The Role of Mixing and Geothermal Heating in Altering AABW and NADW Pathways

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Antarctic Bottom Water (AABW) and North Atlantic Deep Water (NADW) constitute the deep Meridional Overturning Circulation (MOC). Surface mechanisms such as wind forcing, heat and freshwater fluxes have been identified as drivers of the deep-water mass formation. However, the interior drivers help transport NADW and AABW across ocean basins. Using sensitivity experiments in an Atlantic sector model, we diagnosed the influence of two poorly understood interior drivers on AABW and NADW, namely geothermal heating and vertical mixing, both as individual drivers and combined. We found that both enhanced mixing and geothermal heating increased the temperature and decreased the density of AABW and NADW. The meridional overturning circulation of NADW changed minimally (less than 3%) in all perturbations, while enhanced mixing and geothermal heating individually strengthened the AABW cell by 31.6% and 26.3%, respectively. The combined effect of the two mechanisms prompted a decrease in the MOC of the AABW cell by 21.1%. A diagnostic of Water Mass Transformation was applied to quantify the all transformations between water masses over time. The total transformation between AABW and NADW in the perturbations were estimated to be strengthened in the Atlantic sector model due to enhanced mixing and geothermal heating except a weakening water mass transformation from NADW into AABW posed by mixing and geothermal heating combined effect in the basin of south of 30S. The largest water mass transformation changes occurred in the Southern Ocean, where deep ocean property changes were remarkable throughout the water column.

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