

## **Insolation threshold triggered abrupt changes of Atlantic overturning circulation at the end of interglacials**

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Paleoclimate records show that the end of interglacials of the late Pleistocene was marked by abrupt cooling events and increased millennial variability. Strong abrupt cooling occurring when climate was still in a warm interglacial condition is puzzling and its cause remains uncertain. In this study, we performed transient climate simulations for all the eleven interglacial (sub)stages of the past 800,000 years with the model LOVECLIM1.3. Our results show that there exists a threshold in the astronomically induced insolation below which abrupt changes at the end of interglacials occur. When the summer insolation in the Northern Hemisphere (NH) high latitudes decreases to a critical value, it triggers a strong, abrupt weakening of the Atlantic meridional overturning circulation (AMOC)

followed by high-amplitude variations. The mechanism involves sea ice feedbacks in the Northern Nordic Sea and the Labrador Sea. The abrupt weakening of AMOC in turn lead to strong cooling in the NH and its abrupt oscillations lead to similar abrupt oscillations in the simulated temperature, precipitation and vegetation from low to high latitudes. Our simulated results are supported by observations from marine and terrestrial records. Our study shows that the astronomically-induced slow variation of insolation could trigger abrupt climate changes. The insolation threshold occurred at the end of each interglacial of the past 800,000 years, suggests its fundamental role in terminating the warm climate conditions at the end of interglacials. Our results show that the next insolation threshold will occur in 50,000 years, suggesting an exceptionally long interglacial ahead, which is in line with what has been suggested by early studies.

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