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Evolution of the wintertime salt budget of the Arctic Ocean mixed layer observed during MOSAIC

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In wintertime, the Arctic Ocean mixed layer (ML) regulates the transport of oceanic heat to the sea ice, and transfers both momentum and salt between the ice and the stratified ocean below. Between October, 2019, and May, 2020, we recorded time series of wintertime ML-relevant properties at unprecedented resolution during the MOSAIC expedition. Vertical and horizontal salt and temperature gradients, vertical profiles of horizontal velocity, turbulent dissipation of kinetic energy, growth of both level and lead ice, and ice deformation were obtained from both the Central Observatory and the Distributed Network around it.

We find that the ML deepened from 20 m at the onset of the MOSAIC drift to 120 m at the end of the winter. The ML salinity showed a decrease between early November 2019 and mid-January 2020 followed by a pronounced increase during February and March 2020 - marking the coldest period of the observations. Applying the equation of salt conservation to the ML as a guiding framework, we combine the abovementioned observations, to intercompare the temporal evolutions of the different processes affecting salinity. Overall, brine rejection associated with thermodynamic ice growth turns out to be the largest salt flux term in the ML salt budget. Thereby the observed amplitudes of upward ocean heat fluxes into the mixed layer are too small for them to have a relevant impact on limiting ice growth. Horizontal salt advection in the ML is the second-most important flux term, actually representing a net sink of salt, thus counteracting brine release. It displays considerably larger temporal *variability* than brine release, though, due to the variable of ocean currents and horizontal salt gradients. Vertical ocean salt fluxes across the mixed layer base represent the third-most important salt flux term, showing particularly elevated values during storm events, when small-scale turbulence in the ML is triggered by the winds. The results presented will be interpreted in the context of the changes in the regional and temporal ocean,

atmosphere and sea ice properties encountered during the MOSAIC drift.