Simulated abrupt recovery of overturning circulation during Bølling-Allerød using MIROC AOGCM

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During the last deglaciation, a major global warming was punctuated by several abrupt climate changes, likely related to fluctuations in the Atlantic Meridional Overturning Circulation (AMOC). A transient simulation from the Last Glacial Maximum (21,000 years ago) to early Holocene (11,000 years ago) is conducted using MIROC4m, an atmosphere-ocean coupled general circulation model. The changing insolation, greenhouse gas concentrations and meltwater fluxes derived from melting of continental ice sheet are applied based on reconstructions. An abrupt recovery of the AMOC occurred at around 15,000 years ago, even under the glacial meltwater flux that is equivalent to a sea level rise of approximately 5 meters in 1,000 years. The recovery in the AMOC associated with the retreat of sea ice extent in the North Atlantic and the formation of deep water. The recovery in the AMOC produced a well-known “bipolar-seesaw pattern”, and the simulated surface air temperature in the Greenland and Antarctic regions were consistent with reconstructions based on ice cores. The results indicate that the increasing summer insolation and atmospheric greenhouse gas concentrations could cause an abrupt recovery of the AMOC without large fluctuations in glacial meltwater flux. The properties in deep ocean temperature and salinity are analyzed.

Keywords: deglaciation, deep ocean circulation, ice cores

