Geophysical Research Abstracts, Vol. 7, 05828, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05828

POLENET: Polar Earth Observing Network for the International Polar Year

T. Wilson (1) and R. Dietrich (2) for the POLENET Team

(1) The Ohio State University, USA, (2) TU Dresden - Institut fuer Planetare Geodaesie, Germany, (twilson@mps.ohio-state.edu)

The polar regions have unique geodynamic environments where the solid earth, the cryosphere, the oceans, the atmosphere and the global climate system are intimately linked. An IPY programme is proposed to investigate systems-scale interactions within the polar earth system and polar geodynamics by deploying autonomous remote observatories, on the continents and possibly offshore. The principal components of these observatories will consist of continuous GPS and seismometers, with the potential addition of meteorology packages, geomagnetic observatories, tide gauges (at coastal sites), and bottom pressure gauges (at offshore sites). Remoteness and environmental challenges have resulted in a dearth of observational systems in the polar regions of Earth, which this programme will overcome.

Geodetic studies, including GPS measurements of crustal motion, tide-gauge measurements of relative sea-level change, and gravity measurements of mass change, constitute essential elements in developing an understanding of the stability and mass balance of the cryosphere and of ongoing sea-level change. There is a critical need to understand the contribution to sea-level change due to changes in mass balance of the major ice sheets of the world, most importantly the Antarctic and Greenland ice sheets. Accurate measurement of millimeter-scale vertical and horizontal crustal motions is possible in only 2-5 years if continuous GPS trackers are deployed. Deployment of C-GPS stations in optimal positions with respect to historical and modern ice mass changes, and at sufficiently high spatial resolution, provides robust constraints on ice models, improving our ability to predict sea-level change. Deployment of C-GPS stations across tectonic blocks and boundaries allows crustal motions due to global plate motion and intraplate neotectonic deformation to be measured and velocity fields to be mapped and modeled.

Seismological data from the observatories will provide the first relatively high-resolution data on the Earth beneath the polar seas and ice sheets. Advanced techniques to image the Earth's deep interior, such as seismic tomography, will be used to place constraints on the planet's internal processes. Seismic imaging of the crust and mantle will assess causes for anomalously high elevations in East Antarctica, linked with ice sheet development, will provide information on heat flow and mantle viscosity that are key factors controlling ice sheet dynamics and the Earth's response to ice mass change, and will provide constraints on the magma sources for polar volcanism. The axial vantage points of the poles will allow unprecedented studies of Earth's inner core, contributing to our understanding of the initial differentiation of the Earth, the Earth's thermal history, and the physics and variability of the Earth's magnetic field. Enhanced seismic station coverage will vastly improve the detection level for earthquakes and permit evaluation of seismotectonic activity and associated seismic hazard across the remote high latitudes. POLENET is coordinated with the AntarcticArray seismological initiative to establish a permanent backbone sensor network, a lattice seismic array at South Pole (CRYSTAL), evolving regional array deployments, process-oriented experiments, and active-source seismology.