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Bottom melting of Arctic Sea Ice in the Nansen Basin due to Atlantic Water influence

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Our global climate is warming, and a shrinking Arctic sea ice cover remains one of the most visible signs of this warming. Sea Ice loss is now visible for all months in all regions of the Arctic. Hydrographic and current observations from a region north of Svalbard collected during the Norwegian Young Sea Ice Cruise (N-ICE2015) are presented here. Comparison with historical data shows that the new observations from January through June fill major gaps in available observations, and help describing important processes linking changes in regional Atlantic Water (AW) heat transport and sea ice.

Warm and salty AW originating in the North Atlantic enters the Arctic Ocean through the Fram Strait and is present below the Arctic Sea Ice cover throughout the Arctic. However, the depth of AW varies by region and over time. In the region north of Svalbard, we assume that depth could be governed primarily by local processes, by upstream conditions of the ice cover (Northwards), or by upstream conditions of the AW (Southwards). AW carries heat corresponding to the volume transport of approximately 9 SV through Fram Strait, varying seasonally from 28 TW in winter to 46 TW in summer. Some heat is recirculated, but the net annual heat flux into the Arctic Ocean from AW is estimated to be around 40 TW.

The Atlantic Water layer temperature at intermediate depths (150-900m) has increased in recent years. Until recently, maximum temperatures have been found to be 2-3 C in the Nansen Basin. Studies have shown that for example, in the West Spitsbergen Current the upper 50-200m shows an overall AW warming of 1.1 C since 1979. In general we expect efficient melting when AW is close to the surface. Previously the AW entering through Fram Strait has been considered as less important because changes in the sea ice cover have been connected to greater inflow of Pacific Water through Bering Strait and atmospheric forcing. Conversely it is now suggested that AW has direct impact on melting of sea ice. Because of the large increase in AW temperature over the last 30 years we assume that perturbations in the AW are important drivers of location of AW in this region, and that the sea ice and polar water above is passively responding to the AW variability.

Previously it has been argued that the warming of AW could not contribute to increased ice melting because of the strong stratification. Our observations show an ice cover around 2 m, but with active ice formation in between the larger and thicker floes. The ongoing freezing drives brine release and subsequent convection, contributing to the deep $\sim$100 m mixed layer observed in the area until mid-May. Onwards from May solar heating is stratifying the upper layer by adding heat. Data analysis is ongoing but indicates that location of AW is an important factor in bottom melting in the area north of Svalbard. Location of AW and related bottom melting will be evaluated using simulations from a fully coupled climate model.