Role of wind stress and sea surface thermal forcing in the formation of the Atlantic meridional overturning circulation at the Last Glacial Maximum

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In Previous Paleoclimate Model Intercomparison Project (PMIP) simulations of the Last Gracial Maximum (LGM) Atlantic Meridional Overturning Circulation (AMOC), the most of PMIP2 and PMIP3 models reproduced the 'deeper and stronger' AMOC than preindustrial simulations, in contrast to some reconstructions from paleo proxy data.Prior researches pointed out three factors controling the strength of AMOC in LGM climate: the cooling of the oceans in the Southern hemisphere, cooling in the North Atlantic, and the surface wind stresses in the North Atlantic. However, in the above-mentioned prior researches, the influences of these three factors on AMOC were only independently evaluated and the combined influences are still largely unknown. Here we emphasize the relative evaluation of combined influences of above- mentioned three factors on the AMOC. For this purpose, various ocean model experiments with our general ocean circulation model (COCO) were conducted; wind stress and thermal boundary conditions taken from PMIP experiments are replied to our ocean general circulation model. As a result, it was found that the difference of thermal boundary condition in the southern hemisphere most affects the strength of AMOC, and this cooling in the southern hemisphere is a necessary condition for reproducing the ‘shallower and weaker’ AMOC, but not a sufficient condition. From these results, it is implied that the stronger glacial AMOC reported in the PMIP models was possibly caused by the insufficient cooling in the southern hemisphere in LGM experiment, and this insufficient cooling possibly comes from warm bias there in the present state experiment and the associated underestimation of ice albedo feedback of sea ice.

Keywords: The Atlantic Meridional Overturning Circulation(AMOC), Ocean General Circulation Model(OGCM), Last Glacial Maximum(LGM)

