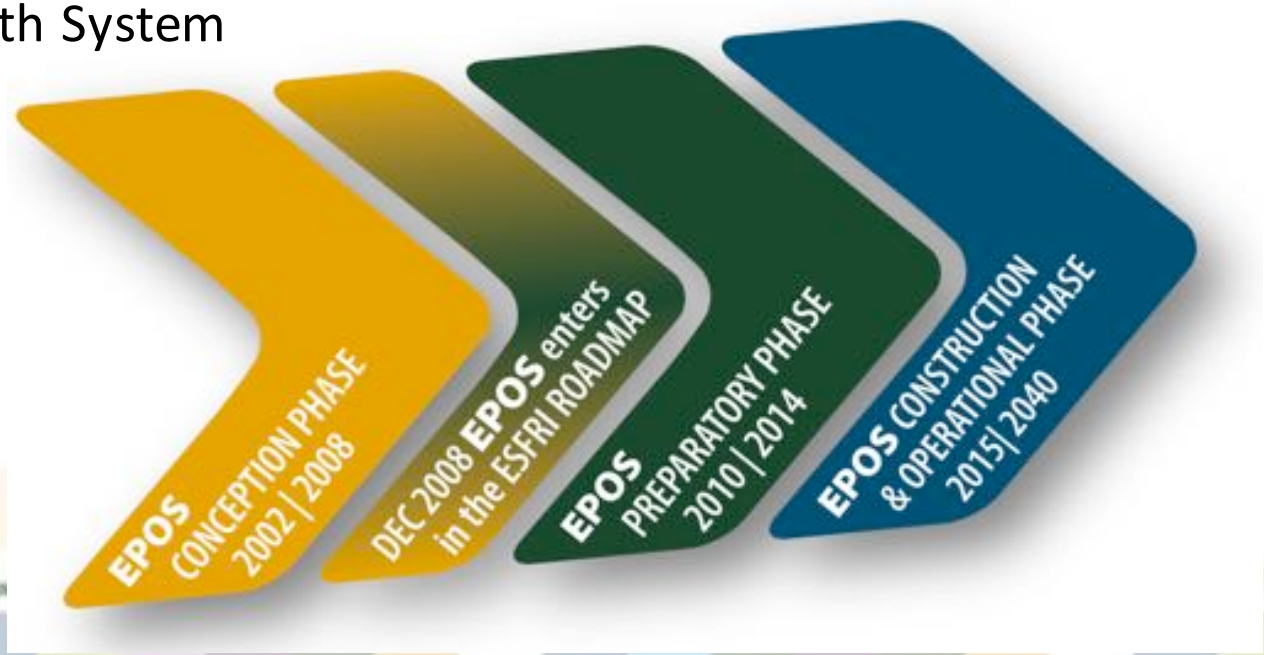
Developing sustainable and relevant community services for Seismology in Europe under the EPOS umbrella

F. Haslinger, R. Bossu, L. Danciu, A. Dupont, T. Garth, L. Luzi, A. Michelini, A. Rietbrock, R. Sleeman, A. Strollo, S. Wiemer, and the EPOS-Seismology consortium

ORFEUS Workshop 2016, Dubrovnik
(modified from ESC 2016, Presentation 451)

EPOS basics

- **The European Plate Observing System (EPOS) is a long-term integrated research infrastructure plan** to promote innovative approaches for a better understanding of the physical processes controlling earthquakes, volcanic eruptions, unrest episodes and tsunamis as well as those driving tectonics and Earth surface dynamics
- **EPOS is integrating the diverse, but advanced European Research Infrastructures for solid Earth Science and will build on new e-science opportunities** to monitor and understand the dynamic and complex solid-Earth System



EPOS basics

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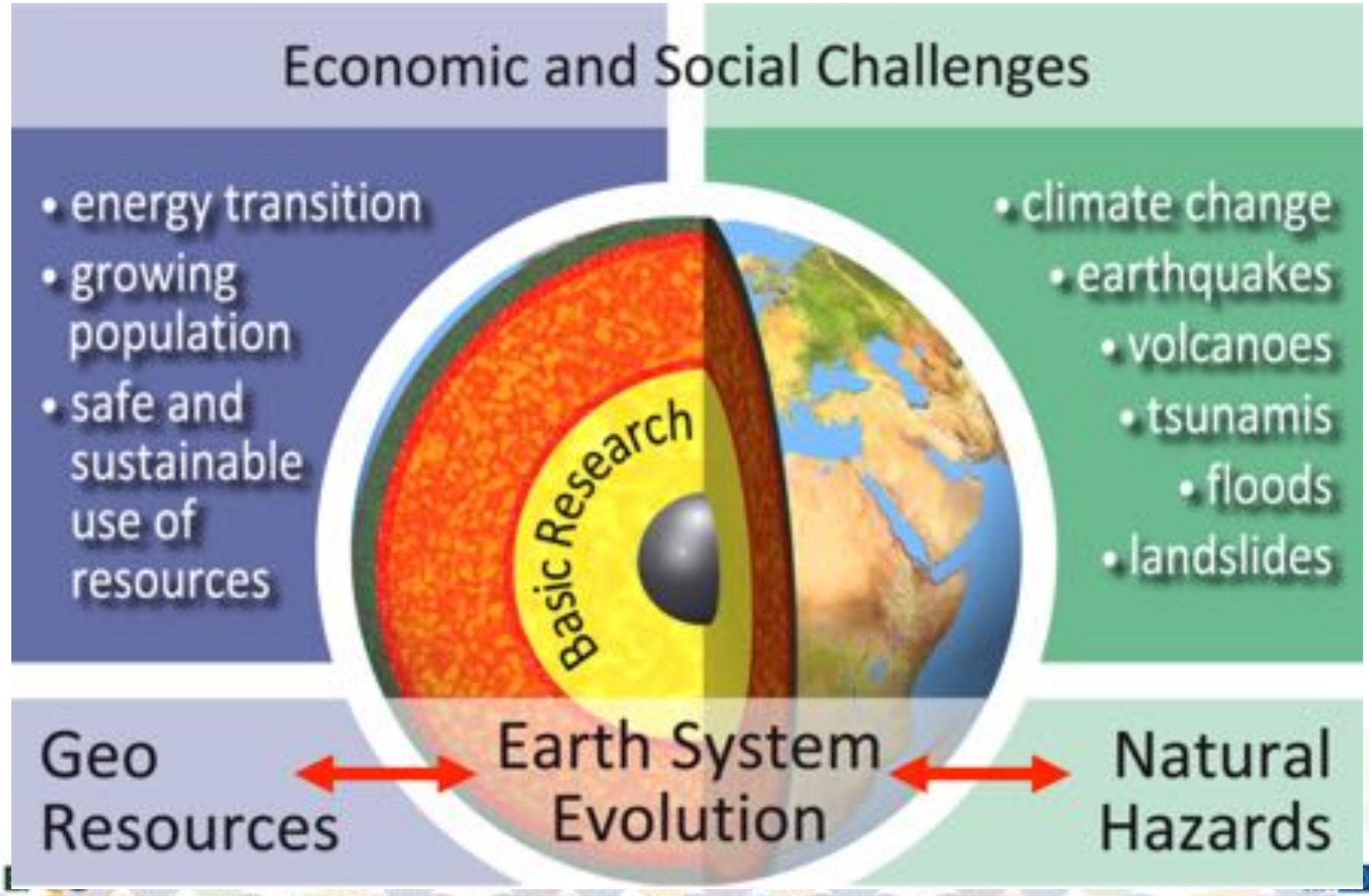
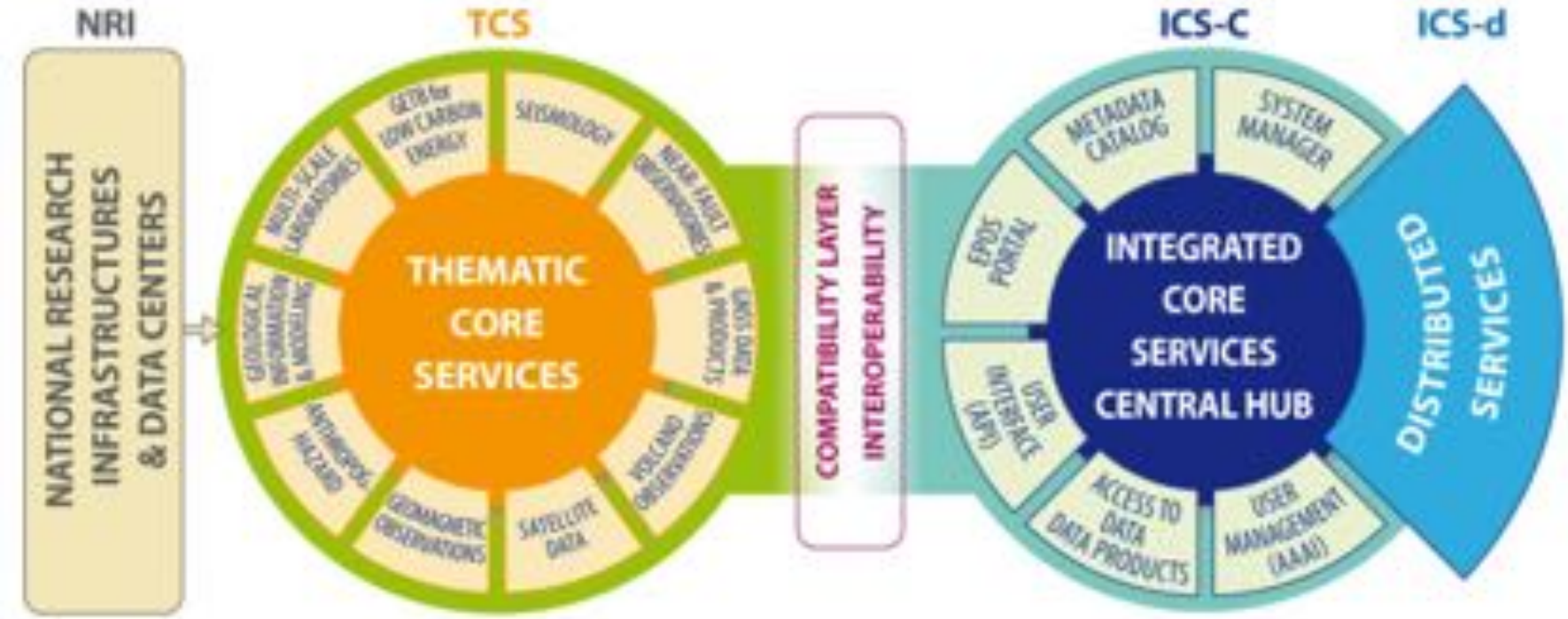


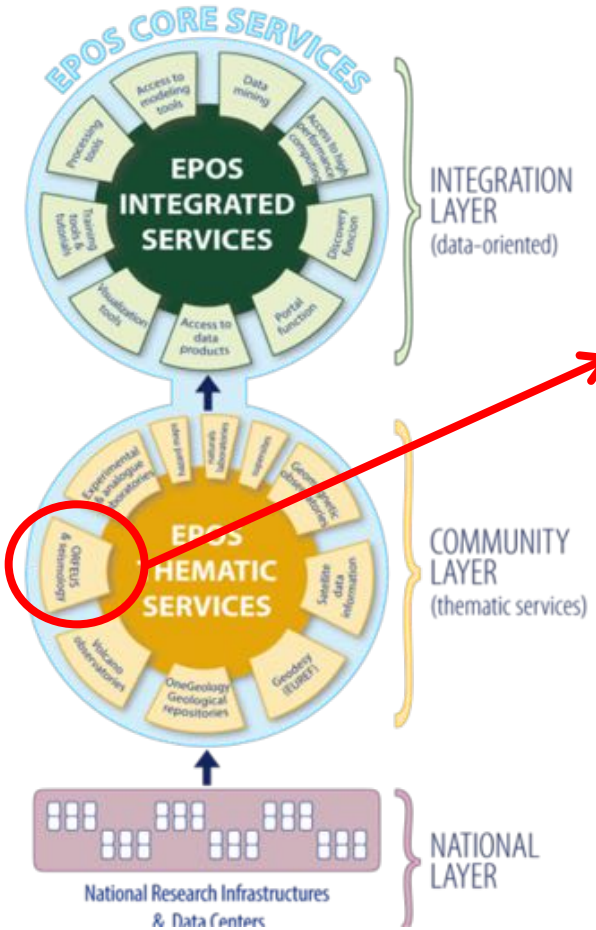
Organization of Seismology within EPOS



Thematic Core Service (TCS) Seismology
is one of 10 'thematic' service infrastructures of EPOS

A Compatibility Layer connects the TCS to the Integrated Core Services (ICS)

Organization of Seismology within EPOS



EPOS Board of Service Providers (all thematic & integrated service Board members)

EPOS Seismology (EPOS-S)

Governance and coordination by Board of Service representatives, 4-6 members

WAVEFORM DATA

Ground motion recordings from seismic sensors *(possible extension to infrasound)*

Structure: Distributed (ORFEUS umbrella)
~8 nodes, including ORFEUS & EIDA nodes, SISMOS, ESM

Products (indicative list)
Continuous and event waveforms from permanent and temporary stations (broadband, short period, strong motion); historical waveform archive; synthetic waveform data; strong motion data (products)

Services (…)
Station information (metadata, site characterization…); data quality (control) information

European Infrastructures
Mobile pools, OBS pools…

SEISMOLOGICAL PRODUCTS

Parametric earthquake information and event-related additional information

Structure: Distributed
~ 5 nodes, including EMSC & its key nodes, AHEAD

Products (indicative list)
Earthquake parameters & bulletins; earthquake catalogues (instrumental, macroseismic, historic, synthetic); moment tensors; source models

Services (…)
Rapid earthquake information dissemination (felt maps, ShakeMaps)

HAZARD AND RISK

Seismic hazard & risk products and services

Structure: Distributed
~3 nodes, including EFEHR (EUCENTER & ETH nodes)

Products (indicative list)
Hazard: Fault maps & models; source zones; hazard maps & curves & disaggregation; GMPEs
Risk: Inventories & inventory models; vulnerability functions; risk maps & scenarios

Services (…)
Tools for model building and visualization; product viewer; hazard & risk calculation software & infrastructure

COMPUTATIONAL SEISMOLOGY

High performance and high end computing, data intensive computing

Structure: Distributed
~3 nodes (build upon VERCE)

Products (indicative list)
Tools for massive scale data applications (processing, mining, visualization,…)

Services (…)
Access to HPC resources; data staging; data massive applications; data simulation; model repository and model handling tools (large 3D velocity models, rupture models,…)

e-Seismology & common services
Seismological services for visualisation, discovery and access to portal
(based on seismicportal.eu)
expert groups, standards

EPOS Integrated Services
Visualisation tool / discovery & access portal
high performance and high end computing (may absorb E-Seismology)
expert groups, standards

EPOS Volcanology

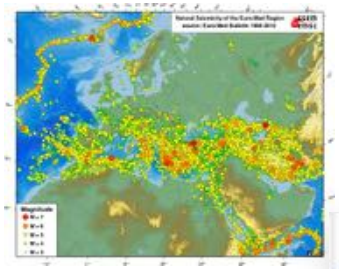
EPOS Geology

… Other EPOS Communities

The landscape of European Seismology

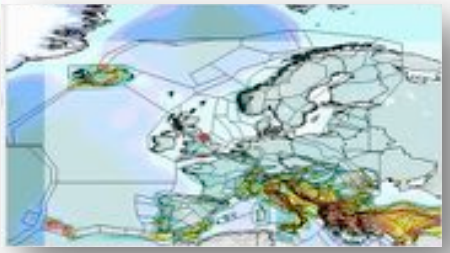
Three Services (and many on-going EC and national projects)

Observatories and Research Facilities for European Seismology
www.orfeus-eu.org Orfeus



European-Mediterranean Seismological Center
www.emsc-csem.org csem emsc

European Facilities for Earthquake Hazard & Risk (EFEHR)
www.efehr.org EFEHR

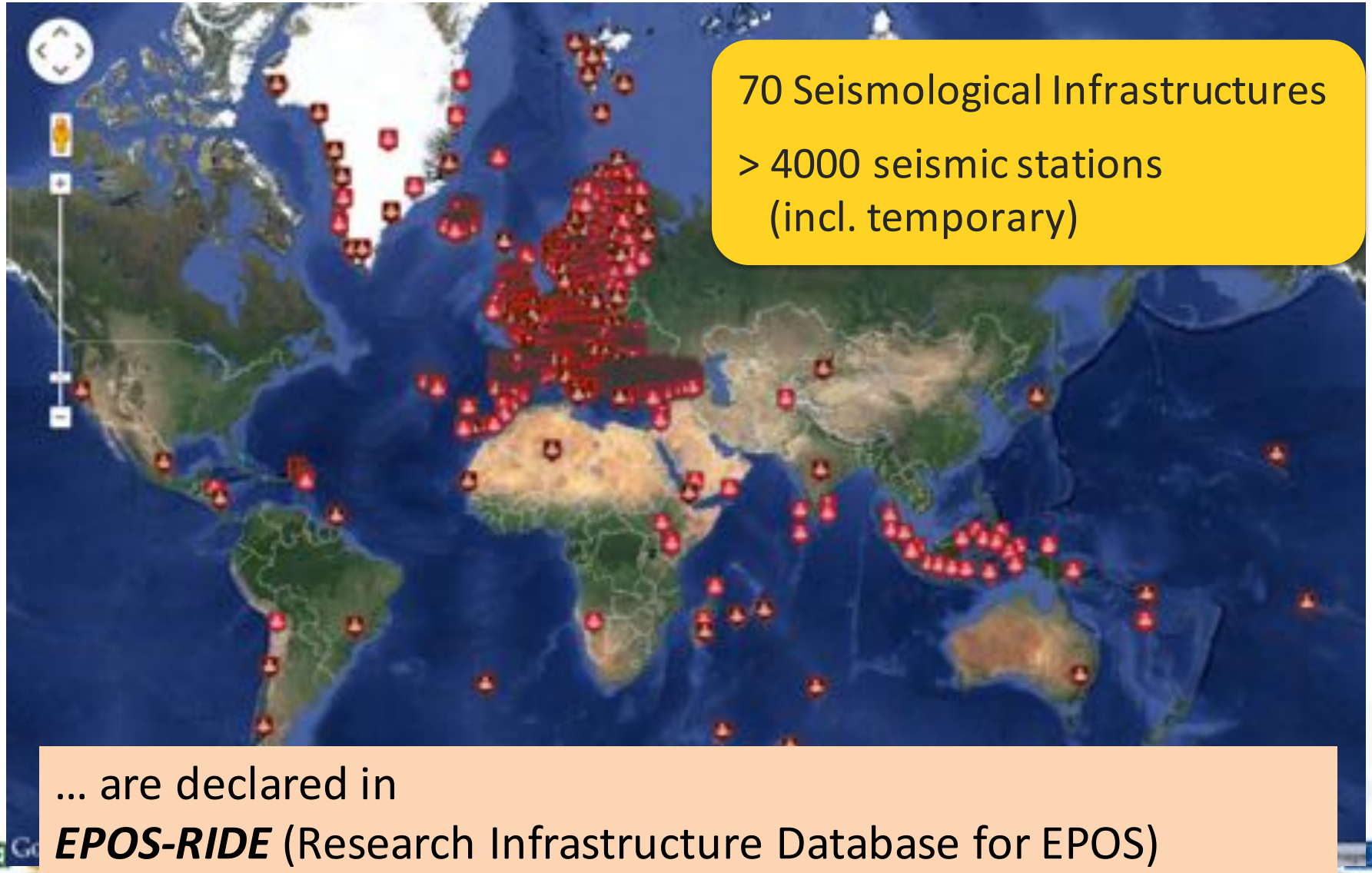


and a large number of past and present (infrastructure and research) projects

VERCE NERA EUDAT ENVRI COMMIT/ REAKT QUEST SHARE

are integrated within and contributing to EPOS (-Seismology)

The landscape of European Seismology



70 Seismological Infrastructures

> 4000 seismic stations
(incl. temporary)

… are declared in
EPOS-RIDE (Research Infrastructure Database for EPOS)

EPOS-Seismology in context

EUDAT 2020 ENVRI plus ...

provide co-funding of specific tasks and cross-domain interaction

EPOS-IP (46 institutions)

EPOS-S beneficiaries
(15 institutions)

Other community partners

International Seismological Centre

- eq catalogs
- magnitudes
- Identifiers
- …

FDSN

- stations & networks
- exchange & archival standards
- data & metadata formats
- metrics & quality control
- Identifiers
- …

GEO

- Intergovernmental coordination
- Data sharing & data management principles
- Cross-disciplinary coordination

Related EC projects

EPOS EUROPEANPLATEOBSERVINGSYSTEM

EPOS IP partnership

Other relevant international projects & organisations

EPOS-Seismology Vision

- A limited set of centralized infrastructures that support / provide a framework for a large variety of services originating from different sources: ***a 'federated' model***

- Enabling continuous innovation and development
  → 'innovation' is not a one-time activity!

- Manage information and strengthen interaction

Implications for EPOS-IP (2015 – 2019):

- Strong focus on structural developments

- At the end (of EPOS-IP) have a sustainable framework that is:
  - State-of-the-art
  - Easy to use (input / output)
  - Modular & distributed
  - Well integrated in EPOS (governance & ICT)

EPOS-Seismology Data, Products, Services Portfolio (a start…)

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seismology@epos-ip.org

Waveform Services

- Waveform selection & access
- Waveform metrics
- Station Information
- Rapid Raw Strong Motion parameters
- Engineering Strong Motion parameters
- OBS data integration
- Mobile Pool coordination & integration
- Waveform modeling

Seismological Products

- Earthquake Parameter Information
- Macroseismic / Historical Event data
- Seismological Products Platform
  - rupture models / SiteCharTool / MT
  - EventID / F-E-Region / …

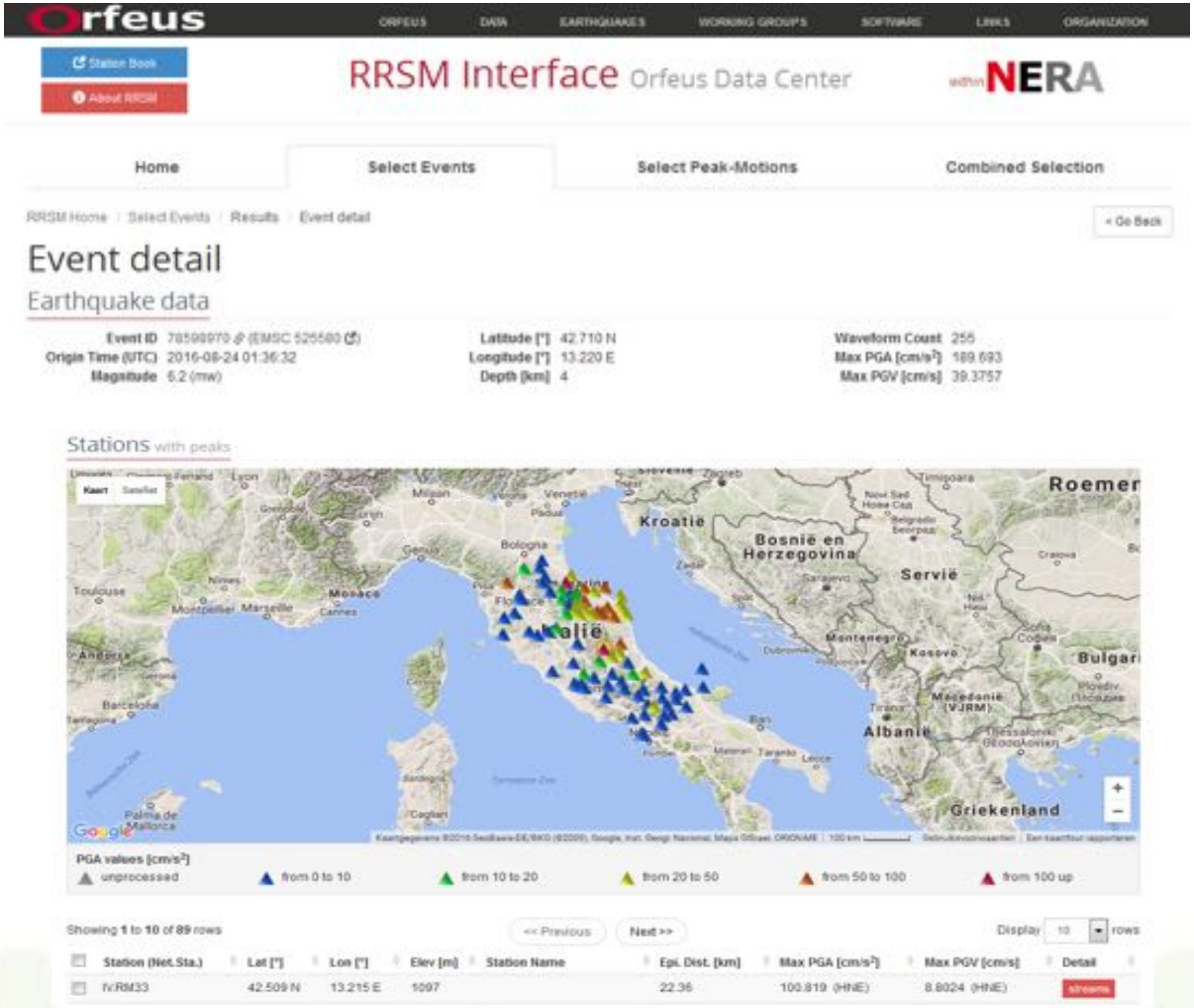
Hazard and Risk Services

- EFEHR platform & hazard model
- Seismogenic Faults
- Ground Motion Prediction Equations
- Geotechnical Engineering Information
- Strong Motion records in buildings
- Earthquake Engineering & Risk Services

Community standards: fdsnws-, QuakeML, StationXML, NRML, …

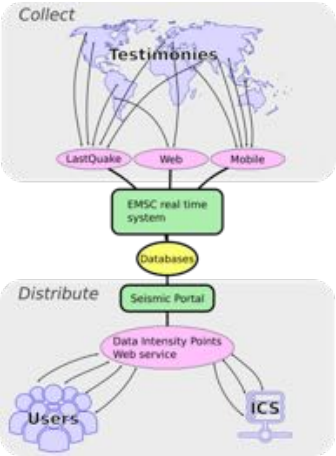
Waveform services

EIDA portal & webservices



Seismological Products

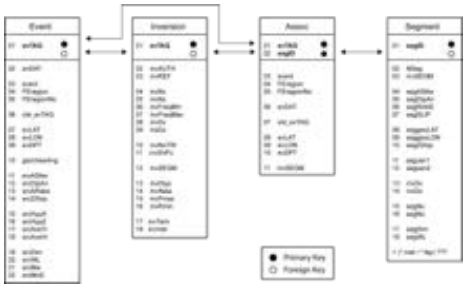
Intensity Data Points



+ Publication SRL (submitted)

« *Thumbnail-Based Questionnaires for the Rapid and Efficient Collection of Macroseismic Data from Global Earthquakes. Rémy Bossu, Matthieu Landès, Fréderic Roussel, Robert Steed, Gilles Mazet-Roux, Stacey S. Martin and Susan Hough.* »

Rupture Model (SRCMOD)



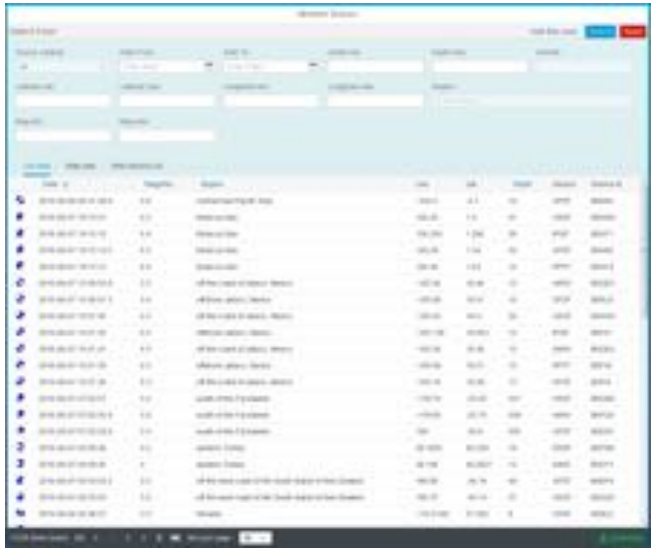
+ Data recovery (relationship tables)
+ Functional specifications (draft)

Event ID

+ Data recovery
+ Functional specifications (draft)

Seismological Products

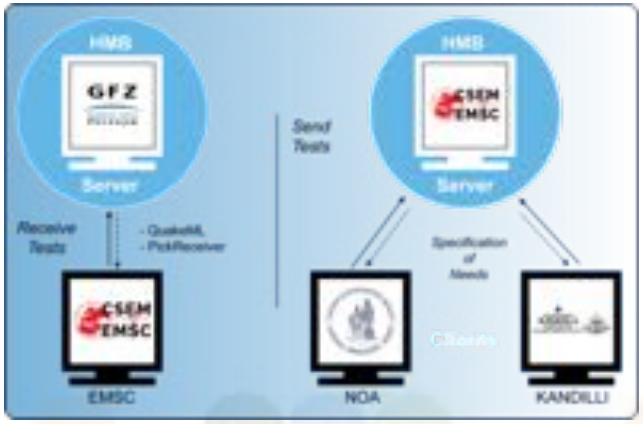
Moment Tensor (MTDB)



+ Functional specifications (document)
+ First release of the webservice

« Accessible online: http://vigogne/mtws/ »

HMB Messaging System

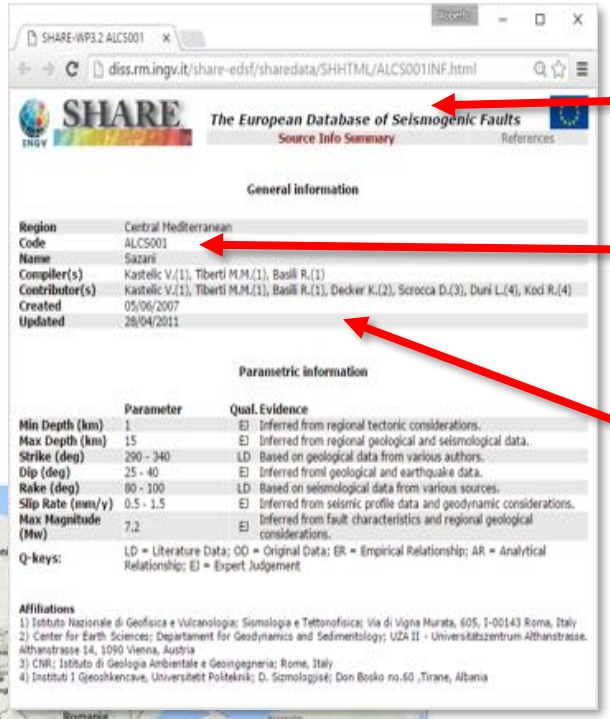


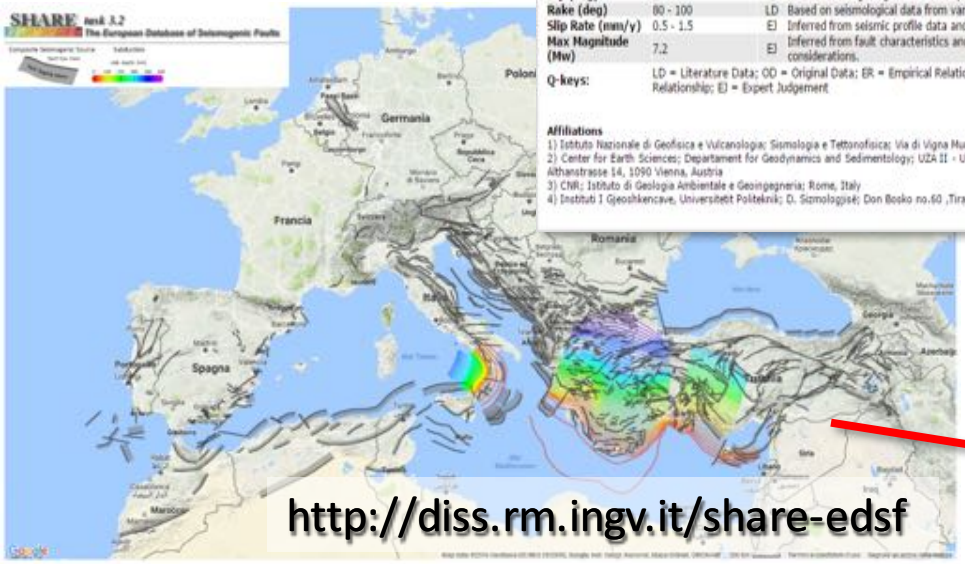
+ Functional specifications (draft)
+ First tests with EPOS partners

« HMB Messaging Service: Test and Application in an EPOS Context »

European Database of Seismogenic Faults

1,128 records for ~63,775 km of crustal faults and three subduction zones, all mapped in 3D and parameterized for earthquake rate calculations.





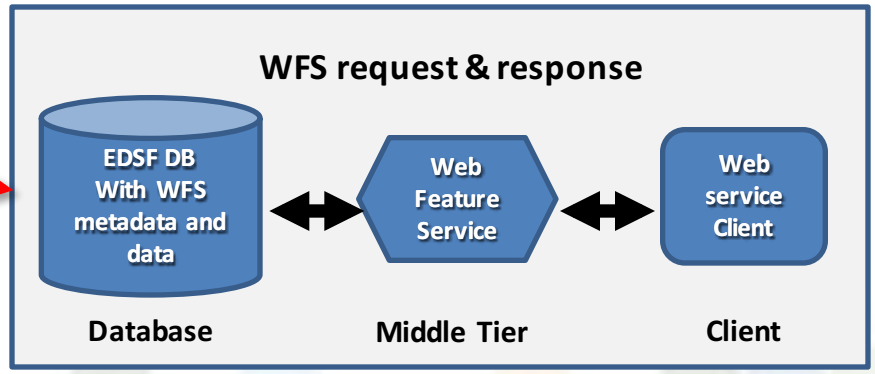
Implementation of Persistent Identifiers (PID)

DOI: identifies the RDB, needs solutions for versioning and fragmentation

Internal ID (main key): identifies faults, needs revision to expand its capabilities and link to update history [# <fragment>]

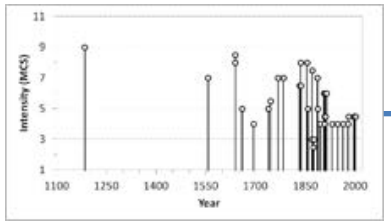
ORCID: unambiguously identifies compilers and contributors, along with their affiliations and scientific profiles

Mapping webservices: OGC ® Web Feature Service 2.0 (WFS) Interface Standard (http://www.opengeospatial.org/standards)



Using the WP8 four pillars:
ground-motion scenarios at a site of interest

SEISMOLOGICAL PRODUCTS

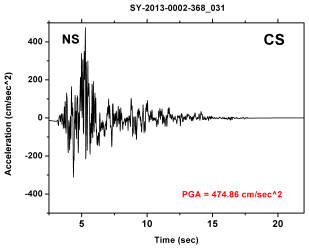


retrieving seismic history at the site

HAZARD & RISK

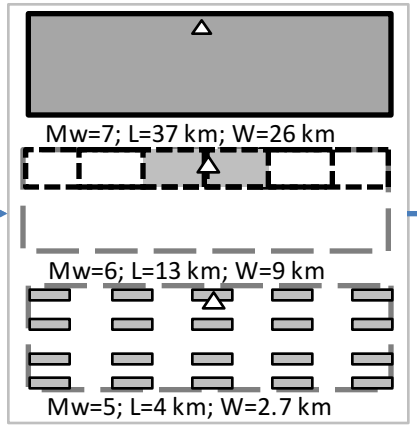
select the nearest fault to the target site and retrieve its parameters

WAVEFORM DATA

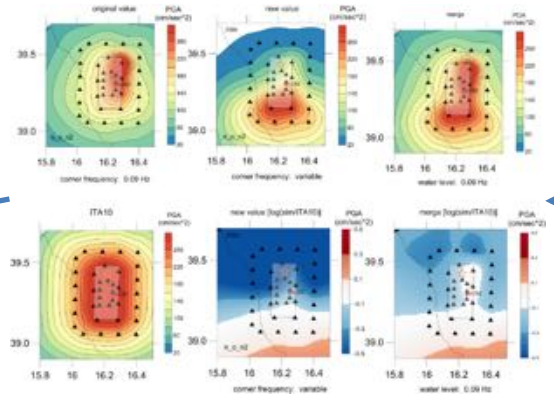


downloading reference accelerograms to validate the model

COMPUTATIONAL SEISMOLOGY



defining fault parameters



calculating ground-motion field for various rupture models

Current challenges / open issues (some …)

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Waveform Services

- Service Consolidation (mediation, routing, stability…)
- Data integration, attribution, federated data management …
- Mobile network & OBS integration and service development

Modeling

- Make platform operational | arrangements for computing resources

Seismological Products

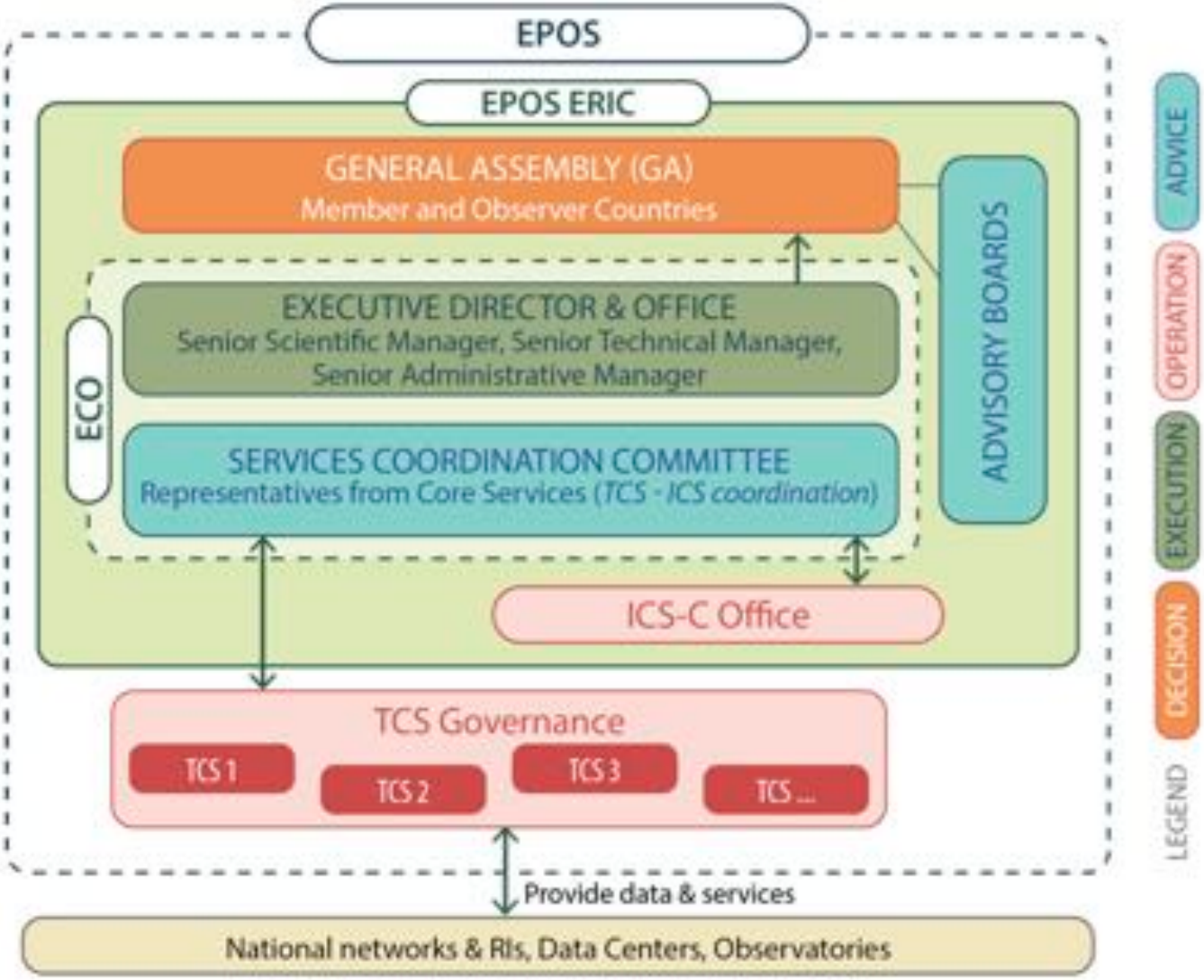
- Operational and populated products platform; federated services
- ***European Integrated Earthquake Catalog (?)***
- *(including a harmonized approach to magnitudes…)*

Earthquake Hazard & Risk Services

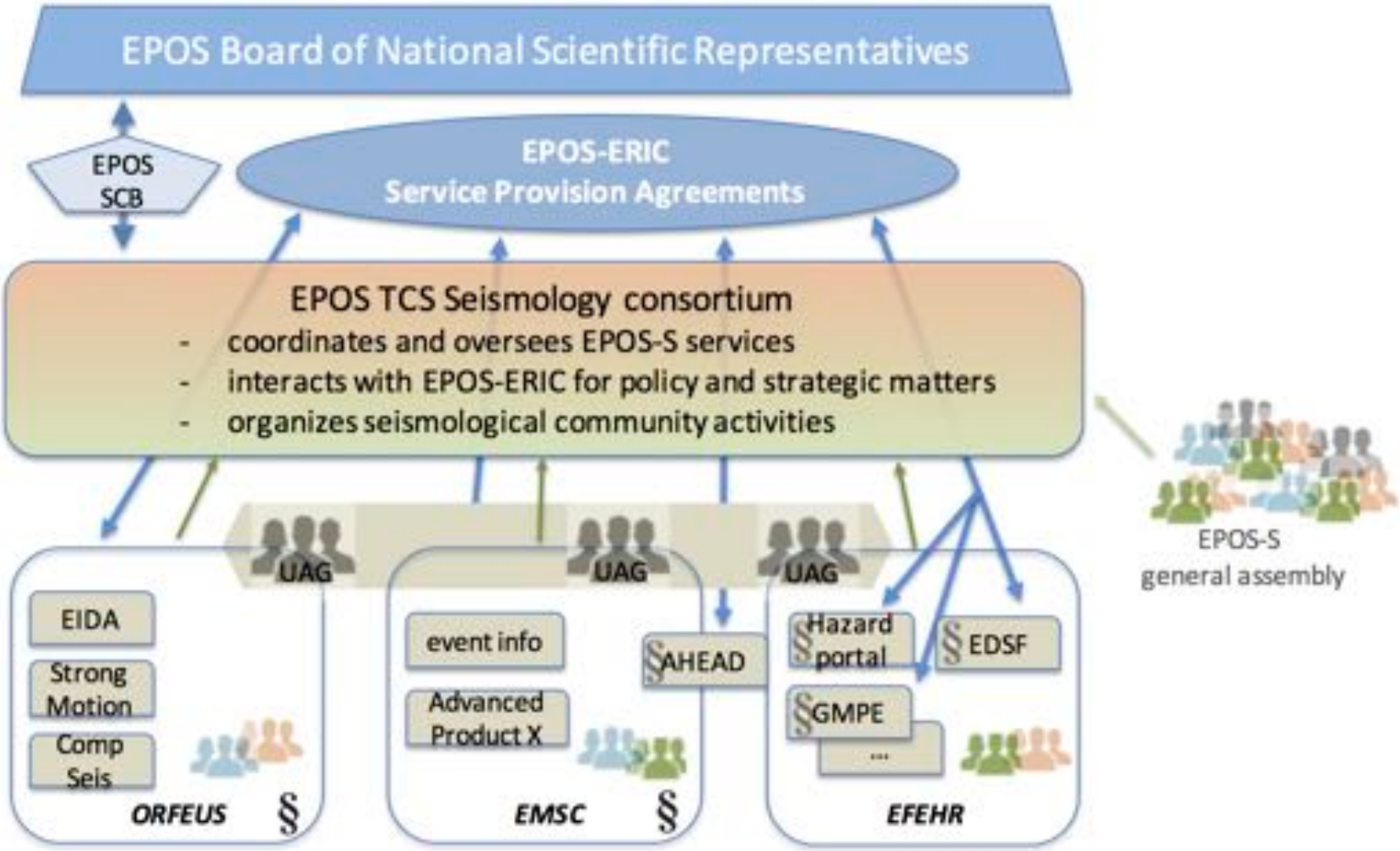
- Community Organization (integration of Engineering)
- *next generation of harmonized European Hazard (include Risk…)*
- **from history of projects to operational infrastructure…**

Governance issues

- the EPOS framework



Governance issues - EPOS-Seismology



Governance issues – relationships

Seismological (waveform) data in EPOS is organized within ORFEUS

EPOS member countries recognize that their 'national contributions' of seismic waveform data to the EPOS framework will be accessible through the EPOS TCS Seismology service operated and governed by ORFEUS.

Technical is trivial – Governance makes the difference

Attribution is key:
Data that is distributed through EPOS / ORFEUS shall
always include a prominent and obvious reference to the original provider (and owner) of that data

EPOS Data, Access & IPR Policies

- Data and facilities will be owned by national RIs (that contribute them)
- EPOS products will be owned by EPOS
- Open Access to:
  - Freely available data in real time or with some time delay
  - Data available without charge to specific users or for specified purposes
- Access to metadata allowing discovery of other relevant data
- Data Licensing: Creative Commons (CC-BY-NC) wherever possible
- Services and software available under CC (or other suitable) licensing
- Access rules: authentication will be required including statements on purpose of using data (for many 'EPOS services')
- Pricing: at this point no requirements for a pricing policy has been identified

EPOS Data, Access & IPR Policies

Guiding principle: open access
- no fees
- no charges

Protect EPOS legally

Trace EPOS use & users

Unrestricted use & access

Balance: Legal risk : Openness : Traceability

Respect: domain customs & standards
e.g. anonymous access, embargo periods

natl. & EU legislation & policies
e.g. INSPIRE, privacy protection,
commercial use of publicly funded data

EPOS Data, Access & IPR Policies

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seismology@epos-ip.org

Balance: Legal risk : Openness : Traceability

Licensing
IPR
Terms & Conditions
Restrictions

Data & Service **Providers** → Open Access deposit terms → EPOS → Open Access license → Data & Service **Users**

Categorization

as needed for legal aspects

Data & Data Products | Tools & Software

Open : Restricted : Embargoed

mix and match as required

Anonymous : Registered : Authorized

Users

Legal interoperability issues – a bigger picture

RDA RESEARCH DATA ALLIANCE

ICSU CODATA

LEGAL INTEROPERABILITY OF RESEARCH DATA: PRINCIPLES AND IMPLEMENTATION GUIDELINES

https://doi.org/10.5281/zenodo.162241

One. Facilitate the lawful access to and reuse of research data.

Two. Determine the rights to and responsibilities for the data.

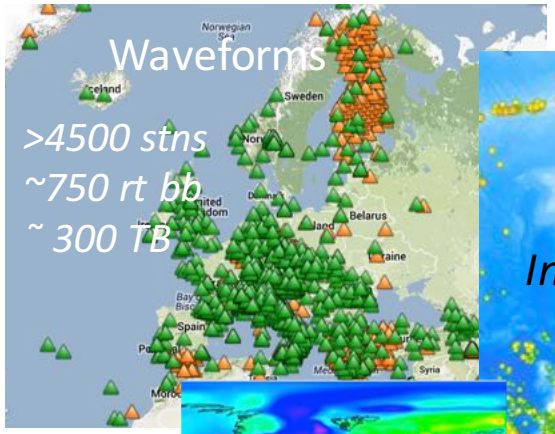
Three. Balance the legal interests.

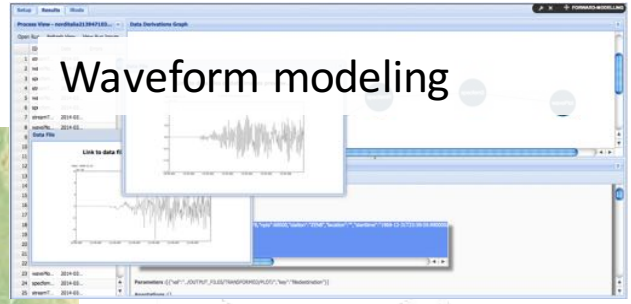
Four. State the rights transparently and clearly.

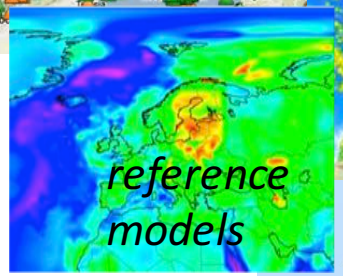
Five. Promote the harmonization of rights in research data.

Six. Provide proper attribution and credit for research data.

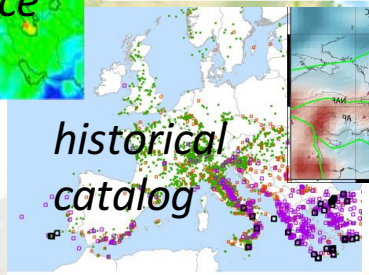
EPOS-Seismology
one house in the EPOS village

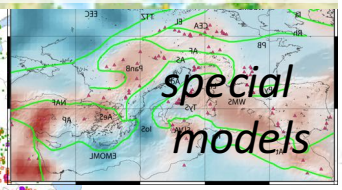






Seismological products





Thank You

Questions / comments / feedback:

seismology@epos-ip.org

PIDs, UUIDs, DOIs, handles or what?

Identifiers on data, products, services:

- Enable ***attribution*** (get credit!)
- Allow ***reproduction***
- Support ***workflow & data management*** organization

But:

- which (type of) identifier for which (class of) products?
- what standard(s) to follow and who decides?
- how many different identifiers can one single datum have? …

Some tasks / groups are already implementing 'their best ideas'

➢ urgent need for organized discussion & action plan