

Forward and Inverse Seismic Modelling

Science Gateway

(a provenance-powered solution)

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ABSTRACT

In recent years the potential to improve resolution of seismic imaging by full waveform inversion has been demonstrated on a range of scales from local to global, and powerful procedures are increasingly developed by researchers to tackle these issues [5]. The VERCE portal has been specifically designed to allow scientists to exploit common seismological software by using large international HPC and, more recently, cloud resources. It grants access to distributed seismic data archives, all through a web-based, interactive graphical user interface accessible from everywhere. Thanks to this platform a much greater range of seismologists and also less expert users can access full waveform forward and inverse modelling tools.

In particular, as we discussed in previous work [1,6], the platform allows to perform seismic waveform simulations on a local/regional scale supporting the widely used spectral element code SPECFEM3D_Cartesian, and more recently also on a global scale using SPECFEM3D_GLOBE. Depending on the simulation software, users can select from a number of regional and continent scale models, including the whole Earth, or upload their own.

In the updated version of the science gateway, which we present in this abstract, the portal has been fully extended to allow its users to process and compare the synthetic seismograms with the corresponding observational data. Researchers can obtain seismic time-series from the available federated services world-wide (FDSN), and further seismological processing can be applied by exploiting a collection of interoperable workflows. Raw-data access, pre-processing and misfit workflows are interactively prepared and monitored with the support of provenance and lineage

metadata collected throughout the different stages of the analysis.

High-level access methods to detailed provenance records and actionable metadata enable short feedback-loops between the users and their experimental outputs, allowing them to evaluate their methods and manage their results already at runtime. The portal assists the users in the configuration of experiments through the combined integration of parameters and data, by analysing the traces from large collections of runs, thus fostering the use of provenance information early in the users' research practice [3]. The underlying provenance management system and workflow technology [7,2] supports the incremental refinement of the metadata, accommodating domain standards as well as experimental definitions, in compliance to the W3C-PROV concepts and with the extensive support of validation and results management tools.

The development and enhancement of the VERCE platform naturally continued into the EPOS-IP project [10]. The enrichment with elastic cloud resources of the European Open Science Cloud and FAIRness of the results is pursued within the EOSC-pilot initiative [9]. More recently, thanks to the new European project "DARE – Delivering Agile Research Excellence on European e-Infrastructures" [8], all the tools, know-how and experience matured will flow into larger scale use cases that require ensembles of simulations in support of emergency response. The backbone of the DARE hyper-platform will rely on abstract software interfaces instrumenting a combination data-intensive tools in the cloud, enabling their control through the management of lineage collections. We will present an anticipation of the objectives and the scale envisaged by this initiative.

Keywords— *seismology; provenance; hpc; cloud; workflows; VRE.*

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