CIG Science Gateways: Using Supercomputers through a Browser

Computational Infrastructure for Geodynamics (CIG) has installed several of its open-source codes on the TeraGrid and is now developing several science gateways. Such an interface will streamline the process of using CIG software since it will enable users to easily start a new job using grid computing technologies. Installing a science gateway will work toward increasing resources available to the community for innovative research by offering a powerful yet more simplified interface to run and benchmark geodynamics applications. Starting with the seismology code SPECFEM3D_GLOBE, the geodynamo code MAG, and a new benchmarking code named Cigma that is a comparison tool that helps define numerical benchmarks for finite element models, CIG aims to support and encourage more of the geodynamics community to benchmark these codes, conduct training sessions on these applications, and encourage new users to try out the TeraGrid to see if it will work for their individual research.

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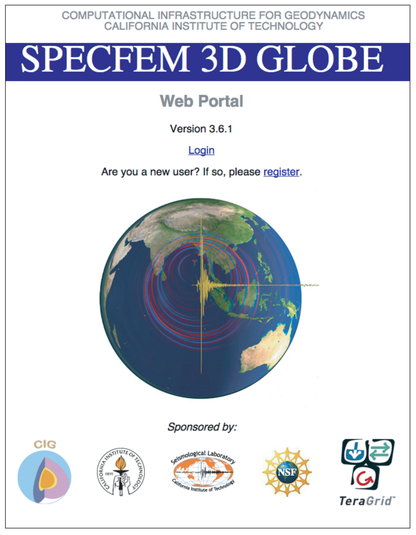
SPECFEM3D GLOBE Web Portal

CIG's central goal for computational seismology has been the development of a seismology Science Gateway which provides automated and on-demand simulations, e.g., seismic wave propagation and synthetic seismograms. This web site launches a simulation on a remote machine using data gathered from various web sites and databases, and returns the results to the user.

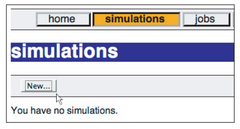
Run a Simulation



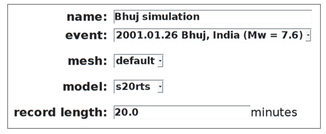
1. Using a web browser, navigate to http://crust.geodynamics.org/specfem3dglobe

2. New users (including those who have an "Invitation Code") begin by clicking register.

3. After you successfully create your username and password and enter the interface, click the simulations tab, and then click New...



4. On the next screen, you name the event and assemble the required components for a simulation: an event, a mesh, an earth model, and a list of stations.

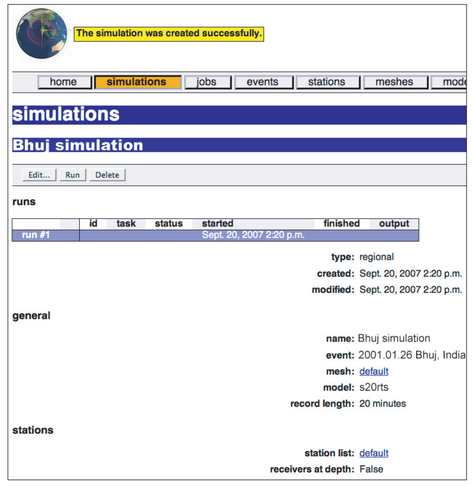


5. You can fine-tune simulation parameters. Mesh and model parameters are edited using a form. Below, the user selects the number of spectral elements for a custom mesh.

Users can also upload custom events and station lists in the form of plain ASCII files.

6. Once finished customizing, click Save & Run.

7. That's it! You've just run a simulation

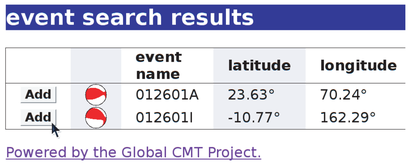


8. All your saved simulations are collected under the simulations tab. Click on a simulation, and you can run it again.

task	status	output
run	done	seismograms.tar.gz stdout.txt stderr.txt

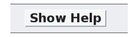
Portal Features

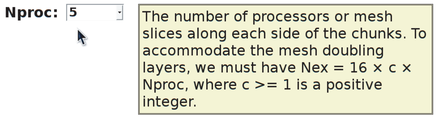
The portal integrates the event catalog from the Global CMT Project, allowing users to easily add event information. To do so, go to the event tab and click Search.



Powered by the Global CMT Project.

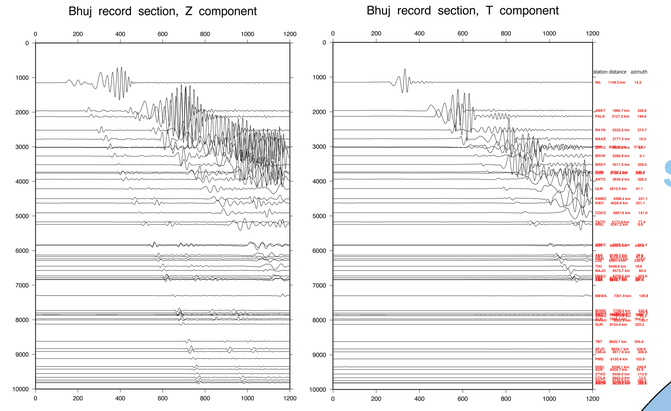
Online help is available at the click of a button. Help text is displayed by form fields for easy reference.

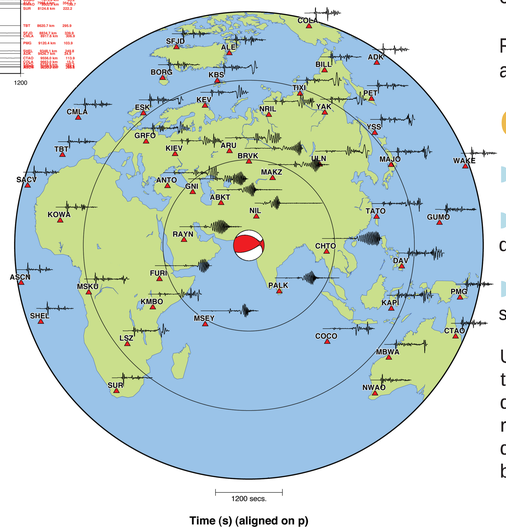




The portal displays the status of the simulation as it runs on a TeraGrid cluster. Upon completion, the user clicks to download an archive containing the output files from the simulation.

Example Results from the SPECFEM3D GLOBE Web Portal





Time (s) (aligned on p)

Synthetic seismogram output from the SPECFEM3D GLOBE Web Portal for the Mw 7.6 Bhuj, India event of 2001.01.26. The simulation ran on 150 processors, is 20 minutes in length, the 3D Earth model is S20RTS, the seismograms are shown for 50 stations within 90 degrees of the epicenter, and the records are filtered between 18s and 300s.

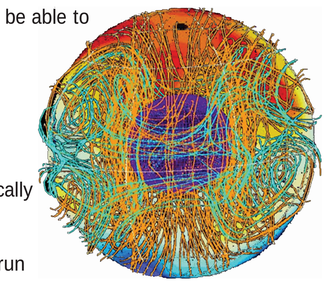
Above left: Record section for the vertical component. Above right: Record section for the transverse component. Right: Map showing the spatial variation in the vertical component records.

OTHER PORTALS IN DEVELOPMENT

MAG CIG's geodynamo code MAG is a serial version of a rotating spherical convection/magneto-convection/ dynamo code which solves the non-dimensional Boussinesq equations for time-dependent thermal convection in a rotating spherical shell filled with an electrically conducting fluid. Via the MAG portal you will be able to

- Create a job, including editing and uploading input files and defining the global longitudinal symmetry and spherical harmonic truncation degree
- Submit that job to a selected TeraGrid site and monitor its progress
- Obtain a downloadable tarball (when the job completes) which contains the job results and which you may further analyze locally or visualize with IDL software

Running MAG on the portal means you don't have to compile the software to run it, and you are able to queue up a long serial run and not tie up your local machine.

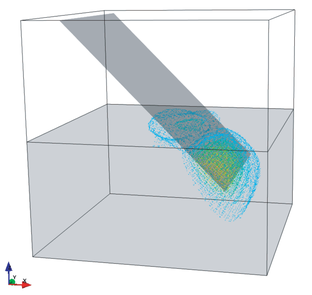


MAG Magnetic Field Lines.

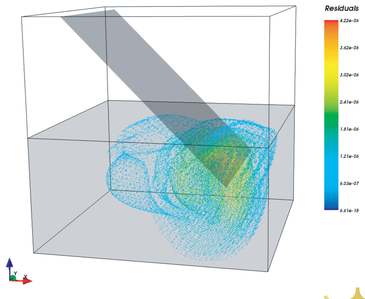
Cigma The CIG Model Analyzer (Cigma) consists of a suite of tools for performing error analysis on numerical models, as well as code verification. The Cigma portal aims to

- Provide a storage place for accessing standardized benchmark data sets;
- Enable users to compare the output of their jobs without having to transfer data back;
- Facilitate some post-processing tasks such as down-sampling of large data sets.

Using Cigma you can obtain a residual field showing the differences between two models. On the right, we show a PyLith-GeoFEST comparison of the displacement field residuals for a reverse-slip benchmark case on a 500m resolution mesh. Here, we display ten equally-spaced isosurfaces on the displacement residuals. Note that after 1 year, most of the disagreement between the two numerical codes occurs in the bottom viscoelastic layer.



t = 1 year



t = 10 years

geodynamics.org

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