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Modelling the Abrupt climate change in millennial scale and its influence upon ice sheets during the middle level glacia

ABE-OUCHI, Ayako[1*], Fuyuki Saito[2], Akira Oka[1], Rumi Ohgaito[2], Kunio Takahashi[2]

[1]AORI, University of Tokyo, [2]JAMSTEC

Abrupt climate change in millennial time scale such as D-O cycles and AIM recorded in ice cores occurs more frequent with high amplitude during the middle level glacial climate state than in the interglacial state or the full glacial state. The mechanism of the frequent occurrence of abrupt change through the Atlantic meridional overturning circulation is unclear and the necessity of the high frequency during the middle level glacial stated is not known. Here we use a coupled ocean atmosphere model, MIROC, to compare the detailed nature of the response to fresh water release (0 to 0.1Sv under different initial condition) of AMOC under middle level glacial state with interglacial or full glacial state. Under middle level glacial state, the AMOC is stronger at the basic state (without water release), nearly switches off with small amount of fresh water release of 0.05 Sv and induces larger cooling in the Northern hemisphere than other background climate states. The recovery of AMOC is induced from a nearly swithed off AMOC state by reducing the fresh water release to 0.01Sv or less, lead by the gradual response in the low latitude and followed by the lagged but sudden response in the convection and sea ice area in the North Atlantic. Laurentide and Fenno-Scandian Ice sheets' melt water estimated by an ice sheet model IcIES is consistent to the melt water amount needed for the AMOC change under middle glacial state, showing a possibility of favorable condition of self sustained oscillation between ice sheet and ocean meridional overturning under middle level glacial climate.