VERCE Newsletter
Virtual Earthquake & seismology Research Community in Europe e-science environment
Autumn 2012 • Issue 1

State of the art VERCE

Seismology research addresses the fundamental problems in understanding Earth's internal wave sources and structures, and augment applications to societal and economical concerns, i.e., hydrocarbon and resource exploration, earthquake and volcano monitoring and hazard assessment. Emerging new applications address climate and environmental changes through seismic monitoring, i.e., ice-quakes and glacier dynamics, landslide mass movement, and ocean wave environment.

For decades, the community has pioneered global open data access and sharing. Internationally integrated seismological observation systems, open access distributed data resources, adoption of standards for data services, have driven proliferating discoveries.

The nature of science is changing – new discoveries and innovation will emerge from statistical analysis and modelling of large amounts of data generated by the seismological observation systems. Our ability to acquire observational data outpaces our ability to analyse and model them. Innovative data-intensive analysis and increasingly complex High Performance Computing (HPC) simulation and inversion methods challenge conventional storage, computation and communication models, and require a new holistic approach.

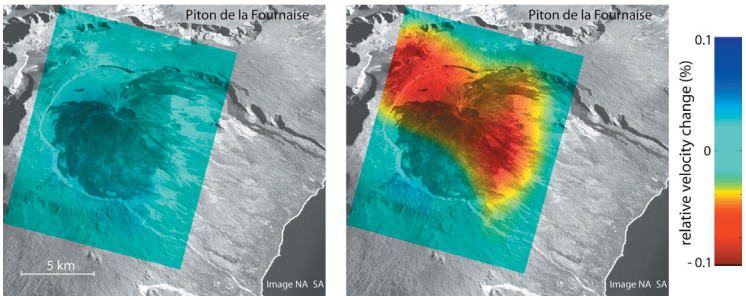
The objective of VERCE is to provide a data-intensive e-science environment enabling transformative methods that can fully exploit the increasing wealth of data generated by observational and monitoring systems, and guarantee optimal operation and design of these high-cost systems.

This e-Science environment comprises a platform of tools, software and workflow libraries enabling the development of data-intensive applications which make efficient and flexible use of distributed private and public infrastructures, i.e., Data, Grid, HPC and Cloud. An important challenge is the orchestration of work and data flows across these infrastructures.

The strategy is user-centric and application driven. Data-intensive analysis and modelling applications have been selected to build up a realistic spectrum of research use cases that will be enabled, and their software implementation productised. Intellectual ramps will provide safe and supported means for the community to advance in innovative data-intensive research.

VERCE is a major contribution to the e-science environment of the Earth Plate Observing System (EPOS), the ESFRI initiative of the solid Earth community in Europe, based on the European e-infrastructures PRACE and EGI, cooperating with IT projects like IGE and EUDAT. VERCE has also strategic synergies with other European projects of the seismology community, including ERC (WHISPER and WAVETOMO), ITN (QUEST), and research infrastructure (NERA, SHARE, REAKT) projects.

In developing VERCE, we are building a collaborative environment among seismology, computer science and engineering to foster the emergence of a new generation of data-intensive researchers and research technologists, and to strengthen the expertise and the competitiveness of the seismology research in Europe.



9 days before eruption of June 2000 — 4 days before eruption of June 2000

- ***VERCE first tutorials are released.*** *More tutorial documents will be added up later. Full documentation. can be downloaded from http://www.verce.eu/Training/Tutorials.php*
- ***VERCE Draft deliverables*** *of the midterm second reporting period are available: http://www.verce.eu/Repository/Deliverables/RP2/*
- ***American Geophysical Union (AGU) Fall Meeting*** *December 3-7, San Francisco http://fallmeeting.agu.org/2012/*
- ***Trainings on HPC*** *http://www.maisondelasimulation.fr/PATC/index.php*
- ***EGU 2013*** *will take place in Vienna from 7 to 13 April 2013: http://www.egu2013.eu*
- ***Annals of Geophysics*** *has just published its latest issue at: http://www.annalsofgeophysics.eu/index.php/annals*
- ***EPOS newsletter n°11*** *is available: http://www.epos-eu.org*

SEVENTH FRAMEWORK PROGRAMME
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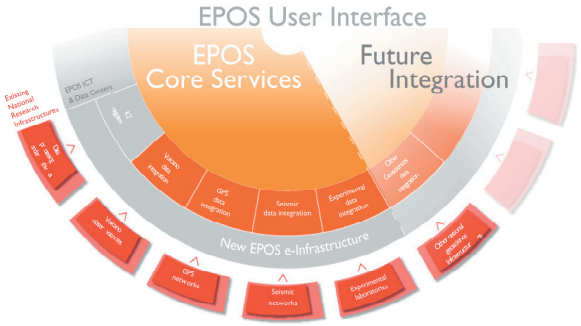
European Plate Observing System

European Plate Observing System: EPOS and its involvement in VERCE by Alberto Michelini (INGV)

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

- Permanent geophysical monitoring networks (seismic, GPS)
- Local observatories (including permanent in-situ and volcano observatories)
- Experimental & analogue laboratories in Europe

EPOS (in the ESFRI roadmap since 2008) is going to integrate the European Research Infrastructures for solid Earth Science, and will build new e-science opportunities to monitor and understand the dynamic and complex solid-Earth System. EPOS will thus promote open access to geophysical and geological data and modelling tools, enabling a step change in multidisciplinary scientific research. The EPOS e-infrastructure involves a multi-layer integration architecture in which the existing national research infrastructures at the lower level integrate into the EPOS Data Centres, which represent community specific services for data archiving and mining having their own computational resources.



The EPOS Elements

Experts Opinion

HEINER HEGEL

Why VERCE?

Undoubtedly most hypothesis testing in the Earth sciences today relies to a large part on sophisticated computational modelling of complex processes in the Earth's interior. This holds in particular for seismology. The physics of wave propagation is well understood and computational solvers exist that already utilise HPC systems. What has been lacking so far is a coordinated effort to provide a comprehensive platform to make these computational tools available via an easily accessible web-based interface to research projects involving large-scale simulations or huge data-volume processing. VERCE is intended to fill this gap and thus build the bridge between seismology and the European High-Performance Computing and Grid infrastructures. I believe this will have a strong impact on many pressing science questions related to earthquakes and Earth's dynamic systems.

NICOLAI SHAPIRO

VERCE and continuous seismic data

Much recent advancement is related to analysis of continuous records from large seismic networks. Common idea is to extract and to analyze coherent signals by systematically applying operations like inter-receiver cross-correlations, stacking, and beamforming. Recently proposed applications include noise-based seismic imaging and monitoring, massive detection of small and unusual earthquakes and of tremors, array-based imaging of large earthquakes, and studies of environmental processes. Implementation of these innovative approaches is very challenging because it requires processing complex datasets of several hundreds of Terabytes (and soon Petabytes) and will largely rely on the data-intensive e-Science environment developed in scope of VERCE.

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