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Evolution of the deep Atlantic water masses since the last glacial maximum based on a transient run of NCAR-CCSM3

Lawrence Mysak (1), Juliana Marson (2), Mauricio Mata (3), and Ilana Wainer (4)

(1) McGill University, Atmospheric and Oceanic Sciences, Montreal, Quebec, Canada (lawrence.mysak@mcgill.ca), (2) Dept. of Earth and Atmospheric Sciences, Univ. of Alberta, Edmonton, AB, Canada, (3) Inst. de Oceanografia, Univ. Federal do Rio Grande, Rio Grande, Brazil, (4) Inst. Oceanografico, Unvi. de Sao Paulo, Sao Paulo, Brazil

During the last deglaciation, the high latitudes of the Atlantic Ocean underwent major changes. Besides the continuous warming, the polar and subpolar ocean surface received a large amount of meltwater from the retracting ice sheets. These changes in temperature and salinity affected the deep waters, such as the Antarctic Bottom Water (AABW) and the North Atlantic Deep Water (NADW). In this study, we present the evolution of the physical properties and the distribution of the AABW and NADW since the last glacial maximum (21 ka ago) using the results of a transient simulation with the NCAR-CCSM3. In this particular model scenario with a schematic freshwater forcing, we find that the modern NADW, with its characteristic salinity maximum at depth, was absent at the beginning of the deglaciation, while its intermediate version – Glacial North Atlantic Intermediate Water (GNAIW) – was being formed. GNAIW was a cold and relatively fresh water mass that dominated intermediate depths between 60 and 20 deg N. At this time, most of the deep and abyssal Atlantic basin was dominated by AABW. Within the onset of the Bolling-Allerod period, at nearly 15 ka ago, GNAIW expanded southwards when the simulated Meridional Overturning Circulation overshoots. The transition between GNAIW and NADW occurred after that, when AABW was fresh enough to allow NADW to sink deeper in the water column. When NADW appears (about 11 ka ago), AABW retracts and is constrained to lie near the bottom.