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SOUTHERN HEMISPHERE RESPONSE TO ANOMALOUS THERMOHALINE CIRCULATION

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ABSTRACT

Based upon an equilibrated climate driven by glacial and present day boundary conditions is demonstrated that the North Atlantic Deep Water (NADW) production rate is approximately proportional to the amount of freshwater inflow in the North Atlantic. The weakening of the NADW induces lower surface temperatures in the Northern Hermisphere whereas in the Southern Hemisphere strong warming is accompanied by an increase in the Antarctic Bottom Water (AABW) - the interhemispheric seesaw. The associated response of the AABW to the amount of freshwater anomalies into the North Atlantic indicates a strong coupling between the Northern and Southern Hemispheres. Nevertheless, it has been found that AABW experiences much larger amplitude changes compared to those related to the NADW. The shutdown of the NADW leads to weaker oceanic heat transport in the North Atlantic by about 1 PW. The out-of-phase climate response of the two hemispheres is characterized by rapid changes of sea-ice volume which leads to slight cooling over Greenland. Moreover, it is interesting to note the strong link between surface temperature anomalies in Weddell Sea and the changes of heat transport at 30_ S. By increasing the heat transport in the South Atlantic by 0.8 PW, the surface temperature over Weddell Sea increases by about 10_ C in a period of 300 years. This in turn reduces the sea-ice volume in the Southern Hemisphere. The suppression of the NADW also drastically change the atmospheric circulation; calculation of the high pass transient eddy activity revealed increased (decreased) low level poleward temperature flux in the NH (SH) in agreement with higher (lower) baroclinic activity. This negative atmospheric-oceanic feedback should play an important role to resume the NADW after the freshwater forcing ends up.