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Simulated pathways, variability and modification of the Arctic Atlantic water

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The distribution of the Atlantic Water (AW) in the Arctic Ocean has impacts on ocean mixing, ocean dynamics, heat and salt budgets, as well as on nutrients and biology. The NEMO ocen model (Nucleus for European Modelling of the Ocean modeling framework) is used at 1, 1/4 and 1/12 degree horizontal resolutions to track the simulated inflow of the AW into the Arctic Ocean via Fram Strait and the Barents Sea. Passive "colour" tracers simulating the AW are released during 1979-2010 in the western Fram Strait and the Barents Sea Opening. We examine the spread of AW in the Arctic Ocean and analyze the impact of model resolution on the AW distribution. Transit times of AW in the Fram Strait and Barents Sea branches and AW circulation in the Arctic Ocean are investigated. The simulations are compared with observational data. The model demonstrates a realistic spread of the Fram Strait and Barents Sea modes of AW into the Arctic Ocean. Fram Strait AW mode occupies a depth range of 200-700m and the Barents Sea AW has a maximum at about 1000m. Using Walin's water mass transformation diagnostics, updated for temperature and salinity classes, we differentiate AW modification due to (i) surface heat loss and freshening and (ii) AW modification through the interior mixing with ambient water masses. In the winter and spring the sea ice-free Northeastern Greenland Sea and the Eastern Fram Strait, together with the Southwestern Barents Sea and the area to the west of Novaya Zemlya are the regions where the AW modification is mainly due to vigorous surface heat loss to the atmosphere. In the summer and autumn there is a moderate warming of the upper AW in the Central and Southern Barents Sea due to atmospheric heating and reduced downward vertical mixing. We analyze interannual variability of the AW circulation and the mechanisms which drive it, including changes in the strength of the Arctic boundary current, vertical and lateral mixing, the role of bathymetric steering of the flow, buoyancy loss, wind and Ekman pumping. The findings are compared with the results of model inter-comparison experiments from the Forum for Arctic Ocean Modeling and Observational Synthesis (FAMOS).