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## In Memoriam

**Charles E. Graham**, 2003, Retired Life Member, Tectonophysics, 1953.

**Robert E. Veiga**, 2003, Atmospheric Sciences, 1990.

**Donald E. White**, 2003, AGU Fellow, Volcanology, Geochemistry, and Petrology, 1944.

## Honors

**Manfred R. Strecker** is a prizewinner of the Deutsche Forschungsgemeinschaft Gottfried

Wilhelm Leibniz Programme for 2004, Germany's most valuable research prize. Strecker is one of the pioneers in the study of the interaction among tectonics, climate, and surface processes. His work deals with topics such as neotectonics, the geology and geomorphology of interference zones, the development of stress fields in orogenes and rift zones, catastrophic mass movements and seismic hazards, climate signals in marine sediments, the deformation of Central Asia, and the development of the Andes or the rift basins in Africa. Strecker's success is primarily based on his ability to

identify the very latest and relevant geoscientific questions and to address these using cross-disciplinary, high-precision field and lab methods. The Leibniz Programme, set up in 1985, aims to improve the working conditions for outstanding researchers, to extend their research opportunities, to relieve them of administrative work, and to make it easier for them to employ particularly qualified young researchers.

Strecker has been an AGU member (Tectonophysics) since 1989.

# MEETINGS

## Converting Advances in Seismology into Earthquake Science

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Federal and state agencies and university groups all operate seismic networks in California. The U.S. Geological Survey (USGS) operates seismic networks in California in cooperation with the California Institute of Technology (Caltech) in southern California, and the University of California (UC) at Berkeley in northern California. The California Geological Survey (CGS) and the USGS National Strong Motion Program (NSMP) operate dial-out strong-motion instruments in the state, primarily to capture data from large earthquakes for earthquake engineering and, more recently, emergency response. The California Governor's Office of Emergency Services (OES) provides leadership for the most recent project, the California Integrated Seismic Network (CISN), to integrate all of the California efforts, and to take advantage of the emergency response capabilities of the seismic networks. The core members of the CISN are Caltech, UC Berkeley, CGS, USGS Menlo Park, and USGS Pasadena (<http://www.cisn.org>).

New seismic instrumentation is in place across southern California, and significant progress has been made in improving instrumentation in northern California. Since 2001, these new field instrumentation efforts, data sharing, and software development for real-time reporting and archiving have been coordinated through the California Integrated Seismic Network (CISN). The CISN is also the California region of the Advanced National Seismic Network (ANSS). In addition, EarthScope deployments of USArray that will begin in early 2004 in California are coordinated with the CISN. The southern and northern California earthquake data centers (SCEDC and NCEDC) have new capabilities that enable seismologists to obtain large volumes of data with only modest effort.

The availability of high-quality digital seismic data and modern, low-cost storage technology is making it possible for seismologists to work with large data sets and to perform complex measurements on millions of waveforms. As researchers assemble their data sets as soon as the shaking stops and focus on getting their results published quickly, there is a need to improve the algorithms, automation, timeliness, and quality of data products such as hypocenters, magnitudes, and moment tensors. Some of these products are being improved with new algorithms provided by the research seismologists.

### *Workshop Convened*

A workshop for seismic network operators and the Southern California Earthquake Center (SCEC) user community of seismologists was convened to discuss these seismic shifts that are occurring in regional seismology. About sixty seismologists and students from academic institutions and government agencies across the U.S. attended the workshop, which was held at Caltech in Pasadena, 22–23 September 2003. The focus was aimed toward observational seismology, where seismologists analyze earthquake data and undertake a variety of seismological research to improve earthquake locations, moment tensor solutions, resolution of physical processes within earthquake clusters, and tomographic models. Many of the most successful users of the seismic network data do not reside in California because the Web-enabled data centers provide equal access to the seismic data, both to remote users as well as to users at the host institutions.

The goals and implementation of strong motion networks and seismic networks have been different in the past. The strong-motion networks focused on deploying many sensors in strategic locations to collect rare records with large signals. The seismic networks

focused on real-time data communications and using high gain sensors. Now the two types of networks are merging, because both see some benefits in real-time or near-real-time data transmission, and the same sensor systems can be used to detect both large and small ground motions. Similarly, instrumentation to monitor building response is evolving to have real-time data communications to record both linear and potentially nonlinear ground motions in buildings. Many of the same data processing techniques apply to both kinds of data, and thus, both frontiers in instrumentation and research for seismologists and earthquake engineers are converging.

The core and affiliated members of CISN operate more than 500 short-period stations, 200 broadband and strong-motion stations, and 1000 strong-motion stations in California. The research seismologists attending the meeting expressed interest in a greater density of broadband and strong-motion stations in northern California. The CISN is already addressing several statewide integration issues. Products such as hypocenters, magnitudes, ShakeMaps, and moment tensors are being standardized to ensure that they are uniform statewide. In the case of a major earthquake, all CISN member data will be made available through several Web sites to service many different user communities such as seismologists, earthquake engineers, and the public.

The users expressed interest in saving more of the high sample rate data during unusual times. Such times could be the hours or days before and following a major local or teleseismic earthquake. These data sets could, for instance, be used to test rate and state friction laws, and improve our understanding of earthquake triggering.

The meeting participants clearly expressed interest in having high-quality earthquake locations available within minutes following an earthquake. The common seismological practice of updating the hypocenter information in the following hours, days, or weeks can create a "moving target" that complicates later analyses. Greater uniformity in hypocenter information would facilitate tectonic interpretation, as well as the production of the derivative products that use the hypocenter as a point of reference and are generated following an earthquake. There is also a clear need for near-real-time moment tensors and first-

motion focal mechanisms, which are an essential part of the parametric description of the earthquake. The new frontier of rapid finite source inversion and its potential applications. The major and potentially most damaging earthquakes have sources that may extend from tens to a few hundred miles, and thus finite source descriptions are a must.

The complexity of metadata used by seismologists to describe their instruments is extreme. It requires detailed understanding of signal processing theory as well as the instruments themselves. The users expressed a strong need for easy and timely access to metadata and associated documentation. In addition to the modern high-fidelity seismic instrumentation, there is a need to determine the ground conditions, often called the site response, where the instrument is deployed. The site response can be measured through a variety of means. The simplest measurements are the field observations done by a geologist. The more complex measurements involve cone penetration measurements, and the most complex involve a borehole and detailed logging of the borehole. The users expressed great interest in having a data base of site response to facilitate interpretation of waveforms for basic source studies, ShakeMap, and long-term seismic hazards studies.

One of the many products routinely produced and maintained by seismic networks are earthquake catalogs. The catalogs contain the date and time, location, magnitude, and solution quality parameters for each earthquake that occurred within the reporting boundary of the network. The California earthquake catalogs contain more than 800,000 earthquakes recorded for the last 75 years. Seismologists use the catalogs to determine earthquake statistics to further their understanding of earthquake occurrence. They also use the catalog along with other types of geological and earthquake information to estimate seismic hazards. The discussion at the workshop about earthquake catalogs focused on several

aspects that might improve the existing catalogs. There was strong consensus about the need for improved documentation of the procedures used to produce and maintain the catalog so users could track changes and updates.

New data often enable new discoveries that are not easily explained with current seismological theory or practice. The attendees at the workshop expressed interest in having more data saved for later data mining. As part of using more of the bandwidth of the seismic signal, participants discussed the mutual benefits of improved coordination between global positioning system (GPS) networks, such as the Southern California Integrated Geodetic Network (SCIGN), and the seismic networks. The GPS networks are now able to capture high-amplitude seismic waves using a dense network of GPS stations that record data at high sampling rates.

The data centers have several tasks; such as to curate legacy data, maintain various types of metadata, archive the latest data and derived products, and to provide user access to all of the data and products. The SCEDC and NCEDC store the legacy earthquake data back for 75 years in the south and almost 100 years in the north. They also provide Web-enabled access to the latest data within minutes in the south and within days in the north. The SCEDC has pioneered a network-based application called Seismic Transfer Protocol (STP). The STP provides Web and command line interface to the data and allows rapid retrieval of both waveforms and parametric data. These new facilities are making possible new seismological research based on ready access to seismograms. Users strongly supported ongoing efforts to make data access more uniform at both data centers, and possibly providing one virtual California data center.

The existing infrastructure of the CISN will be beneficial to the EarthScope project. For instance, the CISN will provide the USArray

Big Foot deployment with sites that are spaced 70 km apart and communication infrastructure to assist in launching USArray. The ANSS program has deployed instruments to provide improved density of free field sites and reference sites near major buildings or structures in the San Francisco Bay area, and it has assisted with operations of the new instrumentation in southern California. Plans for new building instrumentation with real-time data communications are underway as ANSS initiates the necessary user review and implementation process.

The meeting concluded with a survey of the participants to provide relative ranking of the issues that were raised during the meeting. The following issues received high ranking of importance: improved documentation and use of version numbers for earthquake catalogs and other derivative products; consistent availability of Mw and moment tensors for earthquakes of magnitude larger than 3.5; more uniform spacing of broadband instrumentation; availability of instrument calibration data, including geological site description; and the capability to collect high sample rate data for limited time periods to capture unusual signals. Thus, the seismic network operators received feedback about various aspects of the operations needed to facilitate new research in seismology.

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—EGILL HAUSSON, California Institute of Technology, Pasadena; PETER SHEARER, University of California at San Diego, La Jolla; and JOHN VIDALE, University of California, Los Angeles

## FORUM

### Comment: On Science and Pseudo-Science in National Parks

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The article by Wilfred Elders, "Different Views of the Grand Canyon," (*Eos*, 23 September 2003) is a valuable reminder of the continuing need for geoscientists to argue geological facts with groups who confuse belief with scientific study. However, his good work is some-

what diminished by the suggestion at the end of his article that a book published by creationists should not be sold within a National Park. There is a whiff of censorship in this proposal that could have consequences beyond what he may intend.

I have noted in parks in the United States, and probably more obviously in parks in my own country of Australia, that much literature is available on the origins of the park's geology, flora, and fauna, as presented by the lore of indigenous peoples who claim historical links with the area. Any attempt to censor literature

published by creationists would logically result in censorship of material from traditional custodians of the land as well, since their material is equally dubious in terms of its scientific foundation as seen by our post-Darwinian science. Such an attempt at censorship would be both unhelpful and unnecessary for the advancement of our profession in the eyes of the public.

Far better that we ensure that educational material available within parks includes accounts written by knowledgeable and reputable science educators.

—MICHAEL W. ASTEN, Monash University, Melbourne, Australia