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Investigations on the coupling of the Barents Sea sea-ice retreat on the Atlantic Water inflow via an ocean-ice-wind feedback in the context of Arctic Amplification

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One of the fastest changing environments of the Arctic is the Barents Sea (BS), located north of Norway between Svalbard, Franz Josef Land and Novaya Zemlja. Although covering only about 10% of the Arctic Ocean area, the BS is of Arctic-wide importance, as the warm water advected from the North Atlantic cause massive heat fluxes in the atmosphere and sea ice melt, ultimately driving major water mass modifications relevant for the Arctic Ocean circulation downstream.

We focus on the question whether the observed retreat in sea-ice extent in the BS over the past four decades has enhanced the inflow of warm Atlantic water (AW) into the BS via an ocean-sea-ice-atmosphere feedback contributing to Arctic Amplification, as follows. We start by presenting evidence that the retreating winter sea-ice cover of the Barents Sea has been associated with an increase in ocean-to-atmosphere heat flux that can be observed in a strong rise in near surface air temperature - spatially coinciding with the regions of strong sea-ice retreat. Furthermore, the rising air temperature and the associated convective processes in the atmosphere create a local low sea level pressure (SLP) system over the northern BS that results in additional westerly winds in the vicinity of the Barents Sea Opening (BSO), where the warm and saline AW enters the BS. In case these additional winds enhance the AW inflow into the BS a positive feedback is likely as more heat is available for melting further ice, amplifiying the negative SLP anomaly.

In a set of ocean sensitivity experiments using the sea-ice and ocean model FESOM2.1, we investigate the impact of sea ice-related SLP anomalies and their associated anomalous atmospheric circulation patterns on volume transport through the BSO. The simulations rely on a horizontal grid resolution of approx. 4.5 km in the Arctic and Nordic Seas allowing precise modeling of the BS hydrography and circulation. The model is initially driven with a repeated normal year forcing (CORE1) to isolate the impact of the wind anomalies from high frequency atmospheric variability. After a spin-up phase, the model is perturbed by anomalous cyclones over the BS derived from long term SLP differences in reanalysis datasets associated with the observed sea-ice retreat. The results point indeed to a slight increase in net volume transport into the BS across the BSO. This increase, however, is not caused by an *increase in the inflow* of AW, but rather a *decrease of the outflow* of modified AW recirculating back towards Fram Strait. In terms

of the feedback, our results indicate that the BS AW inflow is not sensitive to cyclonic wind anomalies caused by the sea-ice retreat. The additional volume and heat transport in the modified AW range may not be sufficient to provide enough heat to melt further sea-ice and hence likely does not close the proposed feedback mechanism in the BS.