Interannual variability of the Atlantic water transport to the Arctic Ocean in a climate model

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The Atlantic layer water has the highest temperature in the Arctic Ocean. This warm water is originated from the Atlantic water transported by the northward narrow current (the West Spitsbergen Current) at the Fram Strait. The heat of the Atlantic layer water could be elevated to sea surface by vertical mixing and melt the sea ice in the Nansen Basin. Therefore, the recent retreat of summer sea ice is related to the warming of the Atlantic layer water in the Arctic Ocean. Our previous study demonstrated that the synoptic pattern of wind induces the interannual variability of Atlantic water transport at the Fram Strait by using an ice-ocean model (Kawasaki and Hasumi, 2016). On the other hand, several studies showed that the synoptic scale wind field had been affected by the recent sea-ice retreat around the Fram Strait and Barents Sea. Thus, we employ an air-sea coupled model (i.e. climate model) to investigate the interannual variability of the Atlantic Water inflow and heat transport around the Fram Strait.
The utilized climate model is MIROC version 6. The horizontal resolution of the ocean component in the climate model is 0.25 degree, which is higher than that in the standard resolution climate model (1.0 degree). The preindustrial simulation is performed for 700 years after 1000-year spin-up by the low-resolution climate model, and the results in the last 50-year are analyzed in this study.
The narrow West Spitsbergen Current and recirculation of the Atlantic Water in the Fram Strait are well reproduced in our model. The warm Atlantic water is continually transported by eastward boundary current and reaches the Nansen Basin. These results cannot be found in the low-resolution climate model. The Atlantic water recirculation is enhanced by the cyclonic wind anomaly centered at the Nordic Seas. This result is consistent with the previous ocean modeling study (Kawasaki and Hasumi, 2016). The heat transport to the Arctic Ocean is intensified by the anti-cyclonic wind anomaly centered at the Barents Sea. Since the air-sea-ice coupled system acts significantly in the Barents Sea, the role of coupled system on interannual variability of heat transport should be examined. It will be discussed in my presentation by the analysis of results in the ocean-only model.

