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Atlantic Water properties, transport, and water mass transformation from mooring observations north of Svalbard

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The Atlantic Water inflow to the Arctic Ocean is transformed and modified in the ocean areas north of Svalbard, and influences the Arctic Ocean heat and salt budget. As the Atlantic Water layer advances into the Arctic, its core deepens from about 250 m depth around the Yermak Plateau to 350 m in the Laptev Sea, and gets colder and less saline due to mixing with surrounding waters. The complex topography in the region facilitates vertical and horizontal exchanges between the water masses and, together with strong shear and tidal forcing driving increased mixing rates, impacts the heat and salt content of the Atlantic Water layer that will circulate around the Arctic Ocean.

In September 2018, 6 moorings organized in 2 arrays were deployed across the Atlantic Water Boundary current for more than one year (until November 2019), within the framework of the Nansen Legacy project to investigate the seasonal variations of this current and the transformation of the Atlantic Water North of Svalbard. The Atlantic Water inflow exhibits a large seasonal signal, with maxima in core temperature and along-isobath velocities in fall and minima in spring. Volume transport of the Atlantic Water inflow varies from 0.7 Sv in spring to 3 Sv in fall. An empirical orthogonal function analysis of the daily cross-isobath temperature sections reveals that the first mode of variation (explained variance ~80%) is the seasonal cycle with an on/off mode in the temperature core. This first mode of variation is linked to the first mode of variation of the current. The second mode (explained variance ~ 15%) corresponds to a shorter time scale (6-7 days) variability in the onshore/offshore displacement of the temperature core linked to the mesoscale variability. On the shelf, a counter-current flowing westward is observed in spring, which transports colder (~ 1°C) and fresher (~ 34.85 g kg^{-1}) water than Atlantic Water ($\theta > 2$°C and $S_A > 34.9$ g kg^{-1}). This counter-current is driven by Ekman dynamics. At greater depth (~1000 m) on the offshore part of the slope, a bottom-intensified current is detected, partly correlated with the wind stress curl. Heat loss of the Atlantic Water between the two mooring arrays is maximum in winter, estimated to 300-400 W m^{-2} when the current speed and the heat loss to the atmosphere are the largest.