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Small AUV deployment under ice: Pavilion Lake, B.C., Canada (a case study)

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Within the past decade, Autonomous Underwater Vehicles (AUVs) have seen increased application in physical oceanographic work with relatively little limnological application. In 2006, the University of British Columbia research group began field trials of the 'UBC-Gavia', a *Gavia*-class AUV, in two lacustrine systems and one estuarine system: Kelly and Pavilion Lake, B.C., Canada; and, Loch Etive, Scotland. One of the driving forces behind using AUVs for scientific surveys is the ability of these vehicles to reach extreme environments that are impractical to reach by traditional means (e.g. ship based measurements). Exploration of the world's polar environments is currently the basis of several AUV-based research groups. AUVs have successfully completed long distance surveys under sea-ice in both Arctic and Antarctic waters. A long-term objective of the University of British Columbia Environmental Fluid Mechanics research group is to deploy UBC-Gavia under polar lake ice at selected sites in both the Canadian High Arctic and Antarctica. This paper describes preparatory AUV deployment in the more benign environment of a temperate ice-covered lake.

Pavilion Lake, B.C. was selected as a field site for the testing of mission deployment, execution, and recovery using techniques developed over a 2-week span in February of 2007. This site was selected because the mean ice depth is relatively thin ($<$20 cm) and there is relatively little snow cover during an average year ($<$5 cm). In contrast to under-sea-ice AUV applications, mission operations were conducted from a hole in the ice surface rather than an ice edge. Testing included ship-tracks of increasing complexity at varying depths in the water column. Navigation was primarily by acoustic

long baseline (LBL) with 2 LBL transponders moored in the ice surface at fixed positions through the use of GPS. This navigational method was thought to have more applicability for Arctic ice (either sea- or lake-ice) conditions than either dead-reckoning or an Inertial Navigation System (INS) because of the potential for a moving ice-pack and forecasted navigational complications. Results are presented of surveys using the scientific payload, including: optical backscatter; Acoustic Doppler Current Profiler (ADCP); Conducivity Temperature Depth (CTD); and, sidescan sonar.