Direct measurements of near-surface upwelling and vertical heat flux in marginal ice zone of the Canada Basin, Arctic Ocean

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The western Arctic Ocean observation was conducted using R/V "*Mirai*" from October to November 2019. We aim to figure out the oceanic contributions on the delayed onset of seasonal sea ice formation. The 2019 was the remarkable year that hit the lowest and the second lowest records of November and annual sea ice extent, respectively, which are sign of delayed sea ice recovery. The R/V Mirai expedition covers the Beaufort Sea in the western Arctic to conduct hydro-dynamic observations including conventional CTDs, direct microstructure measurement with TurboMap, and upper-water monitoring of temperature with an autonomous instrument, IceBTC60/40 (IceBTC). The IceBTC is a buoy with a 60-m long tether, consisting of 17 thermistors and 3 pressure sensors. The IceBTC was deployed in a marginal ice zone (MIZ) in the Canada Basin where was covered with grease ice. During that, the TurboMap and XCTDs were accompanied in the proximity. The IceBTC observation detected a strong signal of upwelling from the warm Pacific Summer Water (PSW) layer, which locates beneath the cold surface mixed layer. Upward heat flux has changed with the wind regime influencing marginal ice zone. The flux rapidly increased by wind blowing towards open ocean from pack ice, at the same time ice drift speed showed nearly 40 cm s^{-1}. On the other hand, it was stalled down under other wind directions. Surprisingly, a bulk estimate of vertical heat flux towards the ice bottom instantaneously reached 600 W m^{-2}.Our study suggests that the upward heat flux due to PSW might be traditionally underestimated and wind-ice-ocean coupled system can enhance it breaking through strong pycnocline in the marginal ice zone where covered with fragile ice.

Keywords: western Arctic, upwelling, vertical heat flux, sea ice

