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Observations of elevated Atlantic water heat fluxes at the boundary of the Arctic Basin.

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The well documented decline in Arctic Sea Ice cover over the past 30 years has outpaced global models as warming in Polar Regions occurs faster than the global mean. The thermohaline circulation brings warm water from the Atlantic Ocean into the Arctic basin. This Atlantic water circulates at depth and contains sufficient heat to melt the sea ice cover several times over. Recent studies have shown that this Atlantic water has warmed and shoaled over recent decades (Polyakov et al, 2010). The stability of the upper Arctic Ocean has also changed, with stratification reduced in the Eurasian basin but increased in the Canada basin. Along with an increased availability of heat the reduction in sea ice cover allows greater potential for wind to input energy to the ocean to vertically mix heat to the surface and further melt sea ice. Direct measurements of vertical mixing rates across the Arctic are essential to understanding the changes in this supply of heat from below, but are scarce due to the challenges of making such measurements in the harsh Arctic environment.
We present measurements of turbulent kinetic energy dissipation (ε) within the top 500 m of the water column using microstructure measurements made both in open water and under ice during 4 different years. Mean rates of dissipation in the Atlantic water thermocline are calculated and compared for data collected in the European, Siberian and Canadian Arctic, including measurements from 2007 and 2012 when record minimum sea ice extents were recorded. Diapycnal heat fluxes from the mean Atlantic water dissipation rates were calculated from these mean dissipation rates and show significant variation across the Arctic Basin.
Profiles in the deep basin generally revealed very low rates of dissipation were low ε<10-9Wkg-1 and as such heat fluxes of AW were correspondingly low Fh=0.1-0.5Wm-2. However double diffusive staircases were present in all such casts and so vertical transfer of heat may be increased by diffusive fluxes.
Dissipation rates were enhanced by up to 3 orders of magnitude at the boundaries of the Arctic basin with the highest rates North of Svalbard and decreasing ε anticlockwise around the basin with low ε in the Canada basin. Enhanced heat fluxes at the boundaries ranged from 10-100 Wm-2 north of Svalbard decreasing to 2-5 Wm-2 along the Laptev shelf slope and less than 0.5 Wm-2 along the East Siberian slope and Lomonosov ridge. In the Canada basin heat fluxes at the boundary were less than 0.2 Wm-2.
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Arctic Ocean Warming Contributes to Reduced Polar Ice Cap
Igor V. Polyakov, Leonid A. Timokhov, Vladimir A. Alexeev, Sheldon Bacon, Igor A. Dmitrenko, Louis Fortier, et al. in Journal of Physical Oceanography (2010)