Theme 1. Linkages between Polar Regions and global systems
- T1-1
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- T1-8

Theme 2. Past, present and future changes in Polar Regions

Theme 3. Polar ecosystems and biodiversity

Theme 4. Human dimensions of change: Health, society and resources

Theme 5. New frontiers, data practices and directions in polar research

Theme 6. Polar science education, outreach and communication

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NORTHERN WATER MASSES AND MULTIDECADAL CLIMATE VARIABILITY

H R. Langehaug[1,2], T Eldevik[1,2], OH Otterå[2]
[1]Bjerknessenteret, [2]Nansen Environmental and Remote Sensing Center
Time: Wednesday 09 June 10:00
theme: Theme 1. Linkages between Polar Regions and global systems
session: T1-1 Polar Oceans and their importance for global ocean circulation
event: EM9.1-1 Polar Oceans and their importance for global ocean circulation
location: Hall B4

Keywords: Northern water mass transformation, Nordic Seas Overflow, Atlantic Meridional Overturning Circulation

Introduction: Warm and saline Atlantic Water transforms to cold and relatively fresh water in the Arctic Mediterranean. The cold overflows – products of this northern water mass transformation – and their contributions to the Atlantic Meridional Overturning Circulation (AMOC) are important to understand, since successful climate prediction depends on climate models' ability to capture the circulation and (multi-)decadal variability of the North Atlantic Ocean.

Methods: A coherent assessment of water mass transformation in ocean or climate models, e.g. associated with the northern part of the Atlantic Meridional Overturning Circulation, requires thermohaline properties (temperature and salinity) to be analyzed according to the methodology routinely applied to observations. When combining an appropriate (model) water mass analysis with the corresponding model transports, water mass transformation can be quantified (Bailey et al., 2005). This approach has been implemented for diagnosing a pre-industrial multi-century simulation with an updated version of the Bergen Climate Model (Otterå et al., 2009).

Results: Multi-decadal water mass changes have been particularly investigated at the Greenland-Scotland Ridge. In Figure 1 the diagnosis presented briefly above is shown for the Faroe-Shetland Channel. In Figure 2 we see that the Denmark Strait Overflow co-varies with the total overflow across the Greenland-Scotland Ridge, and the AMOC seems to be leading the changes in the Denmark Strait Overflow.

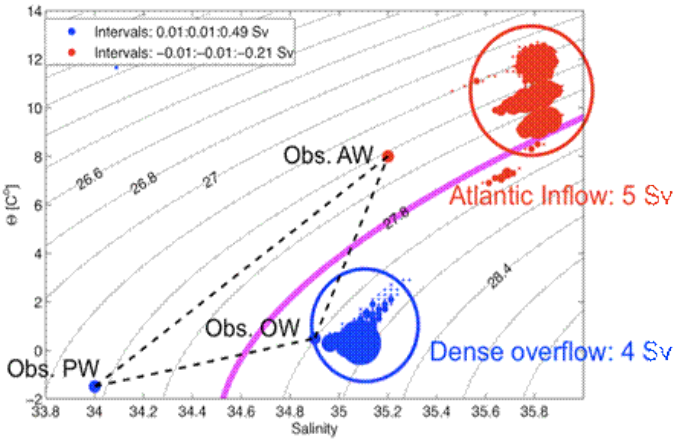

Figure 1: Water masses and their annual mean net volume flux in the Faroe-Shetland Channel.

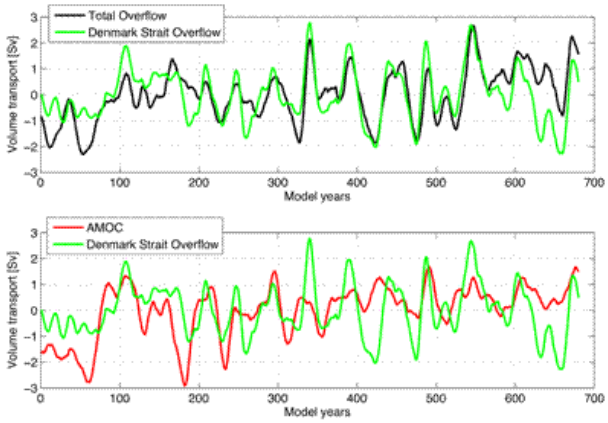

Figure 2: Upper panel: The Denmark Strait Overflow and the total overflow across the Greenland-Scotland Ridge have a high correlation (0.8). Lower panel: The overturning (AMOC) is leading the changes in Denmark Strait overflow by 2 year with a correlation of approximate 0.5.

Discussion: The thermohaline properties and the total volume transport of the Nordic Seas overflow are well-represented in the Bergen Climate Model according to observations (shown for the Faroe-Shetland Channel in Figure 1). In addition the diagnosis provided a novel evaluation of the relations between the products of the northern water mass transformation and AMOC. The results suggest that the changes in the Denmark Strait Overflow is caused by changes in the inflow of Atlantic Water into the Nordic Seas, as was recently showed by Eldevik et al. (2009) by use of observations of temperature and salinity.

References:

Bailey, D. A., P. B. Rhines, and S. Häkkinen, 2005: Formation and pathways of North Atlantic Deep Water in a coupled ice-ocean model of the Arctic-North Atlantic Oceans. *Clim. Dyn.*, **25**, 497–516.

Eldevik, T., J. E. Ø. Nilsen, D. Iovino, K. A. Olsson, A. B. Sandø, and H. Drange, 2009: Observed sources and variability of Nordic seas overflow. Nature Geoscience, 2, 406–410.

Otterå, O. H., M. Bentsen, I. Bethke, and N. G. Kvamstø, 2009: Simulated pre-industrial climate in Bergen Climate Model (version 2): model description and large-scale circulation features. *Geosci. Model Dev. Discuss.*, **2**, 507-549.