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Atlantic Water boundary current along the southern Yermak Plateau, Arctic Ocean

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One of the major branches of the warm and saline Atlantic Water supply is the current along the west coast of Spitsbergen in Fram Strait. The Yermak Plateau is a topographic obstacle in the path of this current. The diverging isobaths of the Plateau split the current, with an outer branch following the 1000-1500 m isobaths along the rim of the Yermak Plateau (the Yermak branch). Observation based estimates of the volume transport, structure and variability of the Yermak branch are scarce.

Here we present observations from an array of three moorings on the southern flank of the Yermak Plateau, covering the AW boundary current along the slope, between the 800 m to 1600 m isobaths over 40 km distance, from 11 September 2014 to 13 August 2015. The aim is to estimate the volume transport in temperature classes to quantify the contribution of the Yermak branch, to document the observed mesoscale variability, and identify the role of barotropic and baroclinic instabilities on the variability.

All three moorings show depth- and time-averaged currents directed along isobaths, with the middle mooring in the core of the boundary current. Depth-averaged current speeds in the core, averaged over monthly time scale, reach 20 cm s^{-1} in March. Temperatures are always greater than 0°C in the upper 800 m, or than 2°C in the upper 500 m. Seasonal averaged volume transport estimates of Atlantic Water defined as temperature above 2°C, are maximum in autumn (1.4 ± 0.2 Sv) and decrease to 0.8 ± 0.1 Sv in summer. The annual average AW transport is 1.1 ± 0.2 Sv, below which there is bottom-intensified current, particularly strong in winter, leading to a substantial transport of cold water (<0°C) with an annual average of 1.1 ± 0.2 Sv.

Mesoscale variability and energy conversion rates are estimated using fluctuations of velocity and stratification in the 35 h to 14-days band and averaging over a monthly time scale. Time-averaged profiles of horizontal kinetic energy (HKE) show a near-surface maximum in the outer and middle (core) moorings decreasing to negligible values below 700 m depth. HKE averaged between 100-500 m depth increases from about 3×10^{-3} m^2 s^{-2} in fall to $(6\text{-}9)\times10^{-3}$ m^2 s^{-2} in winter and early spring. Temperature and cross-isobath velocity covariances show substantial mid-depth temperature fluxes in winter. Divergence of temperature flux between the core and outer moorings suggests that heat is extracted by eddies. Depth-averaged energy conversion rates show typically small barotropic conversion, not significantly different from zero, and highly variable baroclinic conversion rates with alternating sign at 1-2 month time scales. Observations suggest

that the boundary current is characterized by baroclinic instabilities, which particularly dominate in winter months.