

6 | INTERNATIONAL DEVELOPMENT SEISMOLOGY

HISTORICAL CONTEXT OF CURRENT OPERATIONS

Although IRIS was founded as a consortium of U.S. research institutions, the outlook of its members and the scope of its activities have been international from the earliest days. Discovering deep Earth structure, mapping the complexity of continental and oceanic lithospheric structure, and studying great earthquake rupture all require a global perspective. An example of this perspective is that data from USArray—which was envisioned as a facility to study the North American continent—have been used to gain new insights about rupture of earthquakes around the world, the dynamics of the inner and outer core, and other subjects.

The scientific impetus toward a global perspective has led numerous individual investigators and the IRIS facilities to embrace an international approach. Close and long-term collaborations with colleagues from countries in virtually every region of the world have been essential to achieving the goals of research projects and to creating facilities that support such projects. A large majority of GSN stations are located outside of the United States and many rely on local hosts for reliable operation. About half of all PASSCAL deployments are abroad. DMS manages data from geophysical networks worldwide and serves users in dozens of countries. E&O collaborates with educators in many countries.

Seismology abounds with broader societal impacts: seismologists are Earth scientists with observational tools and quantitative skills that are used in numerous applications, including

natural hazard mitigation, resource discovery, national security, and environmental change. It is not surprising that the nature of these impacts is different in developing countries, holding the possibility of even more profound benefits to both science and society.

International Development Seismology (IDS) constitutes one IRIS interface between its NSF-sponsored scientific mission and the imperative to ensure that scientific progress enables socially important outcomes. The specific focus of this effort responds to the recognized importance of developing the partnerships, technical infrastructure, and human capacity required for effective international cooperation, not only as an instrument to accelerate scientific progress through collaboration with technologically equal partners, but also as an essential element of various other modes of U.S. foreign engagement, including foreign assistance and science diplomacy.

In this context, although IDS activities are not directly discovery-oriented, they are closely aligned with those identified in NSF's organic authorizing legislation to initiate and support specific scientific and engineering activities in connection with matters related to international cooperation, national security, and the effects of scientific and technological applications upon society.

Because IDS goals span the boundary between knowledge expansion and its societal impact, IDS is conceived to be only partly dependent on NSF/EAR support. NSF-sponsored IDS activities are thus designed to serve as seeding efforts or pilot projects targeted toward achieving two complementary, synergistic goals. The first goal is to aggressively promote strategies that support fundamental research and exploration through wide and reliable geographic coverage. The second goal is to contribute to reducing global population exposure to seismic hazards through broad education of scientific and technical principles that have an impact on societal resilience through increased awareness, preparedness, and accountability.

IDS evolved from the charge to the IDS Committee created by IRIS Board of Directors in 2008 upon the recommendation of the International Working Group. The recommendation emerged as an IRIS community response to address two complex challenges:



Figure A6.1. The first DMS Metadata Workshop was held in Palmonova, Italy during 2006. It brought together seismologists from Africa, the Middle East, and Central Asia. Subsequent workshops in Brazil, Malaysia (above photo), and Egypt have helped seismologists in developing regions around the world to achieve new standards in data management.



Figure A6.2. One of IRIS's long-term instrument loans was to permanently improve monitoring on the Nicoya Peninsula, Costa Rica, by helping Universidad Nacional to re-occupy vaults that were constructed for PASSCAL experiments. Here, Victor Gonzalez of UNA services a station that part of a cooperative, multi-disciplinary project with the University of California, Santa Cruz, to monitor Arenal Volcano. Other instruments were loaned to AfricaArray, the University of Bangladesh, the Kyrgyzstan Seismic Network, and Instituto Nacional de Prevención Sísmica, Argentina.

1. To leverage U.S. investment in advancing scientific understanding of some of the most complex tectonic systems on Earth by engaging the sustained and active participation of low- and middle-income countries located in these territories in the necessary expansion of modern seismological research capability
2. To address the social responsibility of the scientific community to facilitate the translation of new knowledge into societal benefits, by contributing to efforts toward sustainable development of low- and middle-income countries partly through the mitigation of population exposure to seismic hazard

The potential for special approaches to return greater scientific and societal benefits was widely recognized in responding to the 2005 Sumatra earthquake and Indian Ocean tsunami. IRIS has undertaken several activities that build on this potential, including participation of GSN and PASSCAL staff in training programs, organizing data management workshops for seismologists in developing countries, and making long-term loans of selected and reconditioned PASSCAL instruments to leverage other contributions that improve seismological monitoring networks in developing countries.

CURRENT OPERATIONS

IDS activities are undertaken with the advice and guidance of the IDS Committee and Board of Directors in response to IRIS community international engagement needs.

The ability to promote effective, large-scale engagement of foreign national resources in local seismological development depends on circumstances often unique to each country. The success of any efforts designed to promote the sustainable development of national or regional capacity in geophysics depends on a solid understanding of national institutions and policies and the cultural environment in which the scientific activities will take place. IDS initiates and maintains communication with appropriate foreign governments and officials as well as academic and research leaders to identify optimal strategies to support seismological development in selected countries. IDS identifies partner national, foreign, and international government and nongovernmental organizations (NGOs) that share IRIS scientific goals and objectives, or whose development goals and objectives complement the IRIS mission, and develops an in-depth functional understanding of these organizations to establish suitable partnerships.

While it is valuable to identify alternative funding sources from the country of interest, suitable funds often originate from other high-income countries sharing common scientific and development goals with the United States. IDS identifies non-traditional or small-scale science funding sources in the United States and abroad to leverage NSF scientific investment in seismological research in foreign countries. IDS initiates and maintains communication with key officials in U.S. government agencies, professional societies, and NGOs responsible for international cooperation not only in geophysics, but in science in general, to identify trend and policies that may result in funding and collaborative opportunities for IRIS and its Affiliates. IDS pursues funding or in-kind support to leverage NSF seeding funds for IDS activities from non-traditional funding sources, and for negotiating the terms and conditions of this support while ensuring that scientific objectives remain central to each activity.

DEVELOPMENTS UNDER THE CURRENT COOPERATIVE AGREEMENT

Given the success of the AfricaArray Project (a collaboration among Penn State, the University of Witwatersrand, and the South African Council for Geosciences), in 2008, IRIS convened a workshop—*Out of Africa*—that focused on adapting the AfricaArray model to other regions of the world. Expanding education was identified as the most important issue for geophysics in developing countries. As a consortium in which the member organizations are almost all institutions of higher learning as well as research, IRIS is well suited to address this priority. However, with activities related to seismology in developing countries distributed across all of IRIS, the need to coordinate efforts among diverse IRIS activities and with external organizations was identified. Consequently, the International Working Group recommended to the IRIS Board of Directors the creation of the IDS Committee and the hiring of a Director of IDS.

Over the past two years, IDS activities have spanned from exploratory meetings, to collaborative projects, to multidisciplinary activities in response to destructive earthquakes. Additional efforts have focused on pursuing funding for capacity-building and transitional activities across the science-policy boundary.

The outstanding finding from a joint meeting of the (Centro Regional de Sismología para América del Sur (CERESIS) and the IDS Committee in Lima, Peru, during 2009 was

the remarkable heterogeneity of conditions for conducting geophysical research, as well as earthquake monitoring and preparedness, among individual countries in South America. The conclusion was that effective seismological development in the South American region requires the design of strategies tailored to various unique national conditions. Upcoming IDS activities are planned to outline country-specific seismological development strategies in collaboration with identified scientific and academic leaders.

The devastating earthquakes in Haiti on January 12, 2010 (Mw 7.0) and in Chile on February 27, 2010 (Mw 8.8) dramatically highlighted the significance of socially responsible scientific foreign engagement and largely impacted the nature of IDS activities in 2010. These unforeseen IDS activities have received unexpected generous cross-sector support from U.S. government and nongovernmental organizations, establishing partnership models that demonstrate the feasibility of enhancing the value of NSF scientific investment.

The enormous post-earthquake challenges in Haiti demanded close interaction among the assistance, engineering, and scientific communities from the early stages of the recovery and reconstruction. In light of this challenge, the U.S. National Science and Technology Council's Subcommittee on Disaster Reduction requested IRIS assistance in convening an international, multidisciplinary

Figure A6.3. Seismologists from South-east Asia, South America, Central America, and the Caribbean Sea Region at the Out of Africa workshop agreed that expanded education programs are the highest priority to improve geophysical capacity around the world.

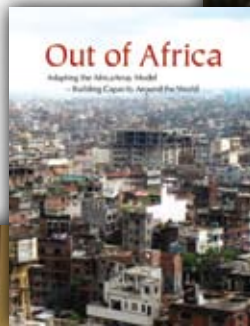


Figure A6.6. IRIS acted as the Workshop organizer for “Rebuilding for Resilience: How Science and Engineering Can Inform Haiti’s Reconstruction.”



Figure A6.4. To explore pathways for international cooperation leading to improved seismological capacity in South America, members of the IDS Committee met with representatives from nine CERESIS member countries.



Figure A6.5. Haiti's earthquake on January 12, 2010, presented unprecedented challenges to the science and engineering communities, to government agencies and nongovernmental organizations providing immediate relief as well as to those involved in longer term reconstruction. Photo credit: Walter Mooney, USGS

and cross-sector workshop entitled “Rebuilding for Resilience: How Science and Engineering Can Inform Haiti’s Reconstruction.” This workshop was cosponsored by the U.S. Department of State, the U.S. Agency for International Development, and the United Nations International Strategy for Disaster Reduction, and held at the University of Miami on its Coral Gables, Florida, campus.

Free and open access to data from deployments in Chile by several different countries was a significant achievement during the response to the Chile earthquake. IRIS received support through the NSF RAPID funding mechanism to install a portable network of 60 stations in the aftershock zone of the Chile earthquakes and closely collaborated with Chilean, French, German and British groups in coordinating site selection and data exchange. IDS contributed to the aftershock monitoring effort by securing supplemental support from the U.S. Department of Defense Southern Command in the form of no-cost transportation of equipment, and assisting with in-field logistic arrangements during service runs. The success of this participation demonstrated the ability to negotiate cross-sector support for scientific projects and establishes a valuable precedent for future cross-agency engagement.

The main focus of IDS is to support and facilitate activities of transitional nature between scientific progress, impact, and development. This requires the consolidation of resources derived from diverse stakeholders often unaware of their overlapping interests. Under the current Cooperative Agreement, IRIS has prepared and submitted proposals to support these types of activities. Notably, various organizations have approached IRIS to offer leveraging of financial support, highlighting current broad interest in scientific capacity as an integral component of development.

One of these activities is entitled “Geophysical Hazards and Plate Boundary Processes in Central America, Mexico and the Caribbean: A Workshop to Build Seismological Collaboration and Capacity.” This workshop, to be conducted in Heredia, Costa Rica, in October 2010 (with support from NSF Office of International Science and Engineering (OISE), USGS, USAID and State Department), will bring together seismologists from Central America, Mexico, the Caribbean, and the United States to plan and coordinate initiatives that will contribute to seismological research and hazard mitigation within the region. The workshop goals include developing a roadmap for research leading to regional site characterization products, “ShakeMaps” for scenario and actual earthquakes, and models of seismic velocity; making concrete plans for new science initiatives with tangible benefits to broader society, including regional data sharing, increasing regional geophysical expertise, and improving existing seismographic networks; and new

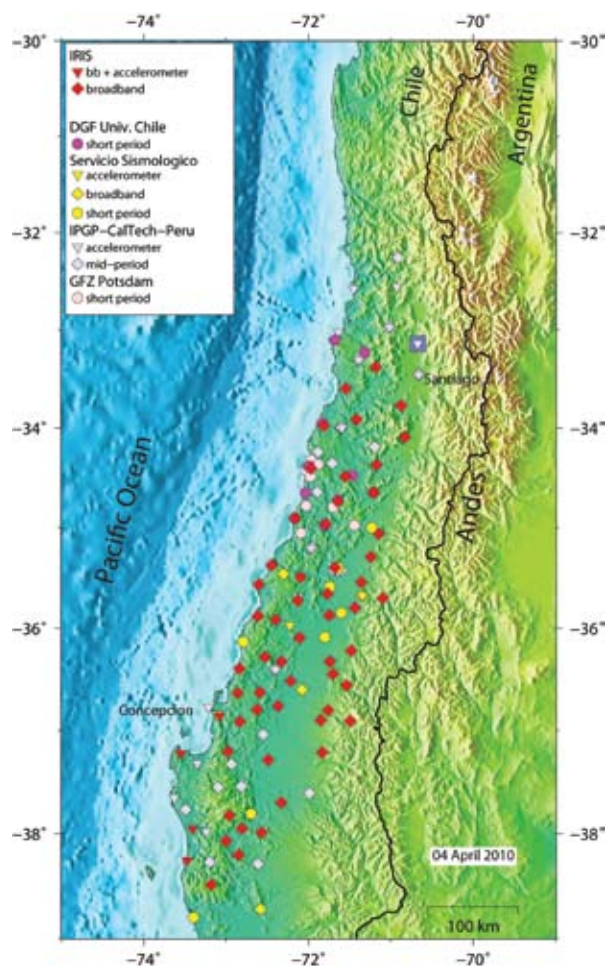


Figure A6.7. Following the February 27 earthquake in Chile, IRIS worked on behalf of its Members with scientists from U.S. universities and the University of Chile on the deployment 58 portable instruments funded by a RAPID award from NSF and coordinated closely with investigators from France and Germany.

scientific collaborations to address key questions regarding plate boundary processes in the diversity of tectonic environments of the region.

A second activity is the “Pan-American Advanced Studies Institute on New Frontiers in Seismological Research: Sustainable Networks, Earthquake Source Parameters, and Earth Structure” Institute to be held in Quito, Ecuador, in July 2011, with primary funding from NSF OISE. This Institute will focus on strategies for developing and maintaining modern seismological observatories and exploring recent advances in the analysis of seismological data in support of basic research, education, and hazard mitigation. The Institute is designed to engage graduate students, postdoctoral researchers, and new faculty from across the Americas in an interactive collaborative learning environment. The Institute’s primary objectives include developing an understanding of the principles of sustainable network operations; promoting open access and data exchange within and between countries in support of research, education, and hazard mitigation; and examining recent advances and current challenges in

characterizing earthquake sources and imaging Earth structure. The Institute can contribute to development of a guide to sustainable network operations, an inventory of networks in the Americas, and an index of data product software.

Other IRIS international activities, such as the DMS data management workshops, the training of co-investigators from abroad to assist in temporary deployments, and working with local operators of GSN stations have continued under the current Cooperative Agreement. Moreover, IRIS continues to look for opportunities to promote data exchange

by sharing software, developing standards, cooperating with data management organizations in technologically sophisticated countries, and by seeking innovative approaches to managing data from AfricaArray and other networks in developing countries. As exemplified by the Central Asia Data Exchange project initiated by the DMS, IRIS has also made extra investments of staff time and financial resources where a focused effort in a developing region seems especially likely to have a high impact.

NEW OPPORTUNITIES AND DIRECTIONS

The long-term goal of IDS is contributing to the understanding of Earth systems through the development of reliable and sustainable seismological research capacity with global coverage. Within the next decade, IDS objectives are to promote the development of nationally operated, sustainable seismological networks in low- and middle-income countries. Between July 2011 and September 2013, IDS will develop and solidify the functional structure necessary for the systematic expansion of ongoing pilot initiatives. Specifically, IDS will focus on two areas. One will be the continuous support of ongoing existing international activities led by IRIS facilities and IRIS Members in multiple geographic regions. The other will be to test a practical model for systematic promotion of seismological research capacity development in a select set of middle-income countries. The expectation is that it will be possible to reproduce and adapt this operational principle to countries in other regions and various development stages.

Seismology research in low- and middle-income countries can be conducted under a wide range of schemes, spanning from complete national autonomy to full dependence on foreign human, technical, and financial resources. The ratio between foreign and domestic involvement generally depends on a combination of economic and political factors that are unique to each country or region. Awareness and understanding of these unique circumstances will be crucial to the success of development initiatives.

IDS will develop and implement comprehensive protocols in pursuit of the IRIS mission, encourage foreign national investment in seismological research and monitoring, forge sustainable bilateral partnerships with national academic and research institutions, and government agencies, and foster the development of regional international seismic networks. Through active participation and support of these invest-

ments, IDS looks to promote the use of current standards for network operations, data formats and exchange protocols, and the pursuit of policies of free and unrestricted data access.

Near-term efforts will be driven by opportunities that arise from recognition by developing countries of the potential economic and humanitarian benefits from geophysical capacity building. Initially, IDS may focus on the Pacific Rim countries in South America (Chile, Peru, Ecuador, and Colombia) and Bolivia. The rationale for this region is that the seismic hazard in all of these countries is great, they have sufficient academic and intellectual absorptive capacity, and they present low logistic difficulty. As this proposal is being completed, IRIS has been informed by NSF that an MRI proposal will be funded to install a backbone network of ten geophysical observatories to augment the new Chilean National Seismic Network. It is hoped that this joint project between IRIS and the University of Chile will provide a model for similar collaborative development efforts in other countries, both in South America and worldwide.

This multistep national and regional development strategy will focus on collaborations with leading seismologists from academia and government agencies in each country and on identifying the best strategy to support the development of national sustainable seismologic networks. The IDS Committee and staff will assist and support the identified leading scientist to pursue the resources necessary for network development and operation. This will likely involve convening country-specific workshops with respective stakeholders to identify all appropriate country leader(s); outline the best course of action; design a five-year plan and budget; identify instrumentation, training, education and outreach needs; and, importantly, assist foreign counterparts in seeking financial support from international donors.

PARTNERSHIPS FOR INTERNATIONAL DEVELOPMENT

Development of seismological capacity and research in low- and middle-income countries presents both a unique challenge and the opportunity to impact general economic development through scientific progress. Meeting these challenges and opportunities

requires multisector and international partnerships that leverage U.S. scientific investment. Over the past year, IRIS has successfully engaged broad support for international science initiatives in collaboration with its member institutions and foreign affiliates.

Rebuilding for Resilience in Haiti: Public Forum

March 22, 2010 7:30 – 9:00 p.m.
Storer Auditorium, 5250 University Drive,
University of Miami, Coral Gables campus



Funded by NSF and USAID

Geophysical Hazards and Plate Boundary Processes in Central America, Mexico and the Caribbean

A Workshop to Build Seismological
Collaboration and Capacity



Funded by NSF, USGS, USAID, and the U.S. Department of State

Pan-American Advanced Studies Institute on New Frontiers in Seismological Research:

Sustainable Networks, Earthquake Source Parameters,
and Earth Structure

Quito, Ecuador, July 11-24, 2011



Funded by NSF