IPY: Collaborative Research: Ocean-Ice Sheet Interaction in the Amundsen Sea: The Keystone of West Antarctic Stability

A joint proposal to NSF and NASA for the International Polar Year

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We propose integrated oceanographic and glaciological field studies linked with regional and local modeling activities to advance our ability to predict future behavior of ice sheets, particularly that portion of West Antarctica that drains into the Amundsen Sea. Our efforts are motivated by the nearly complete absence of direct observations of sub-ice shelf processes, the primary influence the ocean is having on the recent dramatic changes in ice sheet discharge, and the potential increased importance of these changes in the near future through accelerating sea level rise. The societal importance of this work is the need to predict future sea level. Without a process-based understanding of the ocean's interaction on ice-sheet discharge that is supported by measurements and is incorporated into predictive models, policy makers will have no firm basis for action that may protect society.

We will access the never-before seen ocean cavity beneath the Pine Island Glacier directly through hot-water drilling, measure the shape of the cavity by seismic soundings, monitor the properties of the underlying waters with newly developed instrumentation and visually explore the underside of the ice shelf and the seafloor. New instrumentation will monitor both the spatial and temporal variations in water properties inside and outside the sub-shelf boundary layer and associate these variations with the basal melt rate and dynamic response of the glacier. To be most useful to prognostic models, such measurements must include vertical profiling at flexible intervals and at horizontally distributed points. Our measurements link directly to the needs of new models of both ocean and ice behavior by directly measuring both horizontal and vertical fluxes across a model grid cell and we plan to assimilate these measurements into the first-ever coupled model of ice dynamics and ocean dynamics that expressly contains the interactive processes we will measure.

This proposal meets the exceptional challenges of the International Polar Year (IPY). We have assembled an elite international group of leading scientists and engineers with vast Arctic, Antarctic and modeling skills and sterling professional records of success. Our combined talents are focused on overcoming long-standing obstacles to understanding the interactions between ocean waters and ice shelves—urgently needed research in light of increased ice discharge from West Antarctica. Our collaborative approach amplifies the enhancements of linking measurements to models; satellite technology to innovative field instrumentation; modern science to exciting polar exploration; difficult Antarctic field work to our need to know. Working with education and outreach professionals, we believe the public will find our work inspiring and informative. Because it involves aspects directly associated with the International Polar Year solicitations of both NSF and NASA, it is submitted jointly to both agencies. Our success will significantly advance our ability to predict future ice sheet behavior and stand as a major scientific achievement enabled by the IPY.