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A potential feedback for rapid sea ice decline in the Arctic

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Measurements of vertical ocean heat fluxes in the Arctic Ocean systematically show very small values in winter and significantly larger values in the summer as solar heat enters the surface ocean through leads and open water area causing basal sea-ice melt. Here we show modeling evidence of large vertical ocean heat fluxes ($\sim$200 W/m^2), supported by observations [1], at the edges of floes beneath active sea-ice leads where discontinuities in the surface ice-ocean stresses and Ekman pumping are present. The anomalies in vertical velocities reach depths of several hundreds of meters, well below (into) the Near Surface Temperature Maximum (NTSM), Pacific Summer Waters (PSW) or Atlantic Water layer (AWL). The total vertical displacement of pycnoclines during one single event is of the order of tens of meters and heat that is ventilated comes mostly from the NSTM and PSW. We suggest that this process is important in controlling the Arctic sea-ice mass balance in the Southern Beaufort and Chukchi seas where positive ice-ocean surface stress curl is largest and a potentially important player in the recent sea-ice decline in the Beaufort Sea – one that is not represented in lower-resolution global climate models. In a future climate with thinner and more mobile pack ice, this contribution from the ocean will only amplify.

[1] McPhee, M.G., Kwok, R., Robins, R. & Coon, M. Upwelling of Arctic pycnocline associated with shear motion of sea ice. *Geophys. Res. Lett.*, **32**, L10616 (2005)