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A Cloud-Computing Service for Environmental Geophysics and Seismic Data Processing

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Cloud computing is establishing worldwide as a new high performance computing paradigm that offers formidable possibilities to industry and science. The presented cloud-computing portal, part of the Grida3 project, provides an innovative approach to seismic data processing by combining open-source state-of-the-art processing software and cloud-computing technology, making possible the effective use of distributed computation and data management with administratively distant resources. We substituted the user-side demanding hardware and software requirements by remote access to high-performance grid-computing facilities. As a result, data processing can be done quasi in real-time being ubiquitously controlled via Internet by a user-friendly web-browser interface. Besides the obvious advantages over locally installed seismic-processing packages, the presented cloud-computing solution creates completely new possibilities for scientific education, collaboration, and presentation of reproducible results.

The web-browser interface of our portal is based on the commercially supported grid portal EnginFrame, an open framework based on Java, XML, and Web Services. We selected the hosted applications with the objective to allow the construction of typical 2D time-domain seismic-imaging workflows as used for environmental studies and, originally, for hydrocarbon exploration. For data visualization and pre-processing, we chose the free software package Seismic Un*x. We ported tools for trace balancing, amplitude gaining, muting, frequency filtering, dip filtering, deconvolution and rendering, with a customized choice of options as services onto the cloud-computing portal. For structural imaging and velocity-model building, we developed a grid version of the Common-Reflection-Surface stack, a data-driven imaging method that requires no user interaction at run time such as manual picking in prestack volumes or velocity spectra. Due to its high level of automation, CRS stacking can benefit largely from the hardware parallelism provided by the cloud deployment. The resulting output, post-stack section, coherence, and NMO-velocity panels are used to generate a smooth migration-velocity model. Residual static corrections are calculated as a by-product of the stack and can be applied iteratively. As a final step, a time migrated subsurface image is obtained by a parallelized Kirchhoff time migration scheme. Processing can be done step-by-step or using a graphical workflow editor that can launch a series of pipelined tasks. The status of the submitted jobs is monitored by a dedicated service. All results are stored in project directories, where they can be downloaded of viewed directly in the browser. Currently, the portal has access to three research clusters having a total number of 70 nodes with 4 cores each. They are shared with four other cloud-computing applications bundled within the GRIDA3 project.

To demonstrate the functionality of our “seismic cloud lab”, we will present results obtained for three different types of data, all taken from hydrogeophysical studies: (1) a seismic reflection data set, made of compressional waves from explosive sources, recorded in Muravera, Sardinia; (2) a shear-wave data set from, Sardinia; (3) a multi-offset Ground-Penetrating-Radar data set from Larreule, France.

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