European Plate Observing System:
Getting ready for EPOS construction

Massimo Cocco & EPOS PP Team
EPOS a long term integration plan of research infrastructures for solid Earth Science in Europe

Preparatory Phase Project (2010-2014)

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Mission Statement

EPOS will integrate 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 will identify existing gaps and promote implementation plans with other disciplines of environmental science to help solve the grand challenges facing the Earth and its people.
Science Case:
Understanding Earth Dynamics

• Long-term hazard assessment & risk mitigation
• Modelling data to understand the Earth interior
• Understanding the physical processes generating earthquake, volcanic eruptions, tsunami & tectonics
• Real-time data acquisition for rapid alert and Early warning systems
• Short term probability assessment and operational forecasting
Lessons from recent Earthquakes

- Sumatra M 9.3 (Indonesia) 2004
- L’Aquila M 6.1 (Italy) 2009
- Haiti M 7.0 2010
- Maule M 8.8 (Chile) 2010
- Christchurch M 7.2 (New Zealand) 2010
- Tohoku M 9.0 (Japan) 2011
- Virginia M 5.8 (USA) 2011
What is EPOS?

**EPOS** is a long-term integration plan that aims to create a single sustainable, permanent and distributed infrastructure that includes:

- geophysical monitoring networks
- local observatories (including permanent in-situ and volcano observatories)
- experimental & analogue laboratories in Europe

**EPOS** will give open access to geophysical and geological data and modelling tools, enabling a step change in multidisciplinary scientific research into different areas.
EPOS infrastructure concept

Satellite observation infrastructure

Permanent Networks (ORFEUS)

In-situ observatories

Labs Rock Mechanics

Lab Analogue Modelling

Supersites Satellite Data

Geological repositories

Volcano observatories

Computational facilities

Data mining, archives

Ocean observation infrastructure

Ocean Bottom Seismometers – EMSO Marine Geophysics (tsunami hazard, volcanology......

Users, science, education, public

Space Observations DInSar – ESA, .... Volcano Ash Dispersal. GEOSS, GMES, ....

e-infrastructures
Why ?
- Clear science case
- Structuring our community
- Dual role: pan-European vs national

How ?
- Clear technical approach

Who ?
- Data & technological providers

To whom ?
- Solid Earth science community (the users)
- The society

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Why?
Responding to the specific needs for Europe

• Innovation
  ▪ Integrated accessibility to multidisciplinary data will accelerate the discovery of new and novel uses of Earth science results for societal benefit (including both scientific discoveries and technological progress)
  ▪ Development of educational, training and dissemination material (e-learning)

• Connections to other RIs and to other scientific fields

• Maintaining a key role and collaborating with other global and international initiatives

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EPOS: the Partnership

Who?

20 partners
18 countries

6 associate partners
5 countries

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

M 2 EPOS Management Implementation Plan [D1.1]
M 12 Report on possible legal models [D2.1]
M 24 Draft Business Plan for construction [D4.2]
M 30 Report on financial commitments at national level [D4.3, 4.4]

EPOS conception phase (2002-2008)
Dec 2008 EPOS enters in the ESFRI Roadmap

EPOS preparatory phase (2010-2014)
M 36 Legal organization and Governance negotiated [2.3, 3.3]
M 36 Report on access rules & strategic plan for users [D3.4, 5.3]
M 40 White Paper on Solid Earth Science [D5.8]
M 42 Report on e-infrastructure implementation plan [D6.6]
M 48 EPOS construction implementation plan [D7.6]
M 48 Sustainable Financial Plan for construction [D4.6]
M 48 Draft of the Statutes of the Legal Entity [D2.5]

EPOS construction & operational phase (2015-2040)
What is EPOS PP?

The Preparatory Phase is a timely initiative dedicated to establishing a management framework with efficient centralized coordination to achieve the following objectives:

**Strategic**

- To establish efficient coordination and management of the infrastructure at European level that will govern the process of building the necessary components, the expenditure assessment and the outreach at the project level.

- To reach mutual agreement among the countries involved regarding the core legal entity and its governance structure as well as commitments for funding that will ensure the construction of the infrastructure and its long-term operation.
What is EPOS PP?

Technical

• To integrate existing national research infrastructures through the novel EPOS Data Centres representing a network of community service providers for distributed data storage and processing.

• To develop an innovative and coherent e-infrastructure architecture, which will form the platform and data service infrastructure (not community specific) by means of the EPOS Core Services, for interdisciplinary data and metadata exchange, processing tools and computational simulations through the EPOS user interface.

• To link EPOS with other international Earth Observing Systems.

• To promote coherent training, educational and dissemination programmes and outreach.
The existing national research infrastructures are integrated into the EPOS Data Centres, which represent community specific services for data archiving and mining having their own computational resources.

Community specific data centres are further integrated by the EPOS Core Services, representing the infrastructure layer consisting of common data services.

EPOS data service infrastructure will be designed and established during the PP to serve multiple communities studying the solid Earth dynamics.
Monitoring infrastructure: seismological networks

Data ownership: National monitoring interests (hazard, warning, etc)

Regional Coordination: Parameter data EMSC
Waveform data ORFEUS

Current projects:
NERIES (EU)
NERA (EU)
GEOFON (GR)
GEOSCOPE (FR)
MEDNET (I)

~4’000 stations
>180 networks

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Accelerometer networks and data access

Listed stations:
3,695 from > 51 networks
78% digital
38% in free field
52% in buildings
13% accessible in integrated archive
Broadband Stations in Europe and surroundings

Observatories:
>100 networks

Integrated data access:
~ 50%

Funding:
National public, Hazard/Risk, Projects.
Occasionally Research
No EU funds!

Political aspects on data exchange:
Middle East
Russia
Northern Africa

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Distribution of the European volcano observatories

“In situ” complex Research Infrastructures that install/maintain systems to “observe” active volcanoes

Italy: Naples (Osservatorio Vesuviano), Catania (INGV-CT), Palermo (INGV-PA)

France: Observatoires Volcanologiques, IPGP (Observatoire volcanologique du Piton de la Fournaise (OVPF), Observatoire Volcanologique de la Montagne Pelée, Observatoire Volcanologique et Sismologique de Guadeloupe.

Iceland: Icelandic Meteorlological Office (ICAO state volcano observatory); Institute of Earth Sciences, University of Iceland

Portugal (Azores Islands): Centro de Vulcanologia e Avaliação de Riscos Geológicos (CVARG-Univ. Açores); Centro de Informação e Vigilância Sismovulcânica dos Açores (CIVISA).

Spain (Canary Islands): Instituto Geogràfico National (IGN); Volcano Monitoring Program; Institute of Technology and Renewable Energy

Greece: Institute for the Study and Monitoring of the Santorini Volcano (ISMOSAV), National Observatory of Athens


Data from WOVO and http://volcanism.wordpress.com
A Natural Laboratory for solid Earth Science
EPOS: integrating GPS networks
To whom?
User Community and Stakeholders

EPOS stakeholders categories:
(i) National Research Organisations & funding agencies,
(ii) EPOS data providers,
(iii) RI data users (including Academia),
(iv) data and services providers and users outside the research community (including industry).

European Geosciences Union (EGU) & European Seismological Commission (ESC) belong to category (iii)

Regional Conferences are envisioned for the EPOS Strategic Work

Thematic Workshops are promoted

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Defining Mission Needs

- Identify data providers
- Define the EPOS Working Groups for technological work
- Define EPOS core groups of Users
- Define EPOS technical requirements
- Define optimal legal and governance structure
- Validation, authentication and impact assessment
- Provide long-term sustainability at national level
On-going & short-term Future Actions

- Finalizing RI’s inventory (September 2011)
- Finalizing WGs composition (September 2011)
- Updating the e-science plan (October 2011)
- Designing the EPOS Data Centers (end 2011)
- Revising the core group of Data Providers (end 2011)
- First collection of user needs (mid 2012)
Progress of EPOS PP project (1st year)

- We have completed the first inventory of RIs we are going to integrate in EPOS. Updating in process.

- Most of the monitoring infrastructures and existing facilities are operational. Data already available. **Existing Data Centers.** Web-services operational!

- We have involved the data providers and identified & partially involved users (stakeholders categories I &II)

- We are approaching Governmental stakeholders, funding agencies and industry (categories III & IV)

- The design of the EPOS Core Services is in progress
The EPOS Mission Statement. EPOS will integrate 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 will identify existing gaps and promote implementation plans with other disciplines of environmental science to help solve the grand challenges facing the Earth and its people.

by Massimo Cocco & EPOS team

Adding scientific and socio-economic value in Europe by integrating solid Earth science infrastructures

The understanding of the physical processes responsible for earthquakes, volcanic eruptions, landslides, surface and tectonic processes, and tsunamis requires the prompt and continuous availability of high quality data obtained through direct observations and accurate predictive modeling of their temporal and spatial evolution. The accessibility to these data can accelerate the discovery of new and novel uses of Earth science results for societal benefit. The in-situ monitoring and forecast be completely assessed (for instance in terms of energy supply, insurance and re-insurance companies, financial markets, etc...).

In addition to its other effects, the Tohoku earthquake will affect Japan’s and the world’s supply of some minerals, at least temporarily. Up to one-quarter of the world’s lidline and one-third of Japan’s cement production may be affected, according to a recently released U.S. Geological Survey report.

Understanding the processes and forecasting, mitigating the effects of such events requires a pan-European coordination of national facilities and expertise. This plan aims at integrating the currently scattered, but highly advanced European facilities.
Work Packages

- WP 1 Preparatory Phase Management
- WP 2 Legal work
- WP 3 Governance
- WP 4 Financial Plan
- WP 5 Strategy
- WP 6 Technical preparation
- WP 7 Architecture and implementation plan
- WP 8 Stakeholder interactions & dissemination
WP6 Technical preparation

- Task 1 Inter-operability of RIs
- Task 2 Standardization & Technological Challenges
- Task 3 Access to data centres, modelling and technical facilities
- Task 4 IT standardization
- Task 5 WG integration and overview

- WG 1 Seismological data
- WG2 Data from Volcano Observatories
- WG3 Geological and Surface Dynamics data
- WG4 GNSS data and other Geodetic data
- WG5 Other Geophysical data
- WG6 Analytic and Experimental Rock Physics Laboratories
- WG7 e-infrastructures and virtual community (HPC and Grid)
- WG8 Satellite data
EPOS-related European Projects

Training Initiatives: links with existing ITN (QUEST & TOPOMOD) and search for opportunities for new ITN (i.e., for Rock Physics Laboratories)

Links with ESF programs and initiatives (TOPOEurope, MeMoVolc)

Links with other EC Projects (NERIES/NERA, SHARE, .....

Interactions with new submitted EC projects in e-science (VERCE, EUDAT, ENVRI) and cooperation (REAKT, .....

Interactions with other Global Initiatives (Onegeology, GEM, GEO, ...)

Interactions and Collaborations with Satellite data community (ESA, TERRAFIRMA, GENESI-DEC, Supersites)

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Issues for international cooperation: collaborations with US

• There are ongoing initiatives for global coordination and integration of infrastructures in geophysics, seismology and geodesy:
  – International Federation of Digital Seismograph Networks (FDSN, http://www.fdsn.org/) involved in GEO
  – Incorporated Research Institutions for Seismology (IRIS) and the Global Seismographic Network (GSN) coordinated with ORFEUS (EPOS partner)
  – UNAVCO (www.unavco.org/) and European geodesy initiatives

• The Earth science program EarthScope (NSF) and collaborations on scientific drilling, geodesy, rock physics and seismology

• USGS through joined participation to projects

• World Organization of Volcano Observatories (WoVO, www.wovo.org)
THE EPOS RESEARCH INFRASTRUCTURE FABRIC

EPOS PP: meeting data providers and user needs

Satellite WG8
Laboratories WG6
Other data WG5
GPS WG4
Geology WG3
Volcanology WG2
Seismology WG1

ICT e-RI

WP7 (WP6 task 6.3)

WP6 task 5.6
WP5 task 5.5
WP3 task 3.3
WP2 task 2.3
Data policy

Toward the EPOS Core Services: Implementing the data oriented layer

Toward the EPOS Data Centers: Implementing the community oriented layer
Thank you for attention

Possible links to JPIs

• Natural hazards
• Risk mitigation
• Contributing to increasing resilience to natural hazards
• Application of Early Warning Systems
• Data and tools for education and training
• Contribution to capacity building

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Thank you for attention