Simulated Changes in Vegetation Distribution, Land Carbon, and CO_2 in Response to a Collapse of the North Atlantic THC.

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OVERVIEW

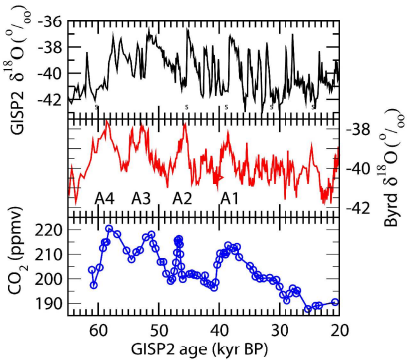
To which extend did changes in vegetation distribution and terrestrial carbon storage contribute to glacial CO_2 fluctuations?

- Several millennial scale climate change events occured during the last glacial period, likely linked to changes in North Atlantic THC.
- The ice core CO_2 record shows multi-millennial CO_2 variations of up to 20 ppm
- Pollen data suggest a reduction in NH tree cover during cold phases

The Lund Potsdam Jena Dynamic Global Vegetation Model is forced with climate perturbations from glacial freshwater experiment with ECBILT-CLIO.

- Modelled NA THC collapses and recovers after about a millennium in response to freshwater forcing
- The initial cooling of several cegree over Eurasia causes a dieback of extant boreal forests.

The simulated changes in atmospheric CO_2 and in vegetation cover are broadly compatible with the available evidence



The ice core record

Greenland (top) and Antarctic (middle) tem-perature fluctuations as recorded by the proxy d^{18}O are asynchonous.

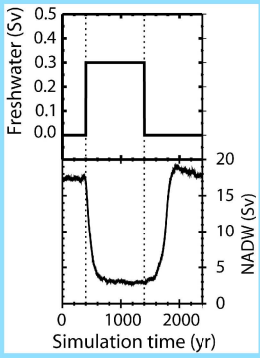
CO_2 fluctuations (bottom) of roughly 20 ppm occured broadly in parallel with the Antarctic warm phases A1 to A4

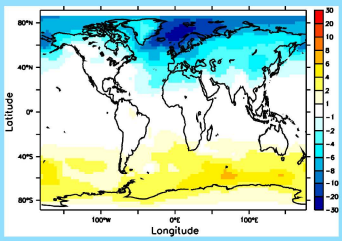
MODEL EXPERIMENTS

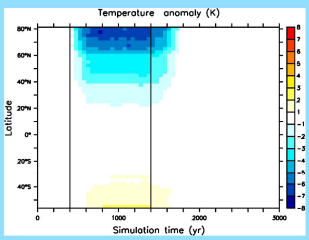
Right: **The ECBILT-CLIO model is forced with a freshwater input (top), leading to a collapse of the North Atlantic Deepwater Formation (bottom)**

Below: **The modeled temperature (and precipitation) anomalies (in K) are used to force the Lund Potsdam Jena Dynamic Global Vegetation Model**

Atmospheric CO_2 is calculated by coupling the LPJ-DGVM to the HILDA ocean model. Changes in the marine carbon cycle are not addressed







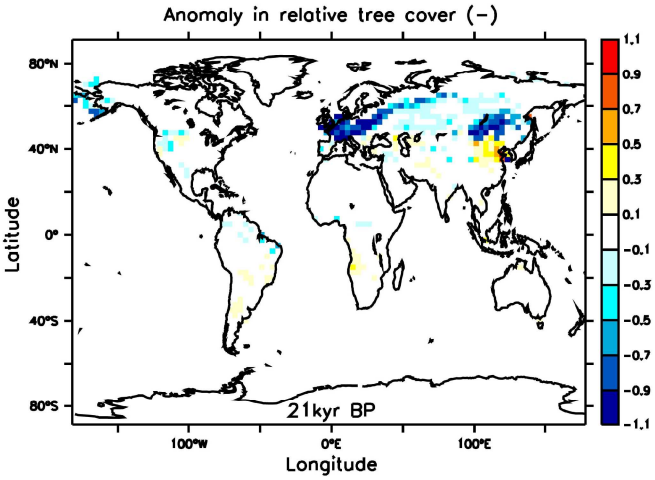
References

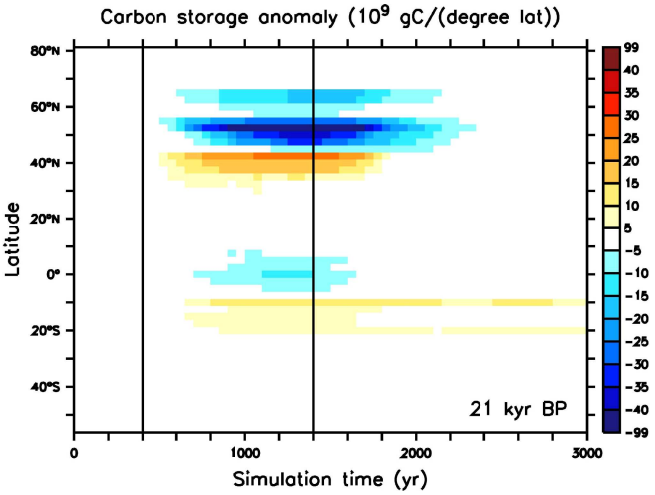
P. Köhler, F. Joos, S. Gerber, and R. Knutti. Simulated changes in vegetation distribution, land carbon storage, and atmospheric CO_2 in response to a collapse of the North Atlantic thermohaline circulation. ***Climate Dynamics***, in press, 2005.

Knutti, R., J. Flückiger, T.F. Stocker and A. Timmermann. Strong hemispheric coupling of glacial climate through freshwater discharge and ocean circulation. ***Nature***, 430, 851-856, 2004.

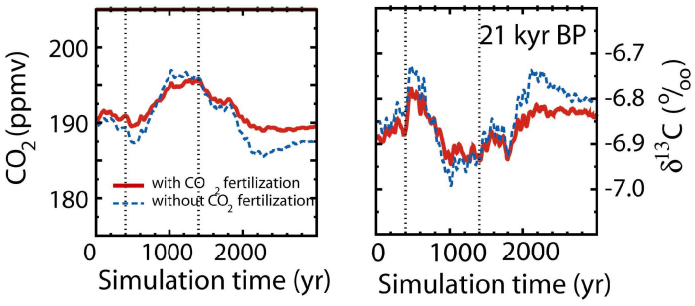
RESULTS

Cooling associated with an NADW collapse causes forest dieback in high northern latitudes and better growing conditions in mid-latitudes





Small Atmospheric CO_2 and $\delta^{13}C$ variations are compa-tible with evidence from ice cores and marine studies



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www.climate.unibe.ch/~joos30/publications.html (Köhler et al.)