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Barents Sea Polar Front dynamics during fall and winter 2020-2021

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The Barents Sea is one of the main pathways by which Atlantic Water (AW) enters the Arctic Ocean and is an important region for key water mass transformation and production. As AW enters the shallow (< 400 m) Barents Sea, it propagates as a topographically steered current along a series of shallow troughs and ridges, while being transformed through atmospheric heat fluxes and exchanges with surrounding water masses. To the north, the warm and salty AW is separated from the cold and fresh Polar Water (PW) by a distinct dynamic thermohaline front (the Barents Sea Polar Front), often less than 15 km in width.

Two cruises were conducted in October 2020 and February 2021 within the Nansen Legacy project, focusing on the AW pathways and ocean mixing processes in the Barents Sea. Here we present data from CTD (Conductivity, Temperature, Depth), ADCP (Acoustic Doppler Current Profiler) and microstructure sensors obtained during seven ship transects and two repeated stations across and on top of a 200 m deep sill (77°18'N, 30°E) at the location of the Polar Front between AW and PW. The ship transects are complemented by five underwater glider missions, two equipped with microstructure sensors. On the sill, we observe warm (>2°C) and salty (>34.8) AW intruding below the colder (<0°C) and fresher (34.4) PW setting up a geostrophic balance where currents exceed 20 cm/s. We observe anomalous warm and cold-water patches on the cold and warm side of the front, respectively, collocated with enhanced turbulence, where dissipation rates range between 10^{-8} and 10^{-7} W/kg. In addition, tidal currents on the sill reach 15 cm/s. The variable currents affect the front structure differently in the vertical. While the mid-depth location of the front is shifted by several kilometers, the location of the front near the bottom remains stationary. The frontal dynamics on the sill result in transformation and mixing of AW, manifested in the troughs north of the sill as modified AW.