ANSS NEEDS FOR THE INTERMOUNTAIN WEST (IMW) REGION

Prepared for
U.S. Geological Survey and
ANSS National Steering Committee

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Recommendations from IMW-Regional Advisory Committee

Because some of the most basic needs of the IMW Region have been repeatedly stated, revisiting earlier needs statements is useful. In the following lists, items still warranting special emphasis have been italicized and obsolete items have a strike-through.

- From FY2002 implementation plan for IMW (http://www.seis.utah.edu/anss/toc.shtml), July 2001:

  - *Need for good balance between new instrumentation for urban strong-motion monitoring and regional/national broadband seismic monitoring because of (a) dramatic population growth in metropolitan areas at moderate to high seismic risk and (b) large gaps in broadband coverage of extensive, seismically active areas within the IMW Region.*
  - Justification for keeping momentum going in developing urban strong-motion networks in Nevada (Reno-Carson City and Las Vegas areas and Utah (Wasatch Front urban corridor).
  - High-priority importance to augmenting broadband coverage in the IMW Region by adding new national backbone stations (significantly under way).
  - ~~Cost-effective proposal by University of Wyoming to cooperatively fund and install, together with the USGS, five broadband stations throughout Wyoming~~ (already acted upon)
  - *Emphatically urging the USGS to consider relatively low-cost ways to help small network operators with technical support—including making available traveling technician and computer professional support and facilitating periodic meetings/workshops.*
  - *Recognizing that state-level earthquake information centers are a desirable part of the structure of ANSS in the IMW Region.*
  - Not using results of HAZUS (FEMA 366) as the only guide to prioritizing ANSS resource allocation in the IMW Region.
  - *Funding for at least one collective meeting of the RAC, possibly a joint meeting with the IMW Working Group (of network operators)*

- From FY2003 implementation plan for IMW (http://www.seis.utah.edu/anss/imw-fy03plan.pdf), October 2002:

Regional Monitoring Strategy and Requirements:

Regional seismic monitoring in the IMW Region continues to rely on a geographic patchwork of seismic networks, involving both stably-funded and unstably-funded operations. Well-established networks cover most of Utah, Nevada, and Montana. Throughout the IMW Region—and especially in Idaho, Wyoming, New Mexico, Colorado, and Arizona—the challenges are to achieve:

- *adequate geographic coverage of seismically hazardous areas, especially in gaps between existing networks and in areas that have been historically neglected;*
- *stable network operations in areas where seismic hazard and/or risk warrants continuous seismic monitoring; and*
- *coordinated data exchange, uniform earthquake reporting and response, and compilation of homogenous earthquake catalogs for more systematically defined regions of responsibility.*

USGS/ANSS efforts for improving regionwide seismic monitoring in the IMW Region have chiefly focused on improved data exchange via Earthworm software and hardware and increased geographic coverage through the addition of USNSN backbone stations and through opportune cooperative funding of some regional broadband stations. The USGS has also tried to incrementally help state-level monitoring through partnerships in Montana, Idaho, Wyoming, and New Mexico. ~~(See also Appendix A for interest by Colorado in partnering with the USGS.) We ask and strongly encourage the USGS to continue these efforts in FY 2003.~~

Perhaps the most important ANSS requirement for regional seismic monitoring in the IMW Region—in order to advance beyond the existing patchwork—is a strategic regionwide plan for dealing with earthquake geography and uniform recording and response. ~~The imminent shutdown of the U.S. Bureau of Reclamation's "Jackson Lake" regional seismic network in eastern Idaho and western Wyoming emphasizes the timeliness of this need.~~

- From summary of needs for IMW region for FY2005 (http://www.seis.utah.edu/anss/imw-needs.pdf), November 2004 [no regional implementation plans were formally compiled for FY2004]:

    - *the need for a coherent regionwide plan for seismic monitoring in the IMW Region*
    - *helping "have not" networks and states in the IMW Region*
    - *need for the availability of portable seismograph arrays to augment inadequate seismographic coverage in the IMW Region*
    - *need to capture strong-motion data for large normal-faulting earthquakes, even if it means instrumenting areas with low population density*
    - *need for USGS to continue refining and developing ShakeMap and ShakeCast*
    - *need to convey the IMW perspective to the ANSS National Steering Committee, especially fundamental, first-order needs for seismic monitoring in the IMW*

- Needs for the IMW region for FY2006—based on teleconference of IMW Regional Advisory Committee, November 15, 2005:

    1. *Need for a coherent regionwide plan for seismic monitoring in the IMW Region*
    2. *Need to help "have not" networks and states in the IMW Region . . . HOW?*
        - *Convene long-overdue meeting between ANSS managers, IMW network operators, and IMW Regional Advisory Committee (to address both items 1 & 2)*

- *Organize "mutual-aid" agreements among regional network operators and NEIC, especially where networking staffing is extremely small as in Montana*
- *Address ways to provide critical information—both via Web and through personal contacts—to information outlets and/or to key officials (such as state geologists and state emergency managers in have-not states) to ensure that they can reliably inform governors, high-level state decision-makers, and local media during earthquake situations*
- *Provide improved software for efficient earthquake analysis*
- *Assist with critically-needed support for station repair and maintenance and engineering of telecommunications*
- *Explore avenues for funding (including ways that unified political activism among IMW participants can gain support for improved network monitoring in seismically active states that are disadvantaged under ANSS)*

3. *Need for availability of portable seismograph arrays to augment inadequate seismographic coverage in the IMW Region (understood that "business rules" need to be developed to govern when instruments will be deployed and what logistic and financial support may be available)*

4. *Need to capture strong-motion data for large normal-faulting earthquakes, even if it means instrumenting areas with low population density*

5. *States without their own seismic networks need clearer understanding from ANSS how and to what level seismic monitoring is carried out in their region using national backbone stations (e.g., Colorado would like a better understanding of the extent to which small-magnitude earthquake activity within Colorado is being routinely located)*

N.B. A report entitled, "Summary of ANSS Needs for the Intermountain West (IMW) Region," dated November 16, 2004 (available online at http://www.seis.utah.edu/anss/imw-needs.pdf), was distributed to the National Steering Committee at its November 2004 meeting in San Francisco. Updates were solicited from individual networks/states for this presentation. Two that are particularly germane to understanding the concerns of "have not" states—namely, contributions from Montana and Idaho—are included here as Attachments A and B.

Attachment A

ANSS Needs for Montana

November 2, 2005

(Submitted by Michael Stickney, Montana Bureau of Mines and Geology with input from Edmond Deal)

Background Information

The Montana Bureau of Mines and Geology (MBMG) operates the Montana regional seismograph network that is focused on western Montana, but also provides some coverage for central and eastern Montana. The network has grown in a piecemeal, opportunistic fashion over the past 25 years and now includes 34 short-period telemetered stations and 5 broadband stations. A total of 78 stations (152 channels including high- and low-pass filtered channels) are currently recorded with an Earthworm data acquisition system at the MBMG Earthquake Studies Office.

During the 2005 field season, we selected sites for two new U.S. National Seismic Network (USNSN) broadband stations, in north-central and south-central Montana but these instruments are not yet installed. Currently, four of the six planned USNSN Montana backbone stations are operational. In response to the M 5.6 Dillon earthquake on 26 July 2005, a new broadband seismograph was installed north of Dillon on August 11-12, 2005. The USGS provided instrumentation and technical assistance, the MBMG arranged for use of a site near the epicenter on private property, coordinated internet access at the UM Western campus in Dillon and assisted with installation. A significant level of recent field effort has been devoted to repairing and modernizing analog seismographs and their telemetry links—many of which were deployed 10-20 years ago—to improve reliability and reduce telemetry noise.

Instrumentation Needs

Even with the full complement of six USNSN backbone stations, several significant gaps exist in seismic monitoring coverage in seismically active parts of western Montana; specifically, along the Rocky Mountain front, the White Sulphur Springs area, and the Libby area of extreme northwestern Montana.

One possibility for inexpensive additional network coverage involves adding a weak- motion sensor to existing USGS National Strong Motion Program (NSMP) instruments currently operating in Montana. The four channels of data (vertical weak motion plus three components of strong motion) could then be streamed in real time via Internet to the MBMG Earthquake Studies Office in Butte for inclusion in routine data processing and archiving. Advantages of this idea include relatively low cost (price of a short-period seismometer and hardware to provide the Internet connection, perhaps $2500-$3000 per site), on-scale digital data for moderate to large magnitude local events, and improved network coverage for several areas of western Montana inadequately covered by the current configuration. Possible disadvantages of this idea are that the existing strong motion stations may be fairly noisy environments for weak-motion stations and Internet access may not exist at all sites. However, the strong-motion instruments at Montana State University in Bozeman and at Carroll College in Helena are bedrock sites and Internet access at these two campuses along with the University of Montana, Western in Dillon should present no problem. Of course any modifications of NSMP instrumentation would need to be implemented with full cooperation and assistance of NSMP personnel. In as much as a stated goal of ANSS in the integration of weak-motion and strong-motion monitoring efforts, I believe this idea is worth pursuing. Successfully streaming data from the NSMP instruments to the MRSN will require technical assistance.

Other Requests

The Montana regional seismic network has benefited tremendously from the Earthworm data acquisition and analysis system implemented in 1999 and 2000 with considerable assistance from the USGS. Since June of 2000, data from all Montana stations and numerous surrounding stations are available for analysis in real time (presently a total of 152 channels of seismic data).

The MBMG is running an Earthworm-driven Oracle database that has operated reliably since 2001. However, the event-review capabilities, methods for inserting non-triggered events, and unresolved issues concerning catalog generation, backup and archival of the database have prevented me from using the database for routine analysis of seismicity. The current method of routinely analyzing and archiving network data is rather convoluted, involving command-line transfer of trace data from wave tank machines to a Unix machine, phase picking with SAC, manual editing of phase pick corrections, and manually constructing earthquake catalogs. The evolution of this convoluted system resulted from the need for continuity of earthquake cataloging procedures through several generations of data collection and analysis systems, and limited technical support for designing and developing other possible solutions.

A primary unmet need of the Montana regional seismograph network is an integrated and flexible method for analyzing, cataloging, and archiving network data collected with an Earthworm system. This need was driven home with great clarity following the 26 July 2005 Dillon earthquake. The largest Montana earthquake in 41 years, this magnitude 5.6 earthquake caused non-tectonic ground cracks in the epicentral area, damaged an Interstate 15 overpass, and damaged a number of masonry structures in Dillon 15 km south of the epicenter, including schools and 50-60% of old brick chimneys. This earthquake also generated several thousand aftershocks. Their numbers completely swamped the analysis capabilities of the ESO staff (one professional and one part-time undergraduate student assistant). The volume of network data overwhelmed traditional data storage capabilities and emergency measures were successfully implemented to prevent data loss. Although all data are safely stored, only earthquakes greater than magnitude 3.0 for the period July 29 through August 30 have been analyzed and cataloged—many hundred events remain to be located. An effort is currently underway to hire an additional student to assist with the analysis of the backlog and then routine operations. Even with another student assistant, the workload of the MRSN (operation, maintenance, and data analysis) justifies another full-time position in the ESO. Such a position currently represents our greatest un-met need.

The Bigfoot array of Earthscope is scheduled to begin installing stations in Montana in 2007. This seismographic deployment will include approximately 70 three-component broadband instruments in Montana during its peak and will be a unique opportunity to gather data from parts of the state never previously instrumented. To take full advantage of this unique opportunity the recording capacity of the existing earthworm system must be upgraded. All of the computers that comprise the Montana earthworm system operate near full storage capacity and are now at least four years old, and should probably be upgraded for reliable operations.

Remote Earthworm nodes at Ronan and Missoula comprise two crucial data concentration and retransmission points in the Montana network. The computers at these remote nodes should receive scheduled (semi-annual?) inspection, maintenance and upgrades by persons with expertise in Earthworm systems, firewalls, and Internet communications issues.

The un-interruptible power supply (UPS) at the MBMG Earthquake Studies Office was installed in 1999, before the upgrade to Earthworm occurred. The existing UPS is now over five years old and is required to power a significantly larger system that originally designed for during power outages. Recent scheduled power outages demonstrated some of the short falls of the existing UPS. We need professional assistance to design and install an adequate UPS for the Earthquake Studies Office.

Finally, I would like to see at least a small amount of technical assistance for institutions that have attempted, or are seriously contemplating implementing Earthworm systems to gather and exchange seismic data for research and education. Although the two institutions that prompt this request are in Idaho, it is relevant to discuss the issue here because Montana and Idaho share a common border as well as earthquake hazards. Data collection and sharing between multiple institutions will strengthen the efforts of all parties. Some general requirements of an institution receiving technical assistance might include that they operate their own stations and share the data (i.e. they must contribute some original data to the ANSS, not simply record data from others) and demonstrate a long-term commitment to their network, data acquisition and data sharing.

Attachment B

ANSS Needs for Idaho — November 2005
Roy Breckenridge, Stephen Weiser

The seismic network situation in Idaho has not changed substantially in the past year. Our previous statement of ANSS vision for Idaho (Weiser) is still applicable. We share many common needs with Montana that Mike Stickney has articulated to you.

We have established and continue to maintain a virtual network site on the Idaho Geological Survey homepage at www.idahogeology.org that provides Idaho earthquake information via Earthworm through shared links with operators in the region.

Idaho network operators continue to have serious difficulty with station maintenance, infrastructure, and inadequate state coverage.

Idaho was host to the 2005 Western States Seismic Policy Council Annual Meeting in Boise on September 24-28. The meeting was co-sponsored by the Idaho Bureau of Homeland Security and the Idaho Geological Survey with substantial participation from member states and the intermountain states in particular. The field trip and panel discussions on the second day focused on the challenges of: 1) quantifying hazards, 2) changing perceptions of risk, 3) setting priorities and 4) implementing ANSS, all using Idaho as an example. The second part of the program was intended to feature NEHERP in the coming decade and the future of earthquake consortia. Hurricane Katrina precluded the attendance of some participants but the agenda was adjusted accordingly and provided an unforeseen opportunity for the geoscientists to interact.

An earthquake swarm(s) in the Long Valley-Cascade area of western Idaho began in September and currently continues. Residents of the area reported many felt many events and focused the media attention on earthquake monitoring and response. State agencies responsible for response, mitigation, facilities, and scientific information responded to the Governor's Office request for overviews, briefings, and status reports. The Idaho Bureau of Homeland Security and the Idaho Geological Survey funded short term monitoring and analysis by Jim Zollweg. More specifically, the Cascade events highlighted the following points:

1) Poor state network coverage emphasizes the need for a readily deployable portable array and support mechanism to monitor earthquake swarms in areas of historical seismicity and no network coverage.

2) More accurate locations of events for study of geologic sources and impacts on critical facilities are needed. Spacing of the USNSN stations was not sufficient to locate the events for planning and response needs requested by state and local agencies. The station at Hailey was off satellite for most of the swarm duration and these data were not recoverable.

3) The need to establish a state Seismic Safety Commission to support earthquake and fault studies and network monitoring and articulate the earthquake hazard in Idaho.

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