Winter Arctic sea ice bottom evolution detected by thermistor string-based ice mass balance buoys (SIMBA)

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A thermistor-string-based Snow and Ice Mass Balance Array (SIMBA) has been developed in recent years and used for monitoring snow and ice mass balance in the Arctic Ocean. SIMBA measures vertical environment temperature (ET) profiles through the air-snow-sea ice-ocean column using a thermistor string (5 m long, sensor spacing 2cm). Each thermistor sensor equipped with a small identical heating element. A small voltage was applied to the heating element so that the heat energy liberated in the vicinity of each sensor is the same. The heating time intervals lasted 60 s and 120 s, respectively. The heating temperatures (HT) after these two intervals were recorded. The ET was measured 4 times a day and once per day for the HT.

A total 15 SIMBA buoys have been deployed in the Arctic Ocean during the Chinese National Arctic Research Expedition (CHINARE) 2018 and the Nansen and Amundsen Basins Observational System (NABOS) 2018 field expeditions in late autumn. We applied a recently developed SIMBA algorithm to retrieve snow and ice thickness using SIMBA ET and HT temperature data. We focus particularly on sea ice bottom evolution during Arctic winter.

In mid-September 2018, 5 SIMBA buoys were deployed in the East Siberian Sea (NABOS2018) where snow was in practical zero cm and ice thickness ranged between 1.8 m – 2.6 m. By the end of May, those SIMBA buoys were drifted in the central Arctic where snow and ice thicknesses were around 0.05m - 0.2m and 2.6m – 3.2m, respectively. For those 10 SIMBA buoys deployed by the CHINARE2018 in the Chukchi Sea and Canadian Basin, the initial snow and ice thickness were ranged between 0.05m - 0.1cm and 1.5m – 2.5m, respectively. By the end of May, those SIMBA buoys were drifted toward the north of Greenland where snow and ice thicknesses were around 0.2m - 0.3m and 2.0m – 3.5m, respectively. The ice bottom evolution derived by SIMBA algorithm agrees well with SIMBA HT identified ice-ocean interfaces. We also perform a preliminary investigation of sea ice bottom evolution measured by several SIMBA buoys deployed during the MOSAiC leg1 field campaign in winter 2019/2020.