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Upper-ocean processes in sea-ice formation season in front of Dotson Ice Shelf

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The upper-ocean processes near ice shelves play crucial roles in the local freshwater budget, carbon take-up, surface albedo, and ice-shelf melting via controlling the air-sea heat exchange and thermocline depth. The upper-ocean processes are particularly complex during the austral autumn when both the air temperature and solar radiation flux drop dramatically, which result in an intense sea-ice formation and further influence the air-sea-ice interactions. However, in regions near the ice shelves like the Dotson Ice Shelf, where sea ice covers the ocean ten months a year, the lack of high-resolution and long-period observations limit our understanding of the upper-ocean processes in this sea-ice formation season. Here we present a dataset of high-frequency (1 Hz) temperature and salinity measurements collected by a recovered seal's tag. This tag recorded the ocean properties during late summer to autumn (mid-February to mid-April 2014) in a small region (within a 15-km radius circle) in front of the Dotson Ice Shelf, when sea ice formed and mixed-layer depth deepened. During those two months, mixed-layer depth increased from about 25 m to 125 m. The mixed-layer water temperature was always near the freezing point, while the salinity increased from 33.35 to 34.25 g per kg, equivalent to a sea ice formation of about 3.26 cm per day. We compare the changes of the upper-ocean properties with ERA-5 reanalysis atmospheric data and find that the upper-ocean heat content can be largely explained by the air-temperature changes. We run a 1-D upper-ocean model with and without sea-ice formation to explore the effect of sea-ice formation on the processes on the salinification and deepening of the mixed layer during autumn.