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Clim. Past, 2, 79-90, 2006

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Coupled climate model simulation of Holocene cooling events: oceanic feedback amplifies solar forcing

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Abstract. The coupled global atmosphere-ocean-vegetation model ECBilt-CLIO-VECODE is used to perform transient simulations of the last 9000 years, forced by variations in orbital parameters, atmospheric greenhouse gas concentrations and total solar irradiance (TSI). The objective is to study the impact of decadal-to-centennial scale TSI variations on Holocene climate variability. The simulations show that negative TSI anomalies increase the probability of temporary relocations of the site with deepwater formation in the Nordic Seas, causing an expansion of sea ice that produces additional cooling. The consequence is a characteristic climatic anomaly pattern with cooling over most of the North Atlantic region that is consistent with proxy evidence for Holocene cold phases. Our results thus suggest that the ocean is able to play an important role in amplifying centennial-scale climate variability.

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Citation: Renssen, H., Goosse, H., and Muscheler, R.: Coupled climate model simulation of Holocene cooling events: oceanic feedback amplifies solar forcing, *Clim. Past*, 2, 79-90, 2006. [Bibtex](#) [EndNote](#) [Reference Manager](#)



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