Current Status of EPOS GNSS Working Group

Rui Fernandes
on behalf of WG4 members

Current Status

WG4 COMPOSITION

First Name	Last Name	Official ROLE within WG4	Country	Institution
Rui	**Fernandes**	WG Chair	PORTUGAL	SEGAL (UBI/IDL)
Luisa	**Bastos**	WG co-Chair	PORTUGAL	FC UP
Carine	**Bruyninx**	WG co-Chair	BELGIUM	ROB
Nicola	**D'Agostino**	WG co-Chair	ITALY	INGV
Jan	**Dousa**	WG co-Chair	CZECH REPUBLIC	Geodetic Observatory Pecny
Athanassios	**Ganas**	WG co-Chair	GREECE	NOA
Martin	**Lidberg**	WG co-Chair	SWEDEN	LM
Andrzej	**Araszkiewicz**	WG Member (National Representative)	POLAND	Military University of Technology
Matthias	**Becker**	WG Member (National Representative)	GERMANY	TU Darmstadt
Richard	**Bingley**	WG Member (National Representative)	UNITED KINGDOM	University of Nottingham
Rahsan	**Cakmak**	WG Member (National Representative)	TURKEY	TUBITAK MAM
Mary	**Carter**	WG Member (National Representative)	IRELAND	GSI
Mariusz	**Figurski**	WG Member (National Representative)	POLAND	Military University of Technology
Jorge	**Gárate**	WG Member (National Representative)	SPAIN	ROA
Ivan	**Georgiev**	WG Member (National Representative)	BULGARIA	BAS
Pasi	**Hakli**	WG Member (National Representative)	FINLAND	FGI
Nicolas	**Houlie**	WG Member (National Representative)	SWITZERLAND	ETH
Ambrus	**Kenyeres**	WG Member (National Representative)	HUNGARY	FOMI
Halfdan	**Kierulf**	WG Member (National Representative)	NORWAY	STATKART
Shfaqat	**Khan**	WG Member (National Representative)	DENMARK	DTU-Space
Alexandra	**Muntean**	WG Member (National Representative)	ROMANIA	NIEP
Markku	**Poutanen**	WG Member (National Representative)	FINLAND	FGI
Benedikt	**Ofeigsson**	WG Member (National Representative)	ICELAND	VEDUR
Giulio	**Selvaggi**	WG Member (National Representative)	ITALY	INGV
Gunter	**Stangl**	WG Member (National Representative)	AUSTRIA	IWF
Bojan	**Stopar**	WG Member (National Representative)	SLOVENIA	University of Ljubljana
Hans	**van der Marel**	WG Member (National Representative)	NETHERLANDS	Delft University of Technology
Andrea	**Waldersdorf**	WG Member (National Representative)	FRANCE	University of Grenoble
Caporali	**Alessandro**	WG Member (GNSS)	ITALY	Univ. Of Padova
David	**Zuliani**	WG Member (GNSS)	ITALY	INOGS
Olivier	**Francis**	WG Member (Gravity)	LUXEMBOURG	UNILU
Sylvian	**Bonvalot**	WG Member (Gravity)	FRANCE	BGI
Jonathan	**Jones**	WG Member (Meteo)	UNITED KINGDOM	Meteo UK
Artur	**Rocha**	WG Member (WG7)	PORTUGAL	INESC-P

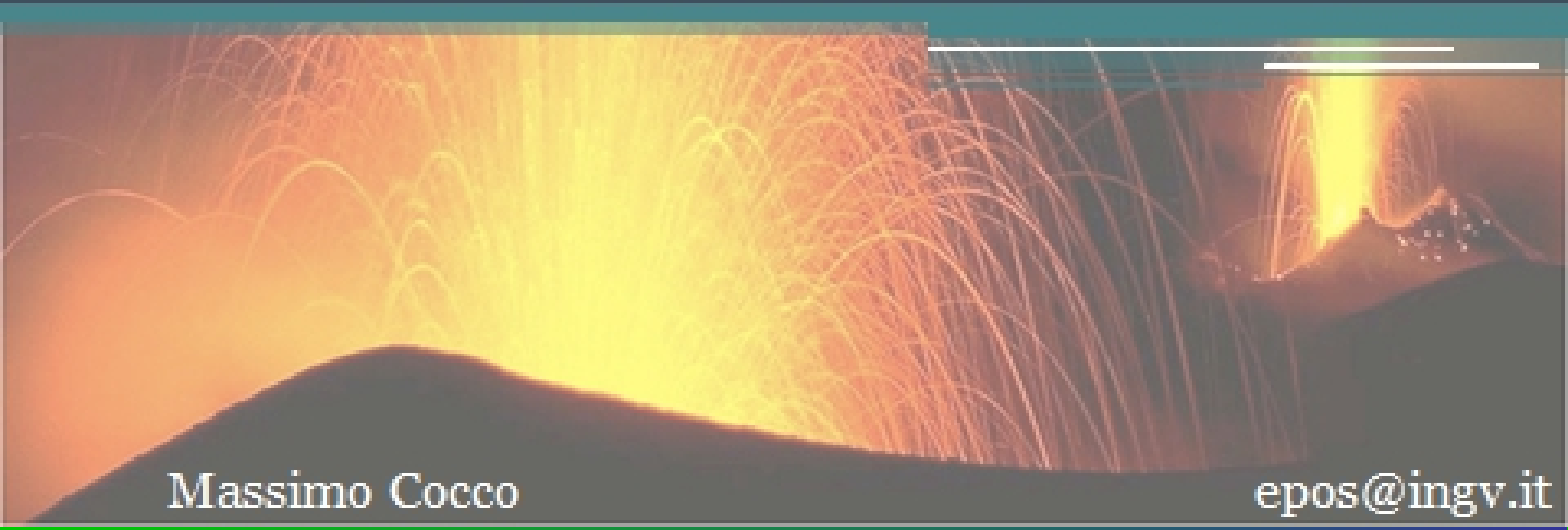
EPOS
EUROPEANPLATEOBSERVINGSYSTEM

Research Infrastructure and e-science for Data and Observatories on Earthquakes, Volcanoes, Surface Dynamics and Tectonics

EPOS a long term integration plan of research infrastructures for solid Earth Science in Europe

Preparatory Phase Project

www.epos-eu.org



Massimo Cocco

epos@ingv.it

What is EPOS?

- It is an ESFRI project (Preparatory Phase)
  - (European Strategic Forum on Research Infrastructures)
- It aims at integrating existing RIs for solid Earth
  - Supporting construction/implementation of community data centers
  - Building core services for different stakeholders
- It aims at creating the governance structure to manage this distributed RI and its services to users
- It aims at building a legal body to secure funds for maintaining RIs for solid Earth science

EPOS PP Mission

- 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

- The EPOS plan aims at integrating the currently scattered, but highly advanced European facilities into one, distributed, but coherent multidisciplinary Research Infrastructure (RI) taking full advantage of new e-science opportunities

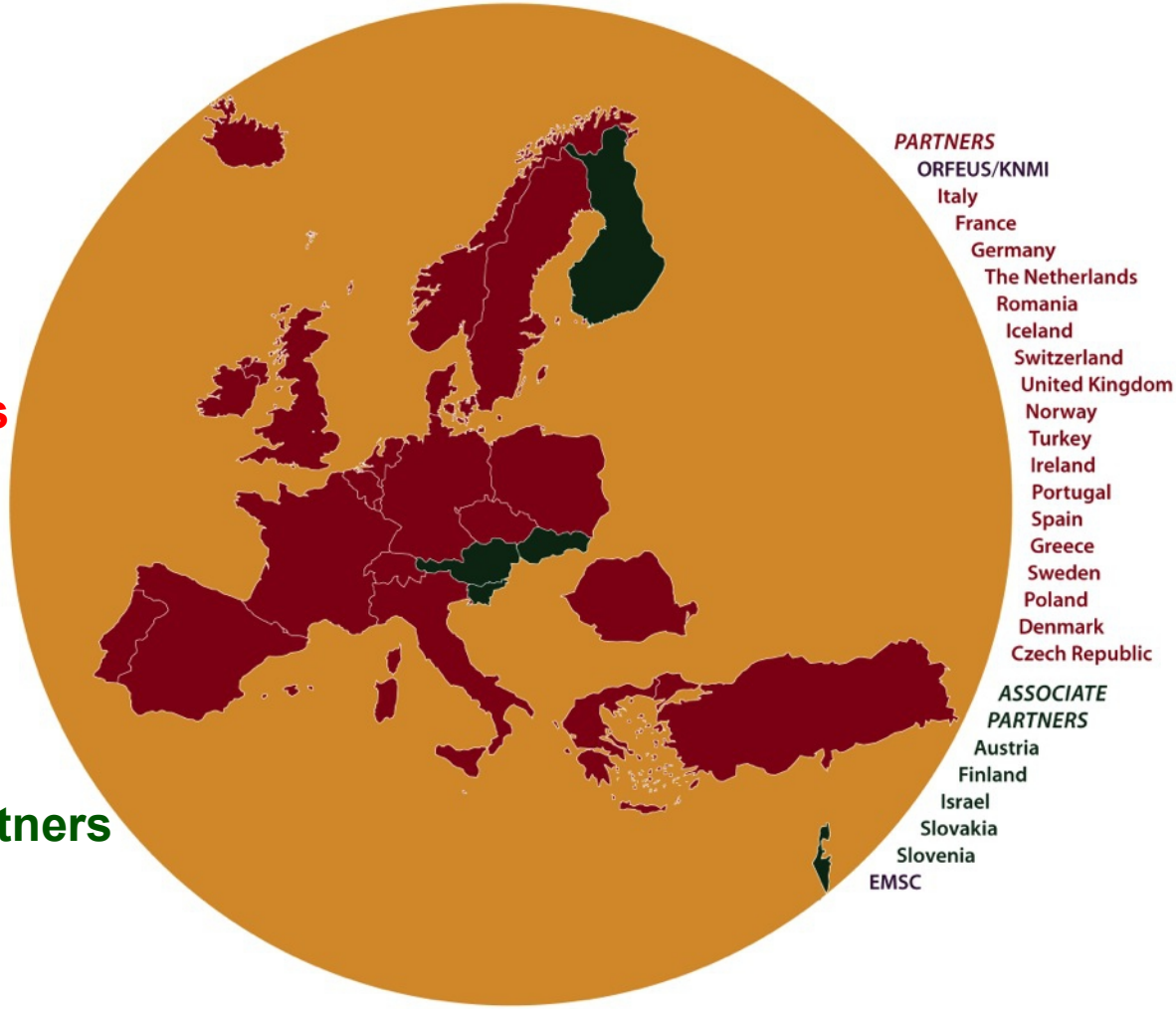
EPOS PP Timeline

www.epos-eu.org

EPOS: the Partnership

Who?

20 partners
for 18 countries



6 associate partners
for 5 countries

On going initiatives for integrating the partnership:
Bulgaria, Belgium, Russia, ...

Erice September 2011

EPOS
EUROPEANPLATEOBSERVINGSYSTEM

Functional Architecture

Higher level data products

INTEGRATED CORE SERVICES

API

EPOS PORTAL

METADATA CATALOGUE

SYSTEM MANAGER

SERVICES

DISTRIBUTED ICS

COMPATIBILITY LAYER

XML SEISMOLOGICAL SERVICES

GSAC XML SERVICES

SUPERSITES SERVICES

INDUCED S. CERIF XML

THEMATIC CORE SERVICES

SEISMIC DATACENTRES

GPS DATACENTRES

SUPERSITES E-INFRASTRUCTURES

INDUCED SEISMICITY DATACENTRES

National Networks

National Networks

Seismic Networks

GPS Networks

Geochemical Networks

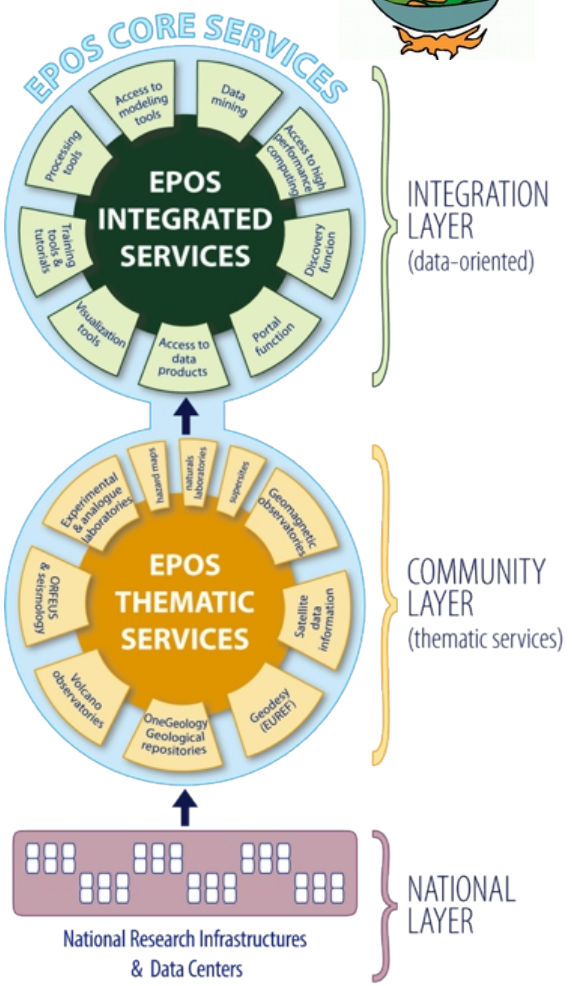
Geomagnetic Data

Laboratories

...

National Research Infrastructures

Compatibility Layer is the TCS-ICS Interface and it guarantees integration & interoperability



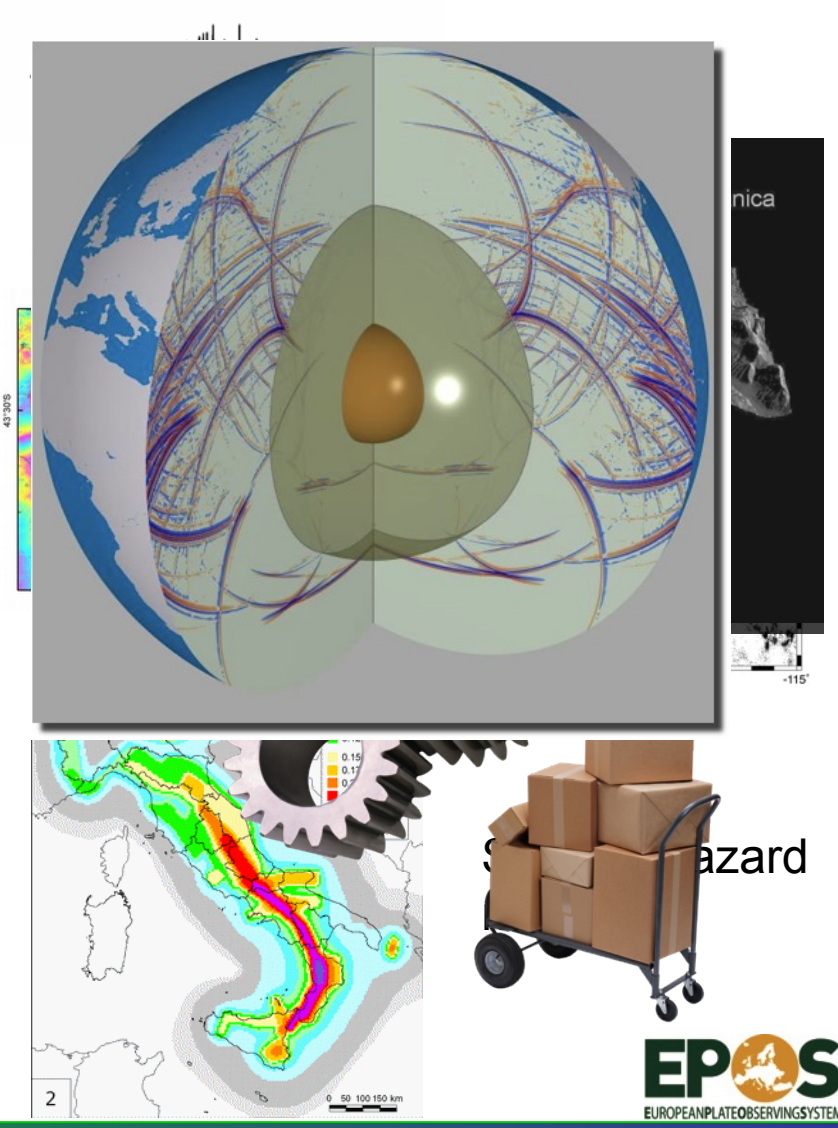
Background to Geodesy in EPOS

WG4 – "GNSS Data and Other Geodetic Data" is the Working Group of the EPOS project in charge of defining and preparing the integration of the existing Pan-European Geodetic Infrastructures that will support the European Geosciences. It is open to the entire geodetic community. In fact, WG4 also includes members from countries that formally are not part of the current phase of EPOS.

Focus on cGNSS (continuous GNSS) as a start but open to include other geodetic data in the future (there are current efforts focused on gravity data).

Access to Data Products (Taxonomy)

- Level 0: raw data, or basic data
- Level 1: data products coming from nearly automated procedures
- Level 2: data products resulting by scientists' investigations
- Level 3: integrated data products coming from complex analyses or community shared products
- Level 4. Software, IT tools



EPOS Database (RIDE)

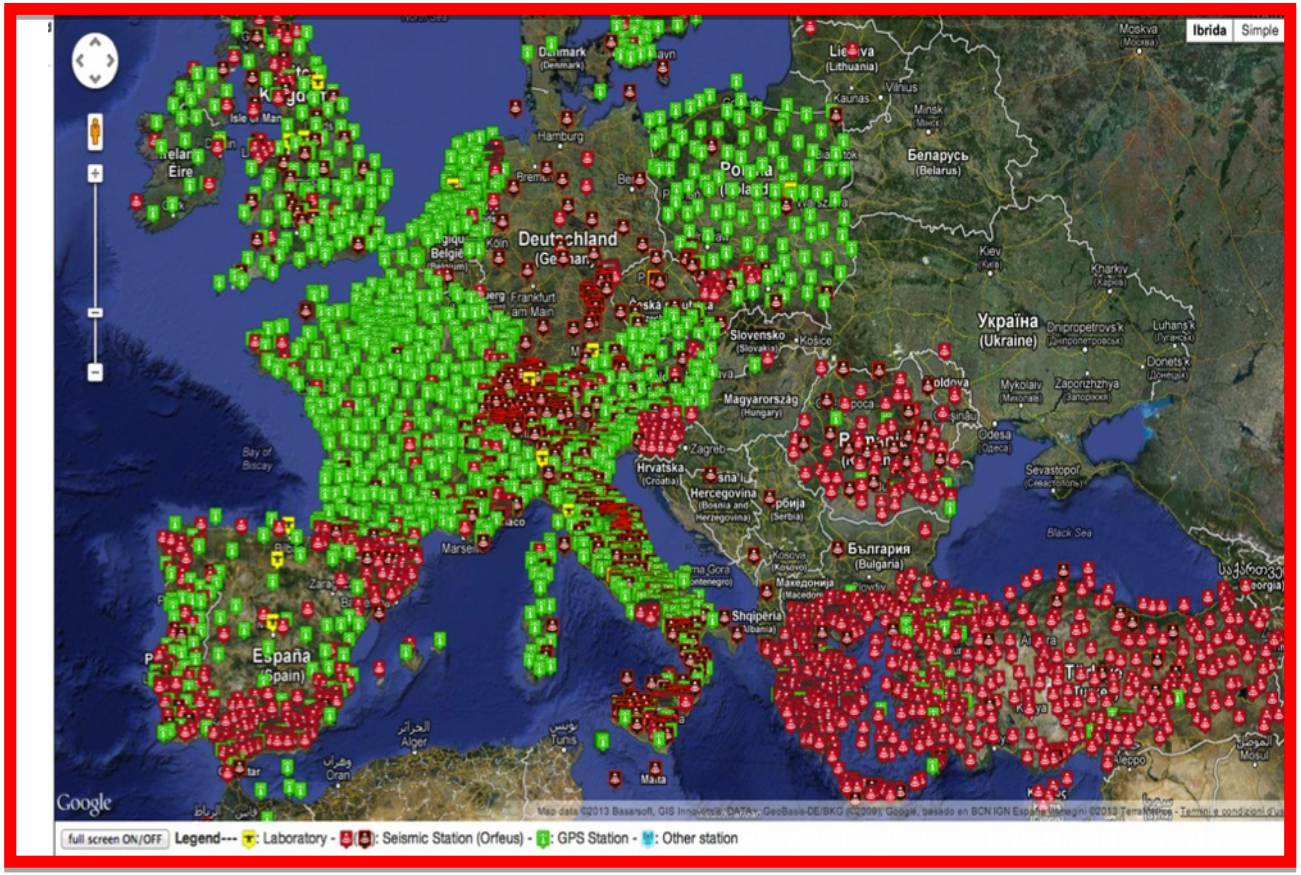
MAP OF:
- Seismic/GPS stations
- Laboratories
-- etc….

Diversity in data type and formats

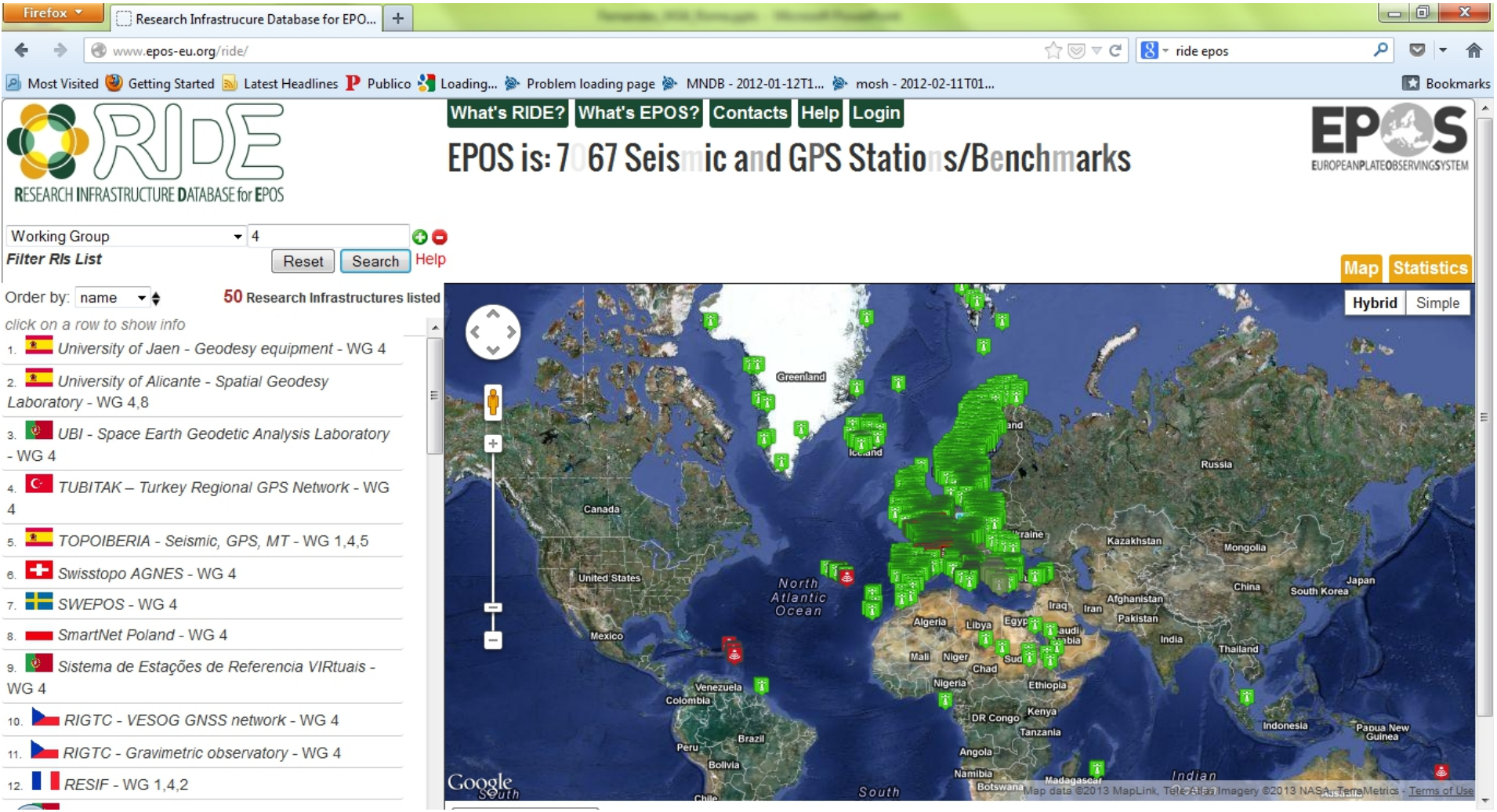
http://www.epos-eu.org/ride/

Research Infrastructure LIst

- 244 Research Infrastructures
- 138 Institutions
- 22 countries
- 2272 GPS receivers
- 4939 seismic stations
- 464 TB Seismic data
- 1.095 PB Storage capacity
- 828 instruments in 118 Laboratories



EPOS Database



About 2200 cGNSS stations, managed by 49 research infrastructures (RI), potentially available for EPOS

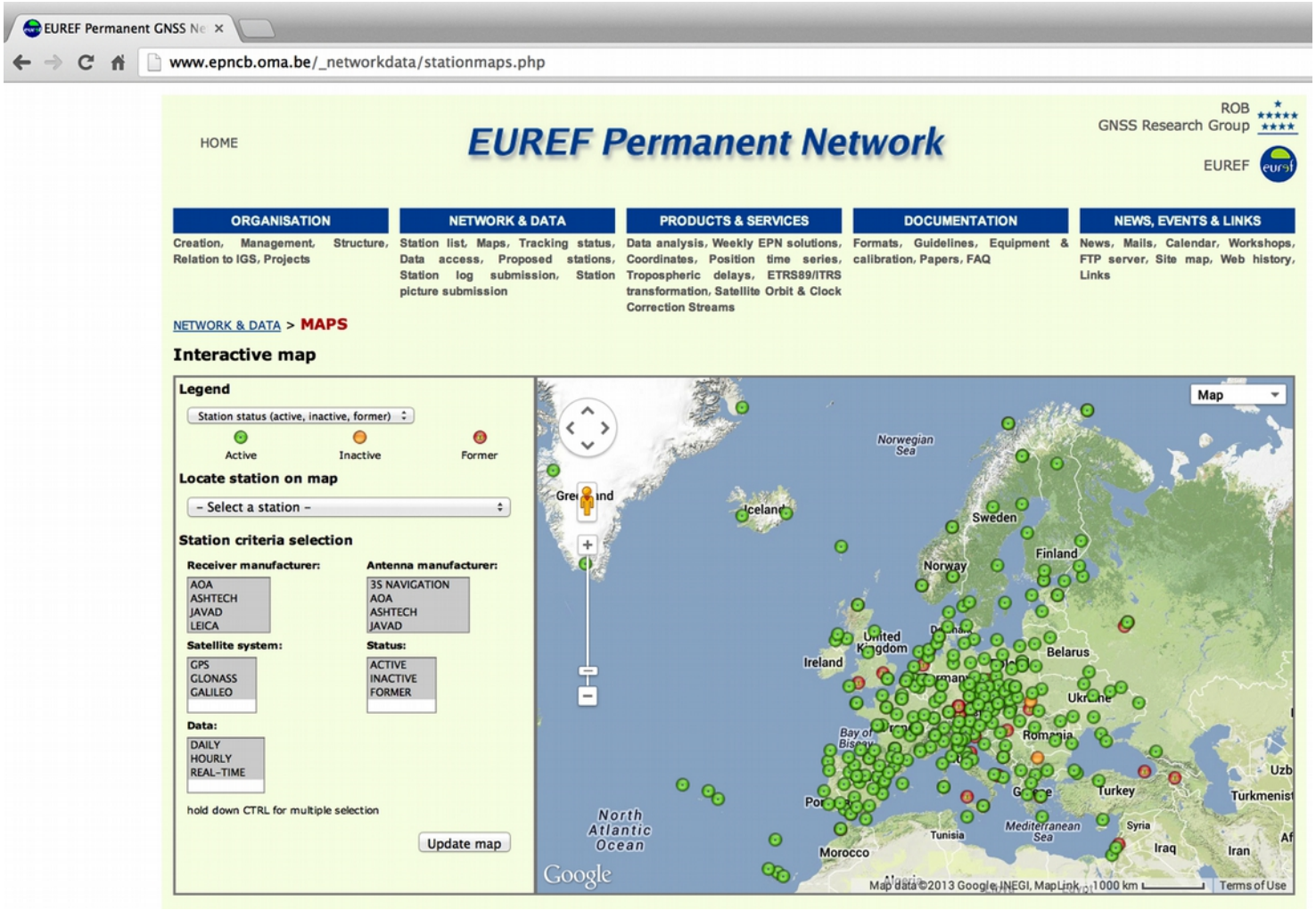
Scientific applications of GNSS data for the EPOS community

Application	Data need	Existing projects	EPOS added value
Tectonics	30s, daily	...	Dense velocity field
GNSS-seismology	1Hz, sub-hourly>=1Hz, real-time (GNSS seismometer)		>1Hz real-time processing, Collocation with seismometers
GIA	30s, daily		Densification
Sea-level change	30s, daily	IGS TIGA, SONEL	Collocation with tide gauges,
Loadings	30s, daily (global) 1Hz, sub-hourly (storm surge) >=1Hz, real-time (storm surge)		Densification
Early warning systems	>=1Hz, real-time		>1Hz real-time processing

Scientific application of GNSS data for other communities

Application	Data need	Existing projects	EPOS added value
Reference frame	30s, daily	EUREF	National level
Meteorology	30s, hourly (forecasting) 1Hz, sub-hourly (now-casting) >=1Hz, real-time (now-casting)	E-GVAP, COST	Unique access to a common dataset, additional collocations with met sensors, ...
Climate change	30s, daily		Data density, homogeneity in long-term processing, collocations
Space weather	30s, hourly (forecasting) 1Hz, sub-hourly (scintillations) >=1Hz, real-time (scintillations)		Densification

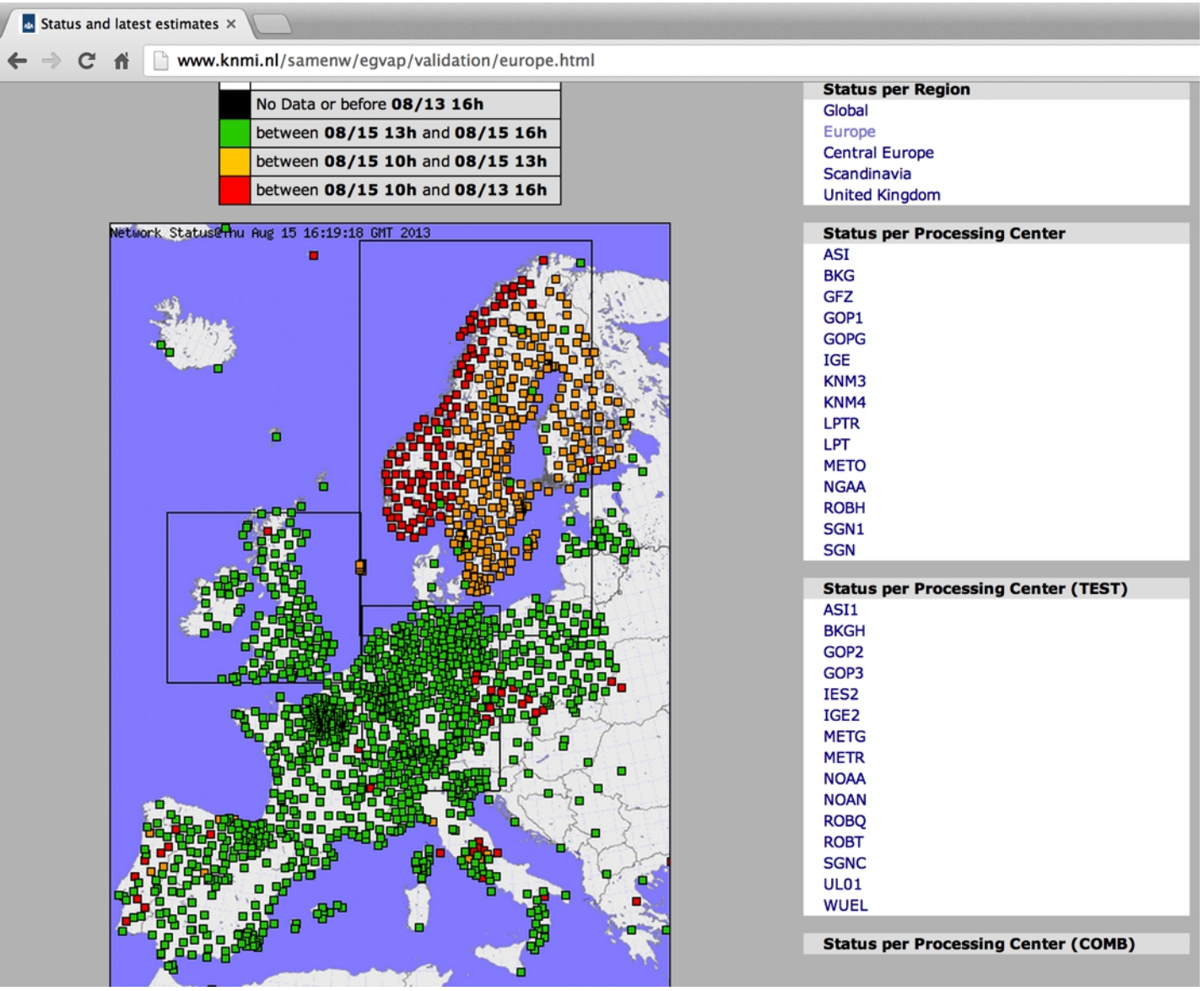
GNSS-related European projects
EUREF – European Reference Frame



EPOS aims to deeply cooperate with EUREF in order to benefit from the experience constructed in the last decades

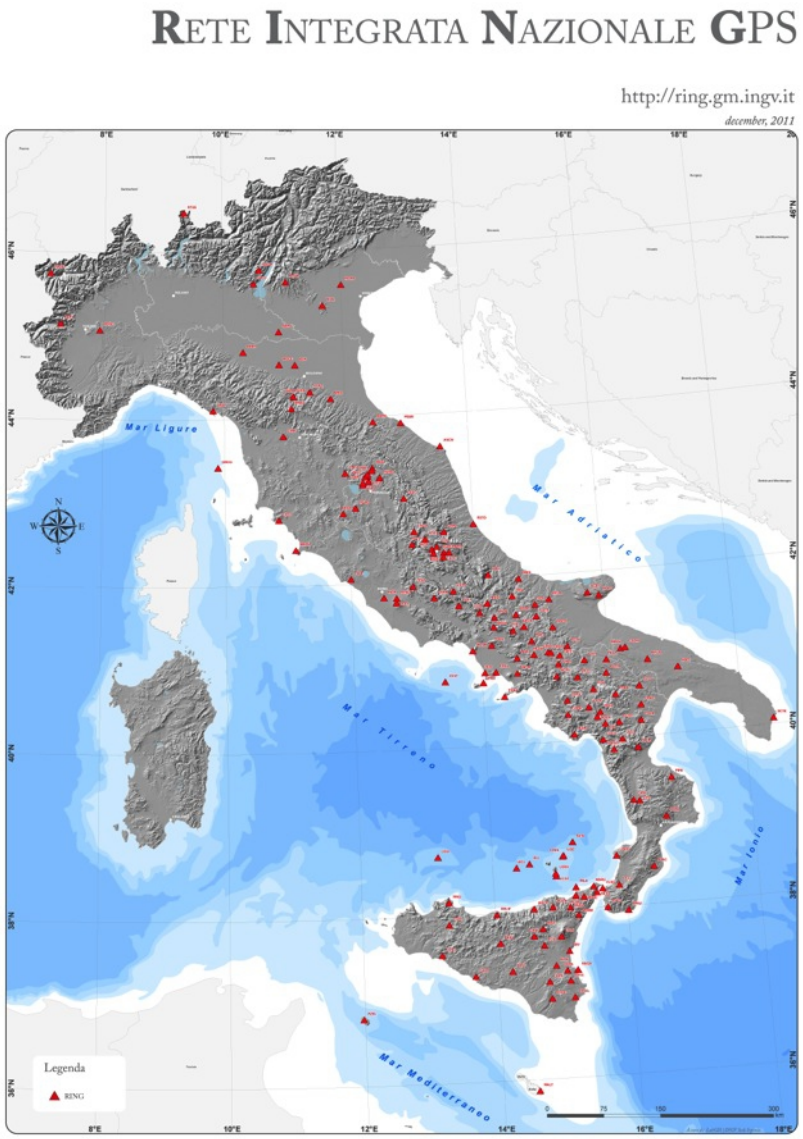
Other GNSS-related European projects

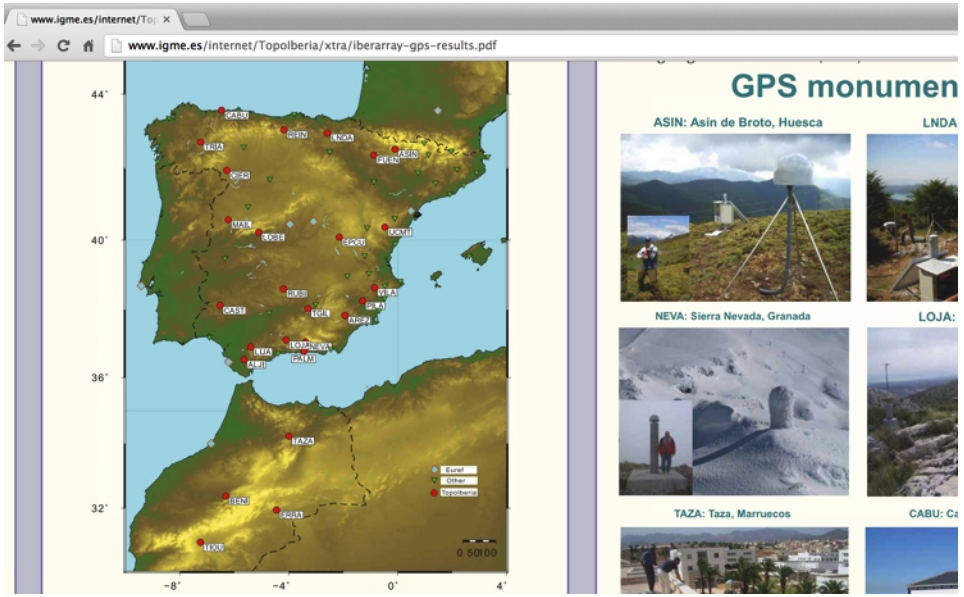
E-GVAP - *EUMETNET EIG GNSS water vapour programme*



Use of many networks installed for surveying at national and regional level.

GNSS-related European projects – Solid Earth
National Level





And many other national projects dedicated to geodynamics:
-Greece, Turkey, Portugal, etc...

Unfortunately, most of them without public data access.

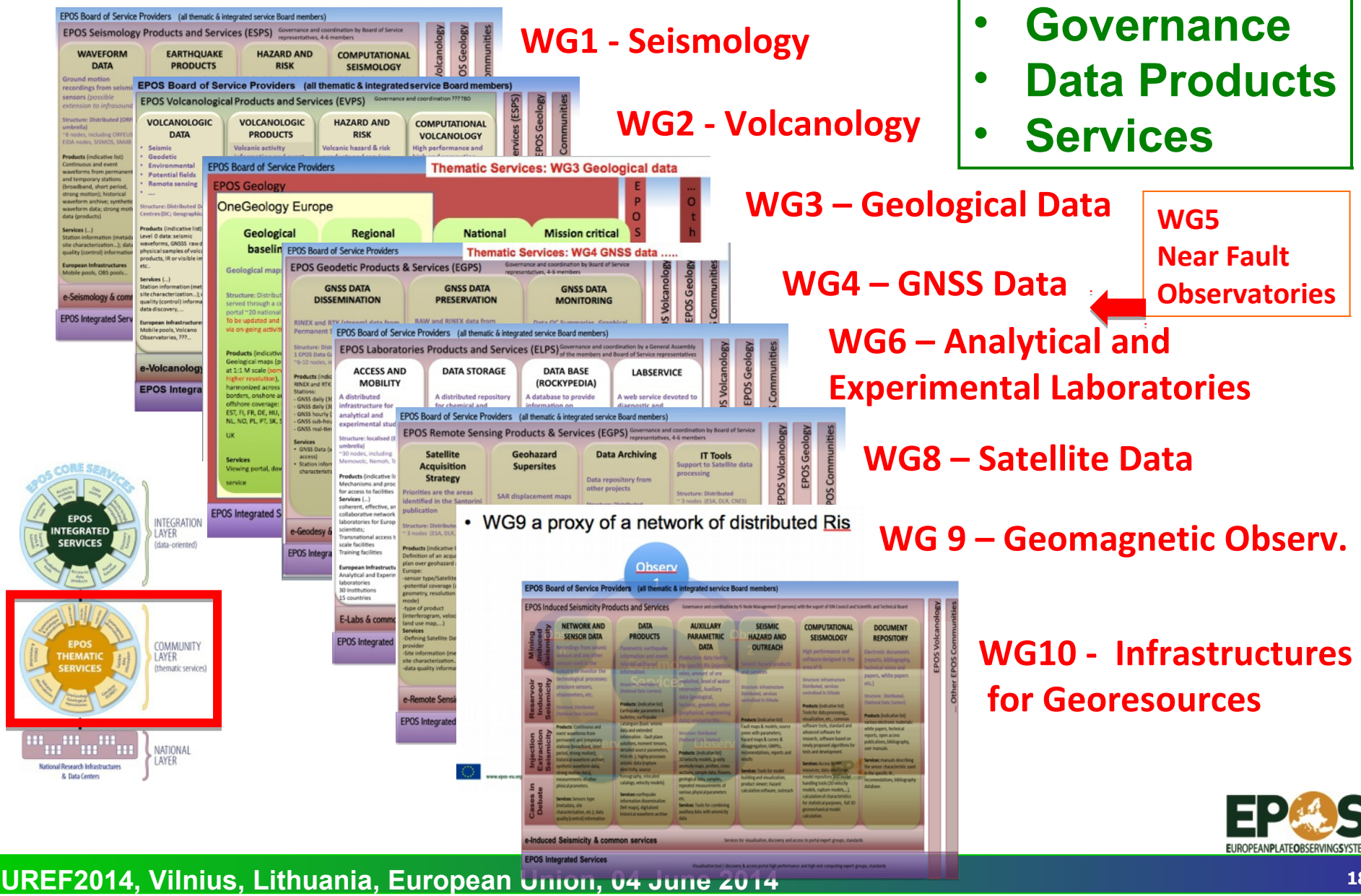
EPOS EUROPEANPLATEOBSERVINGSYSTEM

European GNSS projects

Project	Value to EPOS	Notes
Networks for Solid Earth	- Natural candidates to contribute to EPOS - Use of highest standards for monument setup and data quality control (although no uniform and coordinated effort).	- Many of these networks are not public available - Most are project based (time limited).
EUREF	- Established as top European forum concerning reference frames. Support of national mapping agencies (main GNSS providers in Europe) and also academia. - Dissemination of high standards (close to geodynamics) for monument setup and data quality control.	- Volunteer basis.
TIGA SONEL	- Definition of vertical data and variations on sea and land by linking both the tide gauge and the GNSS databases	- Superposition with EPN sites.
E-GVAP Surveying Networks	- Very dense networks in most of Europe. - Access to much more RTK data	- Many stations with unknown quality and difficulties to manage their metadata.

Thematic Services (TCS)

- Governance
- Data Products
- Services



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

EPOS Geodetic Products & Services (EGPS)

Steering Committee and Executive Committee

COORDINATION
(see next slide)

GNSS DATA DISSEMINATION & PRESERVATION

LEVEL 0
GNSS Observation and Meta-data from Permanent (and Campaign) Stations

Structure: Distributed (GSAC-like)
1 EPOS Data Gateway
National and Regional nodes.

Products:
- Observation data (streams and files).
- Meta-data (site logs, access conditions, QC, etc..) for all archived data.

Services:
- Seamless and redundant access to Level 0 data through GSAC derived web-services.
- Seamless storage and upload of Level 0 data.
- Conversion from RAW into international standard format (RINEX x.x).
- Checking of essential meta-data.

GNSS PRODUCTS

LEVEL 1,2,3
GNSS Data Analysis and Derived Products

Structure:
1 EPOS Product Gateway
National and Regional nodes.

Products:
- Real-time to post-processed positions
- Velocity Fields
  - Secular Motions
  - Periodical and no-periodical signals.
- Strain Fields

Services
- Seamless and redundant access to Level 1,2,3 data through GSAC derived web-services
- Web-services for online GNSS data processing
- Repository of existing Level 1,2,3 data.

USER COMMUNITY SUPPORT

Support to GNSS activities for Solid Earth research

Structure: Centralized
1 node (EPOS-GNSS Center)

Products:

Services
- Diffusion of best practices and tools.
- Support to Research projects (e.g., pool of instruments, installation support, data management)
- Realization of Scientific and Technical Courses.

DEVELOPMENT OF STANDARD TOOLS
(see next slide)

e-Geodesy & common services

Geodetic services for visualisation, discovery and access to portal
expert groups, standards

EPOS Integrated Services

Visualisation tool / discovery & access portal
high performance and high end computing
expert groups, standards

... Other EPOS Communities

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

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Steering Committee and Executive Committee

COORDINATION

Coordination
(based on EUREF experience)

Structure: Centralized
1 node (EPOS-GNSS Center)

Products:
- EPOS Geodetic Web Portal:
  - gateway providing access to the geodetic data/products
  - gateway interacting with the EPOS ICS
- Guidelines & Standards

Services
- Day-to-Day Network Management & Coordination of Pillars.

DEVELOPMENT OF STANDARD TOOLS

Development and Maintenance of software tools in support of other pillars

Structure: Distributed

Products:
- Further Development of GSAC
- Further Development of online GNSS processing services
- Further Development of meta-data management tools
- Development of Interfaces between Pillars (e.g., QC tools)
- Development of Interfaces between Pillar 5 and ICS
- Development of Interfaces with existing services (e.g., EUREF)
- Visualization tools

Services
- Installation support

EPOS Volcanology

EPOS Geology

... Other EPOS Communities

Interaction with other Solid Earth Sciences

Collaboration with other working groups, namely:

Seismology (WG1)
- Data Standardization
- GNSS Seismology

Volcanology (WG2)
- Volcano Instrumentation

Satellite Data (WG8)
- Co-localization with SAR

e-Geodesy & common services — Geodetic services for visualisation, discovery and access to portal expert groups, standards

EPOS Integrated Services — Visualisation tool / discovery & access portal high performance and high end computing expert groups, standards

Benefits of EPOS (for the Geodetic Community)

Formal organization of EPOS will be through "European Research Infrastructure Consortium, ERIC".

Usually countries are members, and *RIs* and *services* are included into EPOS through the contribution from each country

When included in EPOS, there will be a firm commitment from the countries for long term support (and financing!)

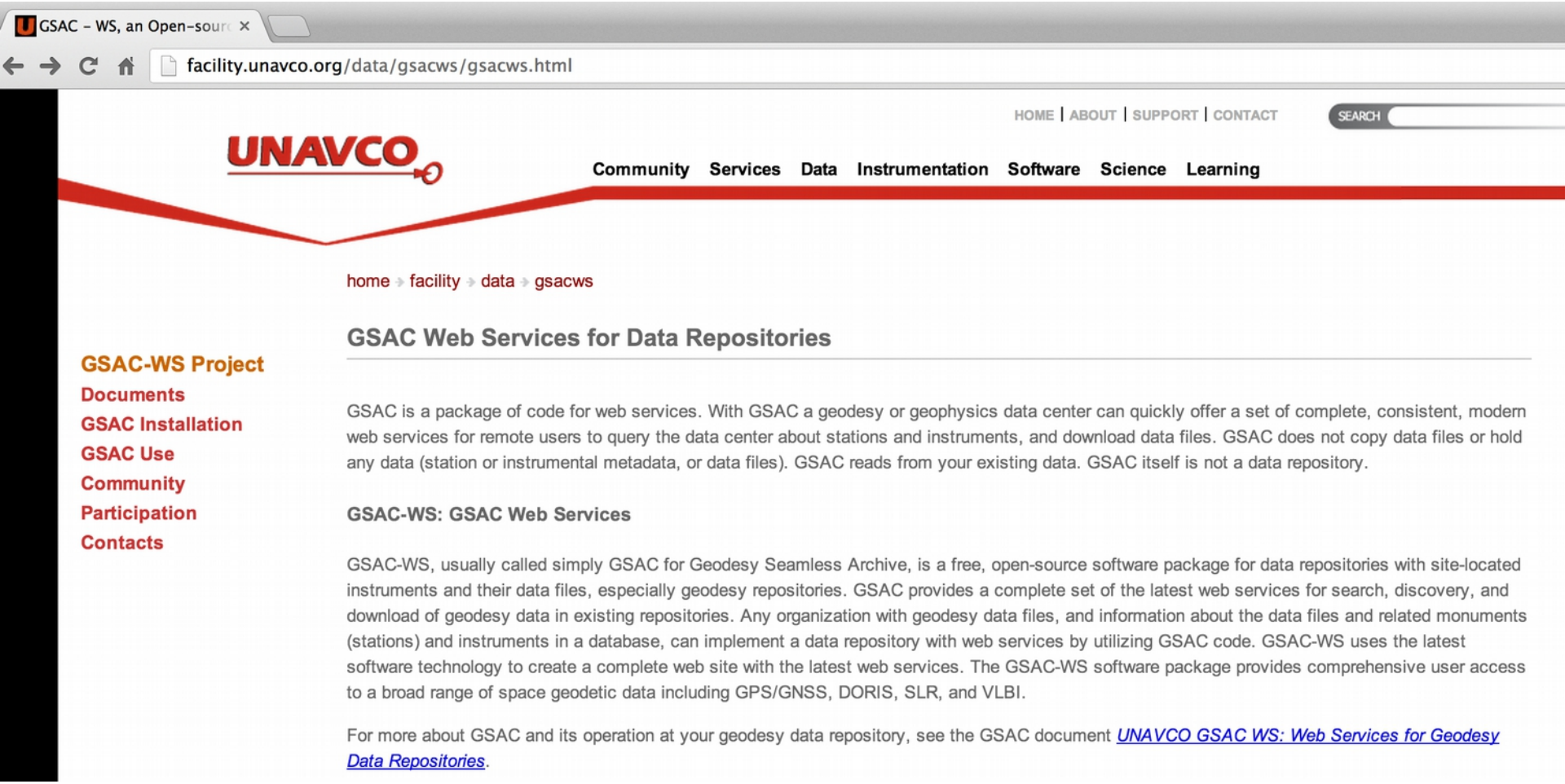
EPOS strive to collect, preserve, and utilize all observations that potentially may contribute to scientific progress

Therefore much more stations and raw (RINEX) data are welcomed and asked for

Data preservation, quality control, archiving and dissemination are priority services to be made available by EPOS WG4 in the near future.

EPOS EUROPEANPLATEOBSERVINGSYSTEM

GSAC – Geodetic Seamless ArChive
Data Dissemination

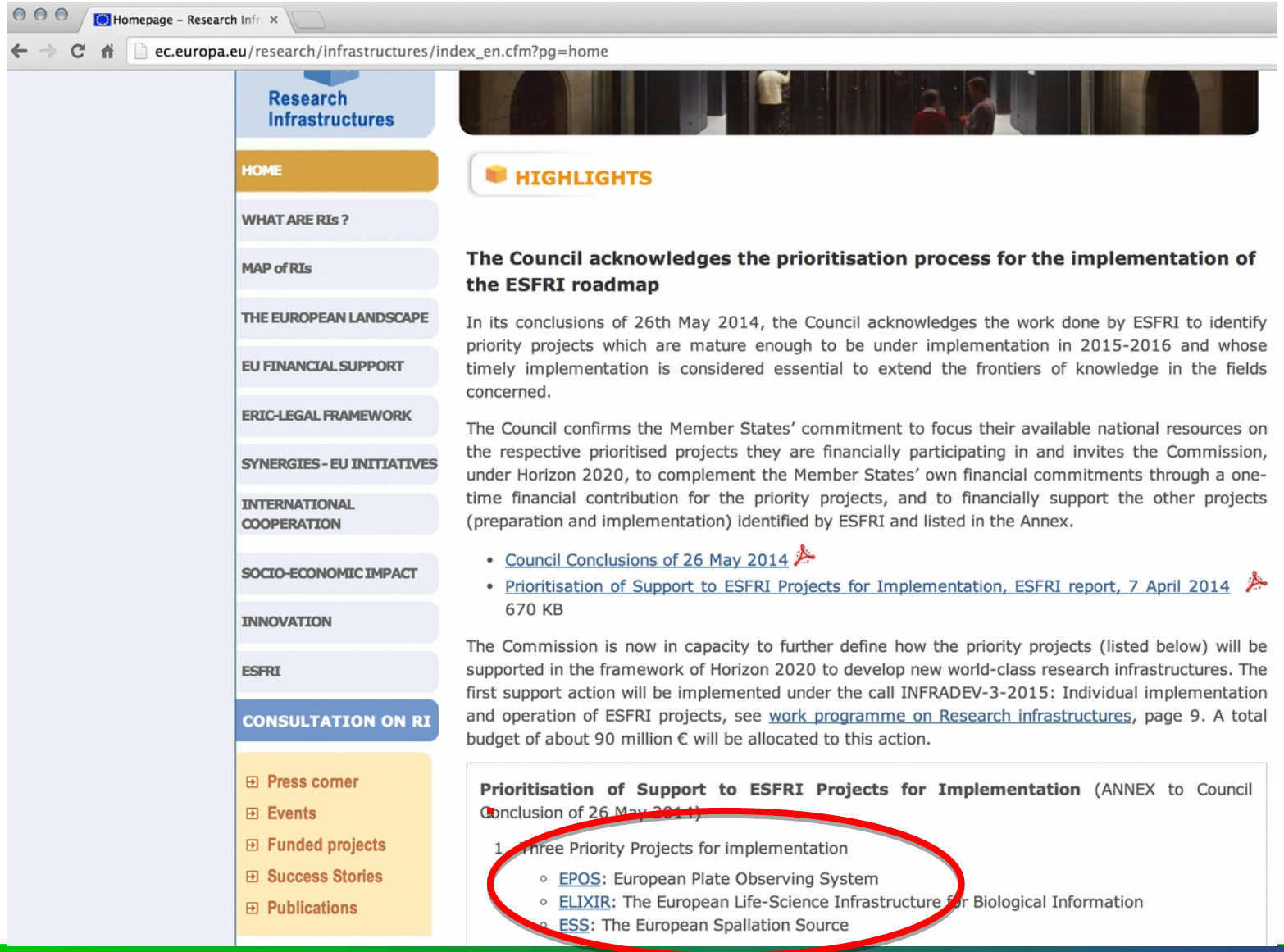


Currently, several WG4 members are already implementing GSAC services in cooperation with UNAVCO:

- Italy, Portugal, Greece, Iceland, France, Belgium

Latest news (03 June 2014)

http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=home



http://www.epos-eu.org/

Thank You