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Structure and variability of the West Greenland boundary current system

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The boundary current along the west coast of Greenland is the main pathway for waters circumnavigating and entering the Labrador Sea, an important site for deep convection. Until now, the year-round structure of the current system has not been investigated from an observational perspective. As part of the Overturning of the Subpolar North Atlantic Program (OSNAP), a high-resolution mooring array was maintained across the West Greenland shelf and slope near Cape Farewell, from August 2014 to August 2016. Here we use the data to investigate the structure, transport, and variability of the boundary current system. Three distinct velocity cores were present: the Deep Western Boundary Current, carrying dense overflow waters from the Nordic Seas; the Irminger Current, advecting warm and salty Atlantic-origin waters; and the West Greenland Coastal Current, transporting cold and fresh polar waters. The two-year mean transport of the full boundary current system is 33.03 $\pm$ 7.25 Sv, with no clear seasonal signal. However, the individual water mass properties show a statistically-significant seasonal cycle in hydrography and transport. In particular, there is an increase in Labrador Sea Water transport during the spring of both years, compensated by a decrease in Irminger Water and Northeast Atlantic Deep Water transport during the same period. These trends are due to changes in cross-sectional area of the water masses, not changes in the strength of the flow. In the case of the Labrador Sea Water, the seasonality can be understood as the lagged response of recently ventilated waters upstream. The boundary current is subject to energetic mesoscale variability. Both cyclonic and anticyclonic eddies progress past the array over the two-year period. We argue that the former are Denmark Strait Overflow Water cyclones that have propagated around Cape Farewell. These mesoscale features may help transport waters from the boundary current into the interior Labrador Sea, where they will influence stratification and thus modulate the strength of deep convection in the basin.