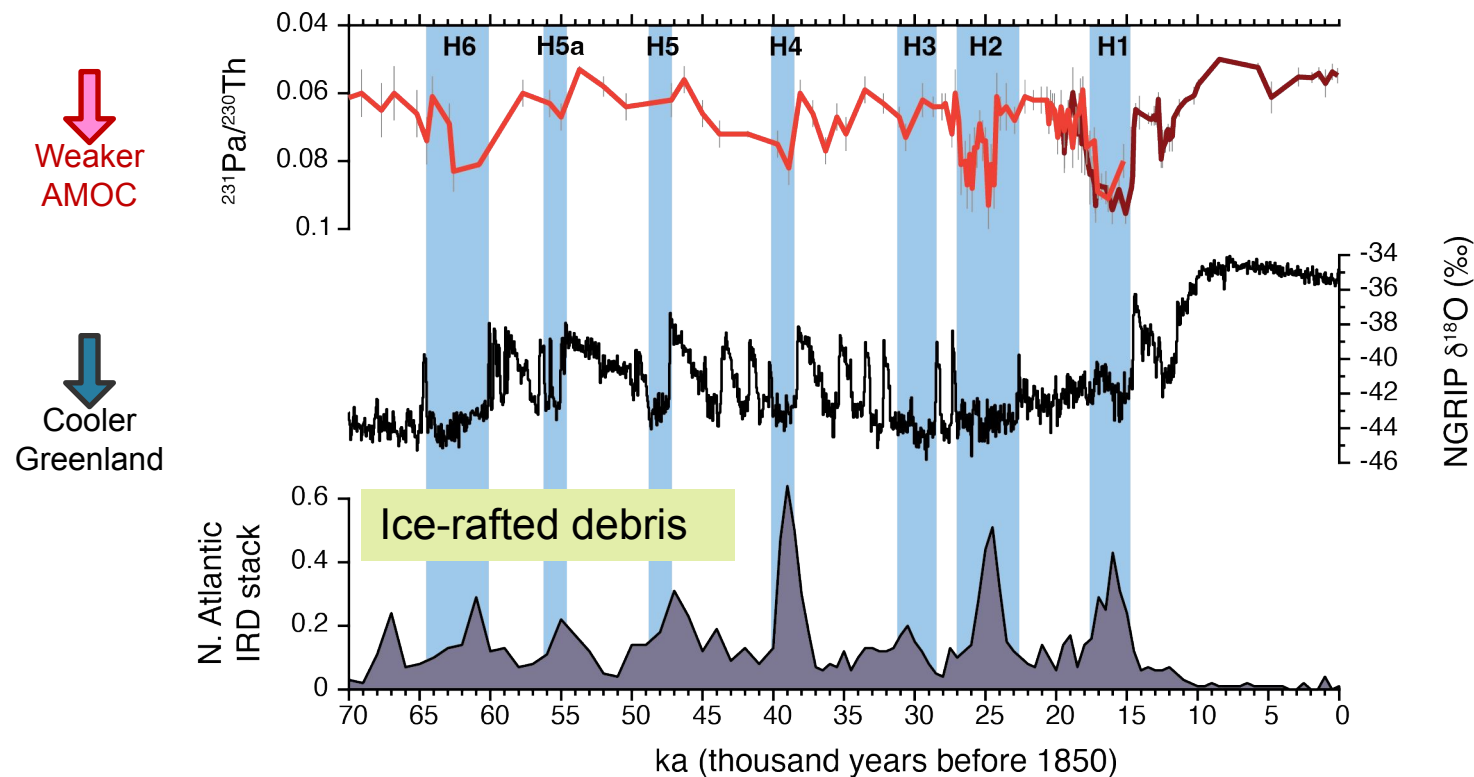


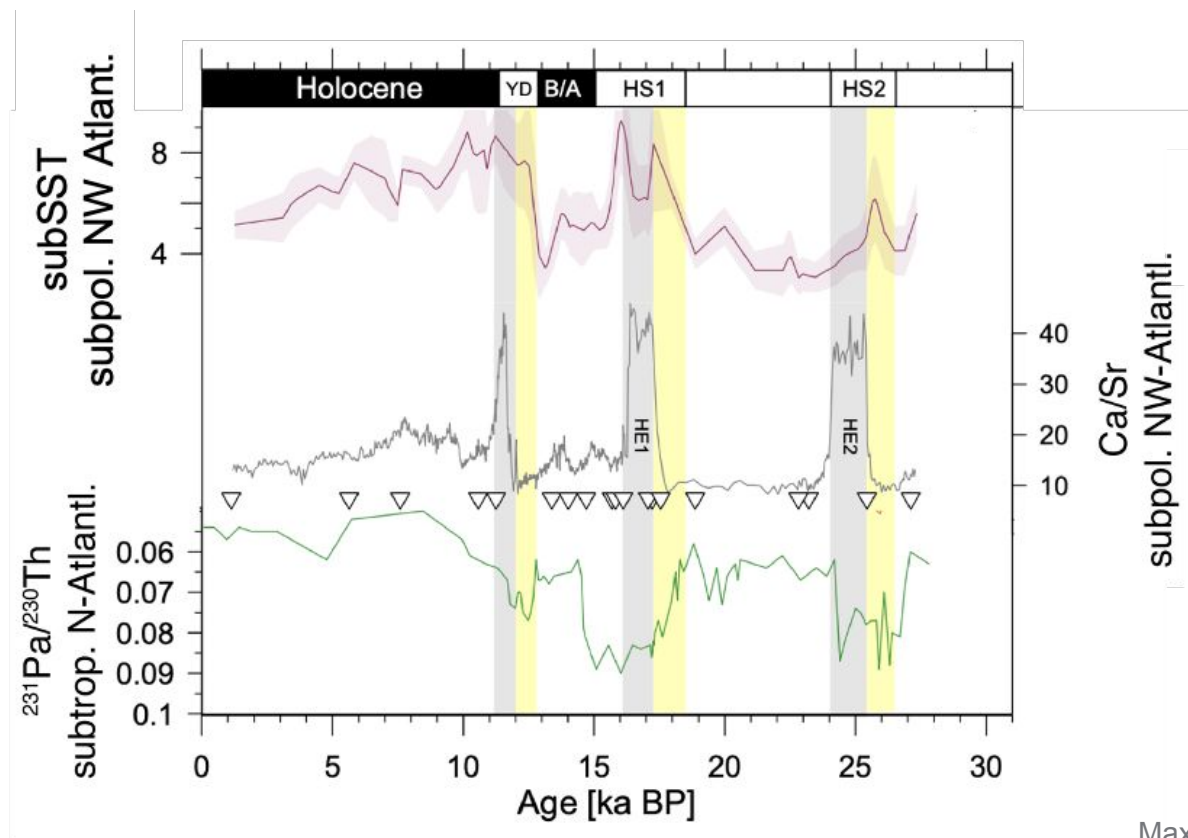
Pacific meltwater as a potential mechanism for preconditioning the North Atlantic for Heinrich event 1

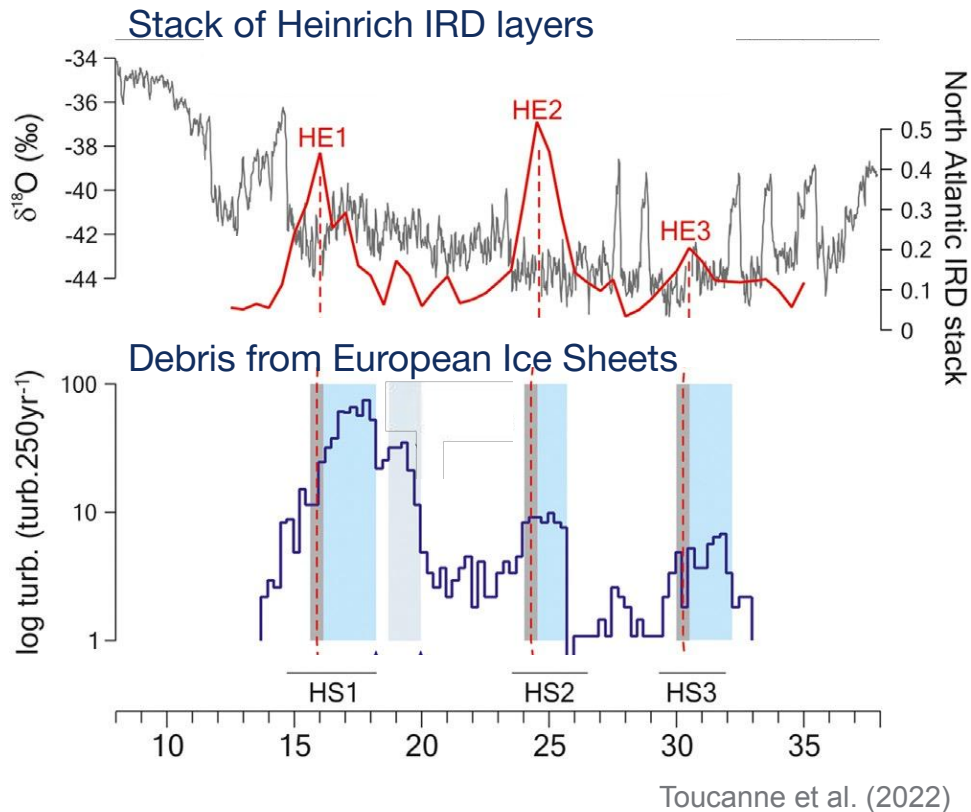
Chijun Sun, Bette Otto-Bliesner, Jiang Zhu, Esther Brady, Sophia Macarewich
Climate & Global Dynamics Laboratory
National Center for Atmospheric Research



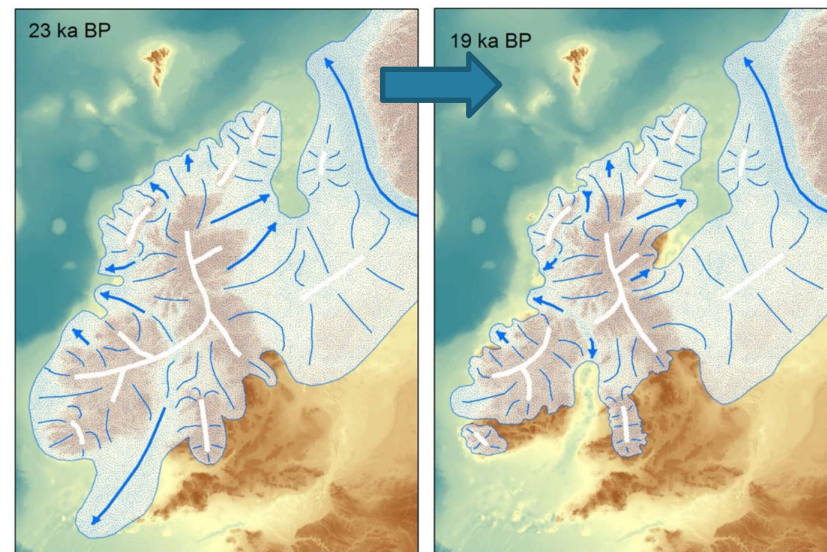
Adapted from McManus et al. (2004; Nature); Lippold et al. (2009, GRL); Böhm et al. (2015, Nature); Andersen et al. (2004, Nature); Lisiecki and Stern (2016, Paleoceanography);

Subsurface warming in the North Atlantic and AMOC weakening precede Heinrich events





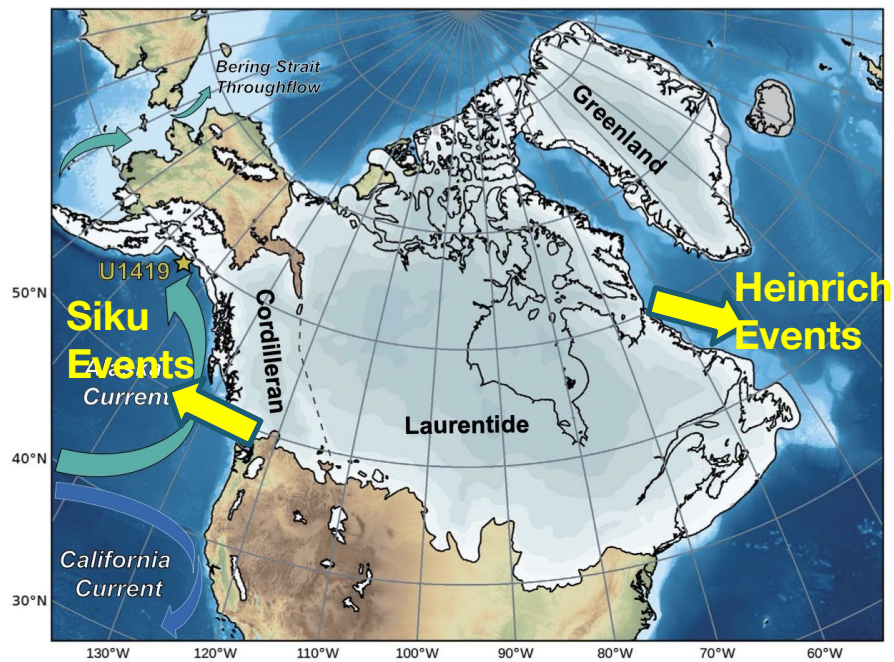
Rapid retreat of the British-Irish Ice Sheet (BIIS) around 19 ka



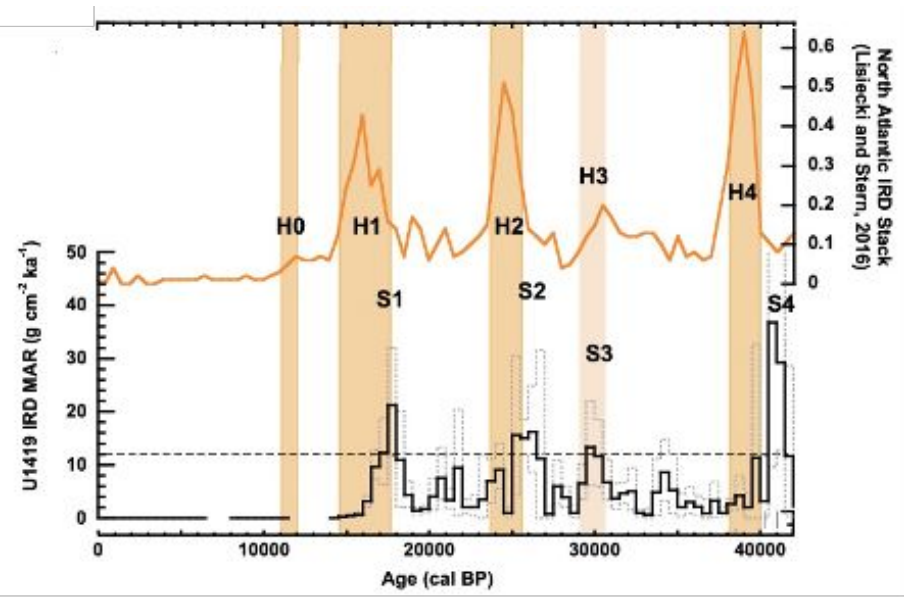
Clark et al. (2012, QSR)

Siku Events – North Pacific meltwater events

North American Ice Sheets at the LGM



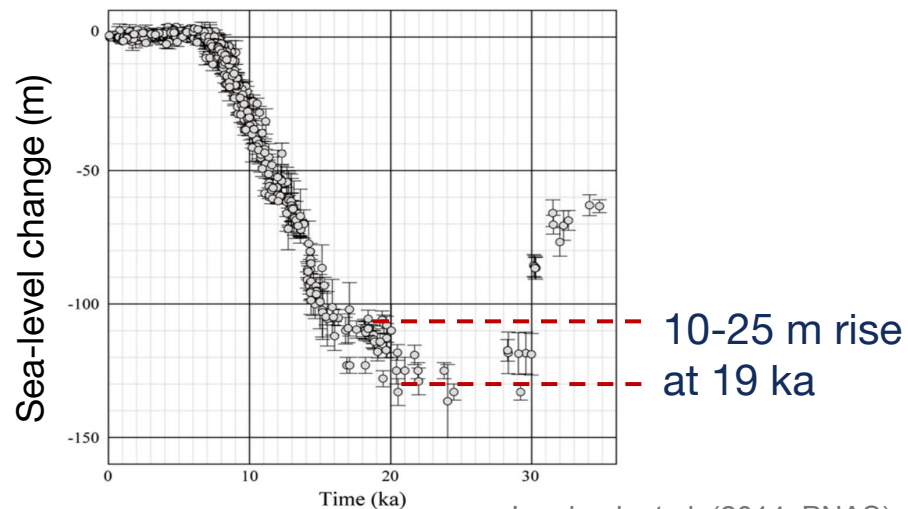
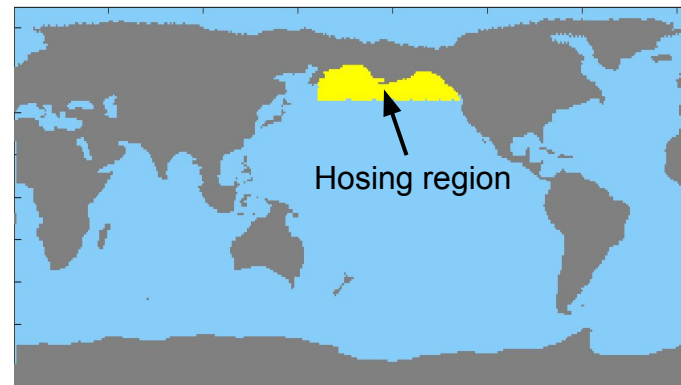
Heinrich (N. Atlantic IRD layers)
Siku (NE Pacific IRD layers)



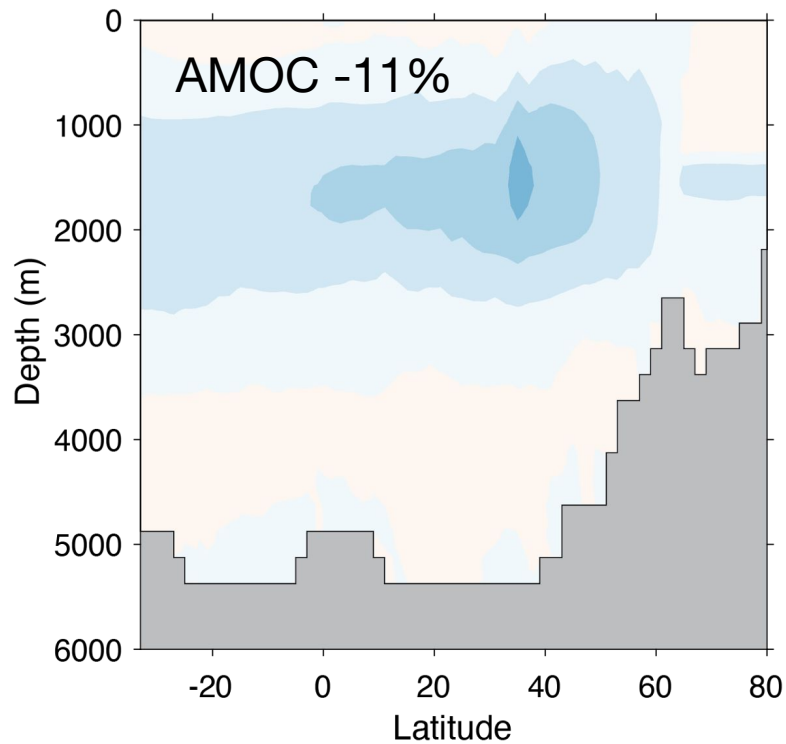
Praetorius et al. (2020, Sci Adv); Walczak et al. (2020, Science)



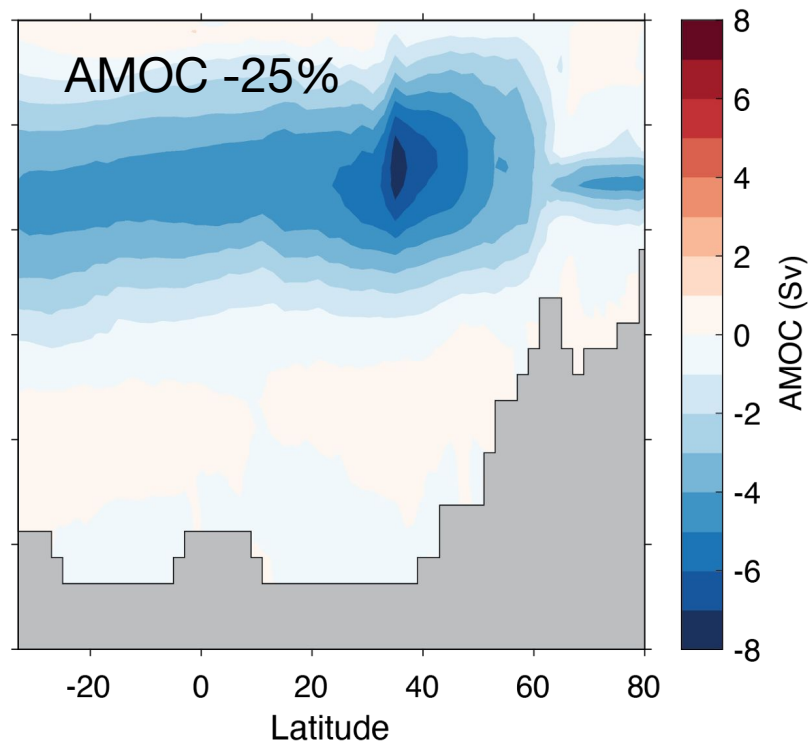
- **Siku 1 (19-17ka)**
- Run on fully-coupled **iCESM1.3** (which has prescribed ice sheets)
- **19 ka boundary conditions** (from iTRACE) to best approximate the mean climate state when Siku 1 occurred.
- **2 sensitivity experiments:** 0.2Sv and 0.5Sv of freshwater was added to the North Pacific for 400 years, accounting for 7.5 and 18.8 m of global sea-level rise, respectively.
- **Passive dye tracers** were added to the hosing region to track the mixing and transport of the added freshwater.



0.2 Sv



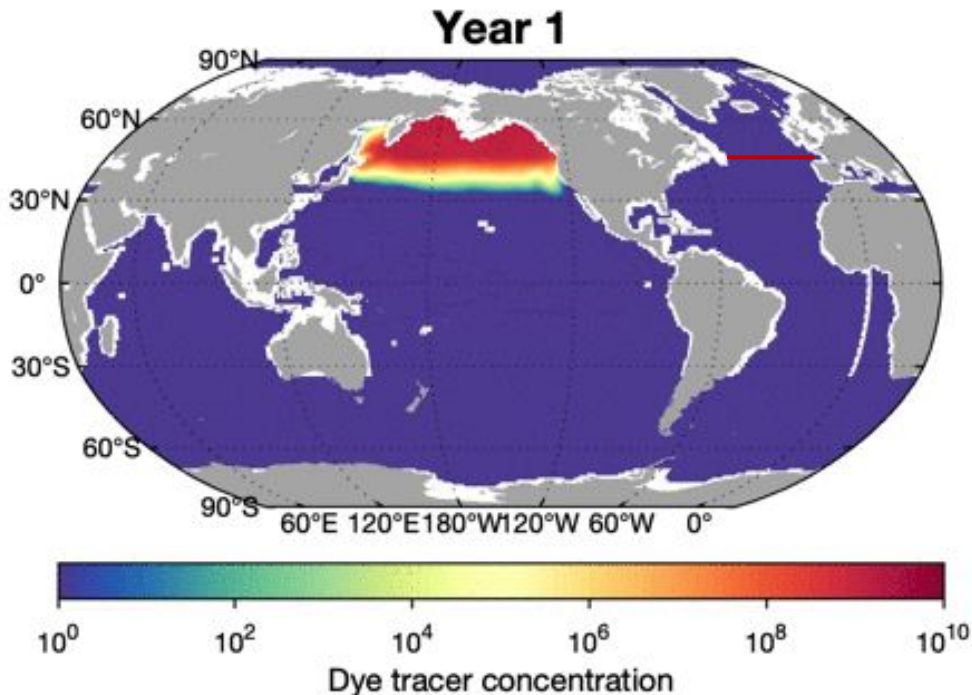
0.5 Sv



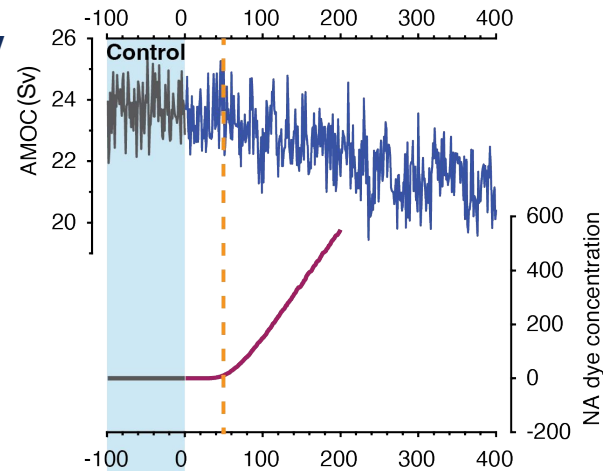
Transport of freshwater weakens the AMOC

Dye concentration in the surface ocean

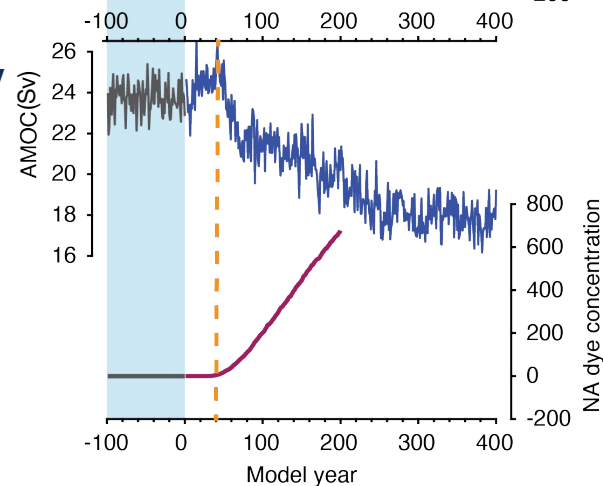
North Pacific 0.2 Sv hosing experiment



0.2 Sv



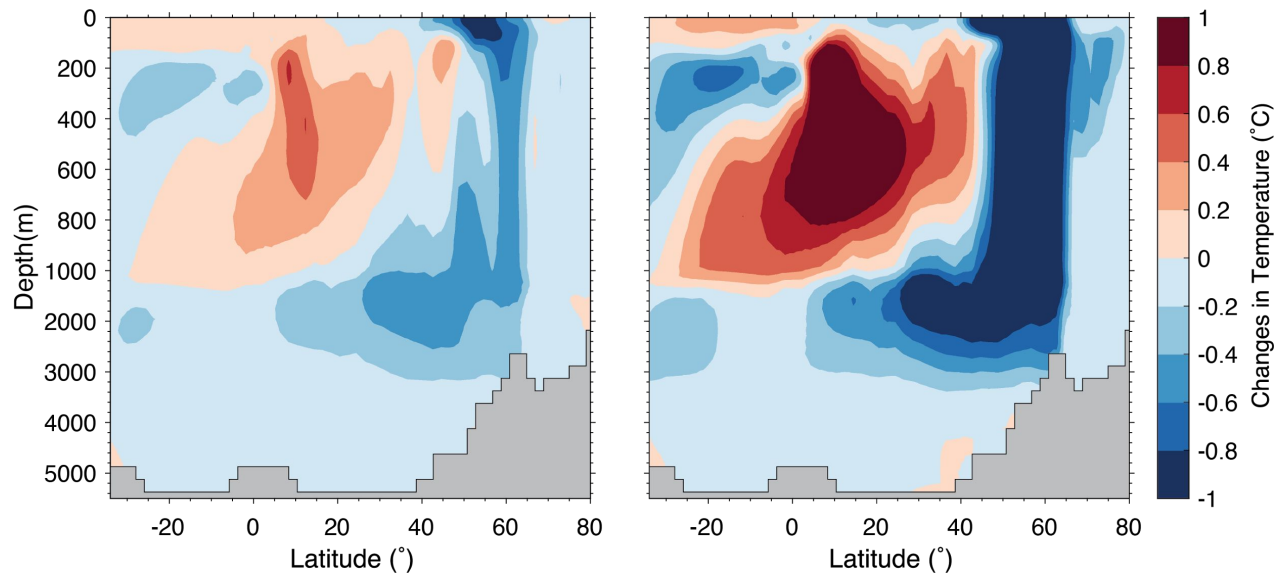
0.5 Sv



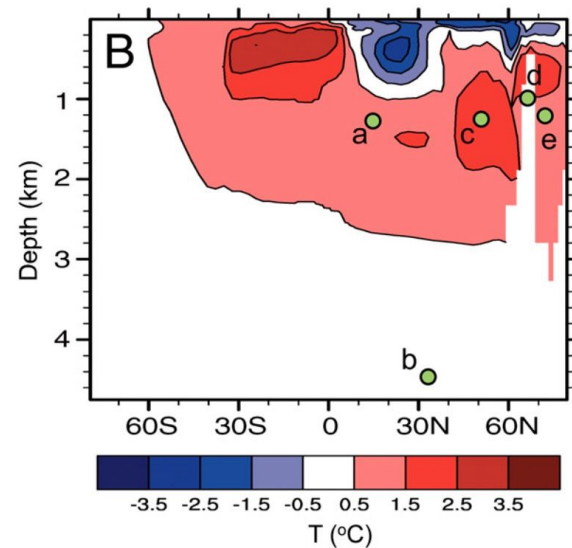
Changes in Atlantic zonal mean temperature at depth

0.2 Sv

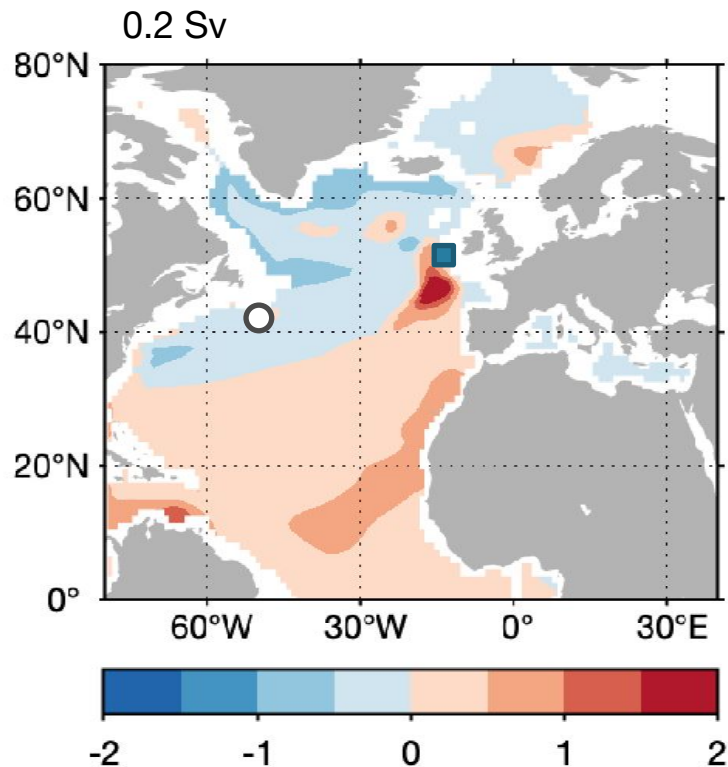
0.5 Sv



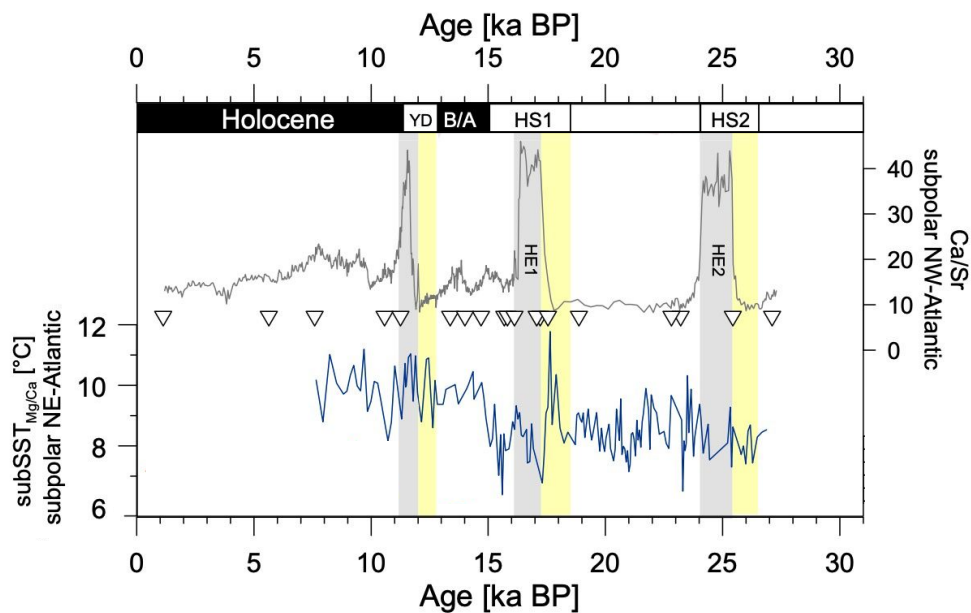
0.2 Sv added to the
North Atlantic



Changes in temperature at 500m depth

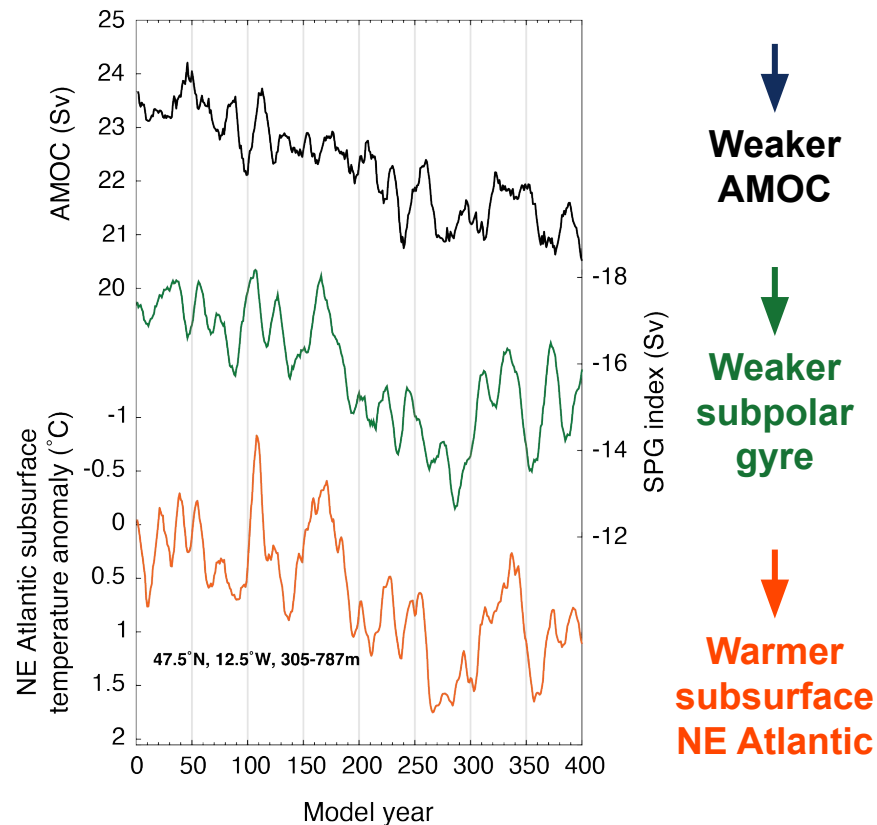
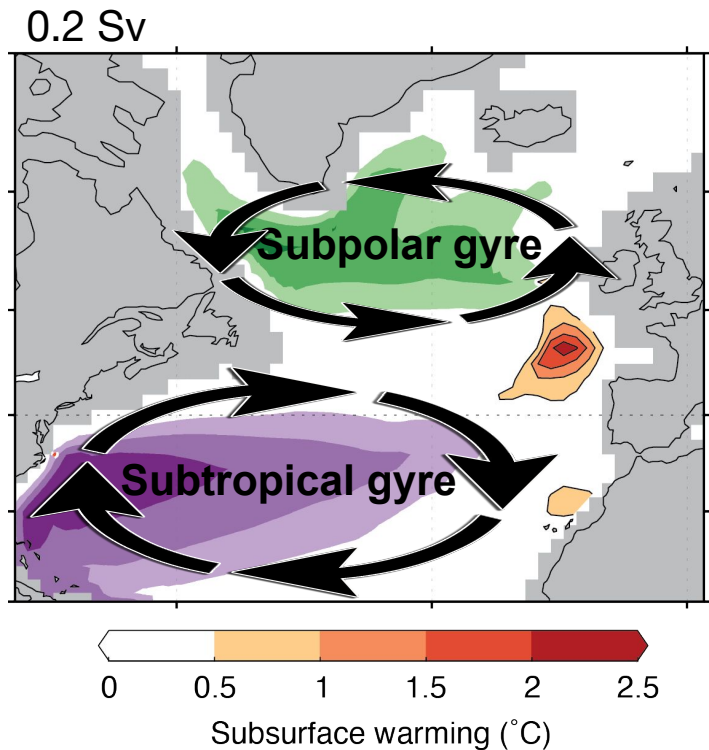


Subsurface temperature record from the NE Atlantic supports an early (~ 1 kyr earlier than H1) warming



Weaker subpolar gyre and AMOC cause the warming

Subsurface warming at 500 m depth
Climatological **subpolar** and **subtropical** gyres



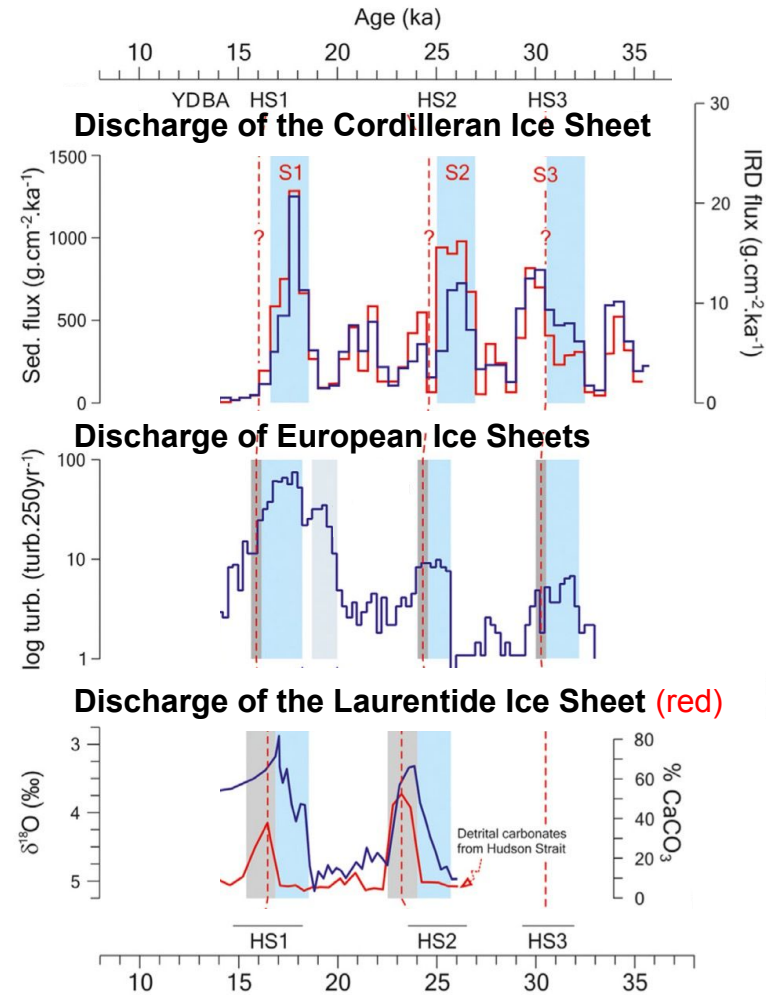
Summary

Cordilleran Ice Sheet discharges into the NE Pacific (Siku events).

The meltwater is transported to the N. Atlantic;
Weakens the AMOC and the subpolar gyre;
Causes subsurface warming in the NE Atlantic;

Implications

Leads to the retreat of the British Irish Ice Sheet, i.e., the European precursor of Heinrich events.



Adapted from Toucanne et al. (2022)