

Southern California Earthquake Center

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Quarterly Newsletter
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What Is the Southern California Earthquake Center?

SCEC Defined

The Southern California Earthquake Center (SCEC) actively coordinates research on Los Angeles region earthquake hazards and focuses on applying earth sciences to earthquake hazard reduction. Founded in 1991, SCEC is a National Science Foundation (NSF) Science and Technology Center with administrative offices located at the University of Southern California. It is co-funded by the United States Geological Survey (USGS) and the Education and Knowledge Transfer programs are co-funded by the Federal Emergency Management Agency (FEMA). The Center's primary objective is to develop a "Master Model" of earthquakes in southern California by integrating various earth science data through probabilistic seismic hazard analysis. The SCEC promotes earthquake hazard reduction by:

- Defining, through research, when and where future damaging earthquakes will occur in southern California
- Calculating the expected ground motions
- Communicating this information to the public

To date, SCEC scientists have focused on the region's earthquake potential. Representing several disciplines in the earth sciences, these scientists are conducting separate but related research projects with results that can be pieced together to provide some answers to questions such as *where* the active faults are, *how often* they slip, and *what size* earthquakes they can be expected to produce. Future work will consider seismic wave path effects and local site conditions for developing a complete seismic hazard assessment of southern California.

Do Buried Faults Exist Under Los Angeles?

A portion of the Master Model research is summarized in a paper published in *Science* (January 1995) by SCEC scientists James Dolan (University of Southern California), Kerry Sieh (California Institute of Technology) and six SCEC co-authors. The article infers the existence of a number of major thrust faults and buried fault ramps beneath much of metropolitan Los Angeles which have the potential for earthquakes as large as $M=7.6$. The existence of these faults is based on a combination of surface and subsurface geological observations.

Most southland residents will remember the excitement caused in the fall of 1994 when SCEC, in concert with the USGS, carried out a major subsurface geophysical study of the region. LARSE — the Los Angeles Region Seismic Experiment — attempted to confirm the existence of buried faults at earthquake-generating depths, and what their relationships to one another might be. It is hoped that these studies will aid in *defining the earthquake potential* of these important structures. LARSE probed the subsurface using seismic waves generated by small explosions detonated on land and high pressure bursts of air released beneath the sea. Much like an "X-ray" or "CAT-scan," the seismic waves scattered off the many hidden subsurface targets and, in turn, were detected by seismometers strategically placed in the Los Angeles basin and surrounding mountains. The data acquired is now being processed to provide images of the subsurface.

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From the Center Directors...

Keiiti Aki
Science Director

Thomas Henyey
Executive Director

Hooray! This issue is the first in what we hope will be an informative series of newsletters coming your way in the next few years. Special thanks must go to SCEC's new Director for Knowledge Transfer for taking the proverbial "bull by the horns" and getting this inaugural issue out. SCEC is now a relatively mature organization, and much has happened over the first four years of our existence. It will take several more issues of the newsletter to bring everyone up to date on where we are and where we're headed — so please be patient!

SCEC passed its biggest test a year and a half ago when we had our third-year site review from our two major funding agencies — the National Science Foundation (currently about \$3M) and the U.S. Geological Survey (currently about \$1.2M). High marks ensured our existence for at least the full 11 years set forth by the NSF to be the lifetime of its Science and Technology (S&T) Centers. Our sixth-year site review will be taking place in 1996, and will determine the level of Center funding for the final six years as well as look beyond 11 years. There is currently active discussion at NSF of what to do with the existing 25 S&T Centers and the entire S&T Centers program after year-11. Most likely, there will be a new round of competition with the older centers free to apply, albeit with some fresh ideas.

Looking back on the history of SCEC, there is no doubt that recent earthquakes in California have helped to shape, and give direction to, our Center. The first discussions about the need for increased funding for earthquake research in southern California, and the possibility of a new Center, took place shortly after the 1987 Whittier Narrows earthquake. These discussions, culminating in an important workshop at Lake Arrowhead in April, 1989, resulted in the preparation of a proposal to the NSF S&T Centers program. While the proposal was in the final stages of review, the Loma Prieta earthquake struck northern California, no doubt giving our proposal a boost.

One and a half years after SCEC was funded, the Landers earthquake occurred and really focused our activities and set the course for the Master Model. Out of this event grew the series of reports — the first two of which are now complete and available upon request. And last but not least, the 1994 Northridge earthquake occurred just in time for our third-year review, and emphatically punctuated our *raison d'être*! It also justified our focus on the L.A. Basin in the science program. But, while earthquakes have stimulated Center research, we hope that the recent spate of events in the greater Los Angeles basin has run its course. ♦

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How often do these faults move?

It is also necessary to confirm geological estimates of fault slip rates. SCEC, the USGS, and the Jet Propulsion Laboratory (JPL) are collectively making use of the new Global Positioning System (GPS) to measure rates of crustal deformation. Using GPS technology, we are now capable of measuring changes in baselines between two points on the earth within about one millimeter. Scientists now suspect that the Palos Verdes Hills are getting closer to the San Gabriel Mountains at a rate of seven to ten millimeters per year. But scientists still don't know how the earth is reacting to this compression or which faults might be "storing" the strain for eventual release in an earthquake. To answer these questions, the number of continuously operating GPS stations in the greater Los Angeles basin must be dramatically increased. GPS stations tripled to a total of 36 following the Northridge earthquake in 1994 with funding from NASA, the NSF, and the USGS. Efforts are currently underway by SCEC, JPL and NASA in Washington to generate funds to install as many as 250 continuously recording GPS stations in southern California.

What size earthquakes can we expect?

The potential for large, and possibly more frequent, earthquakes in the Los Angeles basin has stimulated re-evaluation of current engineering designs, construction practices, and codes related to the built environment. Another paper published in *Science*, authored by seismologists Thomas Heaton and David Wald of the USGS, civil engineering professor John Hall of Caltech, and civil engineer Marvin Halling of Utah State University, addresses the expected response of high-rise and base-isolated buildings to a M=7.0 blind thrust earthquake in the L.A. basin. These authors suggest we may have underestimated the seismic hazard, and thus the risk to many of our structures — particularly in the metropolitan areas.

SCEC will continue to foster further collaboration between scientists and engineers. In 1995, SCEC representatives will communicate research results to target audiences (those responsible for risk reduction in the built environment, land use, and disaster preparedness and response) through its Knowledge Transfer program. ♦

SCEC Board Appoints Directors for Education and Knowledge Transfer

Jill Andrews, Director for Knowledge Transfer

SCEC is pleased to announce that Jill Andrews has joined the administrative staff as Director for Knowledge Transfer. Formerly, Andrews was Director of the Earthquake Programs Office at Caltech. She takes the reins from Laurie Johnson who has returned full-time to William Spangle and Associates, Inc., in northern California. Johnson assisted the Center in initiating an effective knowledge transfer program. Andrews is responsible for



guiding the knowledge transfer process and will oversee program and product development for end users of SCEC scientific products (reports, databases, maps, software, etc.). End users include disaster preparedness officials, practicing design professionals, policy makers, southern California business communities and industries, local, state and federal government agencies, the media, and the general public. She will assemble end-user forums, guide discussions among groups of end users and center scientists, produce written documentation of such interactions, and coordinate development of end user-compatible products.

Andrews Continued on Page 4

Curt Abdouch, Director for Education

Learning about earthquakes is essential to meeting the hazard head-on and being educationally, physically and mentally prepared. Therefore, the Earthquake Center is pleased to announce the appointment of Curt Abdouch as Director of Education. Curt worked part-time as Assistant Director for Education in 1994 under a contract with the Southern California Academy of Sciences, where he was Executive Administrator.



But the demand for a more significant contribution to earthquake education brought Curt and the Center together on a full-time basis, so he will spend more energy and creativity to shape SCEC's earthquake education program, the SCEC GLOBAL SCIENCE CLASSROOM. Among the educational user groups that Curt will target are schools, museums, libraries and the public. These groups are reached through numerous workshops, special events, internships, electronic and mechanical exhibits, multimedia and telecommunications programs.

Abdouch Continued on Page 5

Andrews...

In early 1994, a SCEC Research Utilization Council was formed, comprised of eleven utilization experts who serve in guiding this effort. A select group representing those responsible for risk reduction in the built environment, land use, or disaster preparedness and response, were joined by a representative group of priority users in reviewing the Center's scientific efforts. They discussed in detail specific research product needs, ways to improve communications, and the recommended role of the Center in earthquake hazards reduction in southern California.

The group will meet again in June to discuss priorities and recommended next steps, which may include:

- Developing management policies that enhance knowledge transfer on an ongoing basis;
- Creating an information and product dissemination plan and program which would identify types of information and products the Center plans to produce; target audiences; milestones for product development; and methods of dissemination;
- Identifying communication nodes to assist in dissemination information, such as professional and business organizations, state and federal agencies, "champions" for communication hazard information, and the media.
- Developing Center publications lists;
- Defining the Center's role as a repository and clearinghouse for seismic hazard data in southern California.

The information collected at these meetings will be compiled into a draft research utilization plan, distributed to the SCEC Steering Committee and Research Utilization Council, and then submitted to the SCEC Board of Directors for adoption and implementation as a Center plan for knowledge transfer.

Other activities (some dates to be determined) include:

- USGS seismologist Lucile M. "Lucy" Jones, in conjunction with the Southern California Earthquake Center, has authored *Putting Down Roots in Earthquake Country*, a colorfully illustrated publication introducing new scientific findings on southern California's earthquake hazards and guiding individuals and families through steps of mitigation and preparedness. The project is a flagship partnership of government agencies, the scientific community and select southern California businesses. Initial costs of researching, writing, designing and producing the publication were underwritten by the USGS, the NSF and SCEC. (See article on page 16.)
- Workshops for Geographical Information System users. The workshops target GIS specialists in the SCEC region, including city and county GIS specialists, emergency coordinators, and GIS consultants. In addition to products and databases, topics will include differences in hardware and software, and data disclaimers.
- Insurance Industry Vulnerability Workshop: Using available data from earlier scientific reports of the seismicity of southern California, this workshop will focus on evaluation and upgrading of current methods used by the insurance industry in measuring exposure. Our goal would be to aid the industry underwriters in achieving a fairer rating structure that more closely matches the premium to the severity of exposure. The workshop participants will be members of the insurance industry.
- Series of one-day, urban area bus field trips highlighting research results. Participants may come from the banking, insurance and development industries; or the utilities, lifelines, transportation, and telecommunications industries. They may be practicing design professionals; policy makers; disaster preparedness officials; or from local government. Field trip leaders will include principal authors of SCEC reports, working group leaders and members. ♦

For more information about the Knowledge Transfer program activities, contact Jill Andrews at:

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← Above left: Dr. Lisa Grant, Woodward-Clyde Consultants, co-convened the GIS Workshop held at UC Riverside in March. Left: GIS Workshop participants gather for the afternoon session. In the foreground: Dr. Sally McGill, Professor, Cal State University, San Bernardino, and co-convenor of the Workshop.



Abdouch...

Among the strides made was a summer internship program for college undergraduates — several of whom were minority and women students in the earth sciences. The summer program focused on several aspects of earthquake research including crustal studies and engineering. A similar program for high school students, the Research Training Program of the Southern California Junior Academy of Sciences, was also supported by SCEC under his direction.

Another first was the introduction of the CUBE (Caltech/USGS Broadcast of Earthquakes) into high schools. Primarily used by commercial, industrial, utility and emergency personnel, SCEC recognized this telecommunications-based earthquake reporting network as a relevant and powerful educational tool.

The Earthquake Center also conducted the first major teacher workshop in California on a new set of earthquake education materials developed and released by the Federal Emergency Management Agency (FEMA) and the American Geophysical Union (AGU). Entitled "*Seismic Sleuths*," these materials will be

the focus of numerous workshops this year under the leadership of SCEC. And an all new pilot program, the Summer VINE program, will help students in the inner city learn about the natural and built environment of their own neighborhoods.

The SCEC GLOBAL SCIENCE CLASSROOM takes advantage of the research that the Earthquake Center undertakes. One example is "LARSE on Line" which will package data sets and video clips into exciting educational experiences for students. The title is derived from the Los Angeles Regional Seismic Experiment (LARSE) conducted by SCEC scientists. LARSE captured a kind of underground "CATscan" of the Los Angeles Basin to learn more about the region's numerous earthquake faults. When developed, LARSE on Line will be exported to schools via print/software versions and an Internet version.

Over the next few years, SCEC intends to develop and institutionalize these and other programs under a comprehensive strategic plan that will involve teachers, students, nonformal education professionals and many segments of the public. In this way the SCEC GLOBAL SCIENCE CLASSROOM will both come alive and live up to its name. ♦

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↑ SCEC Summer Interns pause at a rock cut near the San Andreas Fault while on a technical orientation field trip at Palmdale, California.

Avast! SCEC supported three days of earth science experiences for 150 inner city elementary teachers in the Earth Science Summer Institute sponsored by the Center for the Advancement of Precollege Science Education (CAPSE). Teachers participated in field events that ranged from oceanography to geology to astronomy. →



Satellite Infrastructure Centers

The Southern California Earthquake Center Data Center (SCEC-DC)

As part of its infrastructure, SCEC maintains a variety of data and instrument centers at its core institutions. Upcoming newsletters will highlight individual centers. In this first newsletter we describe The Southern California Earthquake Center Data Center (SCEC-DC), the principal archive of seismological and geodetic data associated with seismicity in southern California. This archive currently consists of epicentral, phase and waveform data recorded by the Southern California Seismic Network (SCSN) since May of 1981, triggered TERRAScope waveform data recorded since October of 1990, and selected aftershock data from portable instruments deployed after the Joshua Tree and Landers-Big Bear earthquakes. GPS data in Rinex format is also available for selected time periods since 1991.

Accessing Data Sets

Data sets are available from the SCEC-DC to remote users with access to the Internet via a variety of interfaces. A description of how to retrieve the most commonly asked for data sets from the SCEC-DC is presented below.

Recent Seismicity in Southern California

A listing of all earthquakes greater than magnitude 2.5 recorded by the SCSN in the last 72 hours may be obtained by using the utility "finger quake@scec.gps.caltech.edu". This utility prints the listing to the user's terminal screen. Users without access to the "finger" utility, may obtain this listing by sending e-mail to "quake@scec.gps.caltech.edu".

Weekly Seismicity Reports

Seismicity reports, issued every Thursday morning by the SCSN, are available via the Data Center's "anonymous ftp" site, its World Wide Web (WWW) interface (<http://scec.gps.caltech.edu>), and the Usenet *ca.earthquakes.newsgroup*. These weekly reports consist of a map (e.g. postscript file *950209.ps* or gif format file *950209.gif*) and a commentary (*950209.txt*) at a level intended for the public, but also useful to scientists and engineers.

Instructions to retrieve earthquake reports via the "anonymous ftp" site:

```
ftp scec.gps.caltech.edu
SCEC.GPS.CALTECH.EDU>user anonymous
<Guest login ok, send ident as password.
Password: katrin
<Guest login ok, access restrictions apply.
ftp> cd pub/ca.earthquakes/"year"
ftp> binary
ftp> mget "filename" (e.g. 950209.gif, 950209.ps or
950209.txt)
ftp> quit
```

Retrieving and Viewing Earthquake Reports via WWW

Current and older versions of weekly earthquake reports are also viewable and retrievable via the World Wide Web (WWW) interface. Access the WWW via your interface of choice, (e.g. mosaic, netscape) and open the URL <http://scec.gps.caltech.edu>. There are built links to the current earthquake report and map, as well as to previous earthquake reports as far back as January 1993.

Seismicity Catalogs

Seismicity Catalogs are available in yearly ascii files from the SCEC-DC's anonymous ftp site. Instructions:

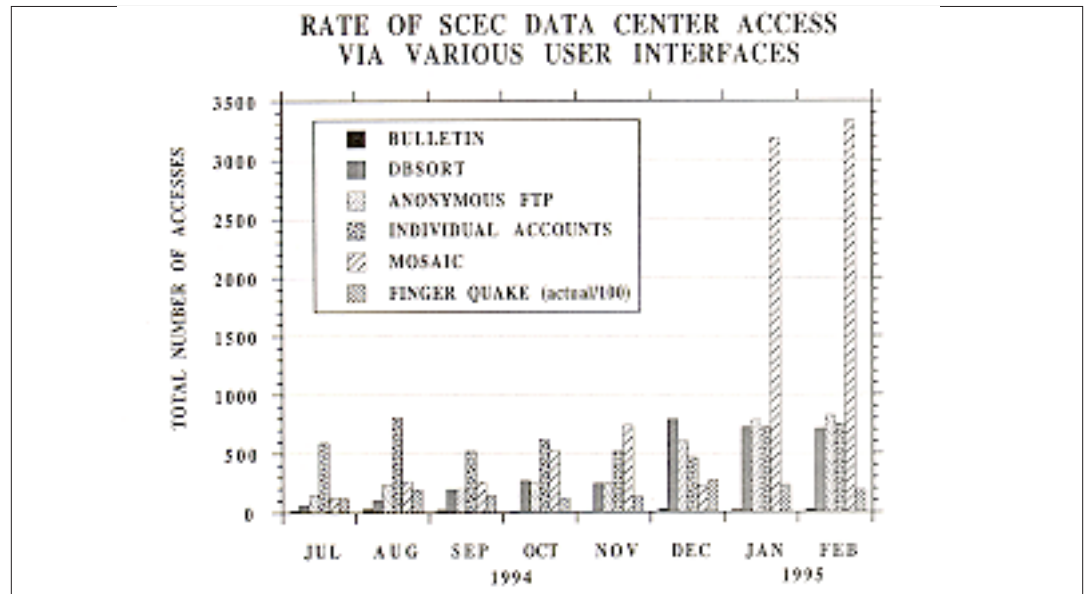
```
ftp scec.gps.caltech.edu
SCEC.GPS.CALTECH.EDU>user anonymous
<Guest login ok, send ident as password.
Password: katrin
<Guest login ok, access restrictions apply.
ftp> cd /pub/catalogs/SCEC-DC/"year"
ftp> binary
ftp> mget 1995.cat
ftp> quit
```

A searchable catalog interface via the WWW (<http://scec.gps.caltech.edu>) is currently being developed.

Phase and Waveform Data

Phase and Waveform Data recorded by the SCSN and TERRAScope are available to users with individual research accounts on the SCEC-DC. Individual research accounts may be requested via the electronic bulletin board system as described below. Once an account has been set up, phase and waveform data can be sorted via the SCEC-DC database searching program "dbsort", and retrieved via the program "scecgram". Further documentation of these programs is available online via the "man info" page, and in the user manual available as a postscript file from the anonymous ftp site in *pub/documents*.

The accessibility of the SCEC Data Center (SCEC-DC) has increased significantly since it went online via the Internet in January of 1992. This figure shows the rate of access to the SCEC-DC via the "bulletin board system," the SCEC database searching program "dbsort," the anonymous ftp site, the World Wide Web (Mosaic) and the finger quake utility.



Requesting an Account

Individual research accounts are available to users wishing to access waveform data archived at the SCEC-DC. To request an account, log into the bulletin board system as follows:

```
telnet scec.gps.caltech.edu
login as "bulletin"
```

You will see: *WELCOME TO THE SCEC DATA CENTER*
If you encounter problems while using this menu, please send email to: katrin@scec.gps.caltech.edu. Then:

```
Enter 'a' to request an account.
'i' for information about Data available at the SCEC-DC
'g' for GPS information
's' for Strong Motion Data information
'w' for SCSN Weekly Earthquake Reports information
'q' to quit
```

Please enter your selection: *a*

You will be asked for your name, phone number, affiliation, e-mail address and research interest. Please fill in the form. Information regarding your account will be sent to you within two working days.

Additional Information

Additional information regarding the SCEC-DC may be obtained by contacting:

Katrin Hafner
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phone: (818)395-2106

Earthquake Map Now Available from the U.S. Geological Survey

"Earthquakes in California and Nevada" depicts the epicenters of 300,000 earthquakes, including 49 of magnitude 6.5 or larger that have occurred in the two-state area since 1836. The earthquake epicenters are depicted by various sizes of open circles and red dots.

Different elevations, from two miles below sea level to the tallest peaks of the Sierra, all water courses such as rivers, streams, lakes and reservoirs, and all major highways are depicted. The map offers a ready reference for areas that have had few if any earthquakes during the past 160 years. California's great central valley, for instance, has only a few dots depicting earthquake epicenters.

The California-Nevada map contains new information, such as epicenters of the Loma Prieta, Landers, Big Bear and Northridge earthquakes that have occurred since the first California earthquake map in the series was published in 1988. The map, priced at \$12 for a paper copy or \$22 for a laminated copy, including shipping costs, is available by mail only from:

**Earthquake Maps
U.S. Geological Survey
Box 25046, Federal Center, MS 967
Denver, CO 80225**

Orders must include the name and number of the map "Earthquakes in California and Nevada; Open-File Report 94-647", and a check or money order, payable to DOI/USGS.

SCEC Scientists' List of Publications, 1991 - 1995

The following publications listing will be updated and available on a continuous basis. Please contact the SCEC Administrative Office, 213/740-5843, to obtain updated listings. Selected publications may be available through the Center; however, to obtain authorized copies of preprints or reprints, please contact the authors directly.

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Feature

Reflection Seismology and Surreal Reflection

Michael Forrest, a Ph.D. candidate in Earth Sciences at USC, shared these notes he made for an upcoming book he's putting together about reflection seismology using October's LARSE survey as an example. He typed the following into his computer one night after coming home from the field. We think our readers will enjoy it. --Ed.

Why do so many think scientists lead boring lives...that all we do is sit in offices, staring at machines? Anyone who thinks our work is boring ought to be put to work for one day deploying REFTEKS for this LARSE survey. If they're still bored afterwards then they're either blind, mad or both.

In the Seal Beach weapons station an ugly black turkey buzzard is ripping apart a crow, while tiny fish jump out of the pools behind field partner Alan Walters' back, as he hunches over his hand-held. Behind him the ominous earth-covered bunkers filled with nuclear weapons are oddly reassuring (with Saddam feeling feisty again this last week).

At the bottom of a concrete flood control channel, a tall, gaunt, handsome blond and bearded traveler, wearing rags, looks up from where he's sitting beside the water, waves like an old friend, and flashes a tired, sunburnt smile. His companion is a sheep dog the size of a goat. Something about the way he moves suggests he is educated and once had a lot of money.

Looking over a suburban fence you see two beautiful women walking two enormous turkeys in their morning garden. They walk with the floating grace of queens and ladies of old. It looks

like something out of an opium eater's dream. Your jaw drops. This is something you see in Fellini movies. This can't be reality.

From a mountain-top corporate facility, you can see across all of L.A. to San Pedro, to Huntington Beach, and to the sea. It's more beautiful in all its flat, spread out twentieth century automotive steel and glass glory, than New York or Paris, or Vienna by far. If the devil came and offered you everything in sight for your soul this clear sunny day, you'd gladly say "yes."

The Puente Hills Landfill mountain turns out, literally, to be a mountain of garbage. Never saw so much garbage in your life. It's taken from the trucks and buried. Beyond the landfill you can see a cemetery. People are being taken from the backs of hearses and buried.

You service a station disguised as a trashbag in a suburban tract home garden. Three youths are leaning against the house wall watching. One turns toward the other and says, "Tony's brother got killed last night." The other looks back and says, "Really?" and shrugs. He looks back at the equipment. "So how does this stuff see inside the earth?"

At night, coming down from the mountains, you enter a valley through which the locked segment of the San Andreas runs. Lovely farmhouses and small cottages cover the valley floor. A linear lake sits on the fault. Lights sparkle on the water as a smiling moon rises overhead. It's Saturday Night in L.A. ♦

Michael Forrest



Clockwise, beginning above left: 1) Michelle Robertson and Ellen Gottschammer have just connected the GPS antenna and are hoping it locks on the signal. 2) Geophone wire is like spaghetti (without the sauce). 3) Anshu Jin is burying a REFTEK, Michelle is tying a GIS antenna to a tree root. 4) Michael Forrest observes a borehole casing that shot out of the ground. 5) Modest Aaron Martin's license plate. 6) Ellen loves traipsing through the REFTEKs with her connectors. 7) Bugs on their backs: 3-component geophones. 8) David Okaya, USC Research Faculty, at field headquarters in Glendora. 9) Center: U.C. Santa Barbara's Robert Lucas, losing his grip.



SCEC Activities...

SCEC and the Business Community Partner in Launching Massive Public Education Initiative

The Southern California Earthquake Center (SCEC), the United States Geological Survey (USGS), and the Business Alliance for Earthquake Education and Mitigation (members of the Association of Contingency Planners) are collaborating with southern California businesses in bringing to fruition a unique and exciting enterprise. Since the Northridge earthquake last year, we've been barraged with media reports about the possibilities of future earthquakes in southern California. In answer to a growing concern within our community, we are taking a lead role in supporting effective earthquake information and mitigation activities.

"Putting Down Roots in Earthquake Country" is an illustrated, 32-page color personal handbook that introduces new scientific findings by SCEC on southern California's earthquake hazard, and guides individuals and families through mitigation and preparedness. It is intended to be a public service, multi-purpose handbook that will serve as an excellent resource for government agencies, schools, and businesses as well. The principal author is seismologist Lucile M. Jones of the southern California Office of the USGS. She has nicely combined the scientific findings of SCEC with the more practical elements of mitigation and preparedness in a well-illustrated and easily readable document — the first of its kind in southern California. Her message is consistent and encouraging: earthquakes are inevitable, but they are understandable, and damage and serious injury are preventable.

The final version is now complete. The initial cost of researching, authoring, designing, and reviewing it was underwritten by the USGS, the NSF, and SCEC. With community support, several million copies in up to five languages (English, Spanish, Korean, Chinese, and Vietnamese) will be distributed. ♦

Left to right: members of the Business Alliance for Earthquake Education and Mitigation Jill Andrews, SCEC; Lorna Winfrey, host, First Interstate Bank; Christopher Wright, Warner Brothers Studios and ACP President, Los Angeles Chapter; Mary Carrido, MLC & Associates and ACP National Chairman; Julie Davenport, host, First Interstate Bank; Lucile M. Jones, USGS; John Bogner, Sony Pictures and ACP Chairman, National Symposium; and Roger Taylor, Toshiba America Electronics Components, Inc.

SCEC Sponsors CORS Meeting

A California Continuously Operating Reference Stations (CORS) committee meeting was held at Scripps Orbit and Permanent Array Center (SOPAC) on January 12, 1995 with the support of SCEC outreach. In spite of the very bad weather for travel, attendees included representatives from SOPAC, the National Geodetic Survey, the Metropolitan Water District of Southern California, County of Orange, Imperial County, Caltrans, San Diego County, the USGS, Menlo Park, Los Angeles County Department of Water & Power, Riverside County Survey Department, and Riverside County Flood Control.

Some items discussed were the criteria by which a new site could be included in the CORS network, acceptable monumentation for CORS sites, and the idea of using the same type of antenna at all sites. Several new sites will be coming on line over the next year including two FAA sites (and eventually sites at all airports), and a 51-station network along the United States coast that the Coast Guard will install to support marine navigation. Also discussed was how to educate the public to take advantage of these data. There are several future survey meetings at which presentations will be made. CORS GPS data are being made available to the surveying public at no charge for one year via a SCEC-sponsored PC bulletin board service. Call SOPAC at 619/534-0229 for more information.

Shelley Marquez



More SCEC Activities...

Geographical Information System (GIS) Workshop

In a collaborative effort, scientists from the U.S. Geological Survey (USGS), the Southern California Earthquake Center (SCEC), the California Division of Mines and Geology (CDMG) and industry are compiling a digital fault and fold map and database for southern California. The primary goal is to summarize current knowledge of the rates and styles of tectonic deformation in the greater Los Angeles area. The database will be an important product of publicly funded research on active faults and earthquake potential in southern California. Proposed features to be included are the location and rates of deformation of active faults and folds, as well as the distribution and age of surficial deposits that provide evidence for, and constraints on, tectonic deformation. The database will include documentation of supporting data and evaluation of data uncertainties. The end product will be designed to be of maximum utility to users in research and industry.

To facilitate these goals, SCEC sponsored a workshop on March 29 at the University of California at Riverside. The workshop was convened by Professor Sally McGill of California State University San Bernardino, and Dr. Lisa Grant of Woodward-Clyde Consultants, with assistance from other project members. The conveners are both specialists in earthquake geology with complementary interests in fundamental and applied research, respectively.

The purpose of the workshop was to bring together the parties who will be working on the database, potential contributors to the database and end users to share ideas on how the map and database should be organized and constructed. At the workshop, project members from the USGS, SCEC and CDMG presented a summary of the current plans for the database, and invited input from workshop participants. Key issues addressed included: What data should be included? How should these data, especially three-dimensional data, be represented in map form? How should uncertainties and varying data quality be handled? How can the database be made most useful and accessible? How should tasks and interim products be prioritized? The resulting fault database should be an important resource for scientists and industry to use in dealing with southern California earthquakes. A summary of the meeting will be available through SCEC. ♦

Lisa Grant

James Dolan Makes Presentation to City of Beverly Hills

"Prospects for Larger or More Frequent Earthquakes in the Los Angeles Metropolitan Region" was the topic of Dr. James Dolan's presentation to the City of Beverly Hills on Wednesday, March 8. Far too few moderate earthquakes have occurred within the Los Angeles, California, metropolitan region during the 200-year-long historic period to account for observed strain accumulation, indicating that the historic era represents either a lull between clusters of moderate earthquakes or part of a centuries-long interseismic period between much larger events.

Geologic slip rates and relations between moment magnitude, average coseismic slip, and rupture area show that either of these hypotheses is possible, but that the latter is the more plausible of the two. The average time between M_w 7.2 to 7.6 earthquakes from a combination of six fault systems within the metropolitan area was estimated to be about 140 years. Large earthquakes like these should not come as a surprise to us, because two such events have already occurred in southern California during historic time, although not within the Los Angeles metropolitan region: a M 7.5 event near Bakersfield in 1952, and a M 7(?) event in 1812 near Santa Barbara. ♦



↑ Dolan's Ph.D. is from University of California at Santa Cruz where he studied the geologic evolution of the northern Caribbean. During these studies, he became more and more interested in earthquakes, and is involved in ongoing studies of very large earthquakes in Hispaniola and Puerto Rico. For the past four years, he has been studying seismic hazards in the Los Angeles region, while a post doc at Caltech. He recently moved to the SCEC at USC, where he will continue to try to elucidate the prospects for future earthquakes in the region and the faults that will produce them.

SCEC Working Group Reports

Excerpts from the SCEC Annual Report, 1994, Volume I

**Group A: Master Model
Construction and Seismic Hazard
Analysis**
Group Leader: Kei Aki
University of Southern California
Los Angeles, CA 90089

The goal of SCEC is to integrate research findings from various disciplines in earthquake-related science to develop a prototype probabilistic seismic hazard model (Master Model) for southern California. During the first four years, considerable progress was made in developing both methodology and prototype products. The 1992 Landers/Big Bear earthquakes aided in providing a research focus and accelerated work toward our goal. The first Master Model products were two reports. *Future Seismic Hazards in Southern California, Phase I: Implications of the 1992 Landers Earthquake Sequence*, was published in November, 1992. It addressed the implications of the Landers earthquake sequence on nearby major faults. The Working Group on California Earthquake Probabilities produced *Phase II: Probable Earthquakes, 1994-2024*, to be published in the *Bulletin of the Seismological Society of America* in April 1995.

In the past year, presentations of the draft Phase II report were made to the communities of scientists, engineers and prospective users in numerous workshops. Discussions and advice given in these workshops helped us greatly in improving various aspects of the report, which has become the Center's first generation Master Model.

Group B: Ground Motion Modeling
Group Leader: Steve Day
San Diego State University
Department of Geological Sciences
San Diego, CA 92182

The primary focus of Group B is on the prediction of strong motion time histories. Ongoing work toward this objective concentrates on research on site effects and development of ground motion estimates for Los Angeles basin scenario earthquakes.

Site effects research includes instrumental studies of recordings obtained in the Los Angeles basin, in order to measure site amplification and produce a data base of amplification factors for integration into SCEC probabilistic hazard maps. Estimation methods developed and applied to strong motion data from seven southern California earthquakes have produced a preliminary contour map of site amplification for the Los Angeles region. The group has focused on establishing conceptual foundations based on information gathered from a large number of strong motion instrumentation sites in southern California, for site effects estimation. Continued modeling of soil non-linearity and work examining the effect of soil saturation are in progress. Scenario ground motion for the Los Angeles basin research includes modeling ground motion from scenario earthquakes developed by Group C (Earthquake Geology), accounting for the complex regional geologic structure in three dimensions.

Group C: Earthquake Geology
Group Leader: Kerry Sieh
California Institute of Technology,
Pasadena, CA 91125

Blind thrust faults within the Los Angeles metropolitan region have been a major focus of SCEC research since inception. The Northridge earthquake provided a dramatic illustration of both the basic correctness and the limitations of our understanding of the earthquake geology of the region. The earthquake was an unprecedented opportunity and stimulus for improving our understanding of blind thrusts and a clear verification of their potential danger to the citizens who fund the SCEC.

SCEC geologists have developed the most comprehensive model yet of potential earthquake sources within the entire metropolitan region and their recurrence characteristics (see the January 13, 1995 issue of *Science*).

Topics studied during 1994 included recurrence intervals for the Newport-Inglewood Fault; rates and styles of faults between downtown Los Angeles and Beverly Hills; geometries and rates of offshore faults; paleoseismic studies of blind thrusts, Los Angeles Basin and Santa Barbara Channel; and Earthquake clustering and characteristic earthquakes in the region of the Landers earthquake.

Group D: Subsurface Imaging and Tectonics

Group Leader: Rob Clayton
 California Institute of Technology
 Pasadena, CA 91125

The main emphasis for this group in 1994 was the Los Angeles Region Seismic Experiment (LARSE). Executed in October, 1994, this experiment involved over 160 people from 15 academic and government institutions. The experiment generated hundreds of Gbytes of data currently being reduced to a form that are usable by scientists. The scientific analysis of this data will begin in the second quarter of 1995. The goals of this study are to image the Los Angeles and San Gabriel Basins, determine the depth and shape of mid- and lower-crust boundaries, image thrust faults in the San Gabriel Mountains, and determine the depth extent of the San Andreas Fault.

Other projects in 1994 included the archiving of oil company borehole observations and industry seismic reflection data from the Los Angeles and Ventura basins; development of a dynamic tectonic model for deformation in southern California; measurement of fault properties by the analysis of trapped fault-zone waves; and tomographic studies of the Northridge earthquake and construction of detailed 3D velocity models for southern California.

Group E: Crustal Deformation

Group Leader: Duncan Agnew
 University of California
 Scripps Institution of Oceanography
 La Jolla, CA 92093

The activities of this working group, and of geodesy within SCEC, are to contribute to the estimates of seismic hazard in southern California by determining the motions of the crust, in which the strain related to earthquakes is accumulated (and released). This is accomplished by the analysis of data from GPS satellites, collected by SCEC scientists, other groups, and continuous data from the Pinon Flat Observatory. One of the major parts of the SCEC geodesy program is the PGGA (Permanent GPS Geodetic Array), operated by UCSD (with SCEC funding). Additional support from NASA and collaboration with the Jet Propulsion Laboratory (JPL) and the USGS has resulted in the inauguration of SCIGN (Southern California Integrated GPS Network), managed under SCEC auspices. Plans are to increase the number of stations to 25 in an area where a year ago there were only two. Following the Northridge earthquake, much of the L.A. area was surveyed, making possible future studies of the details of deformation in this region.

A workshop on future directions for crustal deformation studies in southern California was held in La Jolla in the fall of 1994. One conclusion of the workshop was that geodesy may be the main source of information on the distribution of strain accumulation in the Los Angeles area, especially on blind thrusts.

Group F: Regional Seismicity and Source Processes

Group Leader: Egill Hauksson
 California Institute of Technology
 Pasadena, CA 91125

The major goals of Group F are: 1) an improved understanding of earthquake occurrence; 2) determining relationship between source processes and patterns of damaging ground motions from earthquakes; and 3) providing rapid information following a major earthquake in southern California.

Progress is being made in developing new techniques for analyzing broadband data from TERRAScope. The 1994 Northridge earthquake sequence provided a challenging environment that tested all our present real-time systems to their limit and sometimes beyond. New source estimation procedures under development can be used to predict ground motions in the L.A. Basin for an earthquake on the San Andreas fault, more rapidly than the energy can propagate to the Basin. We continue processing data from the 1994 Northridge and 1992 Landers earthquake sequences recorded by the Southern California Seismographic Network, TERRAScope, and SCEC portable instruments. These data are being used to determine subsurface structure, including high resolution velocity models of the L.A. Basin, and wave propagation effects to explain the distribution of damaging ground shaking. The aftershock data are being used for source studies to improve understanding of the physics of earthquakes and the structure of fault zones.

Working Group Reports
Continued from page 19

Group G: Physics of the Earthquake Source
Group Leader: Leon Knopoff
University of California Institute of Geophysics and Planetary Physics
Los Angeles, CA 90024

This group has attacked the problem of understanding the origin of the Heaton Pulse. Other studies include focusing on the influence of encounters of growing cracks with asperities; and geometrical influences on long-term seismic histories. Continued research will concentrate on testing a program to understand and incorporate fault bends and non-parallel fault segments into a dynamics calculation; testing of a new model of friction and its influence on rupture; initiation of studies of hopping and other aspects of low-friction sliding; and discovery of log-periodic fluctuations in precursory seismicity in regular hierarchical fault networks and in precursors to the Loma Prieta earthquake.

Group H: Engineering Applications
Group Leader: Geoff Martin
University of Southern California
Department of Civil Engineering
Los Angeles, CA 90089

The work of this group is sponsored by Caltrans, the City of Los Angeles, and the County of Los Angeles. Nine technical tasks listed below define the group's focus:

- Characteristics of earthquake response spectra in southern California
- Southern California fault and earthquake parameters
- Effects of local site characteristics on ground accelerations
- Duration of strong motion shaking in southern California
- Geotechnical site data base for southern California
- Evaluation of bridge damage in recent earthquakes
- Probabilistic seismic hazard and ground motion time history analyses
- Liquefaction characteristics and liquefaction potential of southern California sites
- Characteristics of vertical ground accelerations

The overall objective of this project is to improve our knowledge and understanding of the nature and characteristics of strong ground motions resulting from probable major earthquakes in southern California, particularly in the greater Los Angeles region. This will provide for the most cost-effective and reliable seismic design of bridges, structures and the infrastructure in general. A complete report, in three volumes, is available from the SCEC office.

What's Next?

In mid-February, the SCEC Working Group for the third major Center report met to discuss chapter organization. The report will concentrate on site effects based on scenarios suggested in the Center's previous reports.

Chapter I • Seismic source characterization for southern California. Summary of Phase-II report (Seismic Hazards of Southern California: Probable Earthquakes, 1994-2024) and possible update.

Chapter II • Review of empirical attenuation relations for southern California, with comparisons of strong motion predictions by various formula with the observations made during recent earthquakes in southern California since the Whittier-Narrows earthquake of 1987.

Chapter III • Site characterization; mapping of amplification factor and/or site classification.

- Whole of southern California area
- Los Angeles Basin, San Fernando Valley, San Gabriel Valley and San Bernardino areas (finer meshes)

Chapter IV • Probabilistic Seismic Hazard Analyses (PSHA) mapping for the whole of southern California.

Chapter V • PSHA mapping for the Los Angeles Basin, San Fernando Valley, San Gabriel Valley, and San Bernardino areas.

Chapter VI • Scenarios (time history, duration, etc.) for selected earthquakes in southern California. This chapter will include the estimate of strong motion for a large event on the San Andreas fault using the Landers record for calibrating the methodology.

Chapter VII • Conclusions

Note: Research supporting the report is in progress. The report may be published by the summer of 1996.

GIS Database Access

The GIS World Wide Web (WWW) Server is currently under construction, offering GIS resources to the Internet public. An on-line catalog is being developed to allow Internet access (via WWW browsers and FTP clients) to SCEC GIS databases and information.

Researchers interested in acquiring the Mosaic WWW browser software or setting up their own Web Server can contact:

Eric Lehmer, SCEC GIS Lab
Dept. of Earth Sciences, UC Riverside
Riverside, CA 92521
909/787-2104 ph. or 909/787-4324 fax
"elehmer@vortex.ucr.edu"

Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024

Presentation and Panel Discussion Held at the OES Conference, "Northridge Earthquake--One Year Later"

On Friday, January 20, 1995, scientists sponsored by the Southern California Earthquake Center presented new findings on future seismic hazards at the annual Governor's Office of Emergency Services (OES) conference. "Northridge Earthquake--One Year Later" was held in Universal City, CA, January 17-20.

The January 20 morning session was open to the media and featured a panel of renowned scientists, including principal authors of the Earthquake Center Report, "Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024." The report is scheduled for publication in the *Bulletin of the Seismological Society of America* in April 1995.

The report features the SCEC probabilistic seismic hazard model for southern California with estimates of the likelihood that the ground shaking at a given site from all possible earthquakes will exceed some level over a given length of time. The report includes probabilities of earthquakes throughout southern California, with a generalized estimate of the ground acceleration likely to result from these earthquakes. Future reports will present a more detailed estimate that includes the effects of local site conditions.

Probabilistic seismic hazard analysis is based on a knowledge of earthquake sources, seismic wave propagation, and site effects. The study focuses on the first of these, the earthquake sources. The innovative Master Model integrates a variety of geophysical information: historical records of known earthquakes, geological evidence for earthquake faults, and recent strain measurements using the Global Positioning System (GPS).

The last official estimate of earthquake potential in southern California was the 1988 report of the Working Group on California Earthquake Probabilities. The report estimated the probabilities of large "characteristic" earthquakes on major faults, like the San Andreas and San Jacinto faults. The report concluded that there is a 60% chance of at least one large earthquake ($M \geq 7$) on the San Andreas fault before the year 2018. The new report concludes that the probability is even higher, 80-90%, when other faults are included.

Damaging earthquakes (such as the 1994 Northridge earthquake) may occur on hidden faults, or faults obscure enough to be neglected before earthquakes occur on them. The new report estimates the probabilities of all earthquakes above M_6 in southern California, whether or not they occur on recognized major faults. Strain measurements made with GPS indicate that

regions such as the Ventura and Los Angeles basins have the potential for large earthquakes, even though the faults may be obscured and there is a paucity of recent large earthquakes. The Master Model describes the seismic potential of each zone by randomly distributed earthquakes, in addition to characteristic earthquakes on specific faults.

The Master Model can be used to calculate the probability of strong shaking anywhere in southern California. For illustration, the report presents in map form the probability that the peak acceleration would exceed 20% of gravity in thirty years. This probability is significant throughout southern California exceeding 60% at Parkfield and in the Imperial Valley, both sites of frequent historic earthquakes, and 40% in a zone extending from the Santa Barbara Channel across the Ventura Basin and on to San Bernardino.

The predicted long-term rate of future earthquakes exceeds the average rate observed since 1850. Possible reasons include (1) the magnitude of the largest possible earthquake may be larger than that of the largest historic earthquake in southern California, namely the 1857 Fort Tejon earthquake, or (2) a significant part of the strain accumulated in southern California may be released without earthquakes, or (3) during the past 150 years, the actual rate of earthquakes may have been anomalously lower than the long-term rates. In any case, earth-science data suggest that the future may hold either bigger or more frequent earthquakes than the catalog of historic earthquakes has led us to expect.

About the authors:

Dr. C. Allin Cornell is a Professor of Civil Engineering at Stanford University. His expertise is in probabilistic seismic hazard analysis. He has helped pioneer the use of this methodology for critical facility siting.

Dr. Thomas Heaton is a senior staff geophysicist with the USGS in Pasadena. He has broad experience with issues of seismic hazard and risk assessment, with particular expertise in the area of strong ground motions accompanying earthquakes.

Dr. David Jackson is a Professor of Geophysics at UCLA and is the

Publishing Opportunities Through the Southern California Academy of Sciences

The cooperative spirit between SCEC and the Southern California Academy of Sciences (SCAS) has kindled publishing opportunities. Recently the Academy organized an Editorial Board for its journal, the *Bulletin*. The 48-page *Bulletin* focuses mainly on scientific research in southern California and is published three times a year.

The Editorial Board is aggressively seeking articles that reflect the array of research being carried out in the region in all disciplines of science. The board invites scientists to inquire about these opportunities by contacting Dr. Edward Kormondy, Editorial Board Chair, or Dr. Dan Guthrie, Editor, at the Academy.

The address is 900 Exposition Blvd., Los Angeles, CA 90007 and the phone is 213/744-3384.

"Probable Earthquakes" Continued from Page 21

principal author of the report. His expertise is in the areas of crustal deformation (for example using the Global Positioning System to track subtle movements of the earth), and the temporal and spatial patterns of earthquakes. A proponent of earthquake clustering, he advocates objective testing of the characteristic earthquake model and other cornerstones of hazard analysis.

Dr. David Schwartz is a senior staff geologist with the USGS in Menlo Park, and has studied many of California's active faults. He assembled the critical geologic information for the report.

BSSA reprints of "Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024" will be available through SCEC in late May, are \$5 each, and can be obtained by contacting Sue Turnbow, phone 213/740-5843 or fax 213/740-0011. ♦

Denise Steiner is the Administrative Assistant for SCEC. She has been with SCEC from inception in 1991 and with the Department of Earth Sciences at USC for 10-1/2 years. Her responsibilities include travel agent, meeting coordinator, accountant, and support staff for the directors for Education and Knowledge Transfer. Denise can be contacted at 213/740-7048 or e-mail "denise@coda.usc.edu". ↓

Meet the Center Staff...



↑ Susan Turnbow has been with the Southern California Earthquake Center since July, 1994, after 15 years with the Department of Earth Sciences. Susan is SCEC's Senior Technical Secretary and takes care of everything relating to proposals, mailings, purchasing, phones or parking on the USC campus.



Secretary of the Interior Visits Southern California



Left to right, Christopher Wright, Warner Brothers Studios and Association of Contingency Planners (ACP) President, Los Angeles Chapter; Mary Carrido, MLC & Associates and ACP National Chairman; Secretary of the Interior Bruce Babbitt; Jill Andrews, SCEC; Lucile M. Jones, USGS Pasadena.

Secretary of the Interior Bruce Babbitt visited southern California on February 1. During a speech delivered at Caltech in Pasadena, Babbitt identified the proposed Interior Department federal agencies which may be cut. The list

includes the U.S. Geological Survey, the National Biological Survey and the Bureau of Mines. Babbitt, who boasts two degrees in geology, stated that he hoped to "provoke a tidal wave of indignation" against the "notion that science

is a problem, that we'd be better off without knowledge."

Research into better understanding of earthquakes must continue, he said, so that earthquake mitigation is encouraged in areas of high

risk. Babbitt made a point to laud the work of Dr. Lucile M. Jones, a U.S. Geological Survey geophysicist who has authored a handbook on earthquake education and hazard mitigation, due for release in the summer of 1995. ♦

Earthquake Faults in Southern California

The most recent source of information about faults in California is the "Fault Activity Map of California." Copies may be obtained by mailing a check in the amount of \$20, which covers the map and shipping, with your written request for Map #GDM-006, to:

California Division of Mines and Geology
PO Box 2980
Sacramento, CA 95812-2980

Available On Line: The Seismic Hazards Map, Probable Earthquakes, 1994-2024

The Phase II map is now online through the World Wide Web. The URL is:

<http://scec.gps.caltech.edu/PhaseII.html>

We have added explanatory text for end users.

Earthquake Information Sources

...To Visit

**California Institute of Technology
Earthquake Media and Exhibit Center
Seismological Laboratory
Seeley G. Mudd Building
Northeast corner, Wilson St. and California Blvd.
Pasadena, California**

Special arrangements can be made for group tours.
For more information, contact Caltech's Public Relations Office
at 818/395-6326.

Hours: 8 am - 5 pm, Monday - Friday

The Earthquake Media Exhibit Center at the California Institute of Technology provides the general public with historical and practical information about earthquakes and gives the media up-to-the-minute analysis of seismic activity. Established in 1994 through a generous grant from the Times Mirror Foundation, the center consists of two parts: the exhibit center, located in the lobby of the Seeley G. Mudd Building of Geophysics and Planetary Science, and the media center, located on the second floor of the Mudd Building. The exhibit center offers information about earthquakes through a wide variety of interactive, photographic, and other displays. The media center, a hub for journalists following earthquakes, provides reporters with access to Caltech's highly respected seismologists, geologists, and earthquake engineers.

A unique feature of the exhibit center is an interactive computer display where

visitors can touch a screen to access up-to-date information about earthquakes. The display includes three-dimensional views of past earthquakes in California, including the Northridge earthquake; explanations of different types of faults; visual enactments of earthquake activity and fault movements; a list of the most recent earthquakes in California; and up-to-date short-term probabilities for future earthquake activity in southern California.

The exhibit center also includes three operating drum recorders showing earthquake activity recorded by instruments at three nearby stations: Catalina Island, the Mojave Desert, and the Salton Sea. A CUBE (Caltech/USGS Broadcast of Earthquakes) computer monitor pinpoints California earthquakes that have occurred within the past week. The locations and magnitudes of earthquakes are updated on the screen

within minutes after they occur. The exhibit center gives visitors a historical overview of earthquake activity in the region, including computer-generated maps showing the major faults in southern California and the epicenters of the area's 230,000 earthquakes recorded from 1978 to 1994, and detailed maps of the recent Landers, Big Bear, and Northridge earthquakes. Another map identifies the locations of seismological stations in the region, and photographs show some of the sites. Other photographs show the media center, earthquake operations room at Caltech, and the CUBE radio antennae that receive and transmit earthquake information. Accompanying the photographs and displays are descriptions explaining how earthquakes are located, how magnitudes are determined, and how data is interpreted, along with other information about earthquakes and the network for detecting and analyzing them.

...To Call or Write

For information about recent Southern California earthquakes, call 1-800/286-7233, or 818/395-6977.

For information on earthquakes in Northern California, call the U.S. Geological Survey in Menlo Park, 415/329-4011.

To offer or receive assistance from the Red Cross, call 213/739-4543.

For information on earthquakes outside of California, call the National Earthquake Information Center, 303/273-8516.

For phone numbers for emergency or service agencies:

To reach the Federal Emergency Management Agency (FEMA), call: 1-800/525-0321.

For information on earthquake preparedness, please consult your local yellow pages, or call the State Office of Emergency Services at 1-800/286-7233.

If you have been emotionally affected by an earthquake and need counseling, call the Los Angeles County Department of Mental Health at 1-800/854-7771.

Earthquake Engineering Resource Materials

**Earthquake Engineering Research Library
California Institute of Technology
National Information Service for Earthquake
Engineering (NISEE)**

Earthquake Engineering Librarian Jim O'Donnell and Library Assistant Philip Roche can be reached by phone, fax, or e-mail. The library features strong-motion accelerogram data, technical reports, a video and slide collection, conference proceedings and technical serials. The collection is available to the public on an in-house basis, and photocopying facilities are available. For more information, contact O'Donnell or Roche at:

Phone 818/395-4227
Fax 818/568-2719
e-mail: eerllib@caltech.edu

Other Information Resources

**Natural Hazards Research
and Applications Information Center
Campus Box 482
University of Colorado
Boulder, CO 80309-0482**

The Center is a national clearinghouse for data relating to economic loss, social disruption, and human response associated with natural disasters. The Center seeks to strengthen communication between researchers and individuals, organizations, and agencies responsible for reducing losses from disasters.

Phone 303/492-6818
Fax 303/492-2151
e-mail: hazctr@colorado.edu

**Federal Emergency Management Agency (FEMA)
500 C Street SW
Washington, DC 20472**

FEMA acts as the focal point for all levels of government to develop national emergency management capability. Publication lists are located on the FEMA World Wide Web site: <http://www.fema.gov>.

Phone 202/646-4600

Technical Data on Earthquake Hazards

**National Geophysical Data Center
NOAA E/GC1
325 Broadway
Boulder, CO 80303**

The Center collects, analyzes and disseminates technical data on earthquake hazards. Included in the list of products: An Earthquake Data Base; an Earthquake Intensity File; a Significant Earthquake Data Base; a Strong-Motion Archive.

Phone 303/497-6084
Fax 303/497-6513
e-mail: info@mail.ngdc.noaa.gov

**Seismic Safety Commission
State of California
1900 K Street # 100
Sacramento, CA 95814**

The Commission concentrates on public policy, state legislation, and risk mitigation measures which lower earthquake risks to life and property in the State of California.

Phone 916/322-4917
Fax 916-322-9476
e-mail: sscbase@aol.com

**U.S. Geological Survey
National Earthquake Information Center
Box 25046
Denver Federal Center
Denver, CO 80225**

Products and services include an Earthquake Data Base System; an Earthquake Information Line (see page 24 of this newsletter); and an Online Information Program.

Phone 303/273-8500
303/273-8450
e-mail: sedas@gldts.cr.usgs.gov

SCEC Activities Calendar

April

Wednesday, April 12 (all day): SCEC Steering Committee Meeting, SCEC Conference Room, USC Campus, Dept. of Earth Sciences, Room 165.

Wednesday, April 19, 4pm - 6:30 pm: Technical Briefing on the Great Hanshin Earthquake of January 17, 1995. Location: Room 1, Davidson Conference Center, University of Southern California, Los Angeles (SW corner, Jefferson and Figueroa). Registration at the door only, first come, first served basis. \$15 EERI members; \$30 all others (includes copy of preliminary reconnaissance report)). Cash or check only, no advance registration.

Thursday, April 20, 10 am - 4 pm: SCEC Seminar "Real-Time Seismology: Recent Developments." Technical presentations and discussions. Location: Caltech Seismological Laboratory, Salvatori Conference Room, Caltech campus.

Friday - Saturday, April 21-22, 10 am - 4 pm each day: Stop by the SCEC Education and Knowledge Transfer Booth at the L.A. County Zoo, the site of the City of Los Angeles' Earthquake Preparedness Fair. Play the "Great Quake Game" and test your seismic science and safety skills!

May

Friday, May 5, 1:20 pm - 4:20 pm.: "Environmental Effects of Urban Earthquakes", a SCEC-sponsored symposium at the Annual Meeting of the Southern California Academy of Sciences, California State University at Fullerton. Contact Curt Abdouch, 213/740-8256, for more information.

Saturday, May 6: Dr. James Dolan will lead a SCEC-sponsored one-day field trip, "Faults of Los Angeles," for the Caltech Management Association.

Saturday, May 6: Workshop for Science and Education Faculty, "Teaching an Earthquake Course with the Punch of M8", at California State University, Fullerton. Contact Curt Abdouch, SCEC Education Director, for details.

Monday - Wednesday, May 8-10: National Science Foundation Site Visit and SCEC Advisory Council Meeting, San Diego, California.

Thursday, May 18: SCEC Monthly Seminar, subject and venue to be announced. (Save the date!)

June

June (Date and venue to be announced): Third meeting for the SCEC Research Utilization Council and representatives from product user groups.

September

September 17-19: SCEC Annual Meeting, Ojai Valley Inn, Ojai, California.

October

October 19-20: Science and Technology Center Directors Meeting, Washington, D.C.

SCEC Newsletter will accept calendar items for the July 1995 issue no later than June 15, 1995.

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SCEC Quarterly Newsletter

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