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Splitting of Atlantic water transport towards the Arctic Ocean into the Fram Strait and Barents Sea Branches - mechanisms and consequences

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The heat content in the Arctic Ocean is to a large extent determined by oceanic advection from the south. During the last two decades the extraordinary warm Atlantic water (AW) inflow has been reported to progress through the Nordic Seas into the Arctic Ocean. Warm anomalies can result from higher air temperatures (smaller heat loss) in the Nordic Seas, and/or from an increased oceanic advection. But the ultimate fate of warm anomalies of Atlantic origin depends strongly on their two possible pathways towards the Arctic Ocean.

The AW temperature changes from 7-10°C at the entrance to the Nordic Seas, to 6-6.5°C in the Barents Sea opening and 3-3.5°C as the AW leaving Fram Strait enters the Arctic Ocean. When AW passes through the shallow Barents Sea, nearly all its heat is lost due to atmospheric cooling and AW looses its signature. In the deep Fram Strait the upper part of Atlantic water becomes transformed into a less saline and colder surface layer and thus AW preserves its warm core. A significant warming and high variability of AW volume transport was observed in two recent decades in the West Spitsbergen Current, representing the Fram Strait Branch of Atlantic inflow. The AW inflow through Fram Strait carries between 26 and 50 TW of heat into the Arctic Ocean. While the oceanic heat influx to the Barents Sea is of a similar order, the heat leaving it through the northern exit into the Arctic Ocean is negligible.

The relative strength of two Atlantic water branches through Fram Strait and the Barents Sea governs the oceanic heat transport into the Arctic Ocean. According to recently proposed mechanism, the Atlantic water flow in the Barents Sea Branch is controlled by the strength of atmospheric low over the northern Barents Sea, acting through a wind-induced Ekman divergence, which intensifies eastward AW flow. The Atlantic water transport in the Fram Strait Branch is mainly forced by the large-scale low-pressure system over the eastern Norwegian and Greenland Seas, strengthening the coherent shelf break current along the eastern rim of the Nordic Seas. However, long-term moored observations in the Barents Sea Opening and the northern Fram Strait reveal that Atlantic water transport in both branches vary with the opposite phase on the inter-annual time scale. This suggests that in the periods of weaker Atlantic water flow in the shelf break current, the increased transport in the Barents Sea Branch can also further weaken the Fram Strait Branch.

The anomalously warm AW inflow in the Fram Strait Branch has a strong impact on sea ice conditions in the southern Nansen Basin, while positive transport anomalies in the Barents Sea Branch increase availability of oceanic heat in the Barents Sea and subsequently influence its sea ice cover. Here we present the results of the Polish-Norwegian project PAVE, focusing on variability and recent warming of the Atlantic Water inflow through Fram Strait and Barents Sea, and addressing mechanisms that govern the AW split between both branches and its potential consequences.