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Assessment of Seawinds/QuikSCAT scatterometer observations for monitoring ice cover on large lakes in northen Canada

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Lake ice freeze-up and break-up dates have shown to be robust indicators of climate variability and change. During the latter part of the 20^{th} century, trends towards earlier break-up dates have been observed for many lakes across Canada with the most significant ones in the western part of the country. Freeze-up dates, on the other hand, have shown few significant trends over the same period. Variability and trends in ice cover have also shown to be strongly correlated with 0^{o}C spring/fall isotherm dates. Over the last two decades, however, the Canadian ground-based lake ice-observing network has almost totally disappeared. Remote sensing has the potential to rebuild part of the lost network for future studies on the impacts of climate on lakes. Several investigations have demonstrated the potential of SeaWinds/QuikSCAT (QuikSCAT) scatterometer observations for monitoring phenology over various components of the cryosphere (e.g. sea ice, snow, seasonally frozen ground, ice sheets and ice caps) but to date QuikSCAT observations have yet to be evaluated for monitoring freeze and break-up processes (stages: melt onset, water clear of ice, freeze onset, complete freeze over) on large lakes in northern Canada.

In this paper we assess the utility of the temporal evolution of the backscatter coefficient (σ°) from QuikSCAT for monitoring ice phenology on two large lakes in northern Canada: Great Bear Lake (GBL) and Great Slave Lake (GSL). QuikSCAT data at HH and VV polarizations were obtained from the SeaWinds scatterometer onboard NASA's QuikSCAT satellite. The SeaWinds scatterometer is a real aperture,

dual-polarization (i.e., HH and VV) Ku-band sensor operating at 13.4 GHz. It provides normalized cross-section backscatter values at fixed incident angles of 46 (HH) and 54.1 (VV) over a large swath (1800 km) with a spatial resolution 22.25 km. The observations were analyzed over two ice seasons (2004 and 2006), in the main basin sections of GBL and GSL, to assess how well the onset of ice formation and decay, as well as freeze-up (ice-on) and break-up (ice-off) dates, and ice over duration could be determined from QuikSCAT backscatter measurement at both VV and HH polarization. The copolarization VV/HH ratio was also evaluated as potential alterative to resolve single polarization ambiguity. The temporal evolution of σ° over GSL and GBL was validated against surface air temperature and precipitation data from surrounding Environment Canada meteorological weather stations.