ALMAS, 2013 July 26 – 27

Participating: Karen Fischer (teleconf.), Christa von Hillebrandt, Victor Huerfano, Carlos Huerta, Jottin Leonel, Morgan Moschetti (teleconf.), Eugenio Polanco, Marino Protti, Jay Pulliam, Michael Schmitz, Lidia Torres, Ray Willemann

We agreed that it would be useful to establish a web page (using the URL that IRIS has already reserved, almas-online.org) and a Facebook group to facilitate communication. The web page will explain that ALMAS membership is institutional (rather than national or individual), list recognized member institutions (for each member, naming an individual as the primary point of contact, POC, but not a representative of the institution). The web site will explain the region from which members are welcome, which runs from Mexico to Venezuela and includes the Caribbean Sea region. Institutions that do seismological work in the region will be welcome as ALMAS members, regardless of the institution's principal location.

The ALMAS web site will include documents on working groups that were formed during the 2010 Workshop in Heredia, and explain that those working groups were established for a three-year term. During the late 2013, ALMAS POCs will collectively decide about renewing working groups, appointing members and chairs, and setting terms for each person and group.

Newly recognized by IASPEI, the Latin American and Caribbean Seismological Commission (LACSC, http://www.iaspei.org/commissions/LACSC.html) plans to hold the first Regional Assembly of in Bogotá during 2014 July 23-25 (http://geoslac.org). We agreed that ALMAS should hold a meeting of its own in conjunction with the Regional Assembly. We will ask their science committee about the possibility of one or more ALMAS-sponsored sessions.

We identified three projects that attracted broad interest among the participants at this meeting and that seemed to us to have a reasonable prospect for funding, as described on the following pages.

Advanced Studies In Geologically-informed Network Analysis (ASIGNA)

Initial leaders: Jay Pulliam, Victor Huérfano

Potential support: NSF/OISE (Harold Stolberg): Financing for student travel
BRTT (Danny Harvey): Contribute Antelope training and temporary licenses
UNESCO (Christa von Hillebrandt): CMTs useful for tsunami preparation.
IPGP (Jean-Marie Saurel): Student travel from Martinique, etc. (build relationships at 25-27 October

Recently-deployed broadband seismographic and geodetic networks in Middle America – both permanent and temporary – create opportunities to significantly advance our understanding of earth structure and geodynamics in the region. Seismological data products that are informed by geological understanding among earth scientists in the region also can improve mitigation of natural hazards. To take full advantage of these opportunities by facilitating development of the of these products, we envision a short course that makes joint use of data from the Greater Antilles Seismic Program (GASP) with data from other networks, possibly with partial support from the NSF/OISE program for Pan-American Advanced Studies Institutes (PASI).

GASP is a temporary deployment of broadband seismometers all across the Dominican Republic that is facilitated by NSF-owned instruments maintained by the IRIS Portable Instrumentation Center. GASP is led by Jay Pulliam of Baylor University, who has agreed to openly distribute the data in connection with the proposed PASI before the end of the normal embargo period. To leverage data from GASP and other regional deployments, topics at ASIGNA should include development of one-dimensional and three-dimensional models for earthquake location based partly on geological data, and could also SKS splitting and receiver functions. Other relevant topics include updates on double-difference earthquake location, surface wave tomography, and regional CMTs – which were the core topics from “Sustainable Networks, Earthquake Source Parameters, and Earth Structure”, a PASI in Quito during July 2011.

The goals of advancing regional geodynamics and hazard mitigation will require sustained commitments to development by seismographic network operators and ongoing coordination among them. To engage disparate groups in such commitments, we plan to solicit significant contributions from a broad range of different groups. For example, we have already contacted the Institut de Physique du Globe de Paris (IPGP) and Natural Resources, Canada (NRC), which operate or help seismographic networks in Martinique, Haiti, and other francophone territories and countries in the Caribbean Sea region. In addition, we plan to emphasize use of seismic network management systems, such as Antelope, that are widely used despite cost because of their advantages in providing flexibility and reliability. Use of such systems could be facilitated by concessions from the for-profit companies that hold copyrights on the most favored systems.

To appropriately emphasize the potential for mitigating natural hazards, ASIGNA should include coordination related to strengthening the Caribbean Tsunami Warning System (CTWS) and to developing a regional Earthquake Early Warning (EEW) system. Strengthening the CTWS will include planning to generate synthetic strong motion data from great earthquake scenarios, which are required for the worst case planning that the tsunami community regards as indispensible for genuine tsunami-readiness. Progress towards a regional EEW will begin with improvements to managing data within networks, which are required as steps towards the long-term goal of a regional system. Local EEW as a purpose of temporary networks will also be explored as an application in the future for Rapid Array Mobilization Project (RAMP) deployments.

Middle America Micro-Zonation Array (MAMZA)

Initial leaders: Lidia Torres, Michael Schmitz

Potential support: JICA, COSUDE, GEM, EU through CEPREDENAC: Core financial support
USAID: Addition to ProParque project?
US DHS, DOD, DOE: Interest in security for Puerto Cortés?
EERI, AGU, SSA: Travel for selected students
COPECO, CODEM, UNAH: Logistical support
IRIS: Use of instrumentation, data processing and management facilities.

Honduras is located at the convergence of the Caribbean, Cocos, and North American plates. The subduction zone between the Cocos and Caribbean plates has the potential for great earthquakes, but the Caribbean / North American plate boundary – expressed as the Motagua, Polochic, and Swan fault systems – also generates destructive earthquakes. Within Honduras, especially in the west and northwest, active faults produce earthquakes of smaller magnitude that nevertheless have the potential for significant local effects. There are at least three cities in Honduras where earthquake damage would have significant direct impacts all across Middle America:

Tegucigalpa, together with the neighboring city of Comayagüela, comprises the national capital of Honduras with a population of more than 1.3 million people and an area just over 200 km^2. During 2010, JICA identified geological faults in high regions surrounding the capital.

San Pedro Sula, with more than 1.2 million residents in its metropolitan area of 840 km^2, is the second largest city on Honduras by population and generates two-thirds of the national gross domestic product. Located in northwestern Honduras, 60 km south of Puerto Cortés, San Pedro Sula serves as a major transportation hub for the country, maintains a base in light industry, and is the center for commercial production of agricultural products.

Puerto Cortés has a population of only 200,000 but is a major port for Central America. It was the first Central American port included in the U.S. Container Security Initiative, and the U.S. Department of Homeland Security included Puerto Cortés as one of just six ports worldwide in Phase 1 of it Secure Freight Initiative, an effort to build upon existing port security measures.

We envision a three-year program to generate microzonation products for these three cities, together with the capacity to efficiently generate microzonation products for regionally important cities during the years after this project. For each city:

- Urban planners, civil engineers, and seismologists would gather information (GIS, building stock, local geology) and plan methods and logistics for data collection and analysis.
- Selected university students from across the region would participate in a training workshop and then carryout supervised data collection at densely distributed point all across the city over a period of six to twelve weeks.
- Data would be uploaded, quality-controlled, and processed contemporaneously with the data collection.
- Students, with full access to the on-line data and processing results, would participate in on-line data interpretation and report-writing meetings over several months following the data collection and processing.

Micro-Earthquake Surveys to Map Urban Faults (MESMUF)

Initial leaders: Ray Willemann, Marino Protti

Potential support: NSF/MRI and ISDR: Purchase instruments (requires matching contribution)
State Department (Olga Cabello): Project management
USAID (Tim Callaghan): Travel and shipping to project cities
National and municipal governments: Logistics, purchase to extend deploy.

Recent and anticipated developments in seismic instrumentation can facilitate deployment of arrays with an order-of-magnitude more stations, enabling radical new approaches to addressing long-standing challenges in seismology. One such challenge is accurately mapping faults that have caused destructive historical earthquakes. Perhaps most infamously among these in Middle America, an earthquake during April 1910 killed nearly 1000 people in Cartago, Costa Rica, but numerous other cities of Middle America are similarly threatened by poorly located urban faults.

Approximate epicenters and even rupture length of destructive pre-instrumental earthquakes can be estimate from intensity maps. But macroseismically-determined locations are uncertain where reporting is incomplete or fault zones are not well mapped and suffers many sources of potential bias, including rupture directivity, site amplification, and the distribution of buildings at risk or regarded as important. Stress accumulation on many urban seismogenic faults is evidenced by ongoing microearthquakes, but networks are too sparse to compute even approximate locations.

We envision acquiring a pool of hundreds of next-generation seismographic systems dedicated to deployments lasting several months to map urban faults under Middle American cities. The pool could be used to map urban faults in 10 to 15 cities over just five years, since deployments of only 4 to 6 months would be sufficient with a capability to locate most local $M \geq 0$ earthquakes.

Partial support from the NSF's Major Research Instrumentation (MRI) program might be possible, but we anticipate contributions in excess of any NSF support from other sources. NSF support would be justified by benefits to U.S. seismology and broader society that include demonstration of the feasibility and effectiveness of a new approach to urban fault mapping, subsidized by the contributions from governments where we will carry out individual projects.

Mapping of microearthquakes ($M < 2$) is particularly well-suited to anticipated characteristics of next-generation "Large N" arrays, including

- Large scale deployments (25 to 50 km^2 with a station spacing of 0.5 to 2 km) are required, but feasible with efficient deployment strategies that the new instruments will support.
- Low-power data telemetry is facilitated by the proximity of adjacent stations in the array.
- Good dynamic range and low instrumental noise are required only at short periods ($T < 10$ s).
- High sampling rates ($f = 200$ sps) facilitate measurement of features of microearthquakes.
- Broadband records (0.1 to 50 Hz) can be used to detect repeating microearthquakes
- *S* arrivals can be reliably measured with 3-component data, to improve absolute depths and relative epicenters.

Three-component data extending to a moderately long period ($T > 5$ s) can also be used for HVSR and long-baseline SPAC analysis, to further inform seismic zonation within a city by also mapping site response. Next-generation instruments will support quick re-deployment from urban areas, which would be useful if major earthquakes occur in Middle America during the project. Extended deployment of selected stations could monitor for time-dependent coda of nearly repeating microearthquakes to test for evolution in the state of stress on the fault.