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Insolation triggered abrupt cooling at the end of interglacials and implication for the future

Qiuzhen Yin¹, **Zhipeng Wu**¹, Ming-Qiang Liang¹, Andre Berger¹, Hugues Goosse¹, and David Hodell²

¹Earth and Climate Research Center, Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium (qiuzhen.yin@uclouvain.be)

²Godwin Laboratory for Palaeoclimate Research, Department of Earth Sciences, University of Cambridge, Cambridge, UK

Paleoclimate records show that the end of interglacials of the late Pleistocene was marked by abrupt cooling events. Strong abrupt cooling occurring when climate was still in a warm interglacial condition is puzzling. Our transient climate simulations for the eleven interglacial (sub)stages of the past 800,000 years show that, when summer insolation in the Northern Hemisphere (NH) high latitudes decreases to a critical value (a threshold), it triggers a strong, abrupt weakening of the Atlantic meridional overturning circulation and consequently an abrupt cooling in the NH. The mechanism involves sea ice-ocean feedbacks in the northern Nordic Sea and the Labrador Sea (Yin et al., 2021, doi: 10.1126/science.abg1737). The insolation-induced abrupt cooling is accompanied by abrupt changes in precipitation, vegetation from low to high latitudes and by abrupt snow accumulation in northern polar regions. The timing of the simulated abrupt events is highly consistent with those observed in marine and terrestrial records, especially with those observed in high-resolution, absolutely-dated speleothem records in Asia and Europe, which validates the model results and reveals that the astronomically-induced slow variations of insolation could trigger abrupt climate events. Our results show that the insolation threshold occurred at the end of each interglacial of the past 800,000 years, suggesting its fundamental role in terminating the warm climate conditions of the interglacials. The next insolation threshold will occur in 50,000 years, implying an exceptionally long interglacial ahead naturally speaking, confirming earlier studies using other models.