Mechanisms behind climate oscillations in full-glacial simulations

Yvan Romé, Dr. Ruza Ivanovic, Dr. Lauren Gregoire
University of Leeds

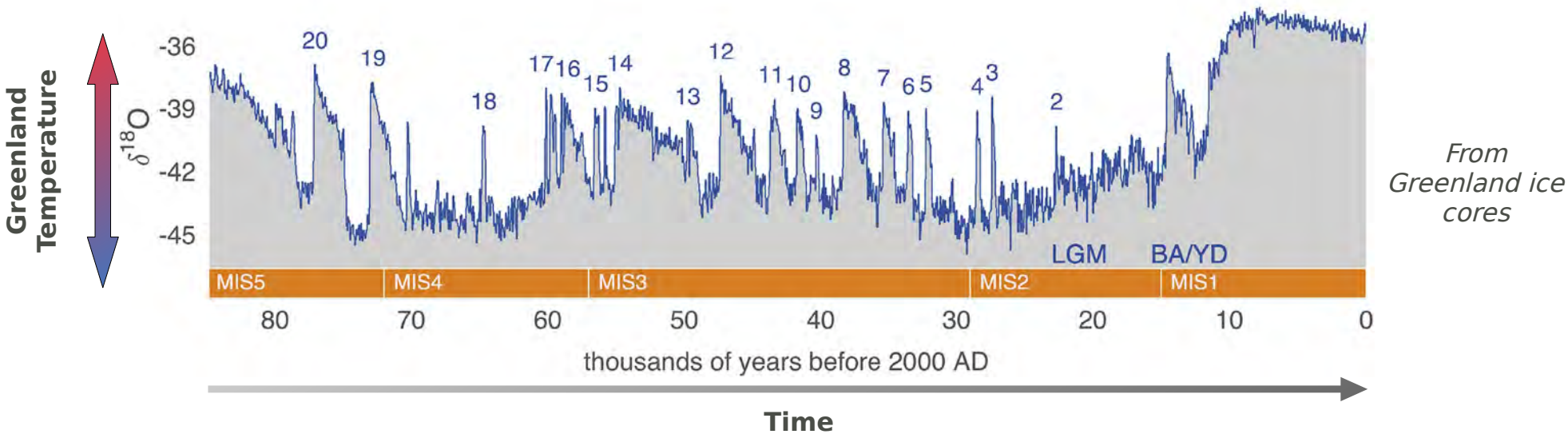
NERC SCIENCE OF THE ENVIRONMENT

UNIVERSITY OF LEEDS

Dansgaard-Oeschger events

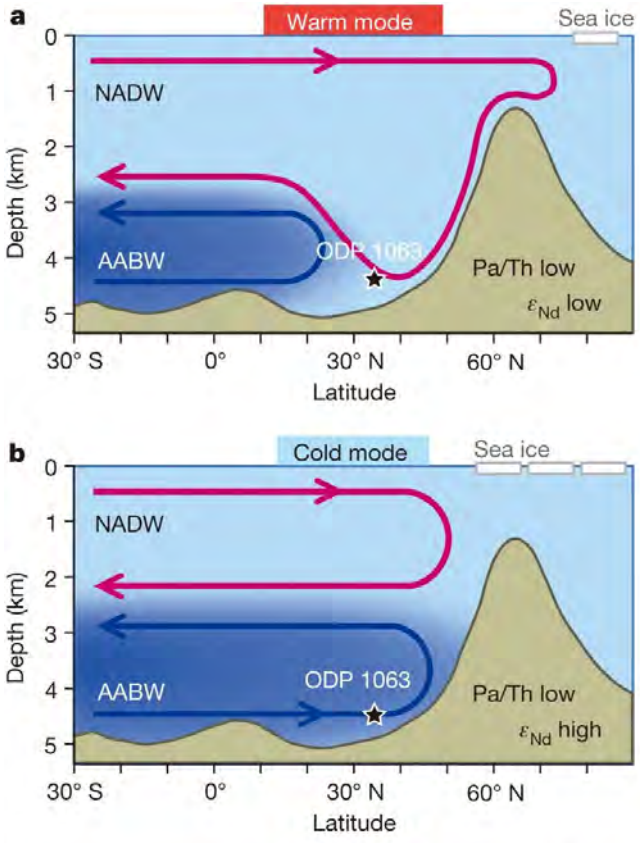
Dansgaard-Oeschger events (D-O events) are millennial-scale **oscillations** between cold **stadial** climates and warm **interstadial** climates

Li and Born, 2019

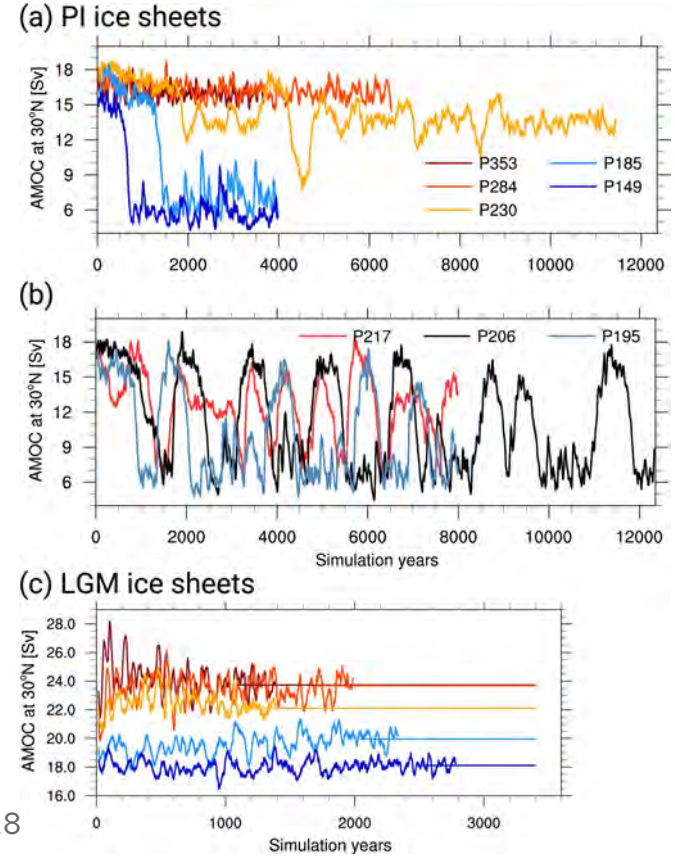


From Greenland ice cores

Millennial scale variability in climate models

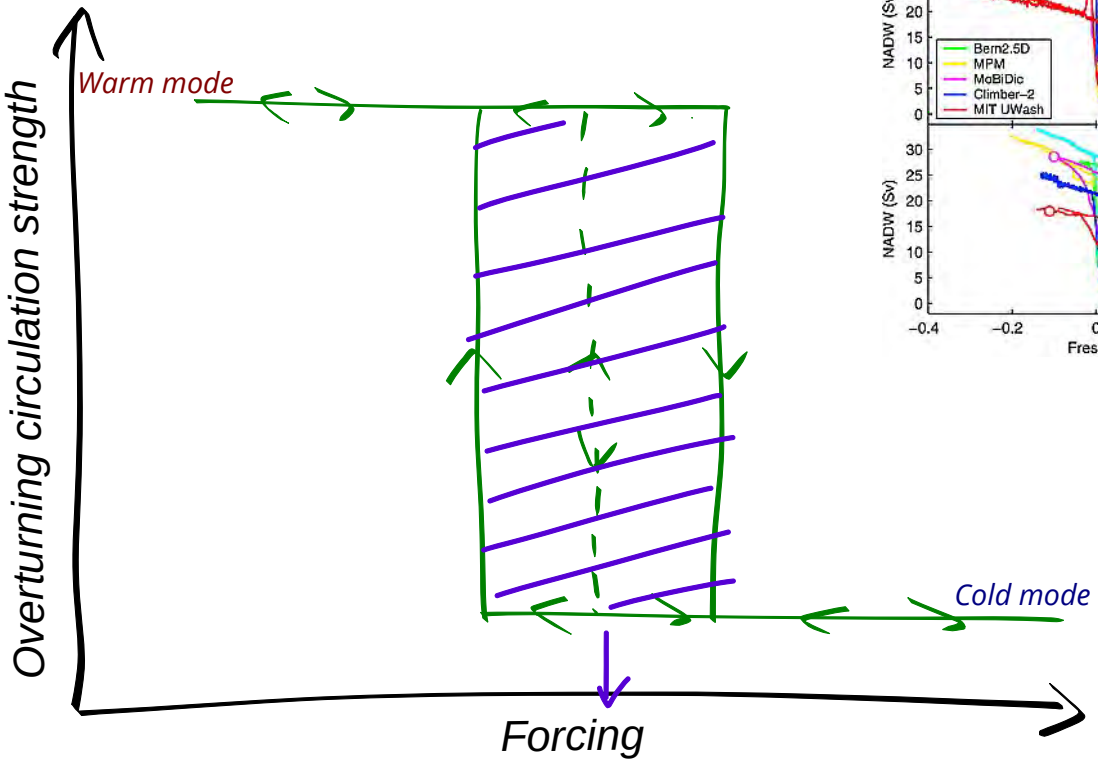


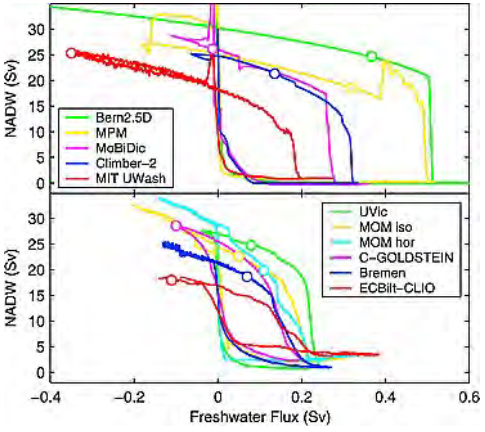
Böhm et al. 2015



Klockmann et al. 2018

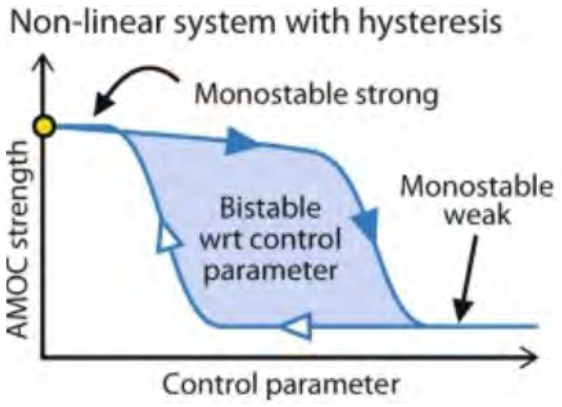
AMOC response to forcing



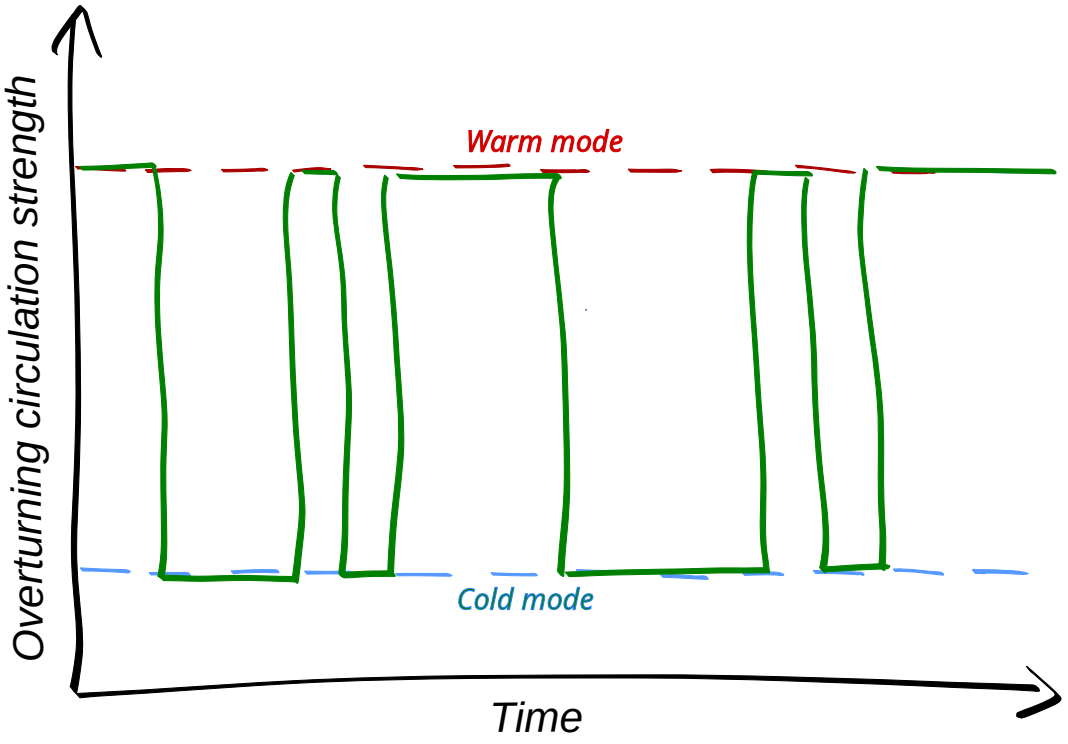


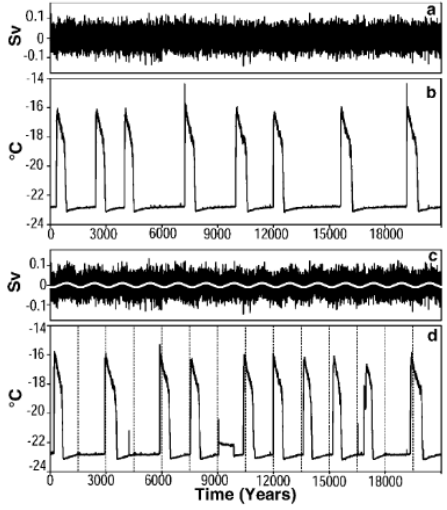
Rahmstorf et al. 2005

Barker & Knorr 2021



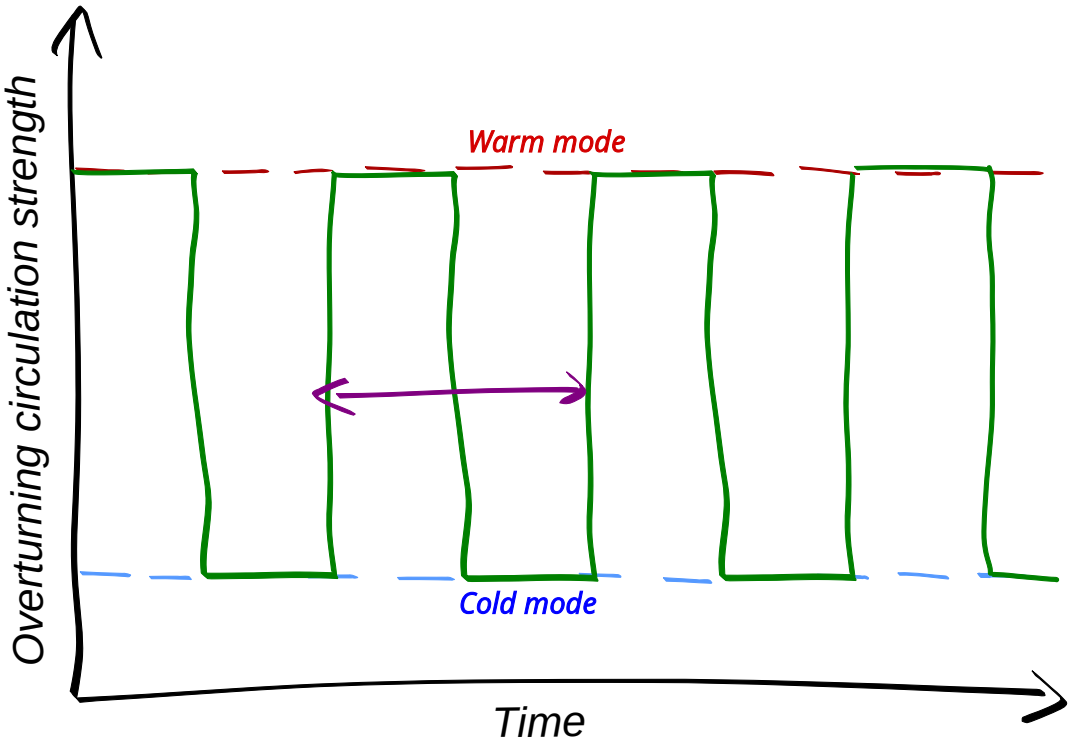
Stochastic dynamics



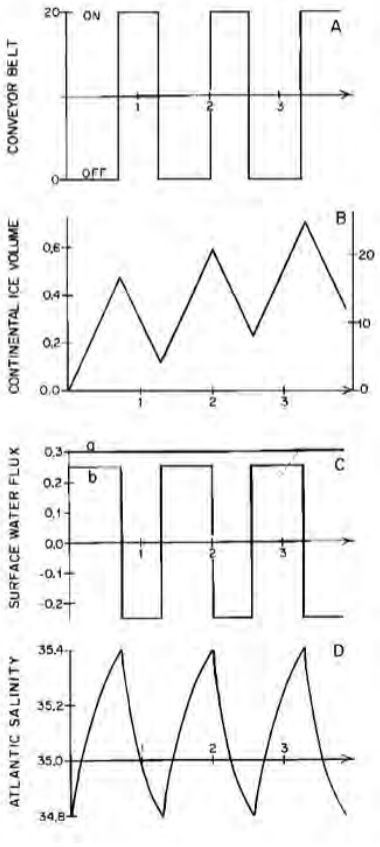


Ganopolski and Rahmstorf, 2002

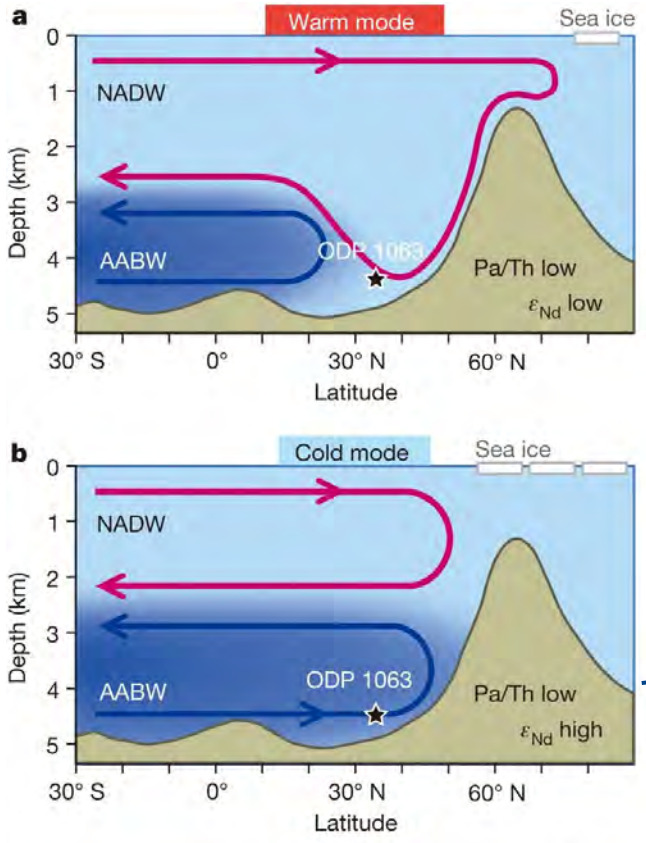
Deterministic dynamics



Birchfield and Broecker 1990

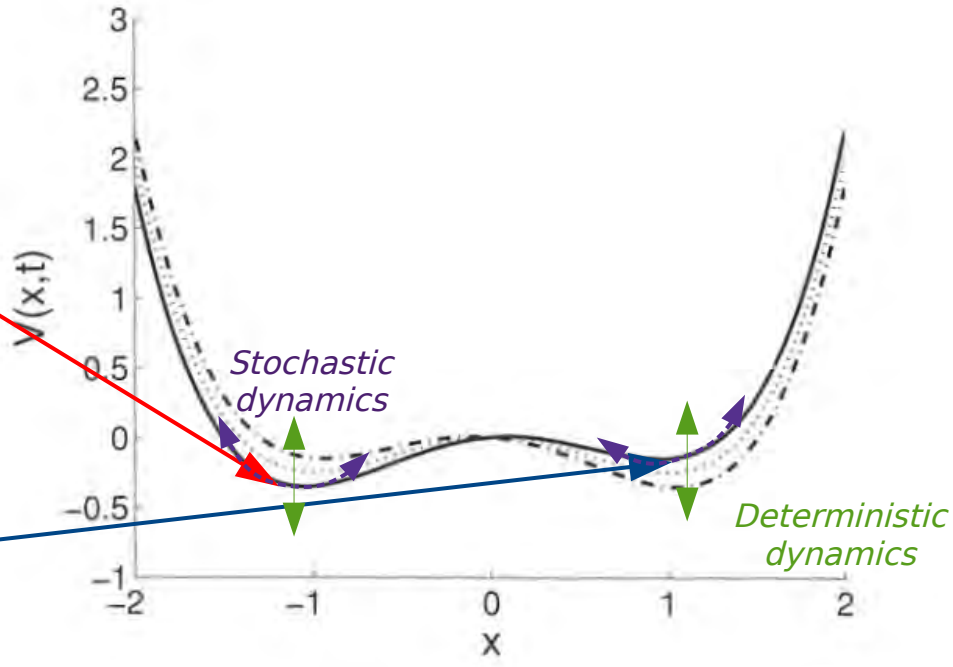


AMOC stability as a potential well



Böhm et al. 2015

Dijkstra 2013



Experimental design

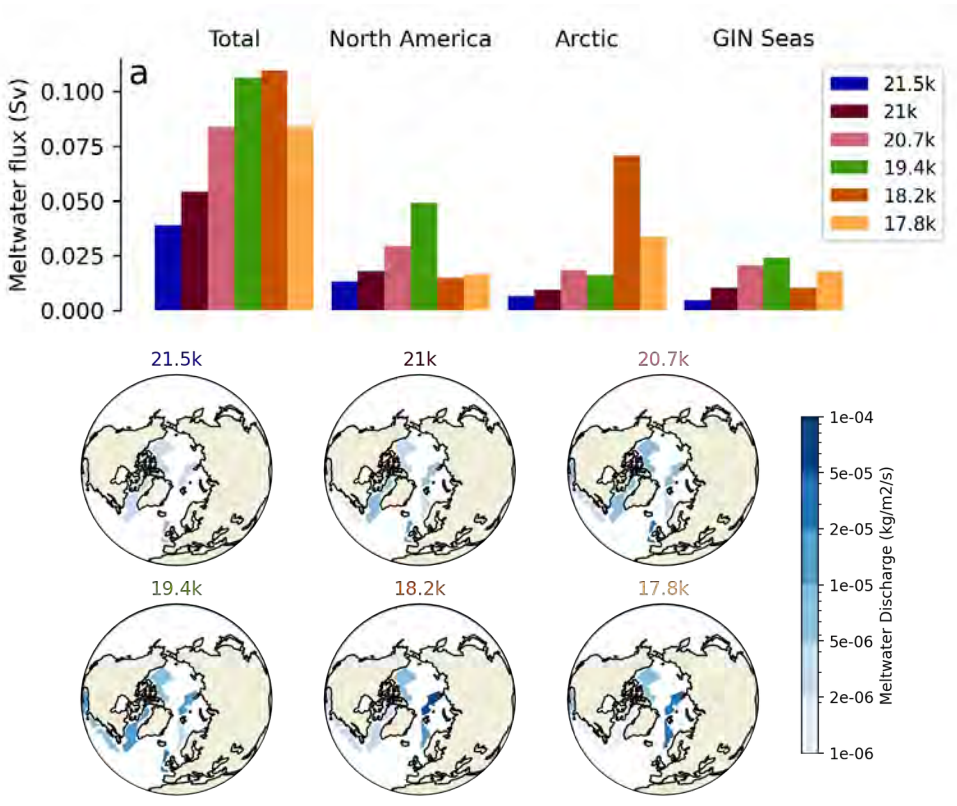
- **Last Glacial Maximum** (LGM – 21 ky) background conditions **equilibrium simulation**
- **Meltwater history** derived from GLAC-1D ice sheet reconstruction, **routed** and **spread** over the ocean
- Six **snapshots** of meltwater discharge of the early last deglaciation were chosen
- They were used as **fixed forcing** for 10.000 years

HadCM3@Bristol

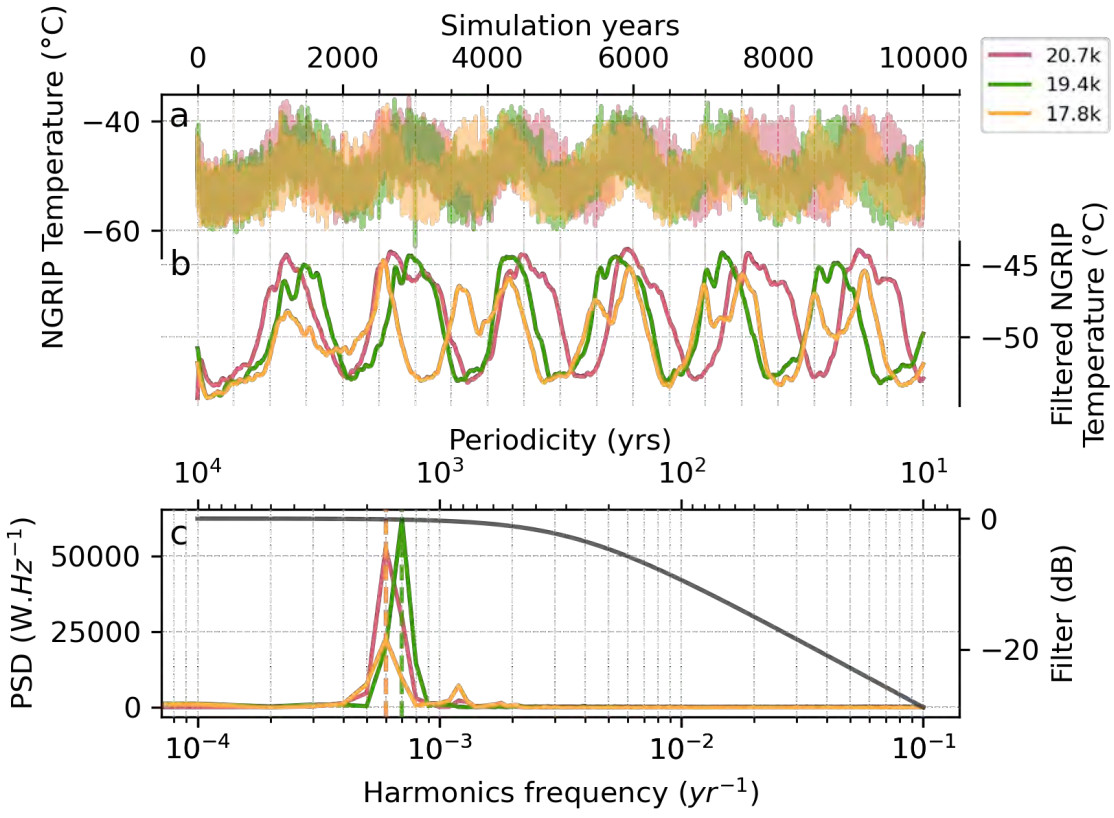
Coupled ocean-atmosphere GCM

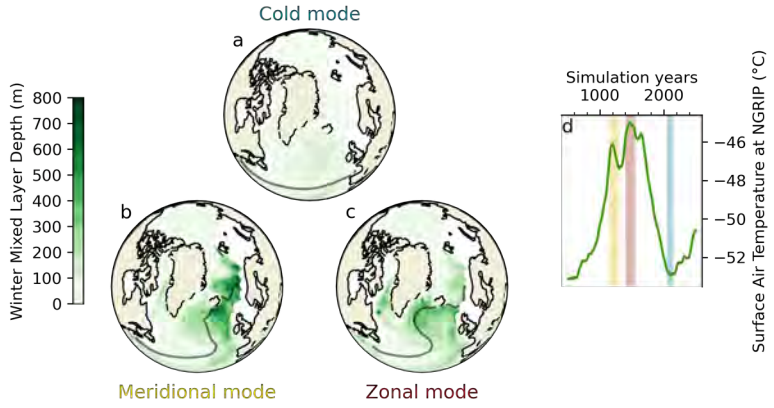
Atmosphere → 2.5°×3.75°x19 layers regular grid

Ocean → 1.25°×1.25°x20 layers regular grid

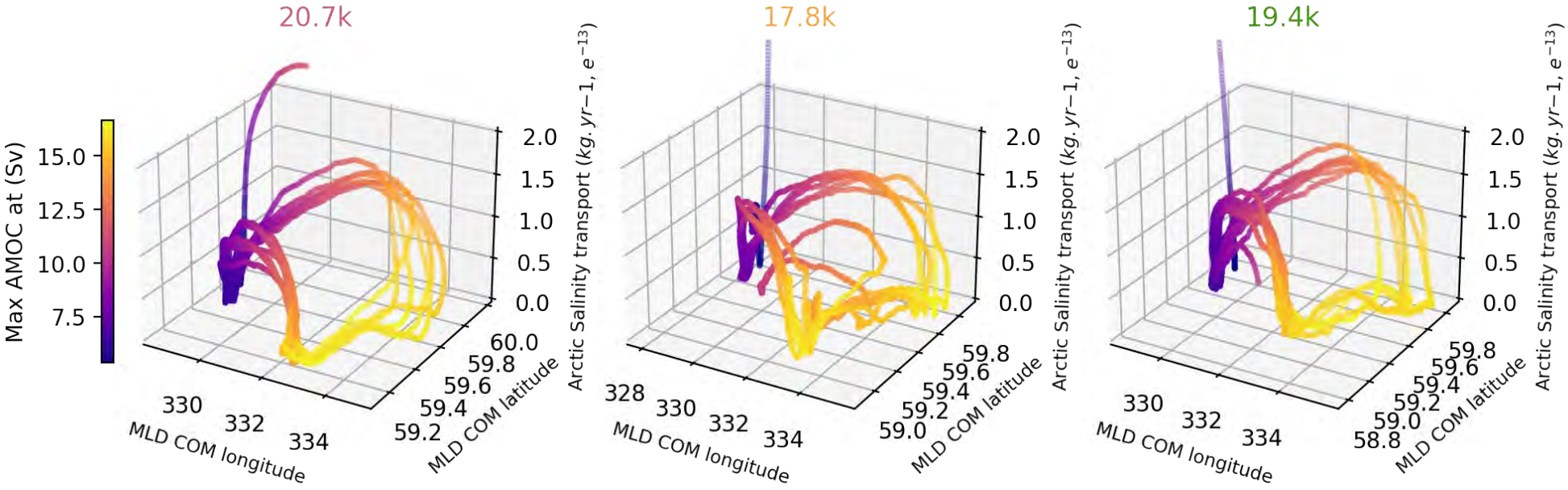


Oscillations in LGM simulations





Visualising stable states



Reviewing the different components

We produced a framework to study millennial-scale variability.

Large Review of different physical components involved in abrupt climate changes.

- **Fast physics** – No clear increase of inter-annual variability prior to a state switch, but a decadal-scale salinity pump in cold mode. Resonance phenomenon?
- **Slow physics** – Slow reorganisation of salinity in the Atlantic, leading to weaker North-South and vertical density gradients. Is it enough to modify the potential?

Contact eeymr@leeds.ac.uk

Thank you!