Geophysical Research Abstracts
Vol. 14, EGU2012-9630, 2012
EGU General Assembly 2012

Greenland meltwater experiments

S.M. Olsen and T. Schmith
Danish Meteorological Institute, Copenhagen OE, Denmark (ts@dmi.dk)

We explore the climatic response to additional Greenland Ice Sheet melting in the EC-EARTH coupled climate model. As reference runs, we use an ensemble of two simulations from 1850 to present with historic forcing. For each of these we pick the years 1935,1950 and 1965, respectively as initial conditions for perturbed experiments with an additional freshwater forcing of 0.1 Sv distributed uniformly around Greenland , a plausible value in the upper end of future Greenland ice sheet melt estimates.

We find give no evidence for abrupt transitions associated with tipping points in the Atlantic overturning circulation and mid-latitude heat transport. In fact, modelled decline in overturning in response to the additional forcing does not project onto a comparable reduction in the mid latitude (36N) ocean heat transport. This result points to an ongoing watermass transformation in the subpolar region and Arctic Mediterranean as a whole and a continued thermal mode of operation of the overturning.

At the northern boundary of the subpolar region (60N) the response in overturning shows a contrasting increase in intensity along with an increase in heat transport. Whereas the latter may be expected as a result of freshwater capping and subsurface warming in the subpolar region, the increased overturning at 60N is more difficult to explain. In order to assess this in more detail we have quantified the individual thermohaline exchange components of light and dense water masses across the Greenland-Scotland Ridge. We find that the intensified overturning at 60N is reflected in increased transports of light Atlantic Water to the Nordic Seas. However, the vertical, thermohalinie overturning loop is not equally strengthened. On the contrary, we model a decline in the denser parts of the outflow, the overflows in the Denmark Strait and Faroe Bank Channel and a strong increase in the polar outflow in the Denmark Strait. We observe a gradual transition from a vertical mode of operation with 70% of the Atlantic Inflow being transformed to dense overflow towards a state approaching an equal contribution of the vertical and horizontal thermohaline circulation loops after 20-30 years. Along with this transition we find an overall decline in the intensity of the barotropic gyre circulation of the Nordic Seas reflecting in part a reduced winter deepening of the mixed layer. Thus, we may seek to explain this transition as a result of more efficient lateral mixing of the Atlantic Inflow during its cyclonic circulation around the basin margins.

Finally, we show that the associated atmospheric response is a standing Rossby wave train reflected in the mean tropospheric thickness anomaly field with a through over Labrador Sea, a ridge over Barents Sea and a minor through over eastern Europe. Corresponding anomalies are found in the surface temperature field.