



Comparison of climatic responses related to the hysteresis behavior of the AMOC under the LGM and the present climates

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Many previous studies have suggested the Atlantic Meridional Overturning Circulation (AMOC) as a trigger of the abrupt climate changes in the past. This implies that the AMOC change with the freshwater flux (FWF) from the rapid ice sheet melting in the future can also bring significant changes in the climate.

However, the climate conditions under which the last deglaciation period began and the conditions now are significantly different. For example, before the last deglaciation, during the Last Glacial Maximum (LGM, about 21,000 years ago) period, climatic boundary conditions such as greenhouse gas concentrations, ice sheet distribution and orbital conditions have led the climate to a different state from today. Such different climate states are expected to affect the response of the AMOC to the freshwater release.

Therefore, using an Earth system model of intermediate complexity, LOch–Vecode–Ecbilt–CLio–agIsm Model (LOVECLIM), we performed the hysteresis experiments of the AMOC starting from two different initial states—the LGM and the Present-. Differences in the initial weakening speed of the AMOC and in the timing of recovery made the shape of their hysteresis diagram distinguishable from each other. Also, in the Present experiment, sudden cooling and sea ice expansion in the Southern Atlantic were observed in the collapsed AMOC state, which is inconsistent with the bipolar climate seesaw (BCS) theory. This southern cooling does not happen in the LGM experiment. We aim to present possible explanations on such different climate responses by focusing on the hydrology in the tropics (i.e. precipitation minus evaporation), the stability of the AMOC and the atmospheric circulation field.