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Did accelerated North American ice sheet melt contribute to the 8.2 ka cooling event ?

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The 8.2 ka event was an abrupt cooling of the Northern Hemisphere 8,200 years ago. It is an almost ideal case study to benchmark the sensitivity of climate models to freshening of the North Atlantic by ice sheet melt (Schmidt and LeGrande, 2005). The event is attributed to the outburst of North American proglacial lakes into the Labrador Sea, causing a slow-down in Atlantic overturning circulation and cooling of 1-2.5 ºC around the N. Atlantic (Alley and Ágústsdóttir,2005). Climate models fail to simulate the ∼150 year duration of the event when forced with a sudden (0.5 to 5 years) drainage of the lakes (Morrill et al., 2013a). This could be because of missing forcings. For example, the separation of ice sheet domes around the Hudson Bay is thought to have produced a pronounced acceleration in ice sheet melt through a saddle collapse mechanism around the time of the event (Gregoire et al., 2012).

Here we investigate whether this century scale acceleration of melt contributed to the observed climatic perturbation, using the coupled Ocean-Atmosphere climate model HadCM3. We designed and ran a set of simulations with temporally variable ice melt scenarios based on a model of the North American ice sheet. The simulated magnitude and duration of the cold period is controlled by the duration and amount of freshwater introduced to the ocean. With a 100-200 year-long acceleration of ice melt up to a maximum of 0.61 Sv, we simulate 1-3 °C cooling in the North Atlantic and ∼0.5-1 °C cooling in Continental Europe; which are similar in magnitude to the ∼1-2 °C cooling estimated from records for these areas (Morrill et al., 2013b). Some of the observed features are however not reproduced in our experiments, such as the most pronounced cooling of ∼6 ºC observed in central Greenland (Alley and Ágústsdóttir, 2005).

The results suggest that the ∼150 year North Atlantic and European cooling could be caused by ∼200 years of accelerated North American ice sheet melt. This forcing should therefore be taken into account in the setup of 8.2 ka simulations.

References:
Alley, R.B., Ágústsdóttir, A.M., 2005. The 8 k event: cause and consequences of a major Holocene abrupt climate change. Quaternary Science Reviews 24 (10–11),1123–1149.
Gregoire, L. J., A. J. Payne, and P. J. Valdes (2012), Deglacial rapid sea level rises caused by ice-sheet saddle collapses, Nature, 487, 219–223.
Morrill, C., A. N. LeGrande, H. Renssen, P. Bakker, and B. L. Otto-Bliesner (2013a), Model sensitivity to North Atlantic freshwater forcing at 8.2 ka, Clim. Past, 9, 955–968.
Morrill, C., D. M. Anderson, B. A. Bauer, R. Buckner, E. P. Gille, W. S. Gross, M. Hartman, and A. Shah (2013b), Proxy benchmarks for inter-comparison of 8.2 ka simulations, Clim. Past, 9, 423–432.
Schmidt, G. A., and A. N. LeGrande (2005), The Goldilocks abrupt climate change event, Quat. Sci. Rev., 24, 1109–1110.