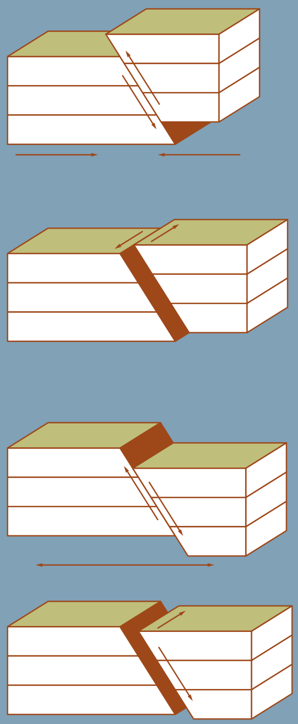
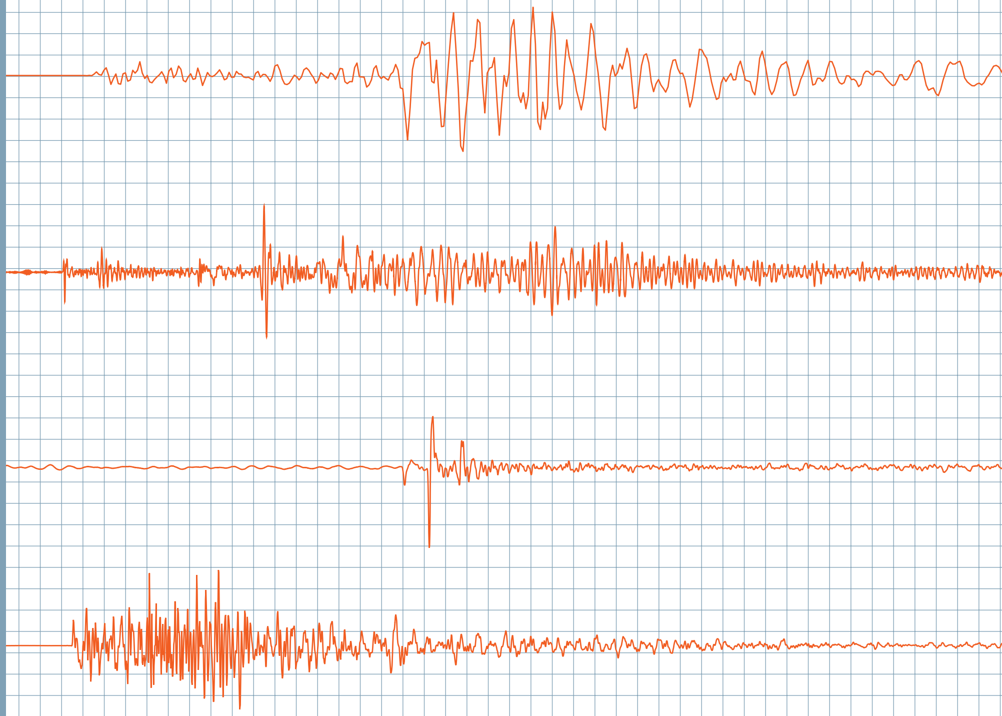
2002 ANNUAL REPORT



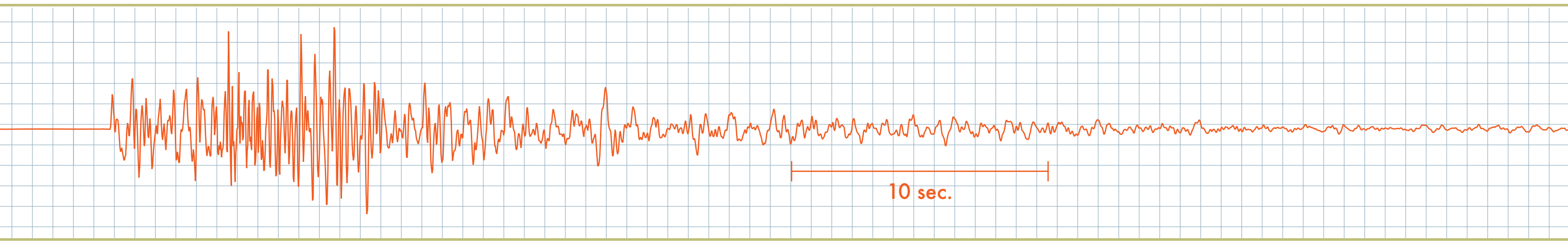


IRIS

IRIS

ANNUAL REPORT 2002

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 international verification regime for the Comprehensive Nuclear 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, 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.



As a facilities program supported by the National Science Foundation (NSF), IRIS' mission is both clear and focused. We will continue to collect and distribute data through our core programs for scientific research, education, earthquake hazard mitigation, and the international verification regime for the Comprehensive Nuclear Test Ban Treaty. As a consortium of 100 universities, we will continue to represent the collective interests of the scientific community, and to provide forums for the development of new initiatives.

The strength and success of IRIS has been derived through the governance of our consortium. It is your advice, guidance, time, effort, and commitment to the consortium that have created what many consider to be a role model for federally funded programs that not only advance our scientific and educational goals, but also benefit our society.

The value of our collective undertaking was most strongly demonstrated on October 7 of this year, when Congress included the EarthScope project in their mark up of the National Science Foundation's Appropriations Bill. When the gavel was struck that evening, it marked the realization of over five years of community effort. Countless meetings, workshops, white papers, program plans, drafts, and Committees had worked tirelessly against long-odds to develop a multi-disciplinary program that would measure the deformation of the North American continent and determine its structure and evolution. EarthScope is the largest federally funded program in the history of solid-Earth Geoscience. It is fitting that such an ambitious undertaking to systematically survey the United States should begin on the 200th anniversary of Congress' funding of the Lewis and Clark expedition.

IRIS' on-going role in this new project will be both to coordinate the development of the overall EarthScope program plan and to manage the USArray component. It is the structures of IRIS that have allowed us to organize as a community for EarthScope. It is the facilities of IRIS that will provide us with the technical foundation for deploying much of the instruments and collecting and distributing much of the data. And it is the cooperative nature of the consortium that will support the scientific and educational benefits that result from this investment in solid-Earth science.

Although the distance we have traveled is great and there is much to celebrate, many challenges still lie ahead. We must maintain our core facilities, for they are the foundation upon which initiatives such as EarthScope are developed. At the same time, we must embrace new opportunities and have the courage to explore new areas of inquiry. And perhaps most importantly, we must remain open to discoveries that are currently unpredictable. At no time has your involvement in the consortium been more important. We continue to rely upon your generous contributions of ideas and guidance in our efforts to support your research and educational endeavors.

Executive Committee and Officers

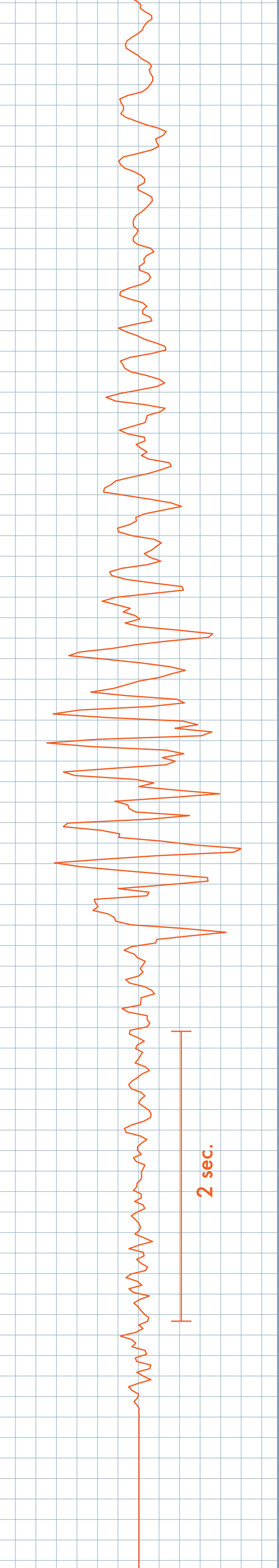
Göran Ekström (Chair)	Harvard University
Thomas Owens (Vice Chair)	University of South Carolina
Andy Nyblade (Secretary)	Pennsylvania State University
Susan Beck	University of Arizona
Stephen Malone	University of Washington
Gary Pavlis	Indiana University
Clifford Thurber	University of Wisconsin, Madison
Robert van der Hilst	Massachusetts Institute of Technology
Candy Shin	IRIS Treasurer
David W. Simpson	IRIS President

Planning Committee

Adam Dziewonski (Chair)	Harvard University
Göran Ekström	Harvard University
Thomas Jordan	University of Southern California
Art Lerner-Lam	Columbia University
Anne Meltzer	Lehigh University
John Orcutt	University of California, San Diego
Terry Wallace	University of Arizona
Gregory van der Vink	IRIS Director of Planning

Program Coordination Committee

Thomas Owens (Chair)	University of South Carolina
Richard Aster	New Mexico Tech
Roy Johnson	University of Arizona
Monica Kohler	University of California, Los Angeles
Gary Pavlis	Indiana University
Barbara Romanowicz	University of California, Berkeley
Timothy Ahern	IRIS DMS
Rhett Butler	IRIS GSN
James Fowler	IRIS PASSCAL
Shane Ingate	IRIS Director of Operations
David W. Simpson	IRIS President
John Taber	IRIS E&O
Gregory van der Vink	IRIS Director of Planning



Consortium

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 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 are convened for special tasks. It is the role of the Standing Committees and the advisory subcommittees to develop recommendations for the Executive Committee which evaluates and approves such recommendations on behalf of the Board of Directors.

IRIS MEMBER INSTITUTIONS

University
  Board Member • Alternate
University of Alabama
  Dennis L. Harry
University of Alaska
  Douglas H. Christensen • Roger Hansen
University of Arizona
  Susan Beck • George Zandt
Arizona State University
  Matthew J. Fouch • Ed J. Garnero
University of Arkansas at Little Rock
  Haydar J. Al-Shukri • Jeffery B. Connelly
Auburn University
  Lorraine W. Wolf
Boise State University
  John R. Pelton • James Zollweg
Boston College
  John Ebel • Alan Kafka
Boston University
  Geoffrey Abers • Rachel E. Abercrombie
Brown University
  Karen Fischer • Donald Forsyth
California Institute of Technology
  Donald Helmberger • Thomas Heaton
University of California, Berkeley
  Barbara Romanowicz • Lane Johnson
University of California, Los Angeles
  John Vidale • Paul Davis
University of California, Riverside
  Stephen K. Park • David D. Oglesby
University of California, San Diego
  Peter Shearer • Jon Berger
University of California, Santa Barbara
  Craig Nicholson • Ralph Archuleta
University of California, Santa Cruz
  Thorne Lay • Susan Schwartz
Carnegie Institution of Washington
  Paul Silver • Selwyn Sacks
Central Washington University
  Timothy Melbourne • Charles Rubin
University of Colorado, Boulder
  Mike Ritzwoller • Anne Sheehan
Colorado School of Mines
  Roel Snieder • Thomas Boyd
Columbia University
  Paul G. Richards • Arthur Lerner-Lam
University of Connecticut
  Vernon F. Cormier • Lanbo Liu
Cornell University
  Muawia Barazangi • Dogan Seber
University of Delaware
  Susan McGeary
Duke University
  Peter Malin • Eylon Shalev
Florida International University
  Dean Whitman
University of Georgia
  Robert Hawman • James Whitney
Georgia Institute of Technology
  Leland T. Long • James Gaherty

Harvard University
Göran Ekström • Adam Dziewonski
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
Idaho State University
Joseph M. Kruger
University of Illinois at Urbana Champaign
Wang-Ping Chen • Xiaodong Song
Indiana University
Gary L. Pavlis • Michael Hamburger
Indiana University/Purdue University at Fort Wayne
Dipak Chowdhury
Kansas State University
Stephen Gao • Charles Oviatt
University of Kansas
Ross A. Black
University of Kentucky
Edward W. Wollery • Zhenming Wang
Lawrence Berkeley National Laboratory
D.W. Vasco • E.L. Majer
Lehigh University
Anne Meltzer
Louisiana State University
Juan Lorenzo • Roy Dokka
Macalester College
John P. Craddock • Karl R. Wirth
Massachusetts Institute of Technology
Robert Dirk van der Hilst • Bradford H. Hager
University of Miami
The University of Memphis
Jer-Ming Chiu • Arch Johnston
University of Michigan
Larry Ruff
Michigan State University
Kazuya Fujita • David W. Hyndman
Michigan Technological University
Wayne D. Pennington • Jimmy F. Diehl
University of Minnesota
University of Missouri
Eric Sandvol • Mian Liu
University of Montana
Michael Stickney • Marvin Speece
University of Nevada, Las Vegas
Catherine Snelson • Jim O'Donnell
University of Nevada Reno
Glenn Biasi • Steve Jaume
University of New Orleans
Abu K.M. Sarwar
New Mexico Institute of Mining & Technology
Richard C.Aster • Harold Tobin
New Mexico State University
James Ni • Thomas Hearn
State University of New York at Binghamton
Francis T. Wu • Jeff Barker
State University of New York at Stony Brook
William Holt • Daniel Davis
University of North Carolina, Chapel Hill
Jonathan Lees • Jose Rial

Northern Illinois University
Paul Stoddard • Philip Carpenter
Northwestern University
Ray Russo • Seth Stein
The University of Oklahoma
Roger Young • Judson Ahern
University of Oregon
Eugene Humphreys • Doug Toomey
Oregon State University
John Nabelek • Anne Trehu
Pennsylvania State University
Shelton S. Alexander
Princeton University
Guust Nolet • Robert Phinney
University of Puerto Rico
Christa von Hillebrandt • Eugenio Asencio
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 • Keith Koper
San Diego State University
Steven M. Day • Eric Frost
San Jose State University
Donald L. Reed • Richard Sedlock
Southeast Missouri State University
Nicholas H. Tibbs
University of South Carolina
Tom Owens • Pradeep Talwani
University of Southern California
Thomas H. Jordon • Ta-Liang Teng
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
Kate Miller • Randy Keller
University of Tulsa
Christopher L. Liner • Bryan Tapp
University of Utah
Robert B. Smith • Gerald T. Schuster
Virginia Polytechnic Institute
J. Arthur Snoke • John Hole
University of Washington
Steve Malone • Kenneth Creager
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, Milwaukee
Keith A. Sverdrup • Vincent Cronin
University of Wisconsin, Oshkosh
Timothy Paulsen
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
Jeffrey J. Park

U.S. AFFILIATE MEMBER INSTITUTIONS

Naval Air Weapons Station, Geothermal Program Office
Francis Monastero
Maryland Geological Survey
Gerald R. Baum

EDUCATIONAL AFFILIATES

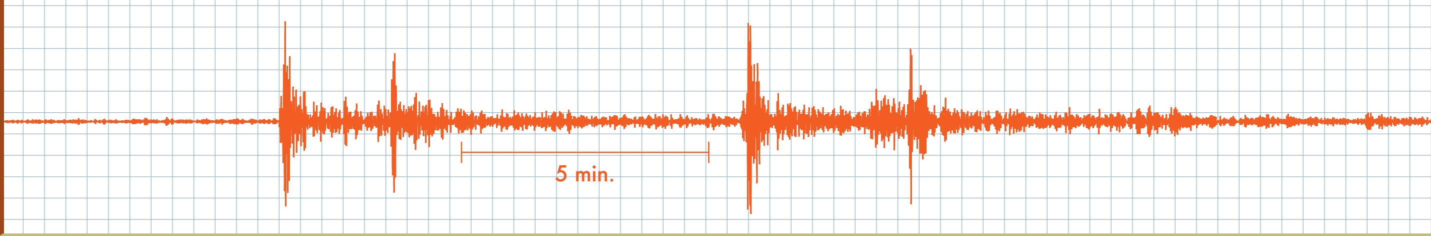
Arizona Western College
Michael Conway
Diné College
Steven C. Semken
Trinity University
Glenn C. Kroeger

FOREIGN AFFILIATE MEMBER INSTITUTIONS

Academy of Sciences, Seismological Center, Albania
Betim Muco
Australian National University, Australia
Brian Kennett
The University of Queensland, Australia
Peter Mora
Observatório Nacional, Brazil
Jorge Luis de Souza
Universidade de Brasilia, Brazil
Joao Willy Rosa
Universidade de São Paulo, Brazil
Marcelo Assumpção
Ecole Polytechnique, Canada
Marianne Mareschal
Geological Survey of Canada, Continental Geoscience Division
Isa Asudeh
University of British Columbia, Canada
Michael G. Bostock
University of Toronto, Canada
Kin-Yip Chun
Universidad Nacional, Costa Rica
Federico Güendel
Geophysical Institute, Czech Republic
Axel Plesinger
Masaryk University, Czech Republic
Petr Firbas
National Research Institute of Astronomy and Geophysics, Egypt
Amin Ibrahim Hussein
University of Bristol, England
George Hellfrich

University of Cambridge, England
Keith Priestley
The University of Leeds, England
Roger Clark
University of Leicester, United Kingdom
Peter Maguire
International Institute of Earthquake Engineering and Seismology, Iran
Manouchehr Bahavar
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada, Mexico
Cecilio J. Rebollar
Utrecht University, The Netherlands
Roel Snieder
Institute of Geological & Nuclear Sciences, New Zealand
Mark Peter Chadwick
University of Otago, New Zealand
Helen Anderson
Victoria University, Institute of Geophysics, New Zealand
Martha Kane Savage
University of Bergen, Norway
Eystein S. Husebye
Instituto Geofisico Del Peru, Peru
Edmundo Norabuena
Chinese Academy of Sciences, China
Ai Yinshuang
Institute of Geology, SSB, Beijing, PRC
Qiyuan Liu
Institute of Geophysics, Beijing, PRC
Gongwei Zhou
Peking University,PRC
Shao Xian Zang
University of Hong Kong, PRC
Lung Sang Chan
Institute of Geophysics, Polish Academy of Sciences, Poland
Pawel Wiejacz
Instituto Superior Técnico, Portugal
Joao F.B.D. Fonseca
Universidade do Porto, Faculdade de Engenharia, Portugal
Rui Carneiro-Barros
National Institute for Earth Physics, Romania
Andrei Bala
Kuban State University, Russia
Vladimir Babeshko
Russian Academy of Sciences, Russia
Vitaly V. Adushkin
Hanyang University, South Korea
So Gu Kim
Institute of Geophysics, Switzerland
Domenico Giardini
Academia Sinica, Institute of Earth Sciences, Taiwan
Honn Kao
National Central University, Taiwan
Kuo-Gong Ma
Istanbul Technical University, Turkey
Tuncay Taymaz
Kandilli Observatory, Bogazici University, Turkey
Nurcon Ozel
Tubitak-Marmara Research Centre, Turkey
M. Namik Yalcin

GSN



The Global Seismographic Network is a permanent network of state-of-the-art seismological and geophysical sensors connected by available telecommunications to serve the scientific research and monitoring requirements of our national and international community.

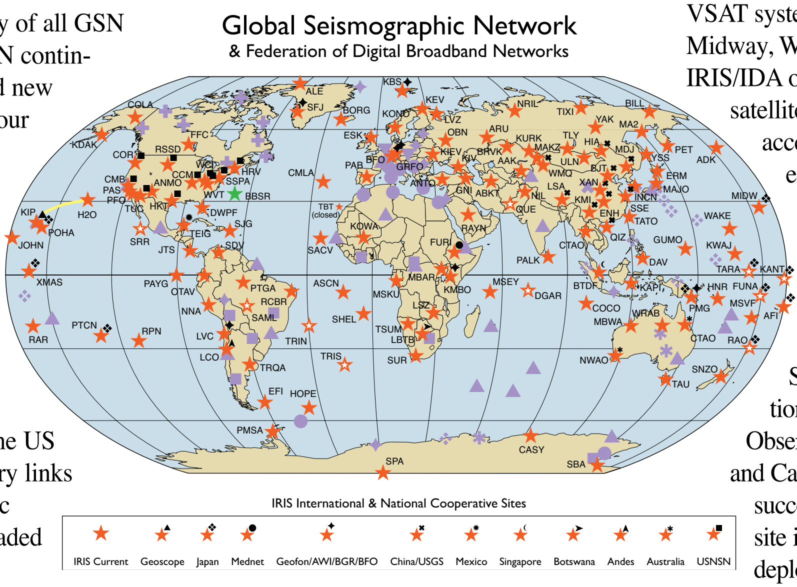
Standing Committee

Barbara Romanowicz (Chair)	University of California, Berkeley
Harley Benz	US Geological Survey, Golden
Ray Buland	US Geological Survey, Golden
Ken Creager	University of Washington
John Filson	US Geological Survey, Reston
James Gaherty	Georgia Institute of Technology
Steve Grand	University of Texas, Austin
Gabi Laske	University of California, San Diego
Jeroen Tromp	California Institute of Technology
Cecily Wolfe	University of Hawaii
Rhett Butler	GSN Program Manager

All GSN data are freely and openly available to anyone via the Internet. Installed to provide broad, uniform global coverage of the Earth, 126 GSN stations are now sited from the South Pole to Siberia and from the Amazon basin to the seafloor of the Northeast Pacific Ocean, in cooperation with over 100 host organizations and seismic networks in 58 countries worldwide.

Continuous, real-time telemetry of all GSN data is a fundamental goal. The GSN continues to create opportunities to extend new telecommunications capabilities to our stations. We are in transition from air-mailed media, dial-up telephone, and slow-speed Internet access to broadband VSAT satellite links and high-speed Internet. In 2002, 75% of the GSN is now on-line via Internet and VSAT links. Real-time access is now available to all GSN stations in the United States. In partnership with the US Geological Survey, satellite telemetry links with the US National Seismographic Network (USNSN) have been upgraded at GSN sites in Oregon, Missouri, Indiana, Illinois, and Pennsylvania. The USGS Albuquerque Seismological Laboratory has arranged for Internet connectivity to GSN stations in Turkey and Japan. The University of California at San Diego IRIS/IDA group has arranged for Internet access to our stations in the Azores, central Canada, and northwestern Russia. Working with Geosciences Australia and the Australian National University, respectively, ASL and IRIS/IDA have linked GSN stations in northwestern and central Australia to their national satellite network and the Internet.

Real-time GSN data are valuable to agencies with responsibility for operational monitoring, and the GSN works to establish direct data links for mutual benefit. About 50 GSN stations are designated for participation in the International Monitoring System (IMS) for the Comprehensive Test Ban Treaty Organization (CTBTO). The US National Weather Service (NWS) uses GSN data for its Tsunami Warning



System. Both organizations require direct access, avoiding less reliable Internet circuits. GSN is working with IMS to link stations to the CTBTO International Data Centre via their global communication infrastructure (GCI) being established for secure communication. To avoid duplication of satellite equipment in remote locations and to provide for operations and maintenance, GSN has been developing with CTBTO the concept of sharing their satellite system to carry GSN data streams to the IRIS DMC. Implementation phase tests at GSN sites in Puerto Rico and Zambia started in March, which have demonstrated the feasibility and benefits for improved data availability. In the Pacific, with cooperation with our Japanese colleagues who provided equipment to IRIS, satellite transmissions were initiated from four islands to bring GSN data directly to the Oahu hub at the Pacific Tsunami Warning Center, which will then forward it to the Internet. VSAT systems have been installed by ASL at Midway, Wake, and Pitcairn Islands, and by IRIS/IDA on Easter Island. NWS is funding the satellite space segment costs for GSN data access. The Oahu hub is also being cooperatively used by UNAVCO/NASA for GPS telecommunication from Easter Island, and by the Pitcairn Islanders for their Internet access.

GSN received a five year funding commitment from NSF Ocean Sciences for the continuing operations and maintenance of the Hawaii-2 Observatory on the seafloor between Hawaii and California. The Ocean Drilling Program successfully drilled a borehole at the H2O site in February for a future seismometer deployment.

Our newest station in the GSN was installed by ASL this year in Bermuda at the Biological Research Station. This site, which includes a borehole seismometer (installed at 30 m depth to reduce the influence of near surface noise) and a strong-motion sensor, holds to the basic GSN design goal to record with full fidelity all signals across the entire seismic frequency band. The GSN Canary Island station was closed this year, pending relocation to a new site in the islands. In cooperation with USNSN, two new NSN sites were installed in Oregon and Montana.

GSN Telemetry and the Pacific Tsunami Warning Center

Rhett Butler, GSN Program Manager

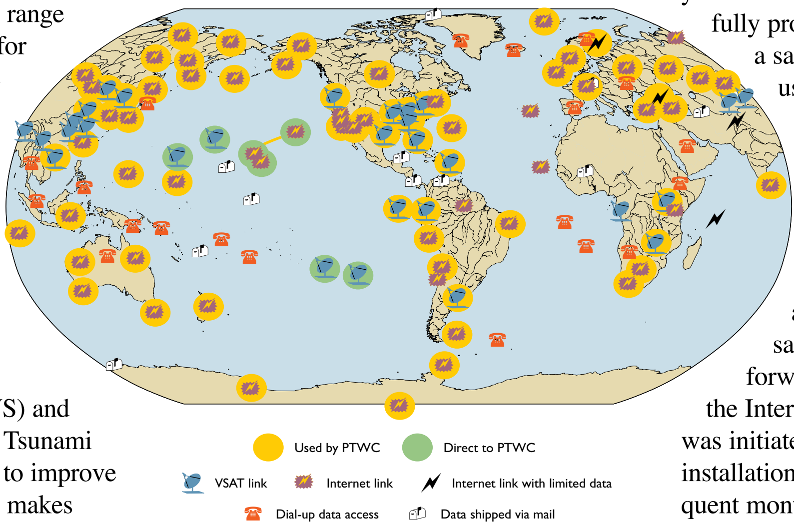
The Global Seismographic Network plays an essential role for tsunami warning. Seismic signals from earthquakes propagate over 20 times faster than a tsunami travels, and thus serve not only to provide early warning and location, but also to characterize the tsunamigenic potential of the event. Large earthquakes are the greatest concern since the area of the fault and the displacement of the seafloor near the earthquake source relate to tsunami size. The long-period and high dynamic range instrumentation which is standard for the GSN is ideal for measuring the earthquake moment from seismic body waves and surface waves generated by such large earthquakes. Rapid access and analysis is essential for timely response to a tsunami threat.

GSN data are widely used by tsunami warning networks, and the GSN has worked closely with the National Weather Service (NWS) and the Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) on Oahu to improve data access for monitoring. PTWC makes wide use of the real-time data from over 50 GSN sites to provide for broad, uniform global coverage, as shown in the telecommunications figure. Most of these links (highlighted in yellow) represent direct access to GSN data servers at the USGS Albuquerque Seismological Laboratory (via the Live Internet Seismic Server—LISS) or from the IRIS/IDA group at the University of California, San Diego (via the Near Real Time System—NRTS), or indirect access to these same data through the USGS National Earthquake Information Center (NEIC) in Colorado (via Earthworm links with NEIC). However, in the rare but important circumstance when circuit connectivity between Hawaii and the mainland U.S. is disrupted, a subset of the GSN data adequate for teleseismic earthquake analysis still needs to get through to PTWC.

GSN Communications

Data Transmission to Pacific Tsunami Warning Center

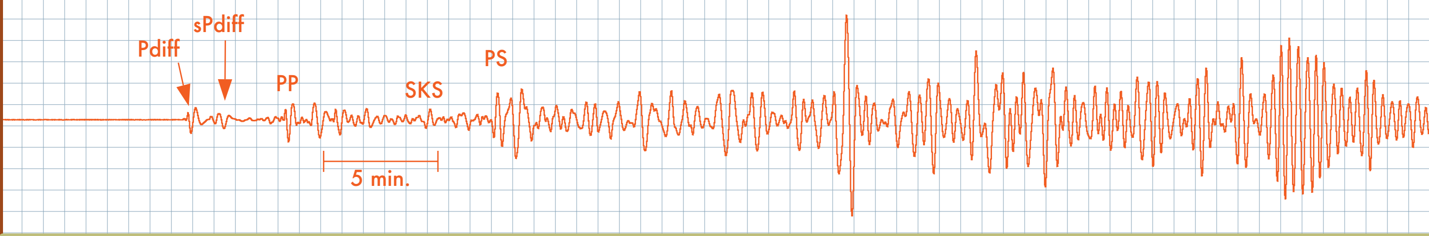
December 2002



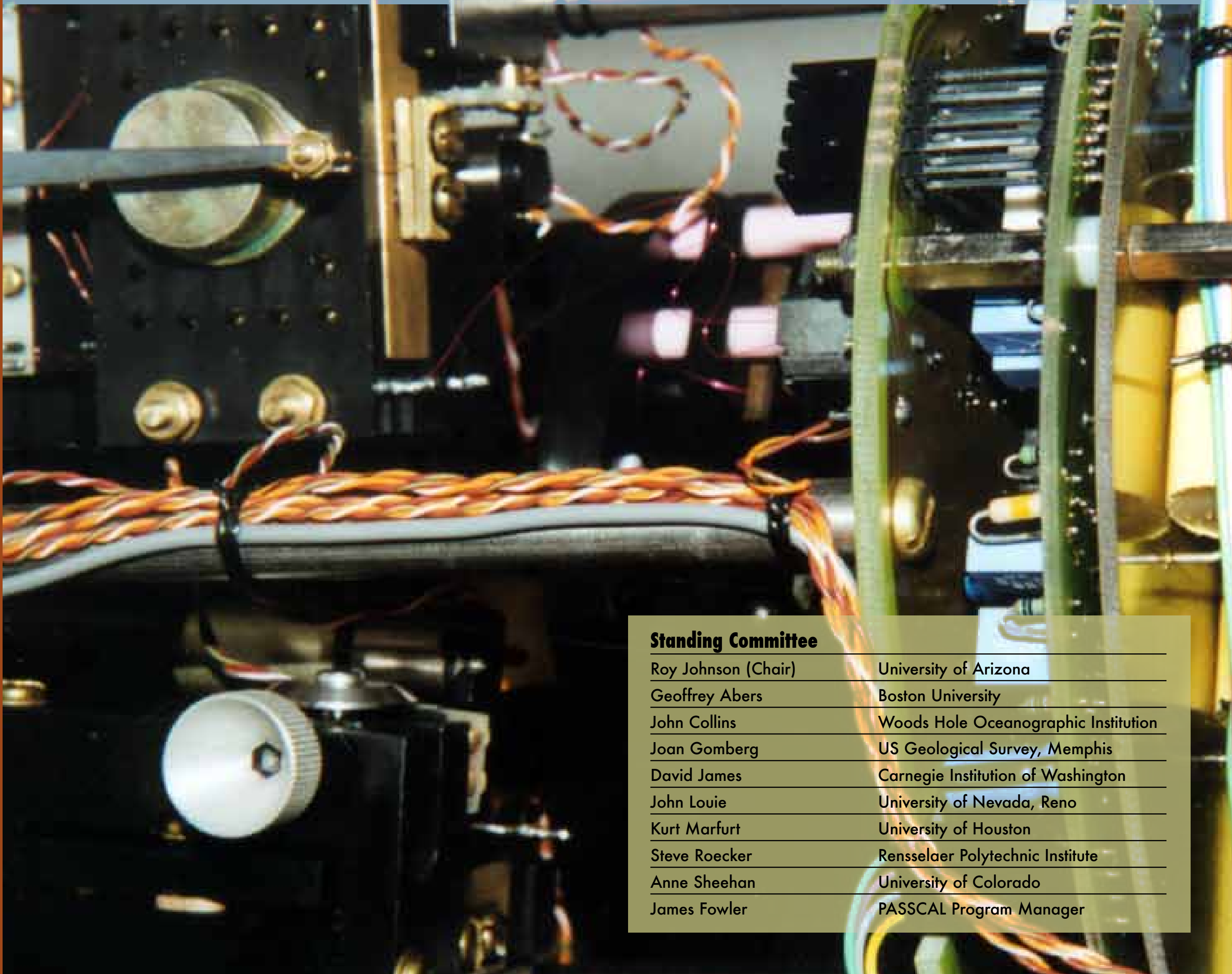
PTWC serves as the host for the local GSN station, KIP, Kipapa on Oahu. GSN has arranged for the routing of data from POHA, Pohakuloa, on the Big Island of Hawaii to come to PTWC via inter-island circuits, rather than through the Hawaiian Volcano Observatory link to California. GSN data from the Hawaii-2 Observatory (H2O) on the seafloor between Hawaii and California comes to Oahu via the Hawaii-2 retired telephone cable, wherein PTWC accesses the data directly from the University of Hawaii LISS server. However, to extend direct GSN connectivity to PTWC beyond the Hawaiian Islands requires satellite access.

From 1996 through 2001 IRIS and the National Research Institute for Earth Science and Disaster Prevention (NIED) of Japan entered into a cooperative plan to install joint GSN-NEID stations in the Pacific. In the final year of this cooperative plan, IRIS successfully proposed that NIED fund the GSN for a satellite master earth station hub for use by the joint GSN-NIED stations. GSN approached the National Weather Service, which operates the Tsunami Warning System, to install the hub at PTWC on Oahu. In exchange for direct data access for PTWC, NWS/NOAA agreed to provide for the recurring satellite space segment costs and to forward the GSN data from PTWC to the Internet. This hub and VSAT system was initiated in February 2002 with the VSAT installation on Pitcairn Island. In subsequent months, GSN has installed VSATs on Midway, Wake and Easter Islands. As shown in the telecommunications map highlighted in green, four VSATs and three local internet connections now provide GSN data directly to PTWC. In 2003 GSN and PTWC plan to expand the VSAT coverage to additional GSN sites in Japan, Thailand, and islands of the central and south Pacific. In addition, NWS is considering using the hub at PTWC to establish a direct connection between PTWC and the West Coast/Alaska Tsunami Warning Center in Palmer, Alaska.

PASSCAL



The Program for the Array Seismic Studies of the Continental Lithosphere (PASSCAL) is a program of portable instruments for use by individual scientists for high-resolution experiments in areas of special interest.



Standing Committee

Roy Johnson (Chair)	University of Arizona
Geoffrey Abers	Boston University
John Collins	Woods Hole Oceanographic Institution
Joan Gomberg	US Geological Survey, Memphis
David James	Carnegie Institution of Washington
John Louie	University of Nevada, Reno
Kurt Marfurt	University of Houston
Steve Roecker	Rensselaer Polytechnic Institute
Anne Sheehan	University of Colorado
James Fowler	PASSCAL Program Manager



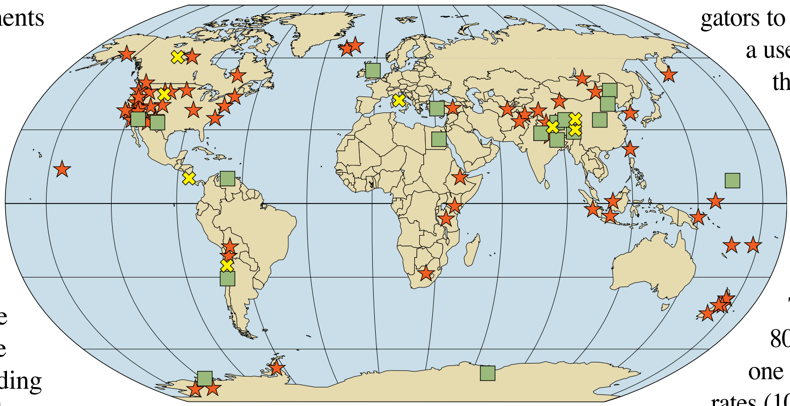
PASSCAL continues to support between 50 and 60 experiments a year. The broadband pool has grown to over 300 instruments, but the waiting time for experiments continues to be around 2 years.

The active-source instrument pool of single channel “Texan” instruments contains over 800 instruments. The instruments continue to be popular because of their light weight and ease of use. Usage of the instruments is quite heavy in the summer field months with both domestic and foreign experiments.

The Broadband Array equipment has been deployed for the last two years in Parkfield. The array is effectively tripling the size of the Parkfield array and is providing a much higher resolution look at the area around the SAFOD drilling site. Data from the array are being received by the PI’s and the DMC in real-time.

To help address the problems of increasing instrument demand, Congress appropriated $1,000,000 for the PASSCAL program in the FY01 budget. The funding, provided through DOE’s Nonproliferation and National Security research and development account, allowed for the purchase of 25 broadband stations. These stations are being deployed on DOE experiments in China. The FY02 budget contained an additional $2.5M which will be used to start replacing the older data recorders in the pool that can no longer be easily repaired.

PASSCAL Broadband Experiments



Broadband Experiment History	Pre 2003	2003	2004
	★	■	✖

PASSCAL took delivery of the first of the new prototype instruments from Quanterra and Refraction Technology in December of 2001. Initial tests of these instruments were very encouraging. We have accepted 25 additional instruments from both manufacturers. These instruments are now being tested under various field conditions.

Large numbers of one or both of the new instruments will be used to replace the existing field instrumentation. We expect the first production instruments to arrive in the second quarter of 2003.

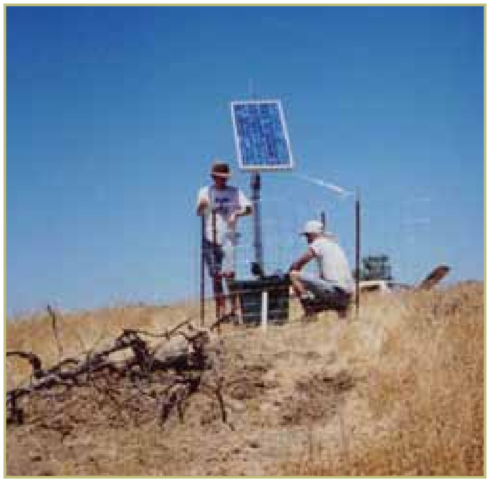
Development of field software has continued with the goal of making it easier for investigators to quality control field data, convert it to a useful processing format and archive it at the Data Management Center. Over the last year, the backlog in delivery of data to the DMC has been reduced significantly. The development efforts are not only aimed at improving the software associated with the broad-band stations, but also with the Texan instruments. The fact that up to 800 of these instruments are deployed at one time sampling at relative high sample rates (100-200 sps) means that large volumes of data can be collected very quickly. The current development is aimed at making it possible to reformat and look at the data with the minimum number of processing steps. Additional software is being developed to allow smooth integration of the data streams for the two new types instruments into the existing data flow.


CALA

Passive and Active Seismic Experiments at Parkfield, CA, 2000-02: the PASO Array

Cliff Thurber, University of Washington, Madison, and Steve Roecker, Rensselaer Polytechnic Institute

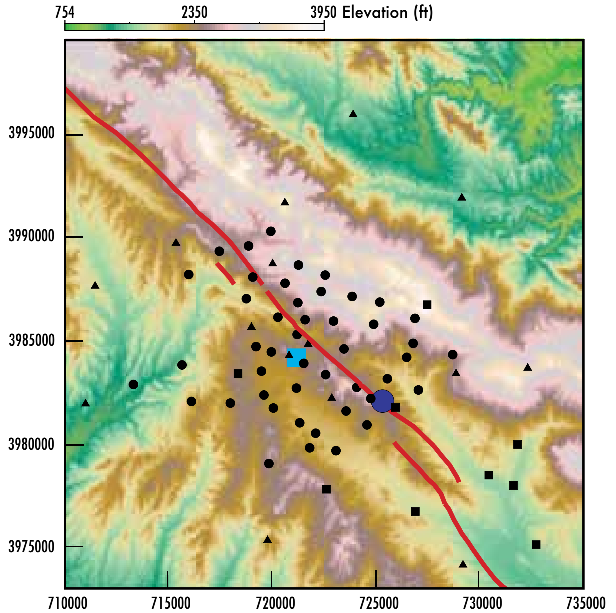
The plan for the first main phase of the SAFOD project (San Andreas Fault Observatory at Depth) as part of EarthScope is to penetrate the San Andreas fault near Parkfield, CA, at seismogenic depths. In a second phase, satellite core holes will be drilled off the main borehole to sample the fault in the vicinity of the rupture patch of a magnitude ~2 repeating earthquake and on a creeping patch. In order to facilitate the drilling plans, groups from UW-Madison and RPI have collected and are analyzing data from local earthquakes recorded on a dense array of PASSCAL instruments and USGS network stations and UC-Berkeley borehole stations. Our primary goals are to image the kilometer-scale three-dimensional (3D) structure of the region around the SAFOD drill site and to provide well-constrained location estimates for potential drilling target earthquakes.



Lee Powell and Cliff Thurber of UW-Madison finish off the installation of a PASO station near the San Andreas fault in July 2000.

The PASSCAL array, nicknamed PASO (Parkfield Area Seismic Observatory), was installed in stages, starting with 15 PASSCAL instruments in July 2000, followed by an additional 44 PASSCAL instruments in June and July of 2001. The original 15 stations were installed in "stand-alone" mode, but in October 2000, with the help of the UCSD broadband array group, 14 of the 15 sites were converted to real-time telemetry. Recording and archiving were initially done locally, using the Antelope system, since the Internet had not yet made it to Parkfield! In February 2001, a Tachyon satellite telemetry connection was established, and data began to flow out in real time. In June 2002, the SAFOD Pilot Hole was drilled to 2.2 km depth, and a 32-element borehole string was installed by Peter Malin of Duke University (see http://www.icdp-online.de/html/sites/sanandreas/objectives/pilot.html).

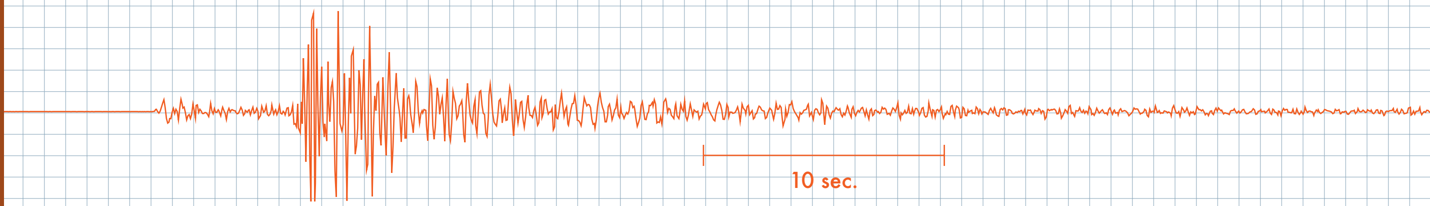
Over the first 2 years of operation, over 1000 earthquakes were recorded within the aperture of the PASO array. Preliminary seismic tomography analysis provided detailed images of the 3D seismic structure of the region (Thurber et al., 2002), but constraints on the absolute locations of potential drilling target earthquakes were not quite adequate for SAFOD, with location uncertainty estimates on the order of 500 m. In October 2002, we carried out an active-source "calibration" experiment in concert with a USC-UCLA fault-zone guided wave study. Our initial results including the calibration shot data have already reduced the location uncertainty to less than 200 m, close to our goal of 100 m accuracy for targeting the SAFOD drilling.



Map of the PASO seismic array (triangles and circles) and nearby USGS and UC-Berkeley network stations (squares). Red line is the San Andreas Fault, blue circle is the 1966 Parkfield main shock epicenter, and the blue square is the SAFOD drill site.

Reference

Thurber, C., S. Roecker, K. Roberts, M. Gold, L. Powell, and K. Rittger, Earthquake locations and three-dimensional fault zone structure along the creeping section of the San Andreas Fault near Parkfield, CA: Preparing for SAFOD, Geophys. Res. Lett., in press, 2002.



DMS

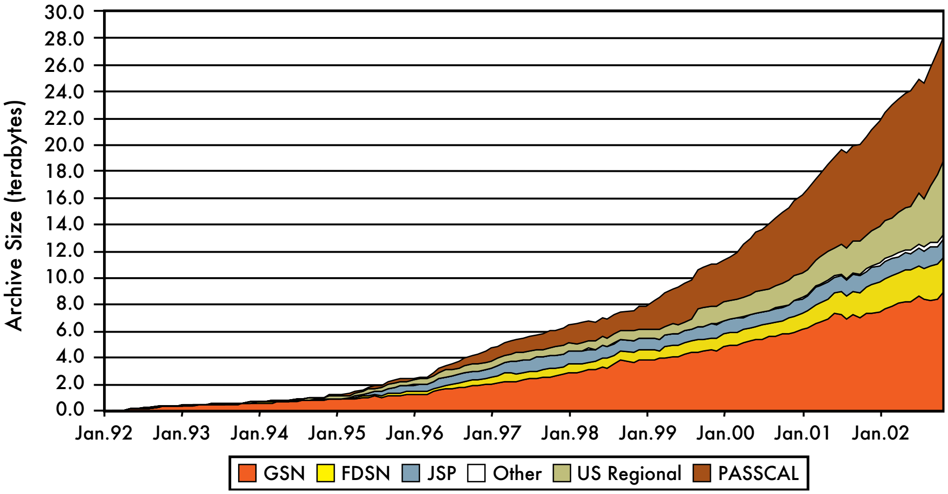
The Data Management System (DMS) is a data system for collecting, archiving, and distributing data from IRIS facilities, as well as a number of other national and international networks and agencies.

Standing Committee

Monica Kohler (Chair)	University of California, Los Angeles
Robert Detrich	Woods Hole Oceanographic Institution
Douglas Dodge	Lawrence Livermore National Lab
Edward Garnero	Arizona State University
Guy Masters	University of California, San Diego
David Okaya	University of Southern California
Stuart Sipkin	US Geological Survey, Denver
Kenneth Smith	University of Nevada, Reno
Timothy Ahern	DMS Program Manager

The DMS has continued to archive and distribute seismological data at an increasing rate as shown in the figure below. The DMC archive now contains more than 28 terabytes of waveforms and it is increasing at an annual rate of 7.5 terabytes per year. By comparison, it took us more than 6.5 years to archive the first 7.5 terabytes of data. While the DMS places a priority on archiving data from the GSN and PASSCAL programs of IRIS, we have always been open to archiving data from other sources. This year saw the archiving rate for US regional network data, mostly from USGS supported networks, surpass the archiving rate of both the GSN and the PASSCAL programs.

The number of customized shipments this year decreased slightly from just over 50,000 last year to a projected 45,000 this year. This decrease can be attributed to a reduction in requests generated by WEED, the flexible tool that can access both the FARM and SPYDER® data sets. Since the FARM and SPYDER® data sets were totally restructured this year, WEED has been unavailable as a front end for these data sets for most of this year. Work is taking place on WEED now and we anticipate its release very soon. Some of the newer methods of accessing data such as through the real time system and through the new Data Handling Interface are not yet included in this statistic.



As of October 30, 2002, the IRIS DMC was managing more than 28 terabytes of waveforms in two sorted orders, one by time and one by station. The rate of data archiving is now most affected by data from US Regional networks, most of which is arriving electronically in real time.

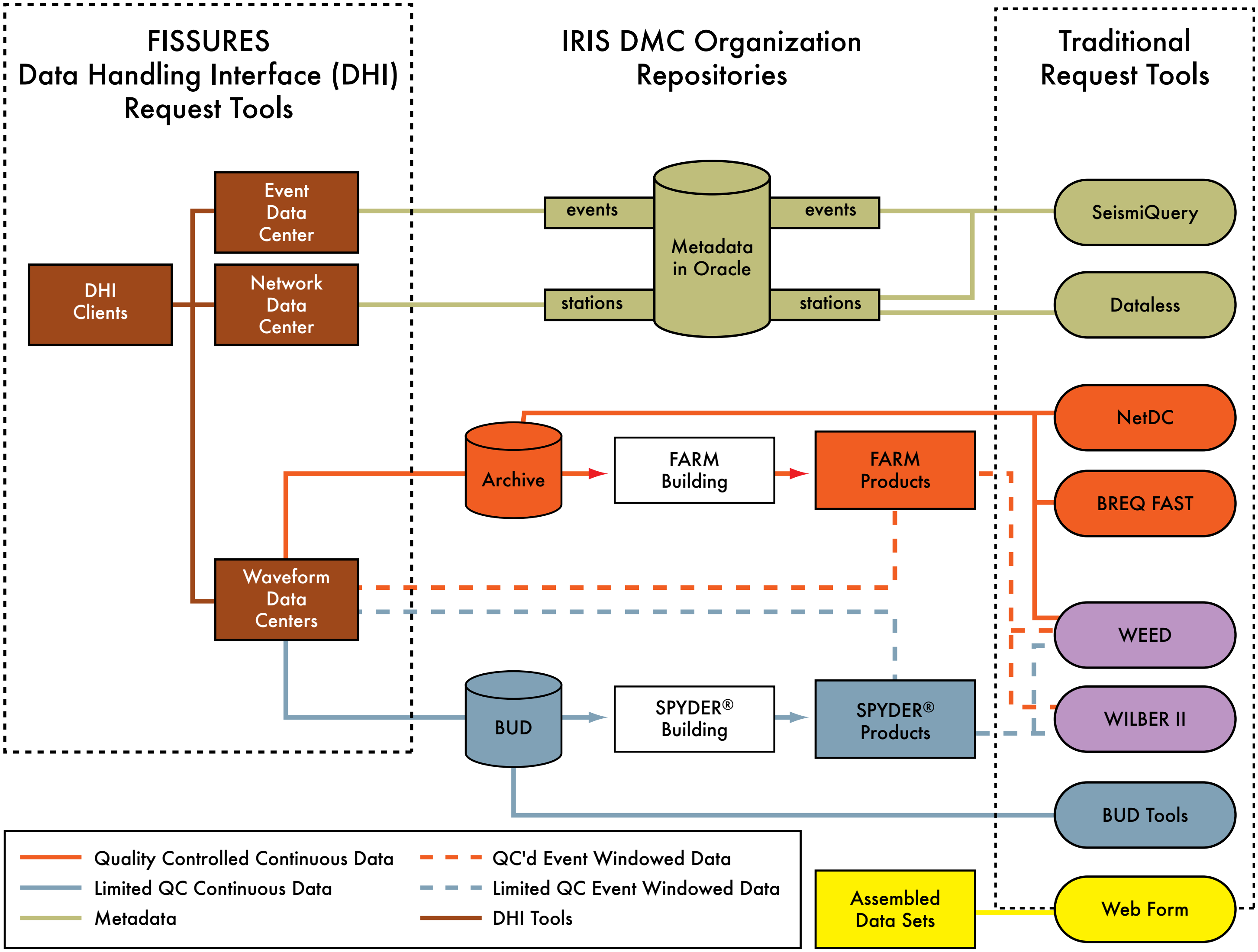
BUD and SPYDER®

A great deal of effort has gone toward preparing the IRIS DMC to manage large amounts of data such as is contemplated in USArray. The Buffer of Uniform Data (BUD) system is now complete and can provide data in near real time for over 700 globally distributed stations, including more than 250 broadband stations. The real time data is buffered on-line for 10 days in the case of the shorter period data but up to two months for the broadband channels. Access to the data in the BUD can be made through a system of utilities called BUD tools, the center-piece of which is a browser-based display utility called "Wiggles" that can display, window, and allow data extraction. BUD data are also available via ftp, a LISS server, autoDRM, and the new Data Handling Interface Tools.

A totally revamped SPYDER® system is now built around the BUD real time system. Now when an event occurs, the data for the event is normally already in the BUD system, even before we are aware of the event. The extraction of the data from BUD to the SPYDER® system takes only a few minutes. The generation of the hundreds of resulting plots can still take a considerable amount of time and will be revamped during the next year. Since the data from more than 700 stations and 3000 channels is now possible through SPYDER®, we have had to implement a queuing system within the WILBER interface to SPYDER® so that a single researcher cannot block access to the data for others.

FARM

Many users' needs can be met with our FARM repository that contains data for all large earthquakes from all networks stored at the IRIS DMC. Originally the FARM only contained data from the IRIS GSN network, but as the number of networks whose data are archived at the IRIS DMC grew, it was clear that the FARM needed to be expanded. At the present time, data from all networks are now included in the FARM directories and exist only as data heaps until a request is made. At that time the metadata for the mini-



Data organization and access methods in place at the IRIS DMC. This diagram shows the relationship between the four waveform repositories (Archive, BUD, SPYDER® and FARM), the metadata repository in Oracle, and the traditional request tools (shown on the right) developed to allow access to the waveforms and the metadata. The new Data handling Interface (DHI) tools are shown on the left. The IRIS DMC operates three DHI Data Center Servers, one for Events, one for Network information, and one for Waveforms. These DHI Servers interact with DHI Clients that run on a user's own computer or workstation.

SEED waveform files are attached, and the data are available as full SEED volumes, or as a variety of less complete waveform formats (SAC, etc.). All of the FARM products are available through the WILBER interface (http://www.iris.washington.edu/cgi-bin/wilberII_page1.pl)

As of the end of October, 2002 there were a total of nearly 3,600 FARM events, with data from all available networks. FARM products exist from 1990 through two months behind real time. The FARM will be extended to the early 1970's during the next year.

The DMC also is in the process of building UV_FARM products. These volumes, available through WILBER II, contain data from all networks that generate Ultra Long Period and Very Long Period data. For each network all of the ULP and VLP data are assembled into one month long files in mini-SEED format. Presently we have data from 1975- 1992 as well as various months in 1993 through 1998. Work continues to generate the remaining UV-FARM products and it should be completed during the next year.

New Data Handling Techniques

This past year saw significant progress made in the new area of delivering data from the IRIS DMC. The Data Handling Interface (DHI) is based upon the FISSURES concept that began within the IRIS DMS in 1998. DHI is a modern object-oriented approach that has its foundation in a proven technology called Common Object Request Broker Architecture (CORBA). The IRIS DMS has focused on aspects of FISSURES that directly relate to methods of efficiently getting data out of the IRIS DMC (or other DHI enabled data centers such as the one at the University of South Carolina), to end users. Philip Crotwell at USC deserves much of the credit for making the DHI a viable distributed computing mechanism within the IRIS DMS.

Traditionally, the IRIS DMC has developed tools that allow you to generate simple or complex requests for data, but only in an offline batch oriented mode. Of course the tools like WILBER do allow interactive access to portions of the data at the DMC, but until now the DMC has been primarily a batch-oriented request processing system. With the DHI, the DMC now offers a well-documented Application Program Interface (API) to let DHI-enabled client applications directly access information that reside at the IRIS DMC.

DHI Servers

The DMC now operates three distinct DHI Servers. The Event Data Center provides information about earthquakes, including their time, location, and magnitude. All of the bulletin information that the DMC has stored in its Oracle Database from NEIC and the ISC are available through this service.

The Network Data Center provides information about the thousands of seismic, stations, channels and related information that the IRIS DMC has in its Oracle DBMS. Among the more complex pieces of information available through this interface is all of the response information for the various recording channels from which the DMC manages seismograms.

The Waveform Data Center provides access to each of the four waveform repositories at the DMC; the archive itself, the BUD system, the FARM event products and the SPYDER® event products. When utilizing the waveform data centers, seismogram objects from any of these sources can appear directly within a DHI enabled client.

All of the DHI Servers have been written in Java although in theory they could be written in any object oriented language.

DHI Clients

The development of DHI clients was also undertaken by the DMS this year. At the present time we have four clients that are now released, and three more that are still in the development stages. You can always visit http://www.iris.washington.edu/DHI to see the current list of clients that are available. Highlighting a few of these clients might be useful.

JEvalResp

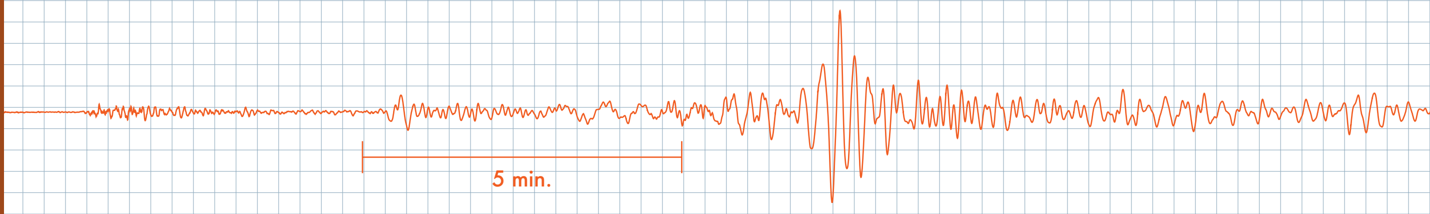
This client application can either read RESP files (as generated by rdseed) on a local disk or connect via the DHI system to access responses from the DMC Oracle DBMS. The interface is easily understood and can result in either files containing the computed response amplitude and phase at selected frequencies or can result in a graph showing the amplitude and phase.

VASE (Visualization and Seismogram Extraction)

VASE is a DHI enabled application that can recover and display any seismograms in the BUD Waveform Data Center. Since the BUD buffer is roughly two months long for broadband channels it can normally be used to recover data for all recent earthquakes. Another very powerful feature of VASE is that if you specify an end time in the future the client will recover existing data from the BUD buffer and then stream data as it is received by the BUD system.

The University of South Carolina has also produced the Global Earthquake Explorer (GEE) client for the IRIS E&O program and also has completed the initial work on the Standing Order for Data (SOD) application. Work continues on the DHI WEED application as well as the DHI to MATLAB Interface by the University of Washington. A group led by Paul Morin at the University of Minnesota is using the DHI to feed a three dimensional waveform viewing package using the GEOWALL.

E&O



The IRIS Education and Outreach program is committed to making significant and lasting contributions to science education, science literacy and the general public's understanding of the Earth, using seismology and the unique resources of the IRIS Consortium.

Standing Committee

Richard Aster (Chair)	New Mexico Tech
Thomas Boyd	Colorado School of Mines
Michael Hamburger	Indiana University
Alan Kafka	Boston College
John Lahr	US Geological Survey, Denver
Robert Mellors	San Diego State University
Susan Schwartz	University of California, Santa Cruz
John Taber	E&O Program Manager

The E&O program has activities that span all educational levels from public outreach to K-12 and college education. The past year has been a time of growth for the program, with the addition of new staff and the initiation of new programs. We have also accepted our first Educational Affiliate members who are interested in helping us develop better access to IRIS educational activities for two- and four-year colleges and universities. A new joint IRIS–SSA Distinguished Lectureship has been established and presentations will be given to large public audiences throughout the US.

Our museum program, a partnership between IRIS, the US Geological Survey, and several major museums across the nation, reaches large audiences (8 million people per year) via three permanent and one traveling exhibit. Our traveling display, on tour with the Franklin Institute's "Powers of Nature" Exhibit, is now in its fifth year. This year's stops have included the Denver Museum of Nature and Sciences and the North Carolina Museum of Natural Sciences. The E&O program continues to work with all museum partners to evaluate the existing exhibits and develop modules for future displays, including for example, software for a new wide-screen earthquake display.

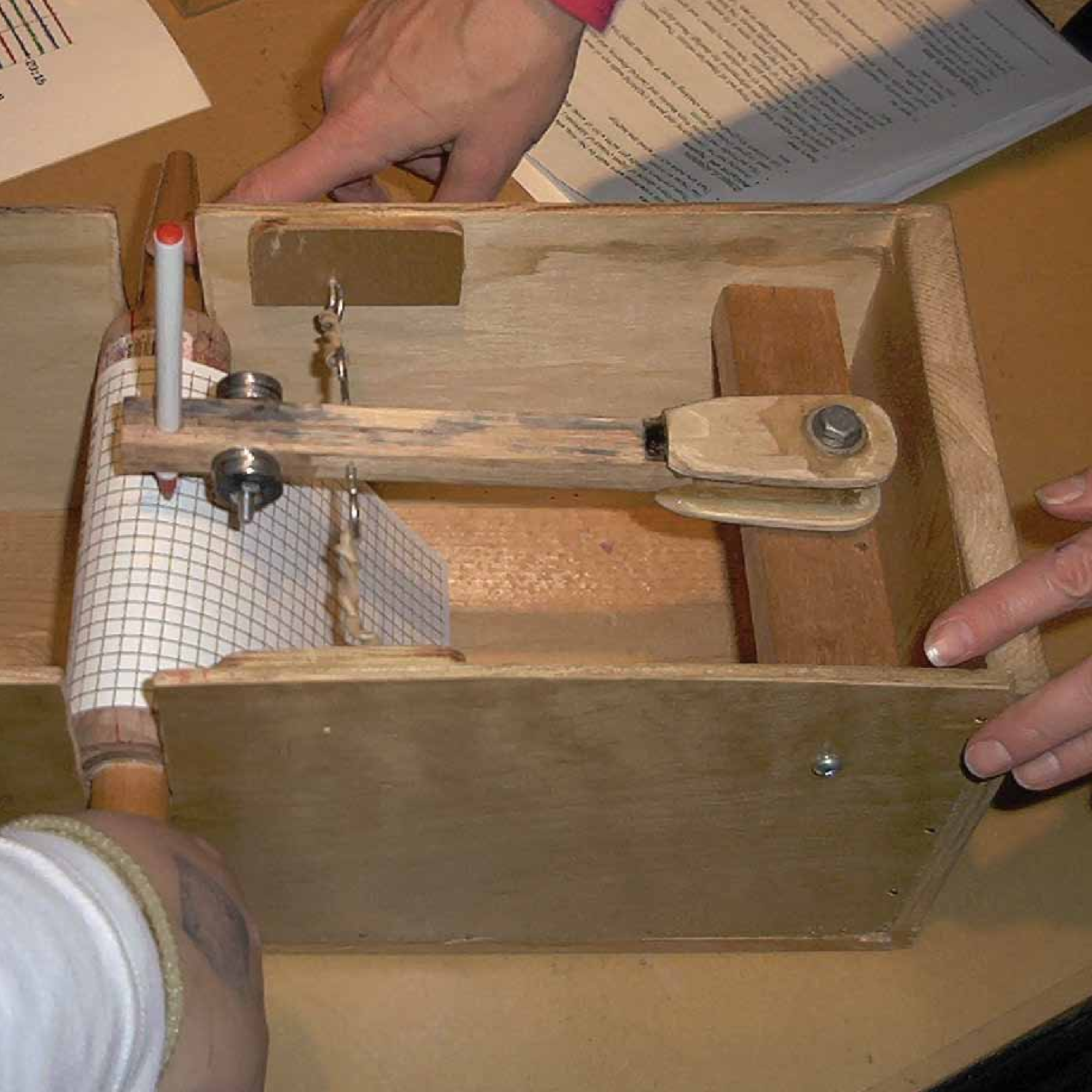
The E&O program promotes Earth science awareness and learning in the pre-college curriculum through educational seismographs for K-12 science teachers. In the past year, inexpensive AS-1 vertical seismographs have been distributed to 30 schools, along with computer software and explanatory materials for use in the classroom, bringing the total to over 50 schools. Technical support (through Indiana University) has also been provided for Princeton Earth Physics Project (PEPP) seismographs. Over 25 school PEPP stations are now connected via the Internet and PEPP data is now archived at the DMC. Using seismograms recorded at the school, students can study seismic waves in the Earth, where earthquakes occur, plate tectonics, the concepts of earthquake magnitude and intensity, earthquake location, earthquake hazards, and many other topics that are interesting and relevant to students.

Continuing E&O core activities include workshops for geoscience educators (see next page), a summer undergraduate internship program, and the development of educational materials. Six interns spent last summer with IRIS researchers on projects ranging from using seismic tomography to determine the structure of the East Pacific Rise to improving earthquake probability estimates. Seed money grants were awarded this year to eight IRIS institutions to develop new educational activities related to the use and interpretation of seismic data. A new, more interactive version of the web-based Seismic Monitor has been completed, allowing users to zoom into selected map regions and to discover related earthquake information. To reach an even wider audience we collaborate with other geoscience education programs, such as the Digital Library for Earth System Education (DLESE). We are a partner in the Electronic Encyclopedia of Earthquakes project led by the Southern California Earthquake Center (SCEC) and have also been involved in the development of a plan for the EarthScope Education and Outreach Network (EON).

New software tools are under development though a subaward to University of South Carolina. These tools will provide much better accessibility to IRIS data sets for educational purposes. The new Global Earthquake Explorer software and associated instructional materials will be the key to leveraging the valuable seismic data sets that are at the heart of IRIS. The success of the E&O program is directly attributable to those who have volunteered their time and energy. In particular we acknowledge the enormous contributions of the E&O committee members, and we encourage continued participation by individuals within and beyond IRIS.

Teacher and Faculty Workshops 2002

Hoosier Association of Science Teachers annual meeting	Indianapolis	February
National Science Teachers Association annual meeting	San Diego	March
AGU's Geophysical Information for Teachers workshop	Washington, DC	May
National Science Teachers Association regional meeting	Louisville	October
California Science Teachers Association annual meeting	San Francisco	October
Geological Society of America annual meeting	Denver	October



Professional Development Workshops in 2002

John Taber, E&O Program Manager

The IRIS E&O program has developed a creative, highly effective, one-day professional development experience to address the needs and demands of the formal education community. These experiences enhance the Earth science foundation of grades 5 – 12 educators and provide them with innovative activities. This supplies them with the tools needed to stimulate an early interest in science for students. Additionally, a modified version of the professional development experience can address the needs of two-year and four-year colleges and universities that do not have a seismologist or geophysicist on their faculty and may desire instructional materials, content resources, ideas, and expertise to teach seismology-related topics.

This year 115 teachers and 25 college faculty took part in workshops organized by IRIS Consortium members. The workshops were held in conjunction with a range of national and regional science meetings and in most cases were a full day in length. The goals for each workshop are to;

- Improve participants foundation in seismology and Earth science
- Provide innovative activities that can be used in the classroom
- Model an active learning environment.

The participants in each professional development experience take on three roles during each session: 1) As an active participant in demonstrations and activities, 2) As a student, being aware of how their students will use the activities, and 3) As an instructor, providing feedback and suggestions to the presenters and the other participants. Through these three roles, participants learn how to understand and use seismological data, educational software and analysis tools, and seismology and related Earth science content. The workshops also provide participants with the experience of learning new content through active-learning investigations and small group activities. Interaction with their peers stimulates additional learning and also provides time to discuss the implementation of the model in their Earth science classrooms.

Participation in an IRIS professional development experience can require physical activity such modeling P and S waves in a human version of a slinky or jogging across the room while simulating the process of earthquake location. In other activities, participants create earthquakes with an earthquake machine or build simple structures and subject them to destructive shaking. Participants experience seismic concepts through a variety of techniques, including interactive computer programs using seismic data, as well as simple and inexpensive foam and cardboard models. Principles of a seismograph are demonstrated using an AS1 seismograph. The participants receive a wealth of materials to take back to their classrooms, including maps, posters, a binder with descriptions of all the day's activities, as well as a book and pamphlets on earthquakes and plate tectonics.

Surveying the participants is critical to our continuous improvement effort and to ensure that the materials and information we are providing addresses the educators' needs. Based on the evaluations of the 2002 and previous year's workshops, it is clear that the teachers find the day very worthwhile. Scores for key questions are shown in the evaluation results table. Quotes from this year's workshop evaluations include:

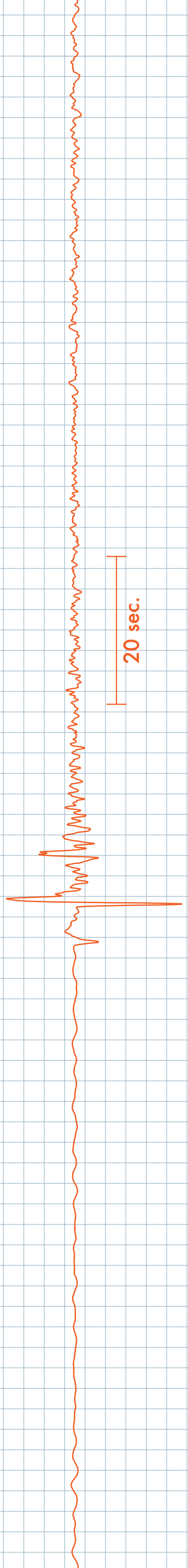
- "Doing, Doing, Doing = Learning. What a great workshop!"
- "I loved doing the hands-on activities! I will use all of them and share them with fellow teachers!
- "I love this workshop. It was the best use of my time!"

While not offered in 2002, IRIS also conducts workshops designed to train seismologists and their graduate students to lead teacher workshops. Future plans include partnering with other non-profit and governmental organizations for multi-day workshops, targeting specific school districts as part of their coordinated, systemic professional development efforts, and developing tools to measure the long-term impact of the workshops.

2002 Workshop Evaluation Results

Questions	Average Response
The instructors displayed a clear understanding of workshop topics.	5.0
The workshop was well organized.	4.9
I can apply information/skills learned in this workshop.	4.8
As a result of this workshop, I will definitely implement some additional seismology and/or Earth science topics in my teaching.	4.8
Overall, the workshop instructors were among the best teachers I have known.	4.5
Overall, this workshop was one of the best that I have ever attended.	4.5
(5) = Strongly Agree, (4) = Agree, (3) = Undecided, (2) = Disagree, (1) = Strongly Disagree	

Data gathered from 125 of the 140 participants (89% response rate) in 2002 IRIS professional development workshops.



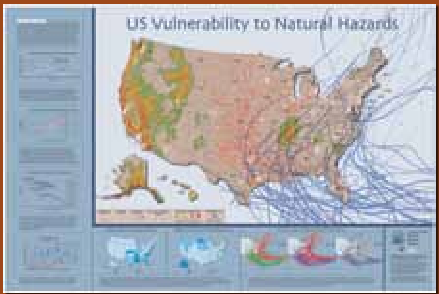
Activities and Publications

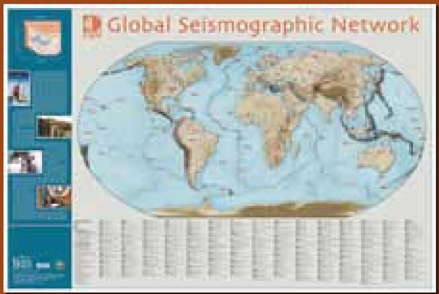
2002 IRIS Workshop, Outrigger, Hawaii

In addition to program oversight and administration, the Consortium also serves the role of an on-going forum for exchanging ideas, setting community priorities, and fostering cooperation. To enhance this role, IRIS engages the broader community through the use of publications and workshops. Our publications, which are widely distributed without charge, are organized around topical issues that highlight emerging opportunities for seismology. The annual workshop is used to assess the state of the science, introduce programs, and provide training. Through a student grant program, young scientists attend the workshop at little or no cost, and become introduced to the programs and services of the Consortium. As a Consortium, IRIS also serves as a representative for the Geoscience community. IRIS staff and Committee members serve on White House Committees, State Department Advisory Boards, US Geological Survey panels, and testify before Congress. Such broad interactions raise the profile of Geosciences and provide a direct societal return from the federal investment in IRIS.

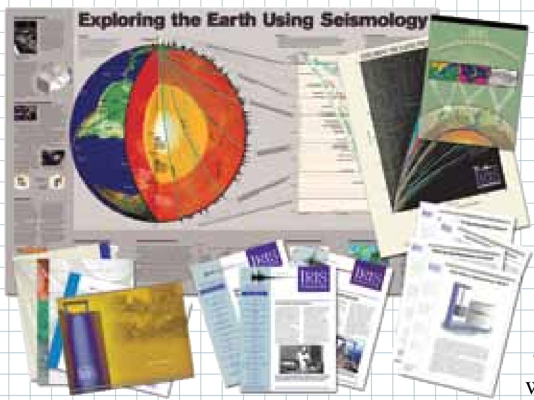
Meetings and Publications Subcommittee

Gary Pavlis (Chair)	Indiana University
Richard Aster	New Mexico Tech
Roy Johnson	University of Arizona
Monica Kohler	University of California, Los Angeles
Barbara Romanowicz	University of California, Berkeley
Gregory van der Vink	IRIS Director of Planning



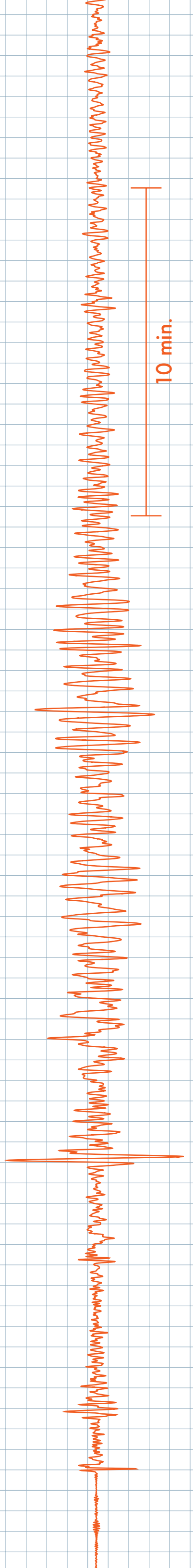


Two new posters are currently being produced for an expected distribution in late Spring 2003.

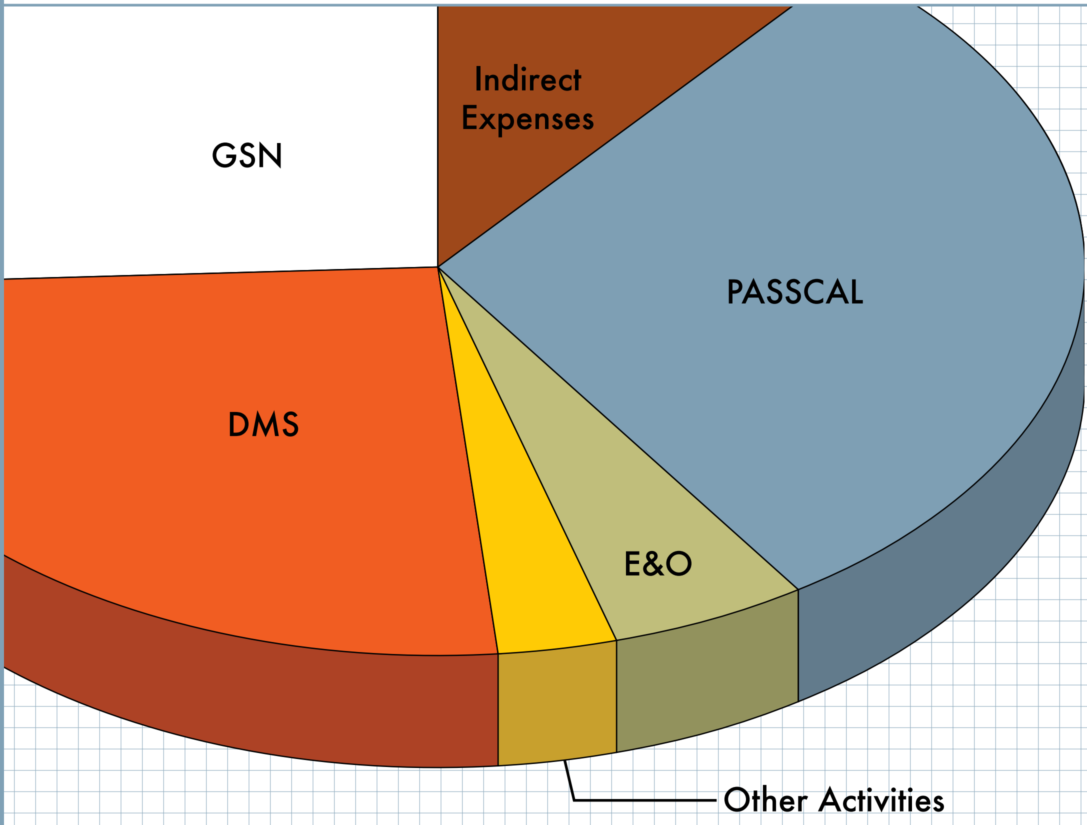


Through the Education and Outreach Program, IRIS develops and distributes posters about seismology. The posters are featured at various scientific and educational meetings, and can be found on classroom walls around the world. IRIS has developed a series of "one-pagers" to attract the attention of students, educators, decisionmakers, and the general public. The one-pagers provide succinct explanations of basic seismological concepts, and are available in hard-copy and on the web in both English and Spanish.

EarthScope publications were produced by IRIS on behalf of the EarthScope community with support from the National Science Foundation



Financial 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 is incorporated in the State of Delaware.

Budget and Finance Subcommittee

Clifford Thurber (Chair)	University of Wisconsin, Madison
Susan Beck	University of Arizona
Robert van der Hilst	Massachusetts Institute of Technology
Candy Shin	IRIS Business Manager

GSN

The Global Seismographic Network 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 stations of the IDA Network and other stations not funded directly within the budget of the USGS. Operation and maintenance of USGS/GSN stations is funded directly through the USGS budget. Subawards include the University of California, San Diego, the University of California, Berkeley, the California Institute of Technology, Columbia University, University of Hawaii, Albuquerque Seismological Laboratory, and Synapse Science Center, Moscow.

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 provide technical support for instruments in the field. Subawards include the New Mexico Institute of Mining and Technology, Stanford University, the University of California, San Diego, and University of Texas at El Paso.

DMS

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, Synapse Science Center, Moscow, and University of South Carolina.

Education and Outreach

Funding for the Education and Outreach program is used to support teacher and faculty workshops, undergraduate internships, the production of hard-copy, video and web-based educational materials, a distinguished lecturer series, educational seismographs, and the development of museum displays. Subawards are issued to IRIS institutions for software and classroom material development, summer internship support and support of educational seismology networks.

Indirect Expenses

Costs include corporate administration salaries, business office salaries, accounting and legal consultant services, insurance, administrative staff, headquarters expenses, and corporate travel costs.

Other Activities

Other activities include IRIS workshops, publications and special projects such as KNET. 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.

IRIS/NSF Cooperative Agreement

Program Budgets	FY2003	%
GSN	3,356,791	26%
PASSCAL	3,898,828	30%
DMS	3,395,847	26%
E&O	596,347	5%
Other	391,345	3%
Indirect Costs	1,446,480	11%
Total	13,085,638	100%

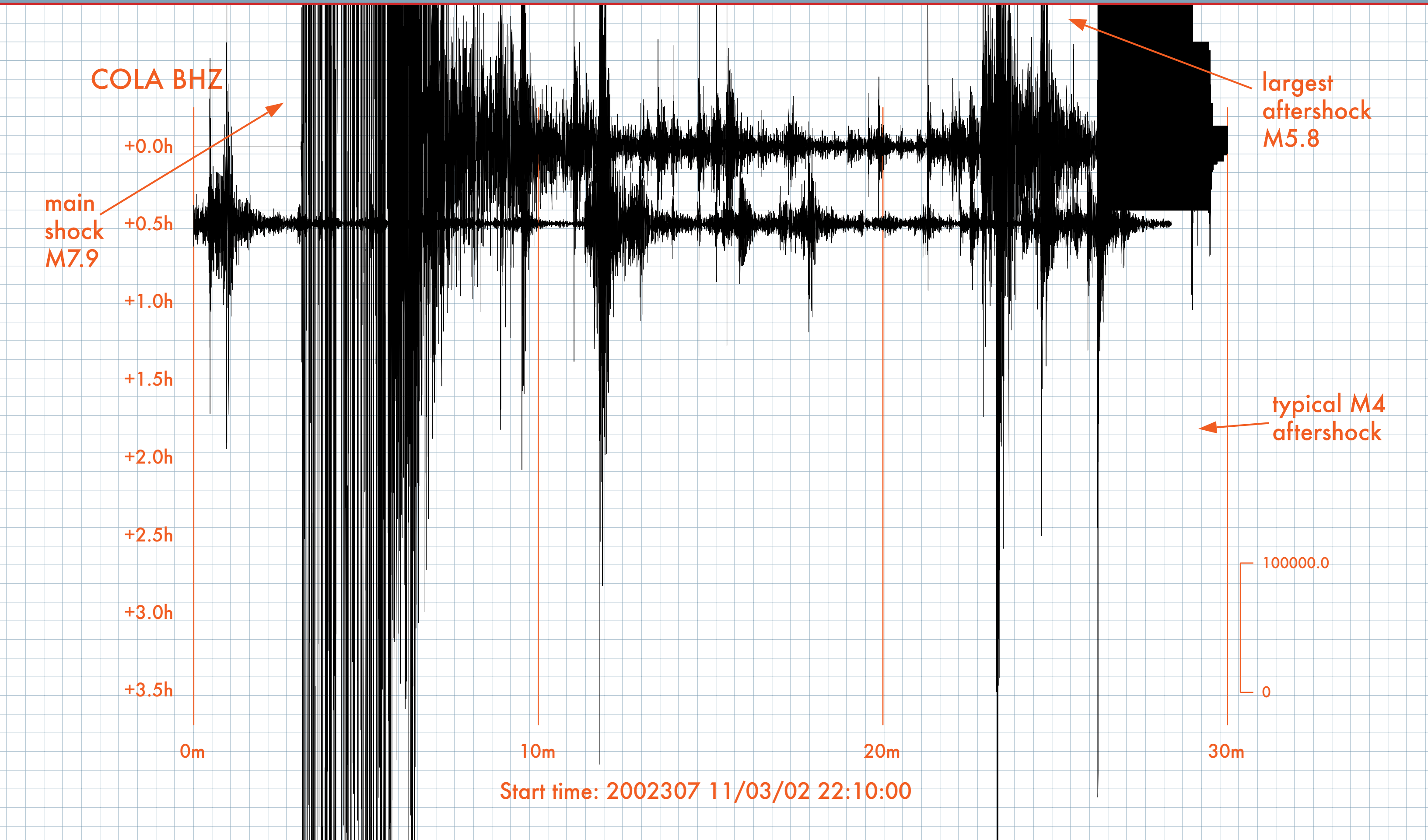
Denali Fault Earthquake Rocks Alaska at 7.9!

Natalia Ratchkovski, University of Alaska, Fairbanks

On Sunday, November 3, a magnitude 7.9 earthquake struck central Alaska. It was the largest earthquake known to occur in the world this year. The epicenter was located approximately 75 miles (135 km) south of Fairbanks and 176 miles (283 km) north of Anchorage. It struck at 1:12 PM local time, causing countless landslides and road closures, but minimal structural damage and few injuries and no deaths.

The earthquake resulted from slip on the Denali fault – a strike-slip fault that stretches over 700 km across the State of Alaska and extends southeastward into Canada. The first motion focal mechanism (University of Alaska, Fairbanks), and teleseismic body waves analyzed by Kickuchi and Yamanaka indicate that the event began as a northeast striking reverse fault, and evolved into a 300 km right-lateral strike-slip rupture. Aftershock locations and surface slip observations indicate that the rupture was predominately unilateral in the eastward direction.

Geologists followed the earthquake rupture by helicopter through valleys, across streams, and along glaciers. Near Mentasta Lake, a village that experienced some of the worst damage in the quake, the surface scar turns from the Denali fault to the adjacent Totschunda fault. Near the Tok cutoff, the eastern highway crossed by the fault, maximum offsets of 13-15 meters were observed. This earthquake is one of the largest ever recorded on U.S. soil and the largest seismic event ever recorded on the Denali fault system.



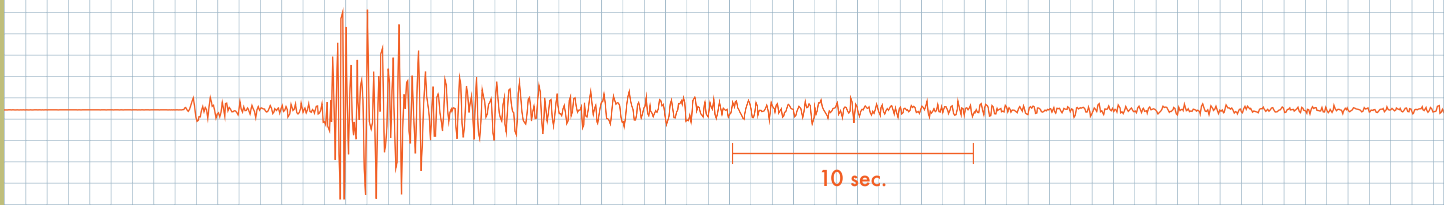
Deep Russian Earthquake, June 28, 2002

Terry Wallace and Robert Fromm, University of Arizona

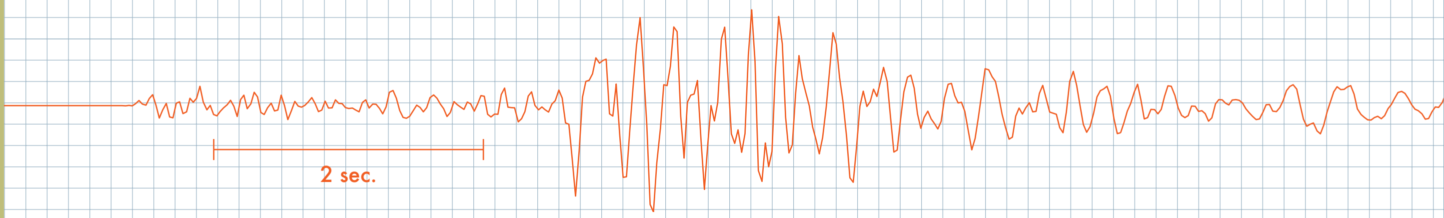
On June 28, 2002 a magnitude 7.3 earthquake occurred at 566 km depth beneath the Russia-China border in eastern most Asia. The earthquake occurred within a very seismogenic zone of the subducting Pacific plate. The focal mechanism for the earthquake indicates that the fault plane is essentially flat; the near-vertical auxiliary plane strikes north-south. The earthquake was recorded on the CDSN-IRIS station MDJ (Mudanjiang, China) equipped with STS-1 very broadband seismometers.

One of the unexpected consequences of using very broadband seismic instrumentation is that components of the seismic wavefield that are traditionally ignored can be recorded, and thus modeled. MDJ sits nearly on top of the hypocenter, and the signals shown above have the instrument removed. The P and S waves are relatively simple; the event was a double source, each about 5 seconds in duration. However, in addition to the P and S wave far-field displacements, the near-field displacement is also recorded. The near-field decays in amplitude proportional to 1/r2, and depends on seismic moment and on its integral rather than seismic moment rate. The near-field displacement is manifested as a ramp between the P and S waves, as well as a static or permanent offset.

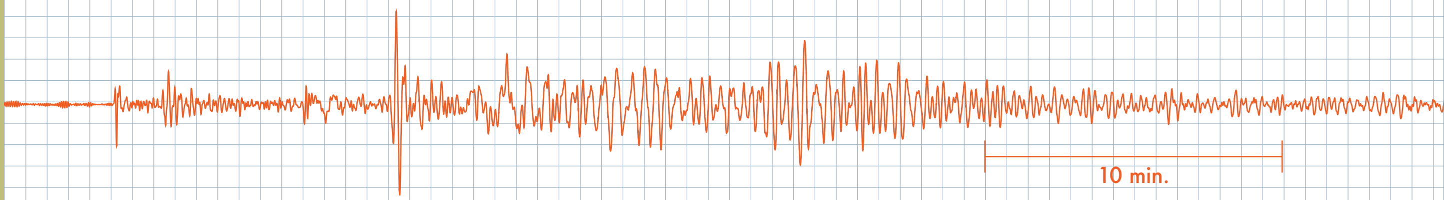
The 2002 earthquake is nearly in the exact location of a magnitude 7.1 that occurred in 1999. The large moment release at the tip of the descending Pacific plate is an important constraint on the mechanics and dynamics of deep earthquakes, which remains as a unsolved problem in seismology.



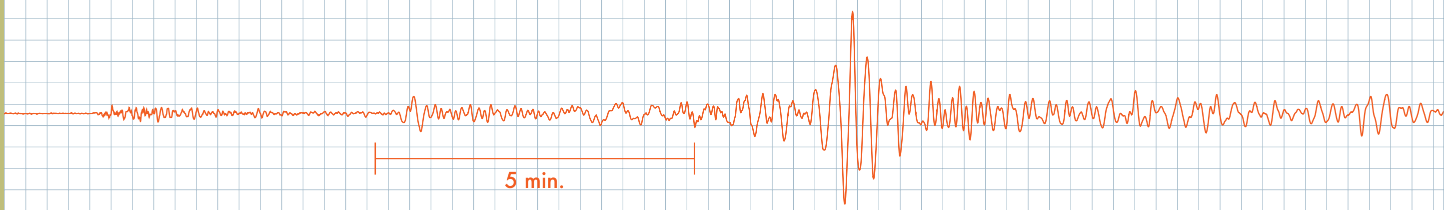
Princeton Community High School in Indiana (PPPCH) recorded this magnitude 5.0 earthquake on June 18, 2002. The earthquake was located near Darmstadt, Indiana and was widely felt with initial reports from as far away as West Virginia. The earthquake caused only minor damage in the immediate area of the event. Station PPPCH is one of 14 Indiana University Princeton Earth Physics Project (PEPP) stations (Gary Pavlis, Indiana University).



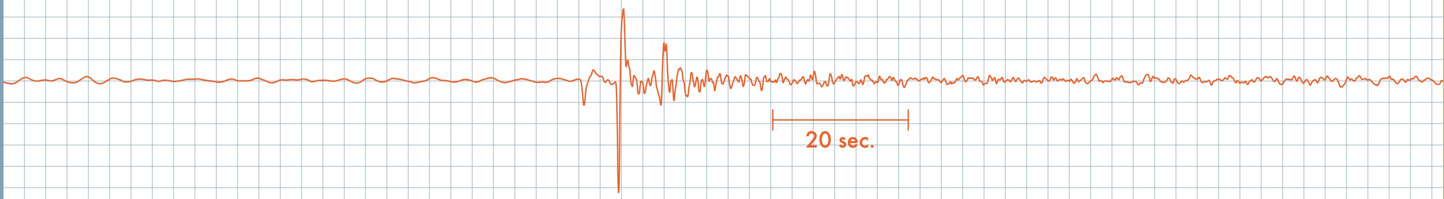
During the Himalayan Nepal Tibet Seismic Experiment (HIMNT) a magnitude 4.2 event was recorded on February 3, 2002. The event occurred at 7:42 am and was located at 32 kilometers depth at latitude 27.27, longitude 86.23 but was not reported in the NEIC catalog. Shown here is the North-South component of station JIRI in northeast Nepal. The HIMNT experiment is designed to study the geometry of faulting and mountain building processes in the Himalaya (Anne Sheehan, University of Colorado).



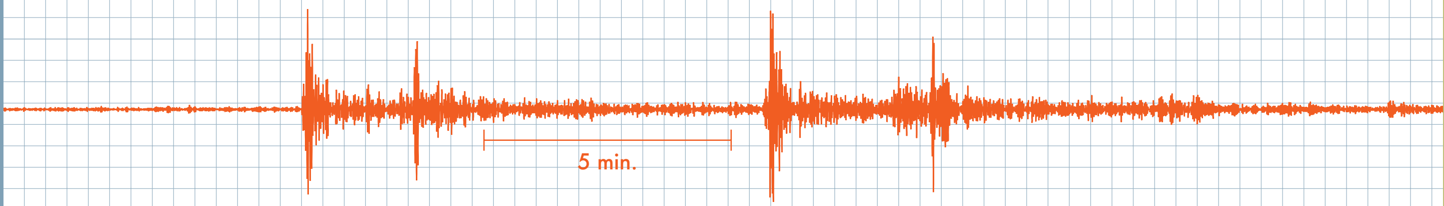
Recording of the June 22, 2002 magnitude 6.2 earthquake in Western Iran. This seismogram was recorded on an STS-2 seismometer during the RUSH (Reflections under the Scottish Highlands) PASSCAL experiment at station STOR on the northwestern coast of Scotland. Station-event distance is 42 degrees leading to amplified secondary phases after the P and S waves due to PP-PcP and SS-ScS interference. The RUSH experiment is designed to image seismic reflectors in the mantle lithosphere and their relationship to major tectonic boundaries in Scotland (Tom Owens, University of South Carolina).



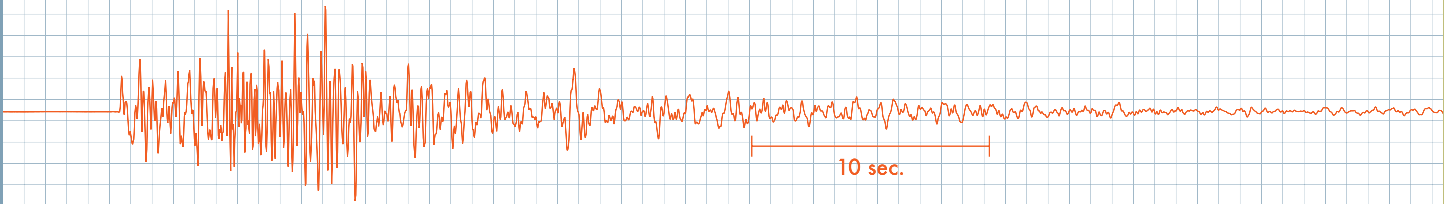
Unfiltered Recording of the October 3, 2002 magnitude 6.3 earthquake in the Gulf of California. This seismogram was recorded on a PMD-2023m seismometer and Symmetric Research PAR4 (24bit) digitizer installed at Batesburg-Leesville High School, a participant in the South Carolina Earth Physics Project. Station-event distance is 25.7 degrees (Tom Owens, University of South Carolina).



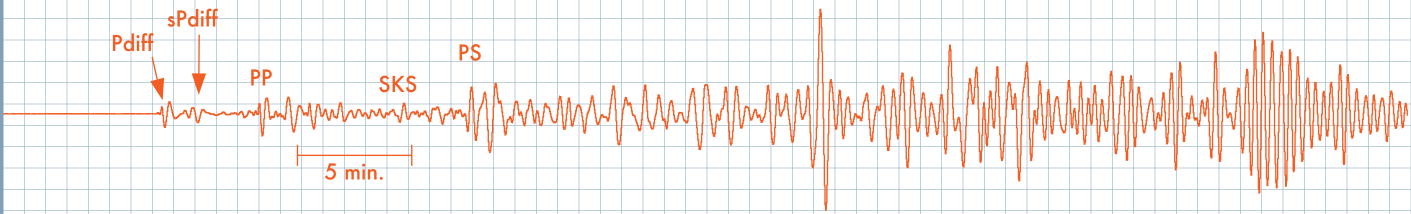
Beautiful PKP triplication seen at Pitinga Brazil (PTGA) from a distance of 149 degrees. The 5.9 magnitude earthquake occurred on January 7, 2002 near the Mariana trench at a depth of 603 km. This event was recorded with a Geotech KS54000 borehole instrument. The data are unfiltered (Tyler Storm, USGS Albuquerque Seismological Laboratory).



Two very deep Tonga trench events (7 minutes apart) recorded on August 19, 2002 at St George's Bermuda (BBSR). The recording instrument was a Guralp CMG3-T-B borehole instrument. The PKP and PP arrivals show up well with a bandpass filter around 1 Hz. Station BBSR is the newest Global Seismographic Network station (Tyler Storm, USGS Albuquerque Seismological Laboratory).



This 4.6 magnitude quake recorded July 24, 2002 on a Pitcairn Island (PTCN) with Streckeisen STS-2 surface instrument appears to have the same source as the earthquake swarm in late 2001. These events have caused considerable excitement since there has not been any activity recorded at this hotspot in recent times (Tyler Storm, USGS Albuquerque Seismological Laboratory).



This seismogram was recorded by station FA08 at Southeast Missouri State University as part of the FLED (Florida-to-Edmonton) PASSCAL deployment to investigate the structure under North America. This magnitude 7.3 earthquake occurred on March 3, 2002 in the Hindu Kush region of Afghanistan at 195 km depth. FA08 is 105.1 degree away from the earthquake. The data was recorded in real-time over the Internet using the Antelope system. (Michael Wysession, Washington University).

IRIS Staff

Headquarters

Incorporated Research Institutions for Seismology
1200 New York Avenue, NW, Suite 800
Washington, DC 20005
Tel: 202.682.2220
Fax: 202.682.2444
www.iris.edu

David W. Simpson	President
Gregory E. van der Vink	Director of Planning
Shane Ingate	Director of Operations
Rhett Butler	Global Seismographic Network Program Manager
John Taber	Education & Outreach Program Manager
Candy K. Shin	Business Manager
Robert Austin	Business Analyst
Michael Hubenthal	Education Specialist
Naim Jones	Business Analyst
Cecelia Kelton	Accounting Manager
Jason Mallett	Publications Coordinator
Maria Teresa Saavedra	Receptionist/Secretary
Susan Strain	Executive Assistant

IRIS Data Management Center

1408 NE 45th Street, Suite 201
Seattle, WA 98105
Tel: 206.547.0393
Fax: 206.547.1093

Timothy Ahern	Program Manager
Rick Benson	Director of Operations
Deborah Barnes	Information Services Coordinator/Webmaster
Rick Braman	UNIX Systems Administrator
Robert Casey	Software Engineer
Mary Edmunds	Data Control Technician
Stacy Fournier	Data Control Technician
Linus Kamb	Software Engineer
Chris Laughbon	Senior Software Engineer
Anh Ngo	Data Control Technician
Leanne (Beach) Rubin	Office Manager
Sue Schoch	Senior Software Engineer
Sandy Stromme	Software Engineer
Bruce Weertman	Software Engineer
Russ Welti	Software Engineer

IRIS PASSCAL Instrument Center

New Mexico Tech
100 East Road
Socorro, NM 87801
Tel: 505.835.5072
Fax: 505.838.5079

James Fowler	PASSCAL Program Manager

"there was something gorgeous about him,
some heightened sensitivity to the promises of life,
as if he were related to one of those intricate machines
that register earthquakes ten thousand miles away."

– second page of *The Great Gatsby*, by F. Scott Fitzgerald

IRIS Consortium
1200 New York Avenue, NW
Suite 800
Washington, D.C. 20005

ADDRESS CORRECTION REQUESTED

Non Profit Org.
U.S. Postage
PAID
Washington, DC
Permit No. 1227