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EPOS-IP and DARE use case: the VERCE platform for a widely accessible forward and inverse seismic modelling

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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. The VERCE portal has been specifically designed to allow scientists to exploit widespread, performing seismological software by using large international HPC resources and granting 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, the platform allows to perform seismic waveform simulations on a local/regional scale supporting the widely used spectral element code SPECFEM3D_Cartesian, and also on a global scale using SPECFEM3D_GLOBE. SPECFEM3D_Cartesian allows users to run simulations on pre-loaded meshes and velocity models for specific areas, or upload their own velocity model and mesh. In the new SPECFEM3D_GLOBE implementation, the user can select from a number of continent scale model regions, or perform simulations for the whole Earth. The platform can access focal mechanisms catalogues, e.g. the GCMT catalogue, but users can upload their own focal mechanism determination. The simulations can run on a range of European supercomputers in the PRACE network.
Once a job has been submitted and run through the platform, the portal also allows to analyse the seismic waveforms and to compare the synthetic seismograms with corresponding recorded traces. In particular, observed data can be easily downloaded from European archives using the platform, and typical seismological processing can be applied on the traces exploiting the flexibility provided by the platform workflows. Finally, the misfit between simulated and recorded seismograms can be estimated using different procedures implemented on the portal, such as the calculation of cross-correlation (using the code pyflex) or time-frequency misfit criteria. These interoperable workflows, for raw-data access (FDSN), pre-processing and finally misfit, offered by the VERCE platform, facilitate the hard task of tackling the inverse modelling in seismology.
The VERCE portal can be also used to produce animations of waveform propagation through 3D models, and synthetic shakemaps. All these data-products are made discoverable and re-usable thanks to the VERCE data, metadata and provenance management layers.
The development and enhancement of the VERCE platform as part of the EPOS e-Science infrastructure naturally continued into the EPOS-IP project, that has supported the transition to cloud computing resources and the extension of the portal features and services especially focusing on tools for waveform misfit calculation.
Now, thanks to the new European project "DARE – Delivering Agile Research Excellence on European e-Infrastructures", all the tools, know-how and experience matured within VERCE and EPOS-IP will directly flow into a new important application, forming the backbone of the DARE seismological use case and greatly benefiting from the functionality of the new DARE hyper-platform.