Geophysical Research Abstracts
Vol. 18, EGU2016-5495-2, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

Effects of melting ice sheets and orbital forcing on the early Holocene warming in extratropical Northern Hemisphere

yurui zhang (1,2), Hans Renssen (2), and Heikki Seppä (1)

(1) Department of Geoscience and Geography, University of Helsiki,Finland (yurui.zhang@helsinki.fi), (2) Faculty of Earth and life Sciences, VU University Amsterdam, Amsterdam, the Netherlands

The early Holocene is an important climatological period, as it marked the final transition from the last deglaciation to the relatively warm and stable Holocene. Previous studies have analyzed the influence of the demise of the ice sheets and other forcings on the climate system during the Holocene. However, the climate response to the forcings together with the internal feedbacks before 9 ka remains not fully comprehended. In this study, we therefore disentangle how these forcings contributed to climate change during the earliest part of Holocene (11.5–7 ka) by employing the LOVECLIM climate model for both equilibrium and transient experiments.

The results of our equilibrium experiments for 11.5 ka reveal that the annual mean temperature at the onset of the Holocene was lower than in the preindustrial era over most of the extratropical Northern Hemisphere. The magnitude of this cooler climate varies regionally and this spatial pattern is suggested by the biologically based proxies as well. In eastern N America and NW Europe the temperatures were 2–5 °C lower than in the preindustrial era as the climate was strongly influenced by the cooling effects of the ice sheets at here. This cooling of the ice-sheet surface was caused both by the enhanced surface albedo and by the orography of the ice sheets. In contrast, in Alaska, temperatures in all seasons were 0.5–3 °C higher than in the control run primarily due to the orbitally induced positive insolation anomaly and the enhanced southerly winds which advected warm air from the South as a response to the high air pressure over the Laurentide Ice Sheet (LIS).

Our transient experiments indicate that the Holocene temperature evolution and the early Holocene warming were also geographically heterogeneous. In Alaska, the climate is constantly cooling over the whole Holocene. In contrast, in N Canada, there was an overall warming during the early Holocene up to 1.88 °C ka-1 in summer as a consequence of the progressive decay of the the LIS. The comparison of simulated temperature evolution with proxy records demonstrates the uncertainties in reconstructions of ice sheets decay exist and can be captured by using the different freshwater scenarios. Overall, our results demonstrate the spatial variability of the climate during the early Holocene.