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Turbulent Mixing and Vertical Heat Transfer in the Surface Mixed Layer of the Arctic Ocean: Implication of a Cross-Pycnocline High-Temperature Anomaly

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This study focuses on the mixing processes in the vicinity of surface mixed layer (SML) of the Arctic Ocean. Turbulence activity and vertical heat transfer are quantitatively characterized in the Northwind Abyssal Plain, based on the RV Mirai Arctic cruise, during the transition from late summer to early winter 2014. During the cruise, noticeable storm events were observed, which came over the ship's location and contributed to the deepening of the SML. According to the ship-based microstructure observation, within the SML, the strong wind events produced enhanced dissipation rates of turbulent kinetic energy in the order of magnitude of ε = 10−6–10−4W kg^{-1}. On thermal variance dissipation rate, χ increases toward the base of SML, reaching O(10−7) K2 s^{-1}, resulting in vertical heat flux of O(10) W m−2. During the occasional energetic mixing events, the near-surface warm water was transferred downward and penetrated through the SML base, creating a cross-pycnocline high-temperature anomaly (CPHTA) at approximately 20–30 m depth. Near CPHTA, the vertical heat flux was anomalously magnified to O(10–100) W m−2. Following the fixed-point observation, in the regions of marginal and thick ice zones, the SML heat content was monitored using an autonomous drifting buoy, UpTempO. During most of the ice-covered period, the ocean-to-ice turbulent heat flux was dominant, rather than the diapycnal heat transfer across the SML bottom interface.