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Increasing insolation and greenhouse gas concentration trigger Bølling-Allerød warming

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During the last deglaciation, a major global warming was punctuated by several abrupt climate changes, likely related to Atlantic Meridional Overturning Curculation (AMOC) (Clark et al. 2012). Transient deglaciation experiments from the Last Glacial Maximum have been conducted by applying time-dependent insolation, greenhouse gas concentrations, and glacial meltwater forcing (Liu et al. 2009). They have showed that reduction in glacial meltwater discharge rate into North Atlantic induces abrupt recovery of AMOC, warming of Greenland and cooling of Antarctica (bipolar response) during the period of Bølling-Allerød (BA, ∼14.6 ka).
We conduct a transient simulation from the Last Glacial Maximum to BA using an atmosphere-ocean coupled general circulation model (AOGCM) MIROC 4m (an IPCC-class Japanese community model). The model is initialized with the 21ka, and we change insolation, greenhouse gas concentrations and meltwater fluxes following the protocol of PMIP4 (Ivanovic et al. 2016). Glacial meltwater is derived from ice sheet reconstruction (ICE6g, Peltier et al. 2015). We assume the glacial meltwater due to ice sheet loss is uniformly applied to the area of 50-70N North Atlantic Ocean. We conduct additional experiments branched from 16 ka, where 50-80% of ICE6g meltwater fluxes are applied without reducing the meltwater fluxes before the BA.
The model results show that abrupt resumption of AMOC and warming of Greenland occurred at around the period of BA even under hosing of 0.06 Sv. Transition from cold stadial mode to warm interstadial mode occurs in about 100 years, which is consistent with reconstructions (Buizert et al. 2014). The result implies that increasing summer insolation and greenhouse gas concentration trigger abrupt AMOC recovery and warming in the Northern Hemisphere, and large fluctuation of meltwater due to ice sheet melting may not be necessary.