



Insolation induced abrupt changes and multi-centennial variability of AMOC

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To investigate the climate effect of astronomical forcing on several timescales, we have performed transient simulations covering the last 800,000 years with LOVECLIM1.3, an Earth system model of intermediate complexity. Our results show that, in addition to changes on orbital timescale, slow-varying insolation could trigger abrupt changes and multi-centennial variability in the Atlantic meridional overturning circulation (AMOC).

The insolation-induced abrupt changes and multi-centennial variability of AMOC are particularly pronounced at the end of interglacials. When summer insolation in the Northern Hemisphere (NH) high latitudes decreases to a threshold, it triggers a strong, abrupt weakening of the AMOC and consequently an abrupt cooling in the NH. The mechanism involves sea ice-ocean feedbacks in the Northern Nordic Sea and the Labrador Sea. During glacial times, the insolation-induced high frequency oscillations of AMOC could be strongly modulated by both reduced CO₂ concentration and enhanced NH ice sheets through their additional effects on the sea ice-ocean system.

The timing of the simulated abrupt events at the end of interglacials is highly consistent with that observed in marine and terrestrial records, especially in high-resolution, absolutely-dated speleothem records from Asia and Europe. This validates the model results and provides a plausible explanation for the abrupt cooling events observed at the end of interglacials in many proxy records. Our preliminary results from ice sheet simulations show that the insolation-induced cooling plays an essential role on the regrowth of NH ice sheets at the glacial inception. The next insolation threshold will occur in 50,000 years, implying an exceptionally long interglacial ahead naturally speaking.