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Winter upper-ocean thermohaline variability observed from drifting ice platforms in the Amundsen Basin, Arctic Ocean

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We analyzed hydrographic data from several autonomous oceanographic buoys within the MOSAiC Distributed Network together with regular CTD casts from the MOSAiC Central Observatory during the 2019/20 winter in the Amundsen Basin. These drifting platforms can yield as small as ~300 m (or 10 min) horizontal resolution, providing unprecedented perspectives for the (sub)mesoscale dynamics. Full-depth CTD profiles yielded the first baroclinic Rossby radii (R_1) of ~7.5 km, which is consistent with previous studies based on climatology. Near-surface layers shallower than the halocline were not always mixed. Restratification was commonly observed, suggesting the onset of baroclinic instabilities and/or eddies emanating from the lateral fronts. A surface-layer eddy with estimated radius of ~5 km was fortuitously observed and coincident with the surrounding mixed geostrophic shear in the vertical, that is, oppositely-sloping isopycnals within the depth range of ~20 – 200 m. This structure is reminiscent of the Charney-type baroclinic instability, resulting from a difference in the sign of the vertical gradient of the interior quasigeostrophic potential vorticity and that of the surface buoyancy forcing. A reconstructed surface dynamic height field supports this argument, showing that submesoscale to mesoscale surface lateral buoyancy gradients are ubiquitous. This result implies that the study domain could be inherently unstable and prone to generate baroclinic eddies. We also observed that the slopes of the density horizontal wavenumber spectra changed at the halocline depths (~40 – 75 m) after a ~3-day storm event with peak speeds ~ 20 m s^{-1}. We hypothesize that such change could be related to the Ekman pumping due to large ice drift (~50 cm s^{-1}) and its resultant stress curl during the storm. Our analyses underline that thinning Arctic sea ice and increasing ice drift could together trigger more oceanic heat flux into the cold halocline by storms, further deteriorating winter ice growth in the Amundsen Basin.

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