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# The impact of catastrophic meltwater drainage on the early Holocene climate: model simulations of the 8.2 kyr BP event

H. Renssen (1), A.P. Wiersma (1), H. Goosse (2), T. Fichefet (2)

(1) Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam, The Netherlands (2) Institut d'Astronomie et de Géophysique G. Lemaître, Université catholique de Louvain, Louvain-la-Neuve, Belgium (hans.renssen@falw.vu.nl)

In the North Atlantic region, the most distinct Holocene climatic event– with a duration of about 150 years – occurred at 8.2 kyr BP (thousand calendar years before present). In this region, this '8.2 kyr BP event' is clearly registered as a cooling in high resolution proxy data, such as Greenland ice cores, ocean sediments, European lake cores and tree-ring records. The main hypothesis is that the 8.2 kyr BP event has been caused by a perturbation of the North Atlantic thermohaline circulation (THC) by a catastrophic release of meltwater associated with the final stages of deglaciation of the Laurentide ice sheet. In recent years, widely varying estimates for the volume of the involved freshwater pulse have been published, ranging from 0.3 to 5.0x$10^{14}$ $m^3$. In addition, estimates for the duration of the meltwater pulse range from less than a year to a decade.

We present an overview of simulation experiments on the 8.2 kyr BP event performed with two versions of the ECBilt-CLIO coupled atmosphere-ocean model. In these experiments, the model's THC was perturbed by releasing freshwater pulses into the Labrador Sea. To test the robustness of the response, each of the meltwater drainage scenarios was repeated 5 times with different initial conditions (i.e. 5 ensemble members). A few years ago, we tested the response to relatively long (10, 20 or 50 yr) and large (4.67x$10^{14}$ $m^3$) freshwater pulses with version 2 of ECBilt-CLIO. In these experiments, the duration of the THC perturbation events depended on the freshwater release rate, with longer events simulated when the same freshwater volume was released in less time. However, the response was stochastic, as the duration of the

THC weakening varied between 150 years and more than 1000 years within a set of ensemble members.

Recently, we performed a new set of experiments with version 3 of ECBilt-CLIO. In these simulations three different freshwater volumes were considered (1.63 x $10^{14}$ $m^3$, 3.26 x $10^{14}$ $m^3$ and 4.89 x $10^{14}$ $m^3$), together with three freshwater release durations (1, 2 and 5 yr). These experiments were repeated in simulations that included the effect of the background-melting of the Laurentide ice sheet by releasing a fixed rate of 0.172 Sv in the Labrador Sea. The results of version 3 suggest that the amount of freshwater released is the decisive factor in the response of the ocean, while the release duration only plays a minor role, at least when considering the short release durations of the applied freshwater pulses. Furthermore, the experiments with the background melting of the Laurentide ice sheet produce a more realistic early Holocene climate state without Labrador Sea Water formation. Meltwater pulses introduced into this climate state produce a prolonged THC weakening, implying that less freshwater is required to produce an event with the same duration. In contrast to the earlier simulations, the THC's response in our model was not stochastic, i.e. the duration and magnitude of the THC weakening was similar within a set of 5 ensemble members.