

**UNAVCO Event response capabilities: Three great earthquakes in the Americas in early 2010**

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UNAVCO

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UNAVCO is a non-profit university-governed consortium that facilitates geoscience research and education using geodesy. Ninety-one U.S. academic Members and 68 non-academic or international Associate Members share UNAVCO's mission and community vision to transform human understanding of the changing Earth by enabling the integration of innovative technologies, open geodetic observations, and research, from pole to pole. The consortium operates a facility that provides engineering, data, and educational services to its investigator community.

UNAVCO supports the research community in the study of significant geophysical events such as earthquakes, volcanic activity, landslides, glacial and ice-sheet movements, unusual uplift or subsidence, and extreme meteorological events. UNAVCO resources include field engineering support; permanent, real-time/high rate, and campaign GPS deployment; data communications and power systems; borehole tiltmeter, strainmeter, and seismometer deployments; ground-based LiDAR measurements and airborne LiDAR project management; InSAR data acquisition; assistance with education and outreach activities; and data archiving and processing services.

As part of the 2008 and 2009 Shake Out earthquake drills in southern California, UNAVCO's organizational event response capabilities were tested and refined to ensure robust protocols for decision-making and geodetic observations in the wake of a natural disaster, with the goal of preparedness for rapid deployments when geodetic observations are required to strengthen geohazards science.

In 2010 four significant earthquakes have tested this capability, requiring adaptive management of response protocols. These include the January 12, 2010 Mw=7.0 Haiti, February 27, 2010 Mw=8.8 Maule (Chile), April 4, 2010 Mw=7.2 El Mayor – Cucapah (Baja California, Mexico), and September 3, 2010 Mw-7.0 South Island of New Zealand earthquakes. For the ShakeOut drills and each of these earthquakes, a different UNAVCO staff member was appointed to serve as Event Response Coordinator, and manage communications, support requests, logistics and decision-making both within UNAVCO and the community at-large.

For the Haiti earthquake, community scientists requested support for short-term field deployments and to download high-rate buffers from continuously observing networks in the region. A response coordinator was appointed, a central web page was created, special GPS, borehole strainmeter, and borehole seismometer data sets were posted, a new discussion forum devoted to the event was created, a GEO Event Supersite was created and hosted, and a Science Highlight was posted with contributions from community scientists. Field deployments included campaign and the installation of continuous GPS stations.

A full debrief and adaptive refinement of response protocols was implemented prior to the occurrence of the February event in Chile.

For the Maule earthquake, four UNAVCO member institutions sought support to build 25 post-seismic GPS deployments in Chile and Argentina. UNAVCO supported these projects with a shipment of 25 complete GPS systems less than a week after the event. UNAVCO then submitted a successful proposal to develop and install telecommunications using a combination of three different systems at the 25 CGPS stations: (1) the satellite-based Inmarsat Broad Global Area Service (BGAN), (2) Iridium systems, and (3), ground based cellular internet services provided by telecom companies in Chile and Argentina. This deployment will allow for daily downloads of daily 15-second files and of 1 Hz data for up to 10 aftershocks over a 1-year period. This effort will serve as the type example in the geodetic community for rapid CGPS data communications following a destructive earthquake and the hardware purchased will become part of the UNAVCO Facility's equipment pool.

The El Mayor – Cucapah earthquake occurred close to the Mexico – U.S. border, at the edge of the EarthScope – Plate Boundary Observatory (PBO) footprint. UNAVCO was one of several community organizations to support event response, providing co-seismic observations from PBO's CGPS stations, borehole strainmeters and seismometers, the shipment of a Terrestrial LiDAR Scanner, and the acquisition of InSAR data through the UNAVCO-hosted WiNSAR consortium. In addition, UNAVCO participated in a successful University of Arizona-led proposal for the deployment of continuous GPS stations for post-seismic observations. These stations will be installed, maintained and data analyzed by UNAVCO/PBO in coordination with CICESE, an Associate Member institution in Mexico.

For the South Island of New Zealand earthquake, to date UNAVCO community members have requested services for coordination of SAR data acquisition as well as a science discussion forum. Resources are readied for GPS campaign observations should they be requested for deployment in collaboration with GNS Science.

These events have led to the testing and refinement of response protocols and decision-making, optimizing UNAVCO's ability to aid in the collection of key data sets for the advancement of hazards science.