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Under-ice turbulent microstructure and upper ocean vertical fluxes in the Makarov and Eurasian basins, Arctic Ocean, during late spring and late summer / autumn in 2015

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The Arctic Ocean is generally assumed to be fairly quiescent when compared to many other oceans. The sea-ice cover, a strong halocline and a shallow, cold mixed-layer prevents much of the ocean to be affected by atmospheric conditions and properties of the ocean mixed-layer. In turn, the mixed-layer and the sea-ice is largely isolated from the warm layer of Atlantic origin below by the lower halocline.

Yet, the content of heat, freshwater and biologically important nutrients differs strongly between these different layers. Hence, it is crucial to be able to estimate vertical fluxes of salt, heat and nutrients to understand variability in the upper Arctic Ocean and the sea-ice, including the ecosystem. Yet, it is difficult to obtain direct flux measurements, and estimates are sparse.

We present several sets of under-ice turbulent microstructure profiles in the Eurasian and Makarov Basin of the Arctic Ocean from two expeditions, in 2015. These cover melt during late spring north of Svalbard and freeze-up during late summer / autumn across the Eurasian and Makarov basins. Our results are presented against a background of the anomalously warm atmospheric conditions during summer 2015 followed by unusually low temperatures in September.

$4-24$ h averages of the measurements generally show elevated dissipation rates at the base of the mixed-layer. We found highest levels of dissipation near the Eurasian continental slope and smaller peaks in the profiles where Bering Sea Summer Water (sBSW) lead to additional stratification within the upper halocline in the Makarov Basin.

The elevated levels of dissipation associated with sBSW and the base of the mixed-layer were associated with the relatively low levels of vertical eddy diffusivity.

We discuss these findings in the light of the anomalous conditions in the upper ocean, sea-ice and the atmosphere during 2015 and present estimates of vertical fluxes of heat, salt and other dissolved substances measured in water samples.