

the

IRIS
CONSORTIUM





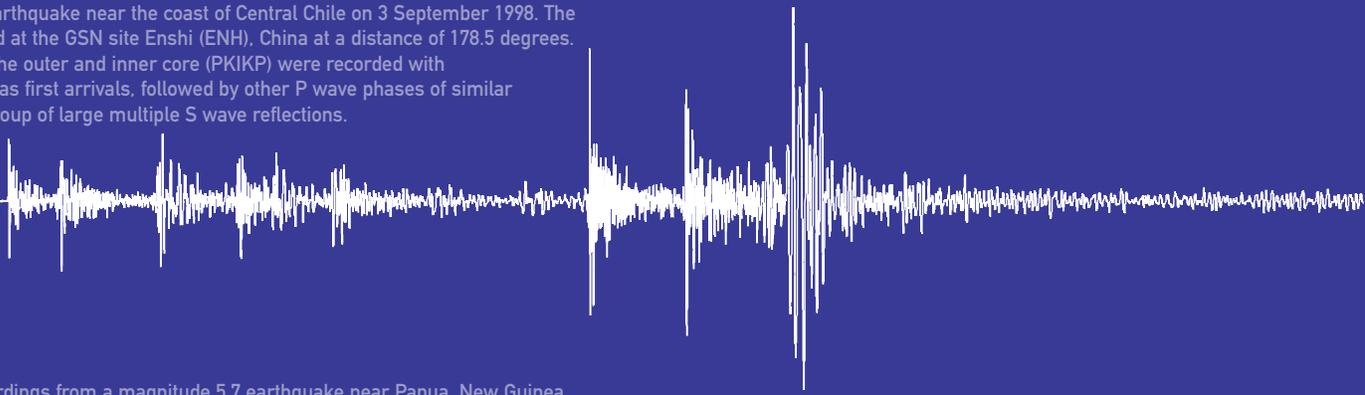


IRIS is a university research consortium dedicated to monitoring the Earth and exploring its interior through the collection and distribution of geophysical data.

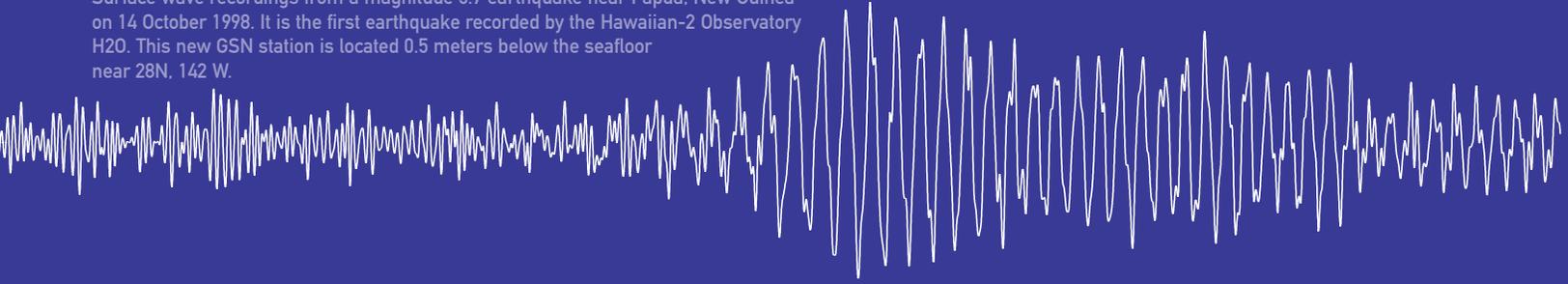
IRIS programs contribute to scholarly research, education, earthquake hazard mitigation, and the verification of the Comprehensive Test Ban Treaty.

IRIS operates through a Cooperative Agreement with the National Science Foundation under the Division of Earth Science's Instrumentation and Facilities Program. Funding is provided by the National Science Foundation, the Department of Energy, the National Imagery and Mapping Agency, other federal agencies, universities, and private foundations. All IRIS programs are carried out in close coordination with the US Geological Survey and many international partners.

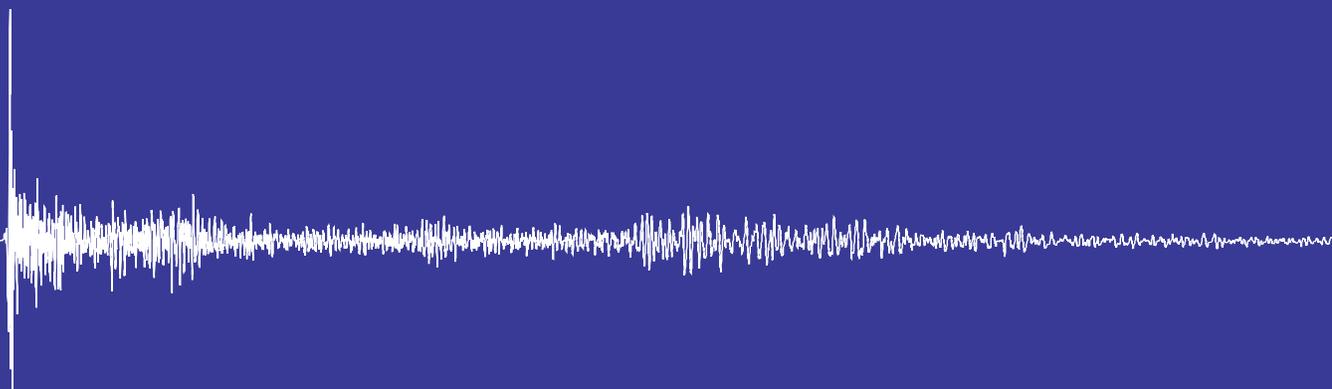
A magnitude 6.5 earthquake near the coast of Central Chile on 3 September 1998. The event was recorded at the GSN site Enshi (ENH), China at a distance of 178.5 degrees. Waves traversing the outer and inner core (PKIKP) were recorded with strong amplitudes as first arrivals, followed by other P wave phases of similar amplitude and a group of large multiple S wave reflections.



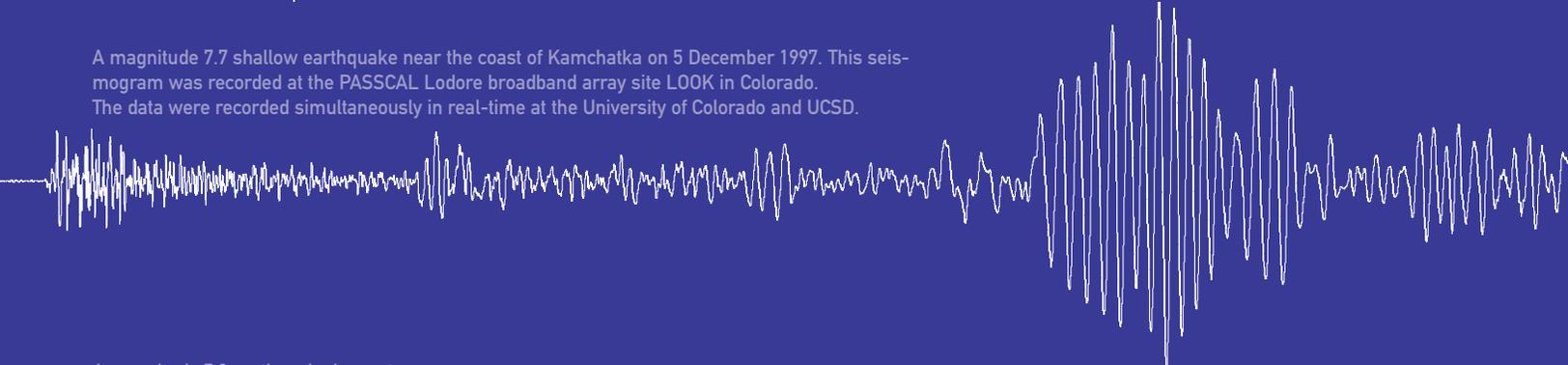
Surface wave recordings from a magnitude 5.7 earthquake near Papua, New Guinea on 14 October 1998. It is the first earthquake recorded by the Hawaiian-2 Observatory H20. This new GSN station is located 0.5 meters below the seafloor near 28N, 142 W.



The magnitude 5.1 Indian Nuclear Test on 11 May 1998. The seismogram was recorded at the GSN site Nilore (NIL) in Pakistan.



A magnitude 7.7 shallow earthquake near the coast of Kamchatka on 5 December 1997. This seismogram was recorded at the PASSCAL Lodore broadband array site LOOK in Colorado. The data were recorded simultaneously in real-time at the University of Colorado and UCSD.



A magnitude 5.2 earthquake in western Pennsylvania on September 25, 1998. This seismogram was recorded by the PEPP station PPMUN located in the Muncie Central High School in Pennsylvania.

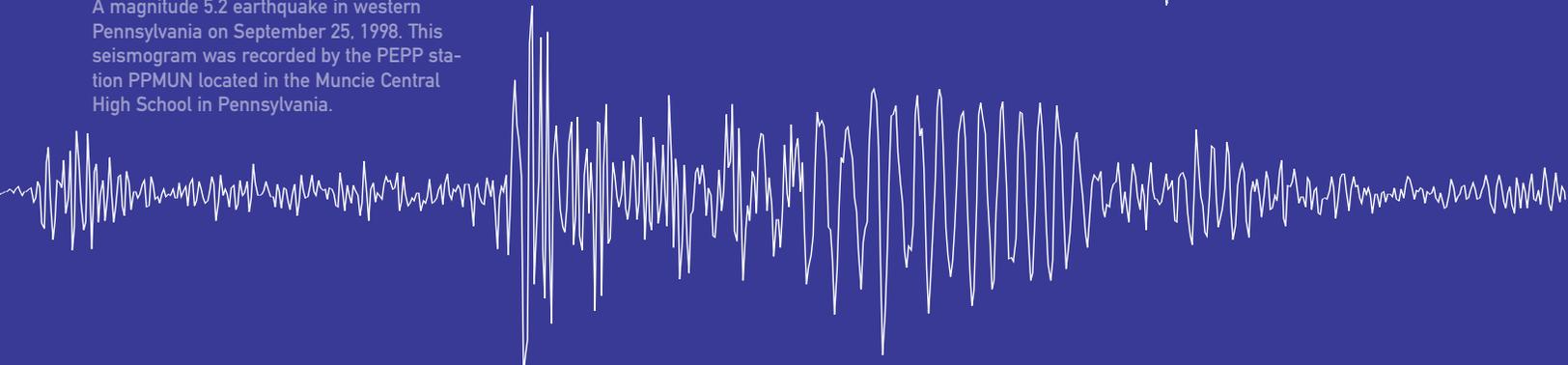


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Adam Dziewonski speaking during Earth Science Week Celebration at IRIS.

We are extremely pleased that Adam Dziewonski of Harvard University and Don L. Anderson of the California Institute of Technology were jointly honored with the award of the 1998 Crafoord Prize - "for their fundamental contributions to our knowledge of the structures and processes in Earth's interior". The Crafoord Prize is awarded by the Royal Swedish Academy of Sciences for outstanding research in fields not covered by the Nobel Prize, including mathematics, astronomy, the biosciences, the geosciences, and polyarthritis. Both Adam and Don were leaders in the creation of IRIS, and this year Adam completes a two year term as Chairman of the IRIS Board of Directors. In addition to being a fitting tribute to the personal research accomplishments of Adam and Don, the award can also be seen as recognition of the importance of the role of seismology in advancing our understanding of the structure and dynamics of planet Earth.

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| | |
|-----------------------------|---------------------------------------|
| Adam Dziewonski, Chair | Harvard University |
| Eugene Humphreys | University of Oregon |
| G. Randy Keller, Vice Chair | University of Texas, El Paso |
| Thomas McEvelly | University of California, Berkeley |
| Peter Shearer | University of California, San Diego |
| John Vidale | University of California, Los Angeles |
| Douglas Wiens | Washington University, St. Louis |

| | |
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| Candy Shin, Treasurer | IRIS |
| Lind Gee, Secretary | University of California, Berkeley |

| | |
|----------------------|---------------------------|
| David Simpson | IRIS President |
| Gregory van der Vink | IRIS Director of Planning |

With special thanks to those members who have completed their term of service on the Executive Committee: Adam Dziewonski, Lind Gee, Gene Humphreys, Randy Keller, Peter Shearer, Doug Wiens

Planning Committee

| | |
|----------------------|-------------------------------------|
| Terry Wallace, Chair | University of Arizona |
| Adam Dziewonski | Harvard University |
| John Orcutt | University of California, San Diego |
| Barbara Romanowicz | University of California, Berkeley |
| Bob Smith | University of Utah |

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| David Simpson | IRIS President |
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Program Coordination Committee

| | |
|----------------------|------------------------------------|
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| Larry Braile | Purdue University |
| Göran Ekström | Harvard University |
| Anne Meltzer | Lehigh University |
| Alan Levander | Rice University |
| Tom McEvelly | University of California, Berkeley |
| Tim Ahern | IRIS DMS |
| Jim Fowler | IRIS PASSCAL |
| Rhett Butler | IRIS GSN |
| Catherine Johnson | IRIS E&O |
| Gregory van der Vink | IRIS Director of Planning |

With special thanks to those members who have completed their term of service on the Program committee: Göran Ekström, Anne Meltzer

Overview

Although we are administrative-ly in an off year - the midpoint of our five-year proposal - 1998 has been a time of unprecedented accomplishment for our Consortium.

The PASSCAL program fielded a record of 53 experiments this year. As demand continues to grow, the full instrument pool and the broadband arrays are already scheduled to remain in near constant use around the world. The new instrument center at New Mexico Tech has opened, and plans for the development of the next generation instrument are beginning.

Continental coverage for the Global Seismographic Network (GSN) is mostly complete, and this year marks the first deployment of a GSN on the seafloor. The Hawaii-2 Observatory (H2O) sea floor installation was completed in September by the R/V Thompson and ROV Jason. The data are being recorded on Oahu at the University of Hawaii through the Hawaii-2 telephone cable donated to IRIS by AT&T. The main product of our Consortium is data; and the core of all our programs is the Data Management System. This year, the Data Management System shipped over 12 million seismograms in response to approximately 40,000 data requests. Our archive currently contains over 7.5 terabits of data. A new mass storage system, obtained with

support from the Keck Foundation and NSF, combined with new tools for rapid customized access to on-line data sets, has made more data accessible, faster, and in formats that are more readily useable.

Strong public support for seismology is as necessary for our future as new instruments and data. In recognition of this need, the Education and Outreach Program has launched a successful campaign to expand the presence of seismology and geoscience in the class room. Through teacher workshops, intern programs, the development of educational materials, the PEPP program, and an affiliation with Teach-For-America, seismology will now be included in hundreds of school programs around the country. The IRIS posters and museum displays are similarly introducing millions of viewers each year to the basic discoveries of our science.

Although the technical and programmatic accomplishments of IRIS have been impressive, perhaps the greatest strength of our Consortium remains its ability to represent the collective scientific interests of over 100 organizations. Such interests, however, evolve. And as they evolve, so must IRIS.

Over 50 scientists representing more than 30 research institutions have been actively

involved in the administration of IRIS over the last year. Seven committees, four subcommittees, and a series of ad hoc advisory groups have worked with the President, the Director of Planning, and the four Program Managers in operating and expanding the facilities available for seismology. The recent implementation of a Planning Committee and a Program Coordination Committee, as approved by the Board of Directors last year, has already resulted in the development of long-range initiatives and shared activities.

With our facility programs mature, and operating efficiently, it is time to look towards the next five-year proposal. Already, plans are underway to convene a series of workshops to develop and review such concepts as the USArray and the Plate Boundary Initiative. We need your suggestions and guidance for developing programs that both advance our understanding of the Earth, meet the needs of our society, and improve our stewardship of the planet. We urge all of you to be active within the Consortium, to see that your views are represented, and to provide us with your ideas for our next five-year proposal.



Photo by Michael Hasting

Tenth Annual IRIS Workshop, University of California, Santa Cruz, July 8-12, 1998

The Consortium

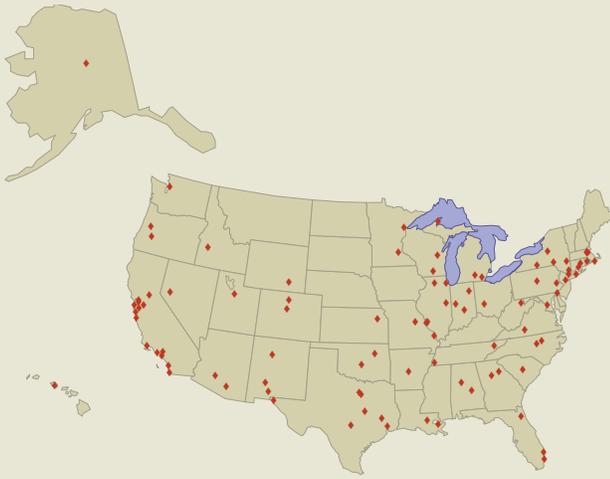
Governance

The IRIS management structure is an interface between the scientific community, funding agencies, and the programs of IRIS. The structure is designed to focus scientific talent on common objectives, to encourage broad participation, and to efficiently manage IRIS programs.

IRIS is governed by a Board of Directors consisting of representatives from each member institution. Operational policies are set by an Executive Committee elected by the Board of Directors. The Executive Committee, in turn, appoints members to the Planning Committee, the Program Coordination Committee, and to the four Standing Committees that provide oversight of the Global Seismographic Network (GSN), the Program of Array Seismic Studies of the Continental Lithosphere (PASSCAL), the Data Management System (DMS), and the Education and Outreach Program (E&O). In addition, special advisory committees and *ad hoc* working groups can be convened for special tasks. It is the role of the standing committees and the advisory subcommittees to develop recommendations for the Executive Committee which, in turn, evaluates and approves such recommendations on behalf of the Board of Directors.

Each year IRIS convenes a workshop to review the state of the science and to discuss new ideas. The workshop provides an ongoing forum for input to IRIS programs and new initiatives; and provides an opportunity for demonstrations and training sessions. Through a student grant program, young scientists may attend the workshop at little or no cost, and thus become introduced to the programs and services of the Consortium.

Special thanks to the 1998 Workshop Organizers: Peter Shearer, University of California, San Diego; Susan Schwartz, University of California, Santa Cruz; and Anne Meltzer, Lehigh University



Member Institutions

Institution, Board Member, Alternate

University of Alabama, *Dennis L. Harry, Louis R. Bartek*
 University of Alaska, *Douglas H. Christensen, Nirendra N. Biswas*
 University of Arizona, *Terry C. Wallace, Jr., Susan Beck*
 Arizona State University, *J. Ramon Arrousmit, James A. Tyburczy*
 University of Arkansas at Little Rock, *Haydar J. Al-Shukri, Jeffrey B. Connelly*
 Auburn University, *Lorraine W. Wolf*
 Boise State University, *John R. Pelton, James Zollweg*
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 University of Colorado, Boulder, *Mike Ritzwoller, Anne Sheehan*
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 University of Hawaii at Manoa, *Gerard Fryer, Charles Helsley*
 IGPP/Lawrence Livermore National Laboratory, *William Walter, Peter Goldstein*
 IGPP/Los Alamos National Laboratory, *Hans Hartse, Leigh House*
 University of Illinois at Urbana Champaign, *Wang-Ping Chen*
 Indiana University, *Gary L. Pavlis, Michael Hamburger*
 Indiana University/Purdue University at Fort Wayne, *Dipak Choudhury*

University of Kansas, *Ross A. Black, Geoffrey Abers*
 Lawrence Berkeley National Laboratory, *D. W. Vasco, E. L. Majer*
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 University of Miami, *Christopher A. Scholz, Julie A. Hood*
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 University of Michigan, *Larry Ruff*
 Michigan State University, *Kazuya Fujita, David W. Hyndman*
 Michigan Technological University, *Wayne D. Pennington, Jimmy F. Diehl*
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 University of Nevada, Reno, *Glenn Biasi, Steve Jaumé*
 University of New Orleans, *Abu K.M. Sarwar*
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 New Mexico State University, *James Ni, Thomas Hearn*
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 State University of New York at Stony Brook, *William Holt, Daniel Davis*
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 The University of Oklahoma, *Roger Young, Judson Abers*
 University of Oregon, *Eugene Humphreys, Doug Toomey*
 Oregon State University, *John Nabelek, Anne Trebu*
 Pennsylvania State University, *Shelton S. Alexander*
 Princeton University, *Guust Nolet, Robert Phinney*
 Purdue University, *Lawrence W. Braile, Scott King*
 Rensselaer Polytechnic Institute, *Steven Roecker, Robert McCaffrey*
 Rice University, *Alan R. Levander, Dale Sawyer*
 Saint Louis University, *Brian J. Mitchell, Charles J. Ammon*
 San Diego State University, *Steven M. Day, Eric Frost*
 San Jose State University, *Donald L. Reed, Richard Sedlock*
 Southeast Missouri State, *Nicholas H. Tibbs*
 University of South Carolina, *Tom Owens, Pradeep Talwani*
 University of Southern California, *Ta-Liang Teng, Jim Dolan*
 Southern Methodist University, *Eugene T. Herrin*
 Stanford University, *Gregory C. Beroza, Simon Klemperer*
 Syracuse University, *Douglas K. Nelson*
 University of Tennessee, *Richard T. Williams*
 Texas A&M University, *Richard Gibson, Philip D. Rabinowitz*
 Texas Tech University, *Harold Gurrola, Calvin Barnes*
 University of Texas at Austin, *Clifford A. Frohlich, Stephen P. Grand*
 University of Texas at Dallas, *George McMechan, John Ferguson*
 University of Texas at El Paso, *G. Randy Keller, Jr., Diane Doser*
 University of Tulsa, *Duryodhan Epili, Christopher Liner*
 University of Utah, *Robert B. Smith, Gerald T. Schuster*
 Virginia Polytechnic Institute, *J. Arthur Snoke, John Hole*
 University of Washington, *Kenneth Creager, Bob Crosson*
 Washington University, St. Louis, *Douglas Wiens, Michael Wysession*
 West Virginia University, *Thomas H. Wilson, Robert Behling*
 University of Wisconsin, Madison, *Clifford Thurber, William J. Lutter*
 University of Wisconsin, Oshkosh, *John Karl, Thomas Laudon*
 Woods Hole Oceanographic Institution, *Ralph Stephen, Alan Chave*
 Wright State University, *Ernest C. Hauser, Paul J. Wolfe*
 University of Wyoming, *Scott B. Smithson*
 Yale University, *Jonathan M. Lees, Jeffrey J. Park*

US & Foreign Affiliate Member Institutions

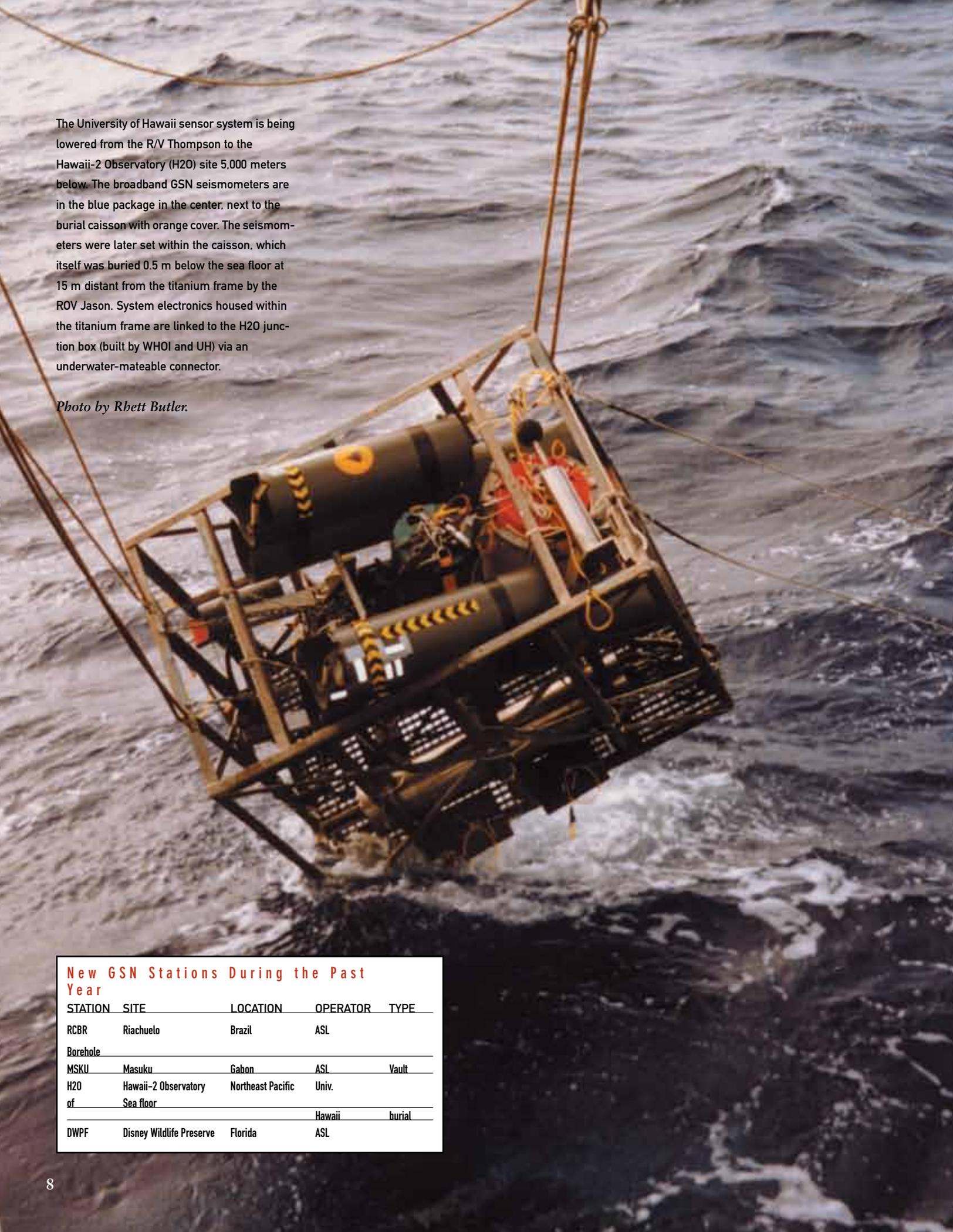
Institution, Country, Representative

Academia Sinica, Institute of Earth Sciences, Taiwan, *Honn Kao*
 Academy of Sciences, Seismological Center, Albania, *Betim Muço*
 Australian National University, Australia, *Brian Kennett*
 Centro de Investigacion Cientifica y de Educacion Superior de Ensenada, Mexico, *Cecilio J. Rebolgar*
 Ecole Polytechnique, Canada
 Geological Survey of Canada, Canada, Continental Geoscience Division, *Isa Asudeh*
 Geophysical Institute, Czech Republic, *Axel Plesinger*
 Institute of Geology, Beijing, PRC, *Qiyuan Liu*
 Institute of Geophysics, Beijing, PRC, *Gongwei Zhou*
 Instituto Geofísico Del Peru, Peru, *Edmundo Norabuena*
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 Istanbul Technical University, Turkey, *Tuncay Taymaz*
 Leicester University, England, *Peter Maguire*
 Masaryk University, Czech Republic, *Petr Firbas*
 National Central University, Taiwan, *Kuo-Gong Ma*

Naval Air Weapons Station, Geothermal Program Office, California, USA, *Francis Monastero*
 Observatório Nacional, Brazil, *Jorge Luis de Souza*
 Peking University, China, *Shao Xian Zang*
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 Tubitak-Marmara Research Centre, Turkey, *M. Namik Yalçın*
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 Universidade de Brasilia, Brazil, *Joao Willy Rosa*
 Universidade de São Paulo, Brazil, *Marcelo Assumpção*
 University of Bergen, Norway, *Eystein S. Husebye*
 University of Bristol, England, *George Hellfrich*
 University of British Columbia, Canada, *Michael G. Bostock*
 University of Cambridge, England, *Keith Priestley*
 University of Hong Kong, PRC, *Lung Sang Chan*
 University of Otago, New Zealand, *Helen Anderson*
 Utrecht University, The Netherlands, *Roel Snieder*
 Victoria University, Institute of Geophysics, New Zealand, *John Taber*

The University of Hawaii sensor system is being lowered from the R/V Thompson to the Hawaii-2 Observatory (H2O) site 5,000 meters below. The broadband GSN seismometers are in the blue package in the center, next to the burial caisson with orange cover. The seismometers were later set within the caisson, which itself was buried 0.5 m below the sea floor at 15 m distant from the titanium frame by the ROV Jason. System electronics housed within the titanium frame are linked to the H2O junction box (built by WHOI and UH) via an underwater-mateable connector.

Photo by Rhett Butler.



New GSN Stations During the Past Year

| STATION | SITE | LOCATION | OPERATOR | TYPE |
|-----------------|--------------------------|-------------------|----------|--------|
| RCBR | Riachuelo | Brazil | ASL | |
| Borehole | | | | |
| MSKU | Masuku | Gabon | ASL | Vault |
| H2O | Hawaii-2 Observatory | Northeast Pacific | Univ. | |
| | of Sea floor | | Hawaii | burial |
| DWPF | Disney Wildlife Preserve | Florida | ASL | |

Global Seismographic Network

Standing Committee

| | |
|----------------------|---|
| Göran Ekström, Chair | Harvard University |
| Susan Beck | University of Arizona |
| Alan Chave | Woods Hole Oceanographic Institution |
| Doug Dreger | University of California, Berkeley |
| Thomas Heaton | California Institute of Technology |
| Anne Sheehan | University of Colorado, Boulder |
| Michael Wyession | Washington University |
| Ray Buland | U.S. Geological Survey, <i>ex officio</i> |
| <hr/> | |
| Peter Davis | University of California, San Diego, IDA Rep. |
| Charles R. Hutt | U.S. Geological Survey, ASL Rep. |
| <hr/> | |
| Rhett Butler | GSN Program Manager |

With special thanks to those members who have completed their term of service on the GSN Standing Committee: Göran Ekström, Susan Beck, Alan Chave, Doug Dreger, and Tom Heaton

The main objective of the Global Seismographic Network (GSN) is to provide a worldwide network of state-of-the-art, low-noise, seismographic stations that operate continuously and provide data in as-near-real-time-as-possible to the scientific community, national and international agencies, educational institutions, and the public at large. The network design goal is about 150 seismic stations globally distributed with a spacing of 2000 km to provide uniform coverage of the Earth. The GSN records with full fidelity all seismic signals at regional and global distances over a dynamic range from minimum Earth background noise to accelerations of up to 2 g from large earthquakes, and over a frequency range from the Earth's tidal motions to high-frequency,

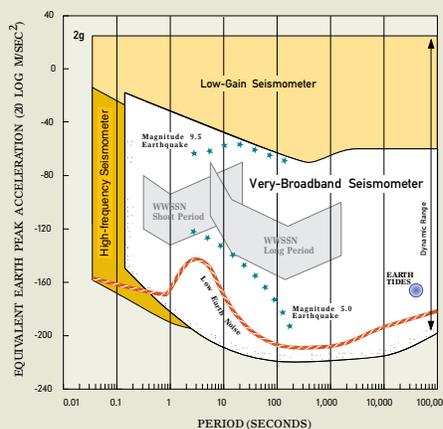
regional phases <100 Hz. The GSN also serves as a platform for other types of geophysical instrumentation.

The GSN now has 107 stations operational; data from three new sites (Gabon, Brazil, and the H2O sea floor site between Hawaii and California) are anticipated by the year's end. The GSN will then be comprised of 65 IRIS/USGS stations operated through the US Geological Survey, 33 IRIS/IDA operated through the University of California, San Diego, 11 stations operated through universities, plus one station as a GSN affiliate. There are 88 stations being accessed by the DMS in near real time. In addition to seismometers, microbarographs are installed at 5 sites, and GPS instrumentation is co-located at 10 sites. The upgrading of remaining 16-bit systems to 24-bit design goal is progressing with the installations in Russia at Obninsk, Kislovodsk, and Talaya, Russia. Site preparations are in progress at Hawaii Island, Midway Island, Indonesia, Uganda, Cape Verde, western Brazil, Kwajalein Atoll, and Raoul Island. Internet connectivity has been established to GSN stations in Tiski in northernmost Siberia, Scotland, and the Galapagos.

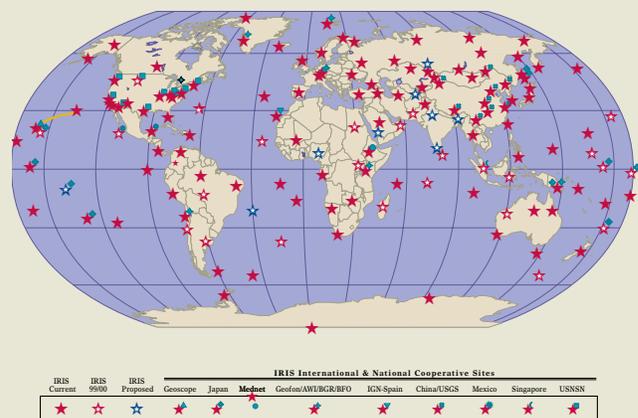
The Hawaii-2 Observatory (H2O) sea floor

installation was completed in September by the R/V Thompson and ROV Jason. Power and communications were established on September 17 to the junction box built by Woods Hole and the University of Hawaii (UH). The j-box is linked via underwater-mateable connectors to sensor systems and to the Hawaii-2 telephone cable donated to IRIS by AT&T. The UH sensor systems, including a broadband Guralp seismometer, were installed on September 18. All data are recorded on Oahu at the University of Hawaii via a FRAME relay link from the cable terminus at the AT&T Makaha Cable Station. The installation of the first sea floor GSN station, which included a novel cable termination deployment and a maintenance retrieval of the H2O j-box from the sea floor, was a success due to the talent of the Captain and crew of the R/V Thompson, and the Woods Hole JASON/MEDEA team. After two months of normal operation, an electrical component in the UH system failed, which will require scheduling JASON for a maintenance visit. Subsequently, only pressure data for tsunami research are currently being recorded on the sea floor. Data from H2O will flow from the data collection center at UH to the IRIS DMC, and will be made available over the Internet.

IRIS GSN System



Global Seismographic Network



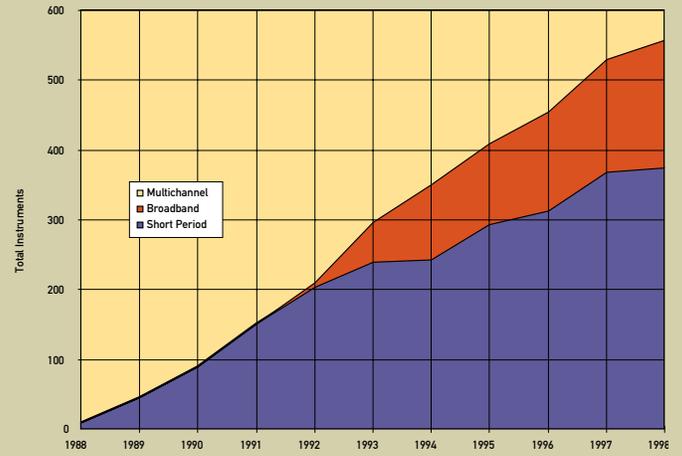
The bandwidth and dynamic range of the GSN system is shown. The basic GSN system records on-scale both minimum Earth background noise and the largest earthquakes from 5 Hz to Earth tidal periods. High-frequency and low-gain seismometers extend bandwidth and dynamic range for large, nearby events. The operational range of the previous analog network, WWSSN, is shown for comparison.

Existing, planned installations in 1999/2000, and proposed sites of the Global Seismographic Network are shown. Many GSN stations are national and international cooperative partnerships.

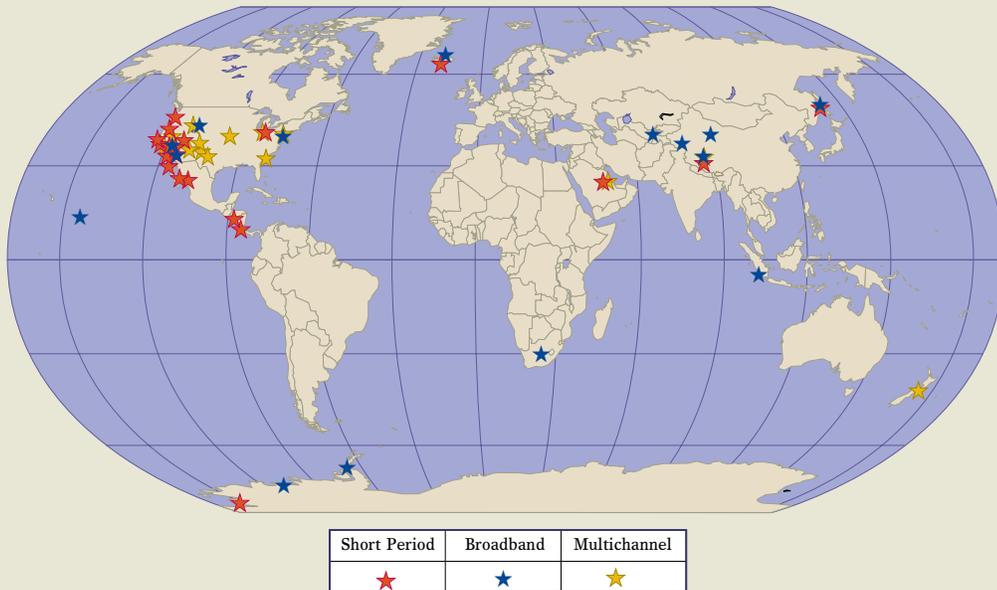


After introductions by New Mexico Institute of Mining and Technology (NMIMT) Vice President of Research and Economic Development Van Romero and NMIMT President Dan Lopez, US Congressman Joseph Skeen cut the ribbon to the new building for the PASSCAL Instrument Center.

PASSCAL Instrumentation



PASSCAL Experiments 1998



PASSCAL

Program for the Array Seismic Studies of the

Standing Committee

| | |
|---------------------|------------------------------------|
| Anne Meltzer, Chair | Lehigh University |
| Ken Dueker | University of Colorado |
| Egill Hauksson | California Institute of Technology |
| David James | Carnegie Institution of Washington |
| Roy A. Johnson | University of Arizona |
| Kate Miller | University of Texas, El Paso |
| Walter Mooney | U.S. Geological Survey, Menlo Park |
| Clifford H. Thurber | University of Wisconsin, Madison |
| James C. Fowler | IRIS PASSCAL Program Manager |

With special thanks to those members who have completed their term of service on the PASSCAL Standing Committee: Anne Meltzer, Egill Hauksson, David James, Walter Mooney, Cliff Thurber

The Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL) is a facilities program that provides portable seismic instrumentation, training and field support to the university research community. The equipment and support provided by PASSCAL are used in seismic experiment throughout the world. The activities of the program can be broken into two main areas: the acquisition of new equipment and capabilities; and the continuing support of the existing facility.

Significant changes were made in both areas during the last year. The experiment support activities are provided through Instrument Centers operated at member institutions. Prior to 1998 there were instrument centers located at Lamont-Doherty Earth Observatory and at Stanford University. The center at Lamont focused principally on long-term natural source (earthquake) experiments, while the center at Stanford focused on shorter-term active source (explosion) experiments. Over the last few years the differences between the two types of experiments have lessened to the extent that consolidation made sense and the decision was made to invite proposals for a single PASSCAL center.

As a result of reviewing the proposals submitted, a decision was made in January to accept the proposal from New Mexico Institute of Mining and Technology (NMT). Construction of a new building to house the center started on the NMT campus during April, and by the first of November the building was in full operation. PASSCAL made significant advances in several other areas:

- *PASSCAL supported a record number of (> 53) field experiments during 1998.*
- *The broadband instrument pool rose by over 17% to almost 200 instruments.*
- *The first telemetered broadband array deployment was completed in Colorado in July with a successful data return of over 98%.*

The fastest growth area as far as experiments are concerned over the last year was in the use of the three 60 channel recorders for reflection work. These multichannel systems have been very much in demand for both research and classroom programs, with a total of 13 experiments being supported in 1998.

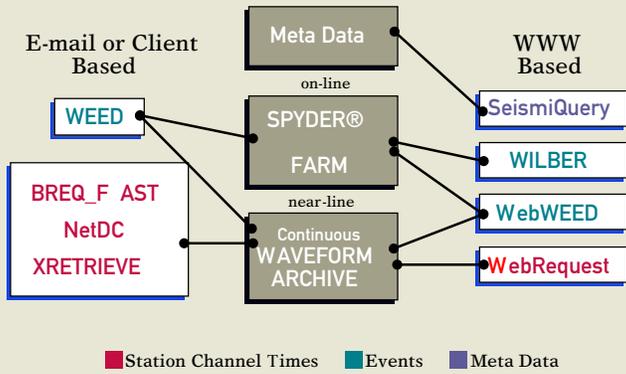
The development of new support capabilities concentrated in the area of software development. Significant work went into the PASSCAL database software. The software is designed to make it easier for the Principal Investigator to collect the data from the field recorders and get it into for-

mats that can be archived and used in subsequent analysis. Work also continued in making the solar power systems more reliable and adaptable to the many different conditions encountered in the field.

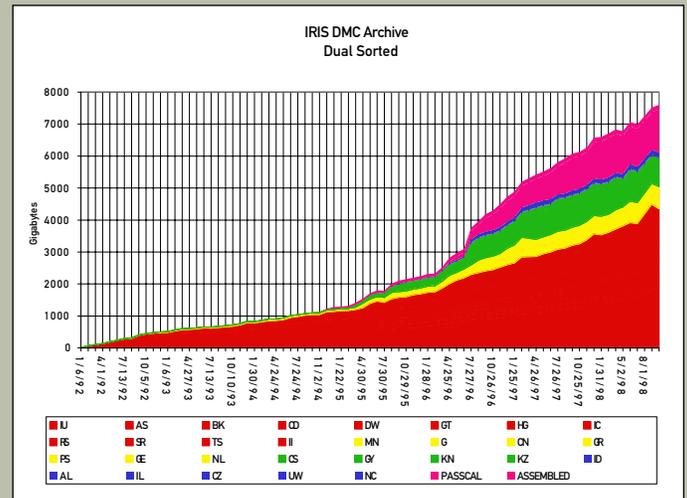
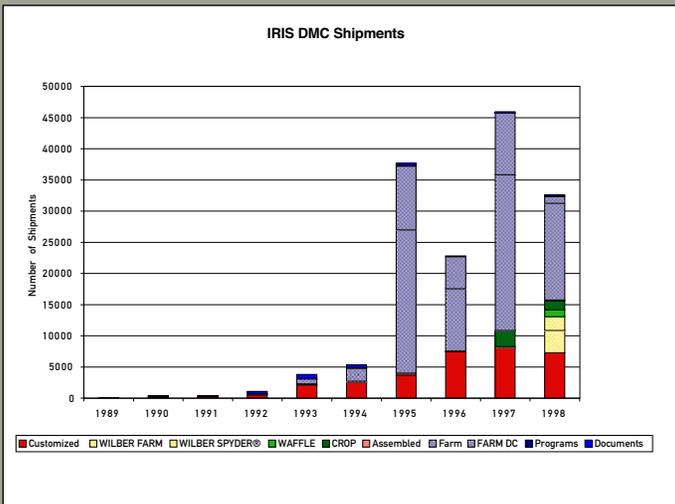
The Instrumentation Workshop held in Santa Fe in November, 1997 was the first step in planning for the next generation of hardware. One of the recommendations of the Instrument Committee was to conduct a survey among the users of the PASSCAL equipment to identify the weaknesses and strengths of the current system. Thirty-one PIs responded to the survey, and the final report is available through the PASSCAL web site. The Instrumentation Committee is continuing the process of evaluating the current facility and looking at the possible technology for the next generation of equipment. Currently this involves studying the possibilities of using satellite communications to connect with not only GSN stations but also PASSCAL instruments. Several small feasibility studies will be conducted during this next year. The second area of interest is in rugged, reliable short period sensors for earthquake and refraction work.

The major efforts for the next year will be the continued integration of the Broadband Array into the program, gradual increase of the broadband instrument pool, and the improvement of the field processing software.

New 50 terabyte mass storage system installed at the IRIS DMC in Seattle. This state-of-the-art addition to the IRIS archive was purchased with support from the W.M. Keck Foundation and the NSF Major Research Instrumentation fund.



Various data request tools available for the IRIS DMS. The selection of the most appropriate tool is determined by whether a researcher wishes to access metadata, data from the on-line data sets, or data from the continuous archive. Further selection is determined by whether one wants access by event or by station channel time window.



Data Shipments from the IRIS DMC. The above graph shows how the number of data shipments has grown through the years. Although the number of customized requests has stabilized, a great number of requests are now being serviced from the on-line data sets of FARM and SPYDER® through access tools, WILBER, WEED, and CROP as indicated by the growth in the yellow and green portions of the 1998 column.

Since 1992 we have archived a total of 7.5 terabytes of seismic data. During the last year, all of these data were transcribed from an older 8.6 terabyte METRUM RSS 600 mass storage system to a new StorageTek Wolfcreek system with a capacity of 50 terabytes.

Data Management System

Standing Committee

| | |
|-------------------------|---|
| Alan Levander, Chair | Rice University |
| Harley Benz | U.S Geological Survey, Golden |
| Kenneth Creager | University of Washington |
| Jonathan Lees | Yale University |
| Paul Richards | Lamont Doherty Earth Observatory |
| Steven Taylor | Los Alamos National Laboratory |
| Robert D. van der Hilst | Massachusetts Institute of Technology |
| Terry Wallace | University of Arizona |
| <hr/> | |
| Peter Davis | University of California, San Diego, IDA Rep. |
| Robert Woodward | U.S. Geological Survey, ASL Rep. |
| <hr/> | |
| Tim Ahern | DMS Program Manager |

With special thanks to those members who have completed their term of service on the DMS Standing Committee: Harley Benz, Ken Creager, Paul Richards, Steve Taylor

The Data Management System (DMS) serves as the primary conduit between the IRIS data generating programs (PASSCAL and GSN) and the seismological community.

The objectives of the DMS are:

- to maintain an archive of continuous seismic data spanning many years,
- to maintain an archive of data from PASSCAL seismic experiments,
- to provide timely access to continuous data from the IRIS GSN and passive and active source PASSCAL programs,
- to augment these IRIS data sources by providing access to data from other global, national, and regional networks. This may be done by either archiving those data at the DMC or by developing techniques to easily access data from other networks,
- ensure that users have easy and rapid access to the data archive,
- to monitor and maintain high quality of these data,
- to advise in the development of software tools for the display and processing of seismic data by users.

To accomplish its mission, the DMS is composed of several nodes around the country. The Albuquerque Seismological Laboratory, operated by the US Geological Survey, and the Project IDA Data Collection Center at the University of

California, San Diego are the two centers that quality control data from the two sub-networks of the GSN. The Harvard University Waveform Quality Center provides additional checks for GSN and other data. The University of Washington hosts the IRIS Data Management Center (DMC), provides valuable input and testing of request and processing tools as well as developing and maintaining the SPYDERÆ system, which provides data from significant events in near real time. The IRIS DMS also supports the Moscow Data Center, and data collection activities for the Kyrgyzstan telemetered Network and at Lamont-Doherty for seismic data collection in Kazakhstan. The DMC in Seattle is the central node of the DMS. The DMC is charged with archiving all data from the GSN and PASSCAL programs, selected data from the broadband networks operated by organizations in other countries, the data from the Council of the National Seismic System including both the US National Seismic Network and several regional networks in the United States.

This has been a busy year within the DMS. The data collection centers have all initiated projects whereby most GSN data will routinely have phase arrivals picked for larger events. While this is being done to improve the timing quality of the data, the picks will be forwarded to the National Earthquake Information Center and International Seismological Center so that this valuable data set can be included in their respective earthquake catalogues. The Live Internet Seismic System (LISS) developed by ASL and the Near Real Time Seismic (NRTS) system developed by IDA can now provide data in near real time from GSN stations to any seismologist. We will continue to cooperate in the development of this ability. In addition, a number of software problems were identified and steps were taken to improve data flow from

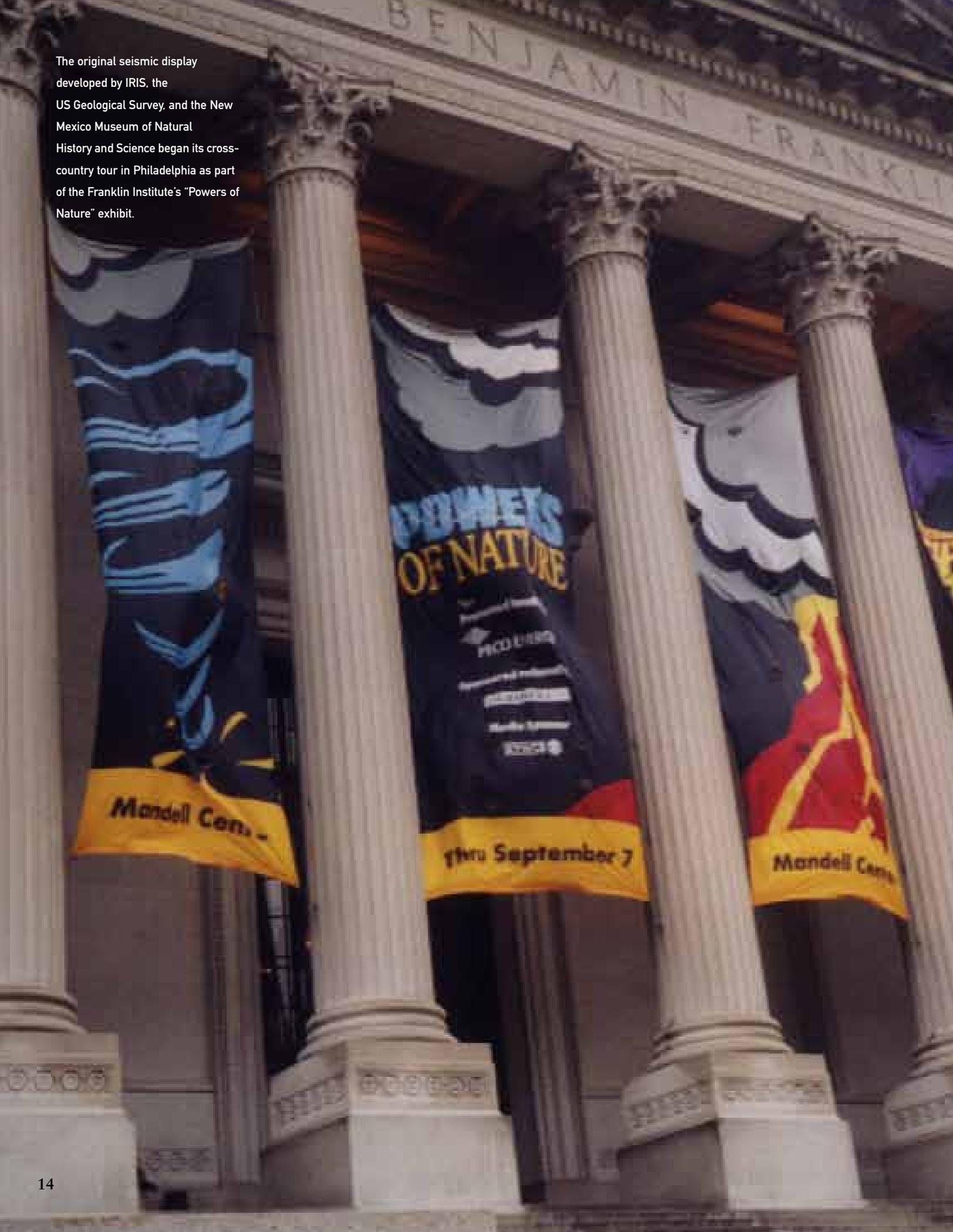
PASSCAL experiments.

To ensure that users have easy and rapid access to the data archive, the DMC continues to develop and improve its data access tools. A figure on the opposite page provides a visual summary of the interface tools and the portions of the DMC data holdings can be accessed by them.

The DMC has placed the new 50 terabyte StorageTek mass storage system into operation, and all data have been migrated from the older METRUM mass storage system. The new system represents an order of magnitude increase in capacity as well as performance. The StorageTek was purchased in part with funds from the Keck Foundation. We also replaced a SUN 690 with a SUN Enterprise system. All data sets including GSN, PASSCAL passive experiments, FDSN, and CNSS sources are now handled in exactly the same manner. The DMC has also moved to using ORACLE as the data base management system. Although the transition was very time consuming for DMC staff, it was almost transparent to the outside community.

The archive presently contains 7.5 terabytes of seismic data. Approximately 40,000 data requests will be serviced in 1998. We have successfully developed the systems that allow most data requests to be processed from on-line datasets in an automated manner. Roughly 50% more user requests will be serviced using the automated request systems than all of the other customized request tools available. This will drastically shorten response time and reduce the load on the mass storage systems. We have also made considerable progress on several new software systems for retrieving and displaying data.

The original seismic display developed by IRIS, the US Geological Survey, and the New Mexico Museum of Natural History and Science began its cross-country tour in Philadelphia as part of the Franklin Institute's "Powers of Nature" exhibit.



Education and Outreach

Standing Committee

| | |
|-----------------------|-----------------------------|
| Larry Braille, Chair | Purdue University |
| Jeff Barker | SUNY, Binghamton |
| Karen Fischer | Brown University |
| Michelle Hall-Wallace | University of Arizona |
| Charles R. Hutt | U.S. Geological Survey, ASL |
| Glenn Kroeger | Trinity University |
| Guust Nolet | Princeton University |
| Catherine Johnson | Program Manager |

The mission of the IRIS Education and Outreach (E&O) program is to use seismology along with the unique resources of IRIS to make significant and lasting contributions to science education, science literacy, and understanding of the Earth. The activities and programs target both formal (K-graduate) and informal educational needs, and draw on IRIS' access to seismological data, computer resources, organizational structure, and widespread membership. The E&O program particularly encourages and supports the involvement of Earth scientists at IRIS member institutions in innovative and non-traditional educational efforts.

The IRIS Education and Outreach program is in its second full year of existence, and a full time program manager was hired in January 1998. A major activity during 1998 has been the definition and preparation of a long-range planning document. The document outlines the vision, goals, and objectives of the E&O program in the context of national educational needs,

recent educational reforms, and educational efforts of other scientific organizations. In April 1998, we held a workshop for approximately 50 representatives from the research, education and funding communities. Discussions and writings from this meeting form the framework for the E&O program planning document. Further preparation and revisions to the document by the E&O committee have been ongoing throughout the year, and input from the IRIS community was solicited at the annual workshop in Santa Cruz. Publication is scheduled for early 1999.

During 1998 we also expanded the ongoing core of IRIS E&O program activities. Development, publication, and dissemination of hard copy and web based materials is now an integral part of the E&O program. K-12 teacher and undergraduate faculty enhancement workshops comprise a major educational effort and are typically one day workshops run either at national geoscience or education meetings, or sponsored by the E&O program but coordinated and run by IRIS member institutions. The workshop schedule for 1998 and 1999 is shown in the table below. An undergraduate summer internship program was initiated and two intern-sponsor matches were made. Funds for five interns are available for



1999, and moneys are provided not only for the summer research project but also for the intern to attend a national meeting to present a paper on his/her work. During 1998, funding for two new seismic displays similar to that currently on tour with the Franklin Institute's Powers of Nature exhibit was provided. One display is at IRIS headquarters, the other at the New Mexico Museum of Natural History and Science. Finally, we welcome input from and the participation of IRIS members in all of our E&O activities.



| MEETING type) | TIME | ATTENDEES (number & |
|---|--------------|---|
| Teach For America (TFA) East Coast Conference | March 1998 | 15 TFA teachers (K-12) |
| National Science Teachers Association Meeting | April 1998 | 28 K-12 teachers |
| IRIS annual workshop "Software workshop" | July 1998 | 20 college / university researchers |
| National Science Teachers Association Meeting | March 1999 | ~25 K-12 teachers |
| IRIS Annual Workshop .. "Seismologists Learning to Teach the Teachers" | June 1999 | ~25 research seismologists |
| Teach For America (TFA) Summer Institute | July 1999 | up to ~75 TFA pre-service teachers (K-12) |
| Geological Society of America | October 1999 | ~25 college / university faculty |

Activities and Publications

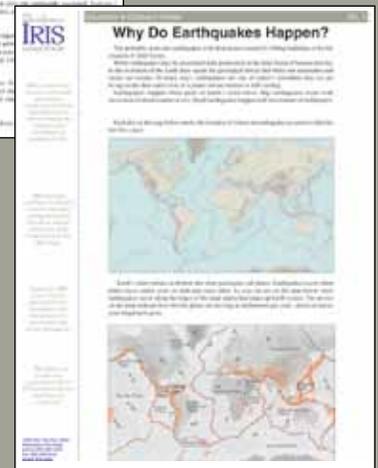
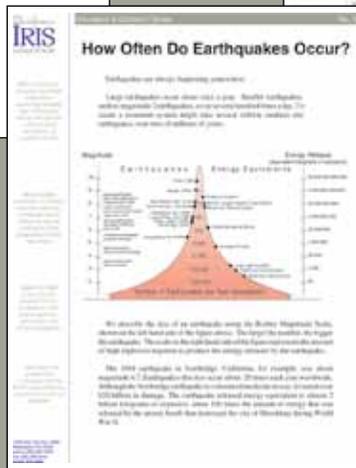
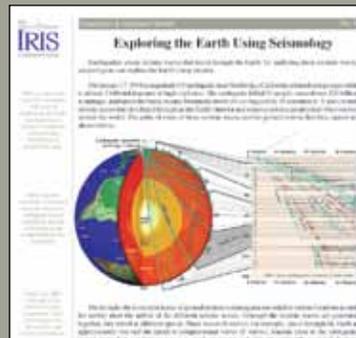
Publications Subcommittee

| | |
|----------------------|------------------------------------|
| Doug Wiens, Chair | Washington University, St. Louis |
| Anne Meltzer | Lehigh University |
| Göran Ekström | Harvard University |
| Larry Braile | Purdue University |
| Alan Levander | Rice University |
| Lind Gee | University of California, Berkeley |
| Gregory van der Vink | IRIS Director of Planning |



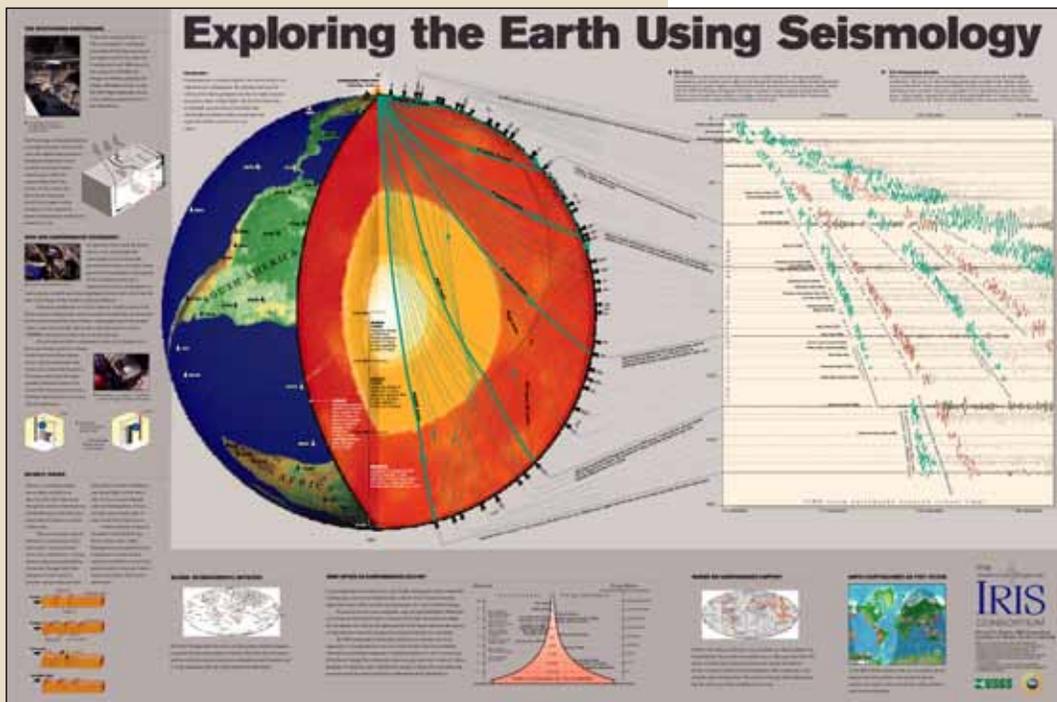
The IRIS Newsletter, with a distribution of 2000, is a well-illustrated collection of technical articles, field reports, news items, and policy discussions of interest to the IRIS community.

To attract the attention of students, educators, decision-makers, and the general public, IRIS has developed a series of "one-pagers." The one-pagers provide succinct, hard-copy explanations of basic seismological concepts and they can easily be photocopied, posted, and mailed.



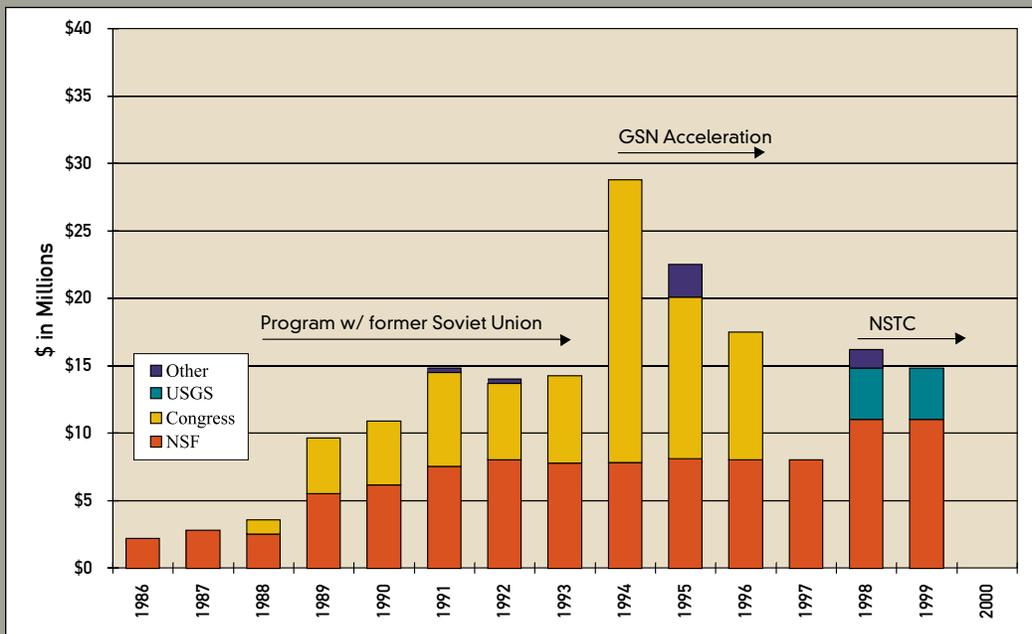
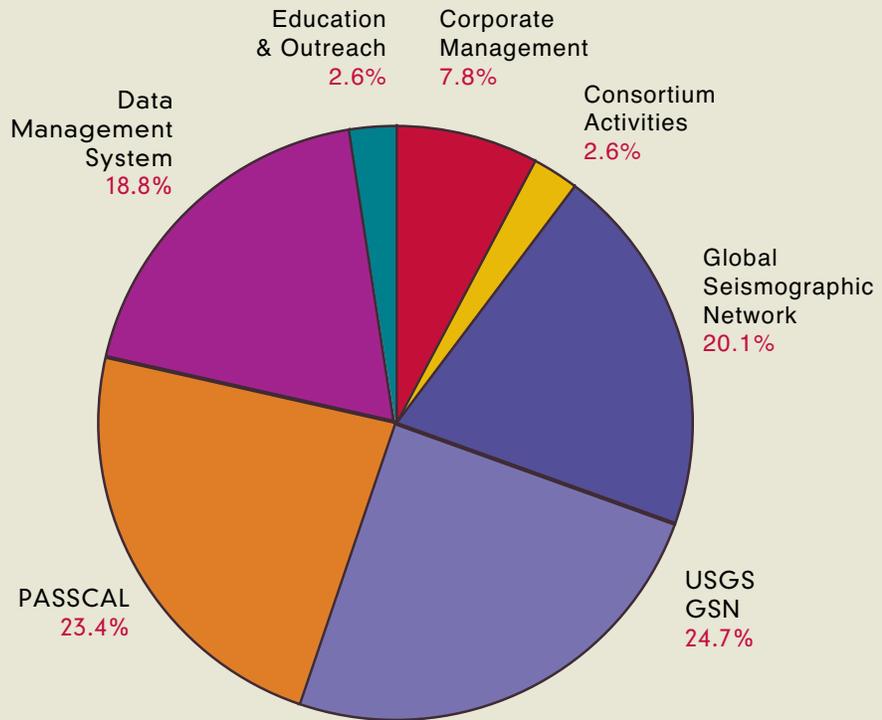


In partnership with the US Geological Survey, IRIS has been developing displays that feature real-time displays of seismicity and ground motion throughout the world. The original display is currently traveling to museums across the country and will be seen by over 6 million visitors during the next three years.



Through the Education and Outreach Program, IRIS has been developing and distributing posters about seismology. The posters are featured at the annual meeting of the National Science Teachers Association and can be found on classroom walls around the nation.

Funding for the IRIS Consortium supports the Global Seismographic Network, the PASSCAL Program, the Data Management System, an Education and Outreach Program, activities of the Consortium, and overall management. This chart shows the percentages of funding allocated to the different activities for 1998.



IRIS has been funded through three Cooperative Agreements with the National Science Foundation. This graph shows the level of funding since 1986.

Financial Overview

Finance Subcommittee:

Tom McEvelly — University of California, Berkeley
 John Vidale — University of California, Los Angeles
 Candy Shin — IRIS

Budgetary Overview

The Incorporated Research Institutions for Seismology (the IRIS Consortium) is a 501(C)(3) non-profit consortium of research institutions founded in 1984 to develop scientific facilities, distribute data, and promote research. IRIS was incorporated in the State of Delaware in 1985.

Funding History

Since 1986, IRIS has operated through five-year Cooperative Agreements with the National Science Foundation. Primary support for IRIS and its facilities comes from the Institution and Facilities Program of the Earth Sciences Division of NSF. From 1988 to 1996, IRIS received supplemental funding from the US Congress. Congress declared IRIS a program of “special Congressional interest” and provided funding for IRIS to the National Science Foundation through the Department of Defense. As stated by the Chairman of the Budgetary Committee “For the past several years, my colleagues and I have strongly supported funding for the seismological research conducted by IRIS. It has been our intention to advance the IRIS programs in order to provide a cost-saving, sustainable, multi-use resource not only for monitoring a future comprehensive test ban treaty, but also for monitoring global seismicity to mitigate earthquake hazards and to advance Earth science.”

From 1988 through 1993, the funds were used for the development of seismological facilities in partnership with the Soviet Academy of Sciences. From 1994 through 1996, the funds were used to accelerate the installation of the Global Seismographic Network in preparation for the Comprehensive Test Ban Treaty negotiations.

Following the special funding for the Global Seismographic Network, an *ad hoc* Working Group of the National Science and Technology Council (NSTC) recommended that both the National Science Foundation and the US Geological Survey budget for the full cost of the program’s continued operation and maintenance. Both agencies implemented the NSTC recommendation in 1997 beginning with their 1998 budget requests. In 1997, the Director of the National Science Foundation and the Director of the US Geological Survey recognized the development of the program as a “blue-print for scientific programs that not only advance our understanding of the physical world, but also address the needs of our society.”

Global Seismographic Network

The Global Seismographic Network (GSN) is operated in partnership with the US Geological Survey. Funding from NSF for the GSN supports the installation and upgrade of new stations, and the operation and maintenance of existing stations. Subawards include the University of California, San Diego, the University of California, Berkeley, the California Institute of Technology, Columbia University, and Michigan State University.

PASSCAL

Funding for PASSCAL is used to purchase new instruments, support the Instrument Center at the New Mexico Institute of Mining and Technology, train scientists to use the instruments, and to provide technical support for instruments in the field. Subawards include the New Mexico Institute of Mining and Technology, Columbia University, Stanford University, the University of California, San Diego, and Indiana University.

Data Management

System

Funding for the Data Management System supports data collection, data archiving, data distribution, communication links, software development, data evaluation, and web interface systems. Subawards include the University of Washington, Harvard University, the University of California, San Diego, Columbia University, the Albuquerque Seismological Laboratory, and the Moscow Data Center.

Education and Outreach

Funding for the Education and Outreach Program is used to support teacher workshops, undergraduate internships, the production of hard-copy and web-based educational materials, the development of museum displays, and coordination with the Princeton Earth Physics Program (PEPP).

Corporate Management

The administration costs include corporate administration salaries, business office salaries, accounting and legal consultant services, insurance, administrative staff, computer and office charges, and corporate travel costs.

Consortium Activities

The consortium activities include meetings of the Executive Committee, the Planning Committee, and the Program Coordination Committee, development of special workshops, the annual IRIS Workshop, the IRIS Newsletter, other publications, and membership services.

The consolidated financial statements of IRIS and IRIS Ocean Cable, Incorporated, and the Auditor’s Report are available from the IRIS business office upon request.



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| Christina Wise Jenkins | Human Resources Administrator |
| Catherine Johnson, Ph.D. | Education and Outreach Program Manager |
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| Maria Teresa Saavedra | Receptionist/Secretary |
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| Rick Braman | Systems Administrator |
| Robert E. Casey | Software Engineer |
| Stacy Fournier | Data Control Technician (since 11/2/98) |
| Chris Laughbon | Senior Software Engineer |
| Tom McSweeney, Ph.D. | Director of Software Engineering |
| Anh Ngo | Data Control Technician |
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