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A Model Study of the Exchanges across the Greenland-Scotland Ridge using an Ensemble Approach

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In a warmer world with an intensified hydrological cycle, the warming and freshening of the subpolar regions of the North Atlantic could be expected to slow down the Atlantic meridional overturning circulation (AMOC). Recent studies have revealed significant changes in the characteristics of the major Atlantic water masses since the 1950es and possibly a decreasing overflow of dense water through the Faeroe Bank Channel.

To investigate whether these observed changes are a consequence of atmospheric forcing (as hypothesised in he above) or rather given by the internal ocean dynamics (in which case the changes says nothing about the atmospheric forcing), we designed an ensemble modelling approach using the MPI-OM ocean model forced with NCEP/NCAR atmospheric reanalyses data as follows: A 1200 year long control experiment with randomised atmospheric forcing was performed. With an interval of 50 years 'transient' runs with forcing 1948-2001 was initiated from the ocean state of the control experiment - in total 20 transient experiment were made.

Variability of the control simulations is dominated by coupled centennial scale changes in the AMOC, watermass characteristics and convection activity in the North Atlantic. This defines distinct initial ocean states for the ensemble of transient simulations.

Changes induced by the atmospheric forcing are identified by statistically analysing timeseries of the transient less the control experiments. This analysis shows that both surface and deeper waters masses of the Nordic Seas and Labrador Sea are freshening for most ensembles, consistent with observations. This is linked to a gradual slowdown

of the AMOC of about 3-4 Sv but superimposed on strong decadal scale variations. Similar variations are also found for the deep overflows across the Greenland-Scotland Ridge, where, interestingly, no significant trend can be identified.