Larsen Ice Shelf Retreat and Glacier Acceleration on the Antarctic Peninsula; A project for International Polar Year.

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Executive summary -

Ice shelves in the Antarctic Peninsula have retreated dramatically in response to rapid climate warming over the past five decades. As the shelves have fragmented and drifted away, outlet glaciers that fed the shelves have accelerated, in some cases reaching speeds ten times greater than before the retreats began. Mass balance of the grounded ice was profoundly changed, and rapid drawdown of the ice sheet continues in the affected areas. An IPY field program is proposed to evaluate the process of ice shelf retreat, glacier acceleration, and the effects of increased surface and basal melting. The study would be of major importance to forecasting the potential impact of Antarctic-region warming on world sea level under climate change conditions of the next few centuries.

Project overview -

Although much has been learned via satellite remote sensing, many of the details, and indeed the main process, of ice shelf retreat in the Antarctic Peninsula cannot be confirmed without field measurement. At present, two broad effects of climate change are thought to lead to retreat: fracturing due to increased surface meltwater in shallow cracks; and enhanced basal melting due to sub-shelf ocean warming. Similarly, the response of feeder glaciers during retreat and breakup, while known to some degree from satellite measurements, requires detailed in situ measurements to fully understand the physical processes involved. To what extent have the shelves served to moderate glacier flow? To what extent is the speed-up due to direct effects of warming and melt?

The study sites proposed are the northernmost sections of the remaining Larsen Ice Shelf, on either side of Jason Peninsula (Larsen ‘B’ and northern Larsen ‘C’). We propose a program of geophysical surveys of the shelf and glacier environment, consisting of an intensive field set-up and measurement program, followed by long-term (1- to 2-year) continuous monitoring of selected areas via telemetry from in situ measurement stations. Field work will consist of GPS surveys and setup of continuous GPS measurement stations; radar profiling and installation of radio-echo ice thickness monitors; small-bore shelf drilling for a temperature profile; seismic and tiltmeter monitoring; and installation of advanced weather, communications, and video monitoring stations for observations during the ensuing seasons. We anticipate that these data, coupled with remote monitoring of shelf surface melting and calving via satellite, will lead to insight into the causes of shelf breakup, and resultant glacier acceleration. Subsequent shelf and glacier numerical models will be used to validate these insights.
The study would incorporate new technology in in-situ telemetry. In concept, local ‘main’ weather and video monitoring stations would be linked via wireless technology to a cluster of distributed GPS, tilt, thickness, and acoustic sensors, measuring an area of interest. The central stations would assemble a data-compressed ‘package’ of information to be transmitted to home institutions regularly (hourly to daily). An early version of such a system is currently deployed and transmitting on the C-16 iceberg near McMurdo (http://thistle.org/ iceberg).

Logistically, we propose to combine resources of the US and UK Antarctic programs. Twin Otter aircraft used in the US program routinely transit through the British base Rothera en route to McMurdo, generally in early November. Our concept is to have these aircraft deploy to Rothera earlier, by three to five weeks, to support a field program in the northern Peninsula shelves and glaciers during early austral spring. This schedule would result in little or no impact on subsequent McMurdo-sector activity. The US program would contribute the extended contract time for the two Twin Otters; the British program would contribute pilot and crew berthing, fuel, and temporary berthing for the field teams.