



The subpolar North Atlantic - Response to North Atlantic oscillation like forcing and Influence on the Atlantic meridional overturning circulation

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The extent and strength of the North Atlantic subpolar gyre (SPG) changed rapidly in the mid[U+2010] 1990s, going from large and strong in 1995 to substantially weakened in the following years. The abrupt change in the intensity of the SPG is commonly linked to the reversal of the North Atlantic Oscillation (NAO) index, changing from strong positive to negative values, in the winter 1995/96. In this study we investigate the impact of the initial SPG state on its subsequent behavior by means of an ocean general circulation model driven by NCEP[U+2010]NCAR reanalysis fields. Our sensitivity integrations suggest that the weakening of the SPG cannot be explained by the change in the atmospheric forcing alone. Rather, for the time period around 1995, the SPG was about to weaken, irrespective of the actual atmospheric forcing, due to the ocean state governed by the persistently strong positive NAO during the preceding seven years (1989 to 1995). Our analysis indicates that it was this preconditioning of the ocean, in combination with the sudden drop in the NAO in 1995/96, that led to the strong and rapid weakening of the SPG in the second half of the 1990s.

In the second part, the sensitivity of the low-frequency variability of the Atlantic meridional overturning circulation to changes in the subpolar North Atlantic is investigated using a 2000 year long control integration as well as sensitivity experiments with the MPI-M Earth System Model. Two 1000 year long sensitivity experiments will be performed, in which the low-frequency variability in the overflow transports from the Nordic Seas and in the subpolar deep water formation rates is suppressed respectively. This is achieved by nudging temperature and salinity in the GIN Sea or in the subpolar North Atlantic (up to about 1500m depth) towards a monthly climatology obtained from the last 1000 years of the control integration.