Pathways and water mass transformation of Atlantic Water entering the Nordic Seas through Denmark Strait

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The transformation of Atlantic Water north of the Greenland-Scotland Ridge is one of the key mechanisms for controlling the strength of the Atlantic Meridional Overturning Circulation. It is important to understand where this transformation takes place in order to be able to predict its response to climate change. Previous research suggests the existence of an overturning loop north of Iceland where the inflowing Atlantic Water is transformed locally into Denmark Strait Overflow Water. Furthermore, idealized model studies have shown that cooling at the oceans' interior can be balanced by eddy fluxes from a buoyant boundary current, where the sinking of the dense water is occurring at the boundary.

This study has the aim to address the following questions:

1. What are the pathways of the Atlantic Water entering through Denmark Strait?
2. Where and when is the Atlantic Water transformed?
3. What is the role of deep convection for the pathways and the transformation of Atlantic Water?

A Lagrangian perspective is chosen, where the Atlantic Water watermass entering the Nordic Seas through Denmark Strait is tracked in two ocean models that differ substantially in their representation of deep convection. The models used are the Modular Ocean Model (MOM) and the Popular Ocean Program (POP). With an equal horizontal resolution of $1/10^{th}$ degree, the models differ most in their representation of the sea-ice (MOM is a coupled ocean-ice model, whereas in POP the sea-ice is restored to a climatological mean).

The resulting pathways are similar in both ocean models, however the partitioning of the particles over the various pathways is very different. The local overturning loop north of Iceland is present, but in the models used, this is not the main pathway for the inflowing Atlantic Water through Denmark Strait. The largest fraction of particles takes a long route along the rim of the Nordic Seas in MOM (51%) or leaves through the Iceland-Shetland passage in POP (21%). The strongest transformation of the Atlantic Water takes place just north of Iceland in both models, regardless of which path the particles take. The large difference in the partitioning of the particles over the various pathways is strongly linked to the simulated mixed layer depth in both ocean models. We will present how the various pathways are connected to the local heat flux, fresh water fluxes, mixed layer depth and wind stress. Doing so will shed light on the role that the various processes can play in setting the various pathways apart and in controlling the hydrographic changes along the way.