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Atlantic water transformation and transport to the Arctic Ocean in the Fram Strait and Barents Sea Branches

Agnieszka Beszczynska-Möller (1), Øystein Skagseth (2), Waldemar Walczowski (1), Vidar Lien (2), and Wilken-Jon von Appen (3)

(1) Institute of Oceanology PAS, Sopot, Poland (abesz@iopan.gda.pl), (2) Institute of Marine Research, Bergen, Norway, (3) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

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 towards the Arctic Ocean. The ultimate fate of warm anomalies of Atlantic origin depends strongly on splitting of the AW flow into the Fram Strait (FSB) and Barents Sea Branch (BSB). Subsequent transformation of AW along these two branches and their relative strength govern the oceanic heat transport into the Arctic Ocean. Atlantic water, which leaves through Fram Strait with temperature of 3-3.5°C, brings between 26 and 50 TW of heat into the Arctic Ocean. Atlantic water inflow to the Barents Sea is warmer (6-6.5°C) and carries oceanic heat of a similar order, but most of it is lost to the atmosphere and sea ice melt before strongly modified AW enters the Arctic Ocean through the Barents Sea northern exit.

In recent decades a significant warming and high variability of AW volume transport was observed in the both branches of Atlantic inflow. AW 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 barotropic current. Transport in the Fram Strait Branch is mainly forced by the large-scale low-pressure system over the eastern Norwegian-Greenland Seas, which strengthens 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 (2013-2016), 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.