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 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.
Experts Opinion

HEINER IGEI

Why VERCE?

Undoubtedly most hypothesis testing in the Earth sciences today relies to a large part on sophisticated computational modeling 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.