Analyses snow and ice thickness from high resolution thermistor temperature profiles

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The thickness of snow and ice is important element in the cryosphere system. The accurate snow and ice thickness is obtained by drill-hole measurements. In remote area snow and ice thicknesses are often obtained by ice mass balance buoy (IMB).

The classical ice mass balance buoy was developed by the USA Cold Region Research and Engineering Laboratory (CRREL). The CRREL IMB equipped with sophisticated acoustic sounders to measure the positions of the surface and bottom in order to determine the thickness of snow and ice. This type of ice mass balance buoys have been widely used to monitor snow and ice thickness in the Arctic Ocean (e.g. Perovich, et al, 2003).

The Scottish Association for Marine Sciences (SAMS) has developed a novel innovated ice mass balance buoy (SIMB), also known as Sea-Ice Mass Balance Array (SIMBA) (Jackson et al., 2013). The SIMB measures the vertical temperature profile of air-snow-ice-water system using a high-resolution ice thermistor chain with 2 cm sensor interval. Additionally, two short heating cycles (of the order of 1-2 minutes) is applied successively on thermistor chain once a day. The cost cutting design of SIMB makes it feasible to be deployed in a large numbers in the remote area, e.g. Arctic Ocean, and it is applicable for snow and ice monitoring in seasonal ice covered seas and lakes. Under cold condition, the temperature distribution in-snow and in-ice can be assumed linear (Leppäranta, 1993). One could apply a linear interpolation/extrapolation to retrieve the snow and ice thickness. The real time air-snow-ice-water temperature and heating cycle temperature profiles are used to analyses the snow and ice thickness. However, analysis the snow and ice thickness from the measured temperature profiles in a seasonal scale is not a trivial task (Cheng et al., 2014).

In this study we describe FMI's's SIMB deployment program. We also reveal a procedure toward development of a reliable algorithm for snow and ice thickness analyses from SIMB measured temperature profiles.

References

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