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The International Polar Year of 2007-2008 will present an exciting opportunity for international scientific collaborations aimed at better understanding the polar seas and their implications for the global oceans and climate. High-latitude areas lack systematic observations that are continuous in time and space, and thus, many first-order processes are still relatively unknown. Understanding of these processes, such as the general subsurface circulation, will require new technology or strategies and long-term observational programs. Here we suggest deployment of ~30 profiling floats within the Arctic Ocean to contribute a substantial hydrographic and velocity data set during the IPY and beyond. These floats will enable us to study some of the key features of the Arctic climate system, e.g. the Arctic Ocean boundary current, diapycnal mixing, lateral spreading of Atlantic Water, for example.

Profiling floats have been very successfully used in WOCE and Argo. These floats drift for 1-3 weeks at a prescribed pressure, and then, by adjusting their buoyancy descend to a deeper depth and then ascend to the sea surface, collecting temperature and conductivity profiles. During the IGY and beyond these floats could drift at the depth of the incoming Atlantic water, ~300 m, and profile from ~800 m depth to the surface. These floats would provide temperature, salinity and velocity data over large areas, describing temporal and spatial variability that is otherwise difficult to obtain in ice-covered seas.

A few improvements to the existing float design are required for operations in ice-covered seas. The existing float design does include the capability to obtain and record acoustic RAFOS source signals that allow the float to be tracked at depth without having to use satellite derived positions. For IPY, these floats could be tracked with a minimum of three low-frequency sound sources that can provide coverage over the entire Arctic Basin. To implement this capability for IPY would involve obtaining 3 or 4 low-frequency (20-50 Hz) transducers and to combine them with existing RAFOS source electronics that would provide a signal appropriate for tracking these floats and providing daily positions of the floats. These floats would travel, for up to a year, beneath the ice, drifting at prescribed depth, for example ~300 m. They would periodically, every ~10 days, make profiles from 800 m to the bottom of the sea ice. In the late summer when open water and leads are at a maximum, the floats would come to the surface and repeatedly cycle for up to 2 weeks on rapid schedule (~ 2 hours) between a very shallow depth (~50 m) and the surface searching for open water. Preliminary investigations suggest that even in the central Arctic there is 5% open water in late summer, given 100 chances to find open water, there is a high probability that each float will successfully surface and send its data home. The data for the previous year would then be transmitted to shore using the Iridium satellite communications system in a few minutes. The floats would then descend to depth for another one-year mission. Using the battery packs used for Argo floats, these IPY floats could sample for 2-3 years. These proposed float and telemetry techniques are going to be tested during the Beringia 2005 cruise in summer of 2005, and will be in place in time for the IPY.

We suggest using profiling floats throughout the Arctic Basin (including shelf areas) in combination with two synergistic collaborations to be proposed independently: Ice-tethered profilers (ITPs) and acoustic tomography. Here the tomography project could supply the floats with position information, and the ice-tethered profilers would provide additional temporal and spatial data. These three systems would generate hydrographic data and basin averaged estimates of heat content and freshwater anomalies of unique quality and coverage, and provide important insight to poorly understood processes that may affect the polar oceans, and ultimately the global oceans and climate.