

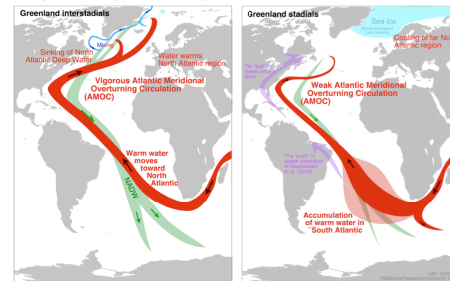
Dansgaard-Oeschger Cycles, Heinrich Events, and the Bipolar See-saw

Observations

Inferences

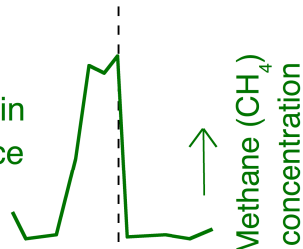
Greenland Interstadial Greenland stadial

A very schematic explanation of the bipolar seesaw



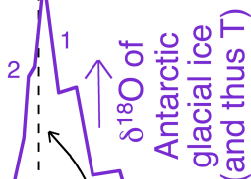
This document may be best read from bottom to top.

Methane (CH₄) concentration in Greenland ice and Antarctic ice



Abrupt increase in concentration of greenhouse gas in atmosphere caused abrupt global-scale warming.

Peak in δ¹⁸O of Antarctic glacial ice when δ¹⁸O of Greenland glacial ice hits minimum



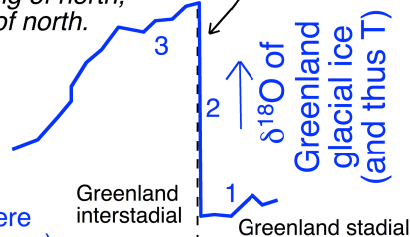
1. Warming in far Southern Hemisphere as weakening of AMOC fails to move heat from Southern Hemisphere to Northern Hemisphere.

2. Cooling of far Southern Hemisphere as renewed AMOC resumes transport of heat northward.

Bipolar See-saw:
First warming of south and cooling of north, then cooling of south and warming of north.

Abrupt increase in δ¹⁸O of Greenland glacial ice

(This pattern also appears in paleoclimate records from many places in the Northern Hemisphere and northern Southern Hemisphere.)

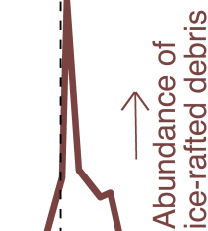


1. Extreme cold in Greenland as Atlantic Meridional Overturning Circulation (AMOC) weakens. Cooling of Northern Hemisphere and northern Southern Hemisphere.

2. **Abrupt warming of several degrees C over years to a few decades.**

3. Warmth for decades to a few centuries.

Heinrich Event: Deposition of ice-rafted debris (dropstones) in North Atlantic



Increase in outflow of glacial ice from North America and Eurasia to the North Atlantic with cooling in the Northern Hemisphere.

This document encapsulates changes during the ~20 D-O cycles that occurred during the last glacial cycle, during MIS 2 to MIS 5b from 10,000 to 90,000 years ago.

Later ← Time Earlier

Sources include Blunier and Brook (2001, *Science*), Johnsen and Stocker (2003) as shown in Mogensen (2009, *Encyclopedia of Paleoclimatology and Ancient Environments*), and Rasmussen et al. (2016, *Scientific Reports*).