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POLENET – the polar Earth observation network

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The science programme of the POLENET consortium will investigate polar geodynamics, the earth's magnetic field, crust, mantle and core structure and dynamics, and systems-scale interactions of the solid earth, the cryosphere, the oceans and the atmosphere. Activities will be focused on deployment of autonomous observatories at remote sites on the continents and offshore, coordinated with measurements made at permanent station observatories and by satellite campaigns. 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 at sufficiently high spatial resolution, and co-located GPS and absolute gravity measurements, will allow discrimination of the elastic response to modern mass change from the secular viscoelastic response to ancient ice mass change. Present-day rebound models are least well constrained in the polar regions and a bi-polar effort during IPY will reduce uncertainty levels and allow more reliable ice history models to be constructed. Together with satellite-based measurement of ice volume and mass change (ICESat, GRACE, GFO, ENVISAT, CRYOSAT), we can use these data to provide robust constraints on ice models and earth models, improving our ability to quantify ice mass loss/gain and 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.