

## Importance of the sea ice-surface wind feedback on simulating the LGM AMOC

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Simulating and understanding the dynamics of the glacial Atlantic meridional overturning circulation (AMOC) is one of the main challenges in the paleoclimate community. However, most climate models in the Paleoclimate Model Intercomparison Project cannot reproduce a weak AMOC in their simulations of the last glacial maximum (LGM). Previous studies show that a stronger glacial surface wind over the northern North Atlantic induced by the Laurentide ice sheet is causing this model-data discrepancy. They suggest that a weaker wind over the northern North Atlantic may be important in simulating the weak LGM AMOC. Dome F members (2017) recently succeed in simulating a weak LGM AMOC in their simulations using a coupled model MIROC, and show that the surface wind over the northern North Atlantic is substantially reduced compare to previous LGM simulations. Differences in the sea ice extent over the northern North Atlantic are suggested to be the cause of the weaker surface wind, though the impact of the sea ice extent on the surface wind remains elusive. In addition, it remains unclear that whether the weakening of the surface wind plays a role in simulating the weak LGM AMOC. Therefore, in this study, we first investigate the role of sea ice expansion on the weakening of the surface wind, and then we explore the impact of the weakening of the surface wind on the LGM AMOC. For this purpose, simulations results from MIROC4m are utilized (Dome F members, 2017). To clarify the impact of changes in sea ice and associated changes in diabatic heating on the surface wind, sensitivity experiments are conducted with an atmospheric general circulation model and a linear baroclinic model. Additional experiments are conducted with the coupled model MIROC, which we modified the surface wind stress over the northern North Atlantic to assess the impact of weakening of the surface wind on the LGM AMOC. Results show that expansion of sea ice substantially weakens the surface wind over the northern North Atlantic. Analysis and experiments with linear baroclinic model shows that two processes are crucial in reducing the surface wind; the suppression of atmosphere-ocean heat exchange and the increase in the stability of the boundary layer over the sea ice due to an intense surface cooling. Additional experiments with MIROC show that the weakening of the surface wind due to the expansion of sea ice plays a role in maintaining the weak AMOC in the LGM simulation.

キーワード : LGM、AMOC、地表風

Keywords: LGM, AMOC, surface wind