Collaborative Research: Development of a Power and Communication System for Remote Autonomous GPS and Seismic Stations in Antarctica (proposal, January 2006)

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The attached .pdf file contains the proposal "Collaborative Research: Development of a Power and Communication System for Remote Autonomous GPS and Seismic Stations in Antarctica" submitted by UNAVCO and IRIS on behalf of the Polar Community to the National Science Foundation (Major Research Infrastructure and Office of Polar Programs) January 2006.

Project Summary

Major advances in addressing many compelling questions in polar geoscience require continuous recording of GPS and seismic data. Logistic expenses require systems that can operate unattended for multiple years. We propose to develop a new system that will enable the polar science community to obtain critical new data sets to address many fundamental questions about the nature and behavior of the crust and mantle beneath Antarctica and its relationship to ice sheet dynamics and climate. While new technological achievements in GPS receivers and seismometers make it possible to use off-theshelf units for autonomous recording in polar regions, there is still no companion power/communication system available to permit year-round autonomous station operation. Decreasing power needs of the GPS and seismic instrumentation, coupled with promising advances in power and communication technologies, have now put us on the threshold of building such a system. Consequently, a development effort is proposed in which IRIS and UNAVCO will team with the Antarctic GPS and seismology scientists to capitalize on these advances to design and build a reliable power/communication system for autonomous polar station operation. The power/communication units built will form the nucleus of a new IRIS/UNAVCO equipment pool, and will allow the science community to achieve the first long-duration deployment of continuouslyrecording GPS and seismic stations across the Antarctic continent proposed to commence during the International Polar Year (2007-2009).

The goals of this project are to use the latest power and communication technologies, linked with the collective experience/expertise of the science community and IRIS/UNAVCO staff, to 1) design, integrate, and test a scalable power and communication system optimized for ease of deployment and reliable multiyear operation in severe polar environments; and 2) provide an initial pool of these systems for deployment and testing in science experiments. The technical requirements guiding the design of the system were established at two workshops (2004, 2005) and are driven by the needs of the research community, including year-round, continuous operation and real-time delivery of as much data as technically feasible. A robust power module will consist of two parts – one based on solar panels and sealed lead acid (SLA) batteries for summer operation, and one for winter operation that incorporates advanced battery technologies and wind turbines. A system controller will be designed to integrate data handling, charge control, power management, system housekeeping, thermal monitoring, autonomous system reset, and report system stateof- health via the communication device. A three-tiered approach for communication and data retrieval will be adopted that includes: a) radio modems/radio repeaters to connect directly to the Internet via LAN where stations are close to permanent bases, b) a commercial Iridium satellite-based connection for GPS, state-of-health, limited seismic data retrieval, and system

control, and c) onboard memory to allow for data uploads during maintenance or opportunity visits (possibly including flyovers and wireless data transmission). Custom environmental enclosures will accommodate thermal and wiring requirements. The system will be deployable from light aircraft in no more than two missions per station and with a three person field team. A staged testing and qualification process will be implemented to ensure that final field units are robust and meet design goals.

Project leadership will be shared between the IRIS and UNAVCO facilities, with an overall project manager at UNAVCO. IRIS and UNAVCO have experience in working together on major projects, e.g., EarthScope. A six member Science Oversight Committee (SOC) will ensure that the MRI effort remains well coordinated with science needs and takes best advantage of existing experience within the PI community. The SOC will appoint a Science Coordinator who will serve as a liaison between the SOC, IRIS, and UNAVCO, via facility site visits and inclusion in regular progress teleconferences between the facilities.

Broader Impacts

A new capability for continuous, year-round seismic and geodetic measurements at remote sites will meet longstanding polar and global geoscience goals that have previously been unattainable. Access to the new systems through UNAVCO and IRIS will open doors for scientists and institutions that do not have the technical and field skills currently required to execute remote polar GPS and seismic research projects, thus stimulating participation in polar science by a new generation of researchers. An upper-level undergraduate student will participate in this MRI effort within an established undergraduate research program called “Research Experiences in Solid Earth Science for Students”.

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