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Snow depth on Arctic and Antarctic sea ice derived from autonomous (Snow Buoy) measurements

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The snow cover on sea ice received more and more attention in recent sea ice studies and model simulations, because its physical properties dominate many sea ice and upper ocean processes. In particular; the temporal and spatial distribution of snow depth is of crucial importance for the energy and mass budgets of sea ice, as well as for the interaction with the atmosphere and the oceanic freshwater budget. Snow depth is also a crucial parameter for sea ice thickness retrieval algorithms from satellite altimetry data. Recent time series of Arctic sea ice volume only use monthly snow depth climatology, which cannot take into account annual changes of the snow depth and its properties. For Antarctic sea ice, no such climatology is available. With a few exceptions, snow depth on sea ice is determined from manual in-situ measurements with very limited coverage of space and time. Hence the need for more consistent observational data sets of snow depth on sea ice is frequently highlighted.

Here, we present time series measurements of snow depths on Antarctic and Arctic sea ice, recorded by an innovative and affordable platform. This Snow Buoy is optimized to autonomously monitor the evolution of snow depth on sea ice and will allow new insights into its seasonality. In addition, the instruments report air temperature and atmospheric pressure directly into different international networks, e.g. the Global Telecommunication System (GTS) and the International Arctic Buoy Programme (IABP). We introduce the Snow Buoy concept together with technical specifications and results on data quality, reliability, and performance of the units. We highlight the findings from four buoys, which simultaneously drifted through the Weddell Sea for more than 1.5 years, revealing unique information on characteristic regional and seasonal differences. Finally, results from seven snow buoys co-deployed on Arctic sea ice throughout the winter season 2015/16 suggest the great importance of local effects, weather events, and potential influences of dynamic sea ice processes on snow accumulation.