The Southern California Earthquake Center (SCEC) is a multi-institution, multi-disciplinary research center bringing together geoscientists and computer scientists from over 54 institutions to develop a comprehensive and predictive understanding of earthquakes and to disseminate this information in ways that increase awareness, reduce economic losses and save lives. An important component of the SCEC research program is a distributed, grid-based, high performance computing environment - the SCEC grid. The SCEC grid allows scientists to configure and execute large-scale scientific workflows across a heterogeneous computing environment.

The SCEC computational platforms have been used to produce important SCEC research results including a Puente Hills Earthquake Loss Estimate study (Field et al (2005), Earthquake Spectra) and the TeraShake simulations of large earthquakes on the Southern San Andreas fault (Olsen et al (2006), Geophysical Research Letters).

All of the SCEC computational platforms require high performance computing and large scale data management tools. The SCEC computational platforms share common cyberinfrastructure that includes grid-based scientific workflows through the use of the Virtual Data System (VDS) that includes Globus, Condor, Chimera, RLS, MCS, and Pegasus.

This velocity magnitude map of TeraShake 1.3 data shows how strong ground motions are channeled into the Los Angeles region for a large Southern San Andreas Earthquake. (Image: SDSC)
and the Storage Resource Broker (SRB) data management software.

Complex, multistep computations performed by the SCEC platforms are modeled as scientific workflows and the SCEC grid-based workflow tools securely distribute the computations across a heterogeneous collection of computing resources. This system allows SCEC to share computing and storage resources across the multi-institution SCEC collaboration.

The SCEC earthquake system science program requires a wide variety of high performance computing capabilities including capability computing, capacity computing, and data intensive computing as well as scientific workflow capabilities. The SCEC cyberinfrastructure must also support the highly diverse SCEC research community in which researchers have a wide range of high performance computing expertise.

The SCEC Earthworks science gateway was developed in order to provide non-traditional supercomputer users with access to the high performance computing and scientific workflow capabilities of the SCEC grid. The SCEC Earthworks system allows users to configure, execute, and monitor earthquake simulations through a browser-based interface. Multi-step earthquake simulations are converted into workflows by the Earthworks system. The SCEC Earthworks system provides users with access to the high performance computing, scientific workflow, and data management capabilities of the SCEC grid including access to computing resources at SCEC, USC/HPCC, and the TeraGrid.

SCEC has outlined a series of simulations that will advance the SCEC earthquake system science research goals. This graph shows the estimated computing performance required to complete each of these simulations within 100 hours. Vertical bars indicate simulations that can use capacity computing.

The output of a CyberShake calculation is a Probabilistic Seismic Hazard curve – the probability of exceeding an Intensity Measure Level (IML) at a site. This image compares several CyberShake hazard curves to attenuation relationship-based hazard curves, for spectral acceleration at a period of 3.0 seconds.

The SCEC Earthworks Science Gateway allows SCEC researchers to configure and run an earthquake simulation using grid-based scientific workflow technologies on the TeraGrid national supercomputer facilities through a web-based portal interface.