Chapter 5: Information from Paleoclimate Archives

(1) To place current and future changes in the broader perspective of natural past changes.

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(3) To document “slow” components of the system, e.g. ice sheets and vegetation, for which the instrumental record is too short.

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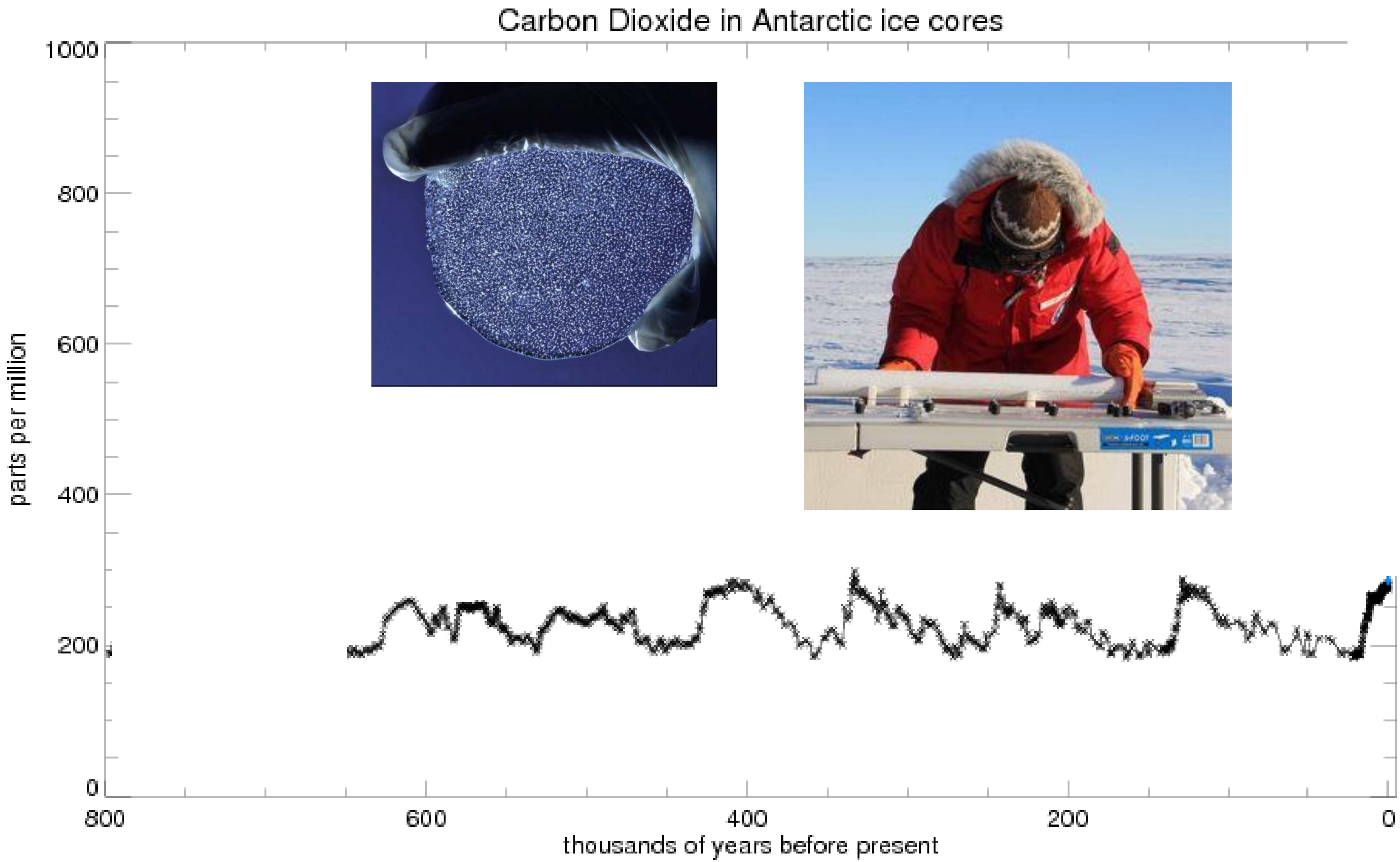

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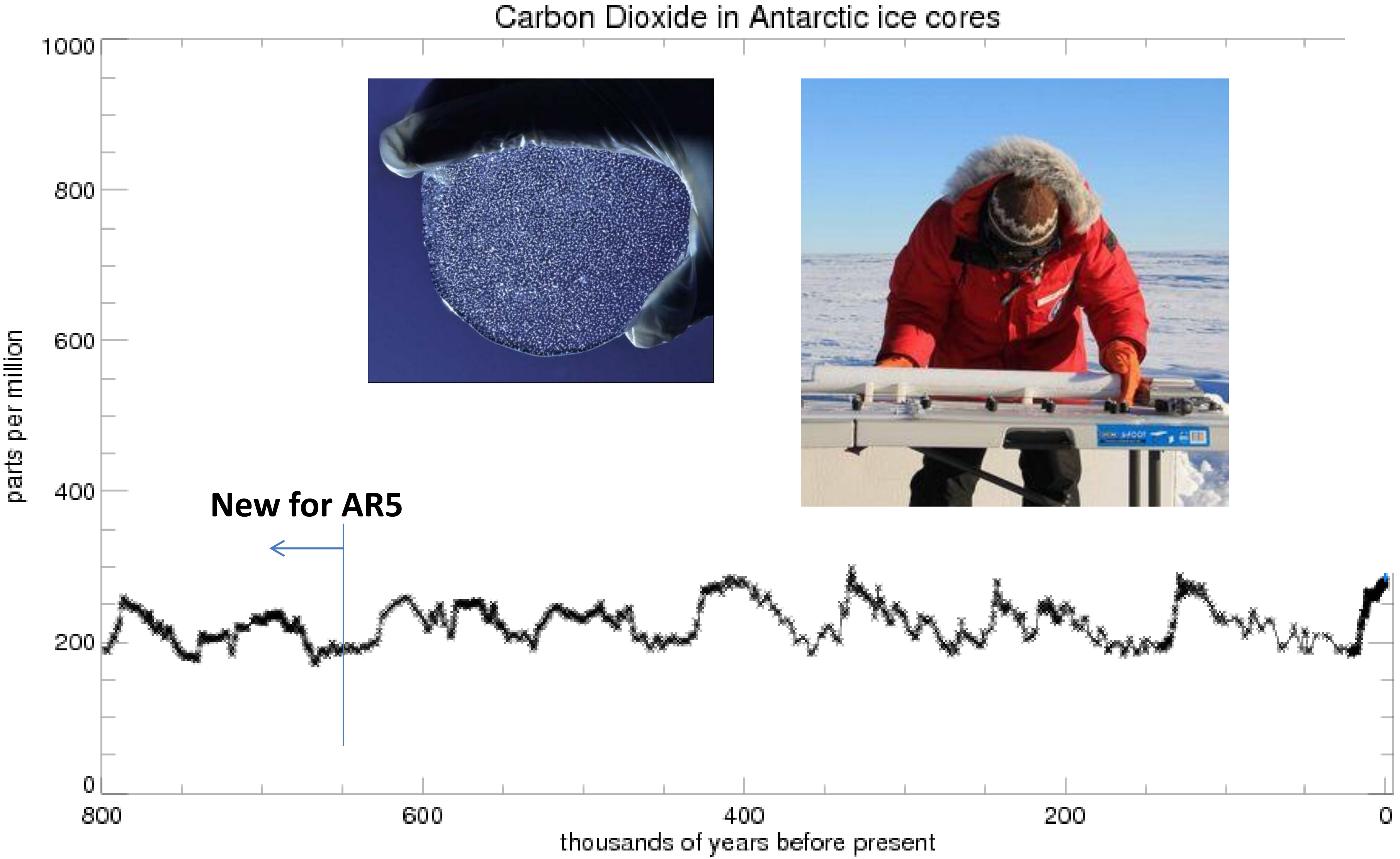

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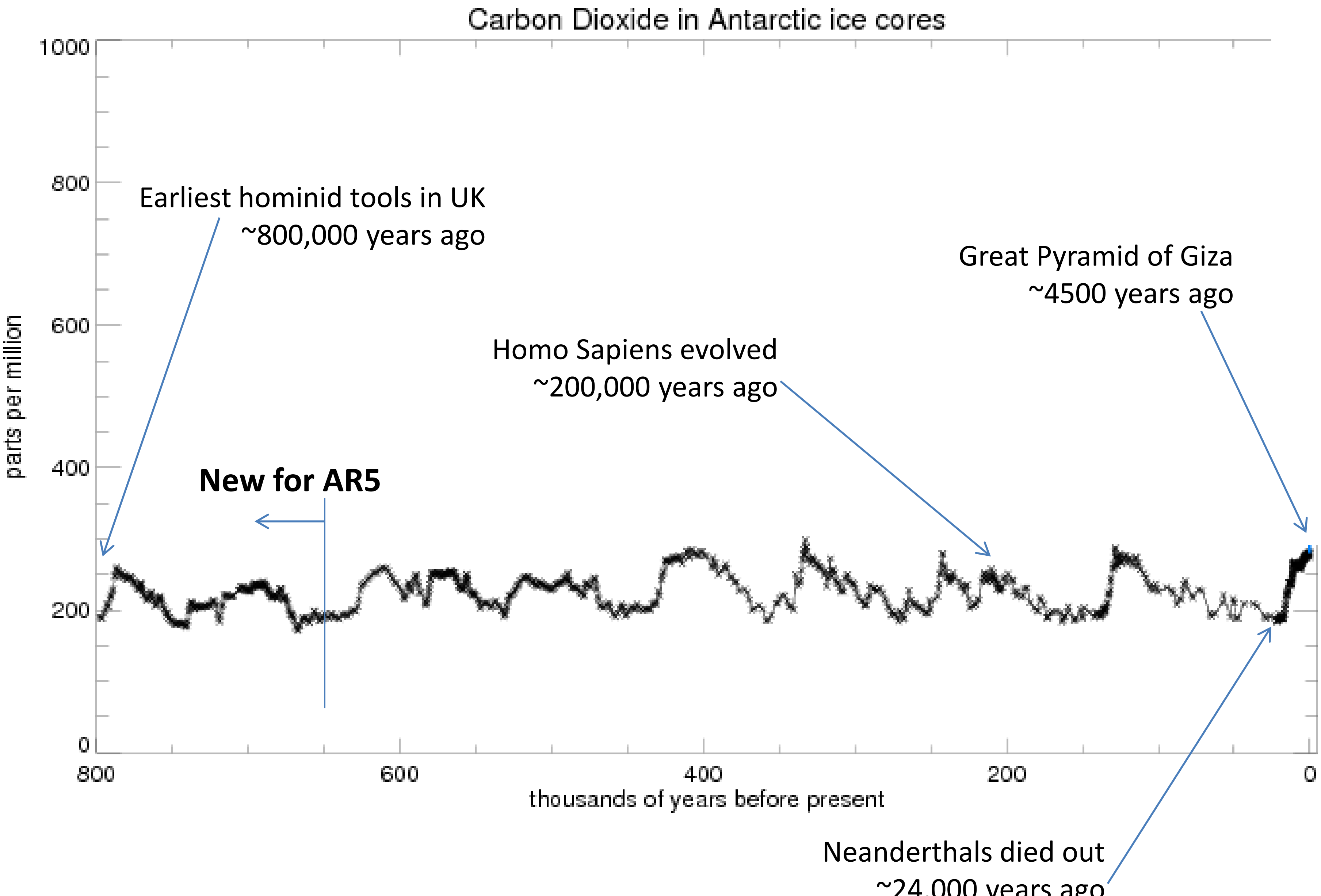

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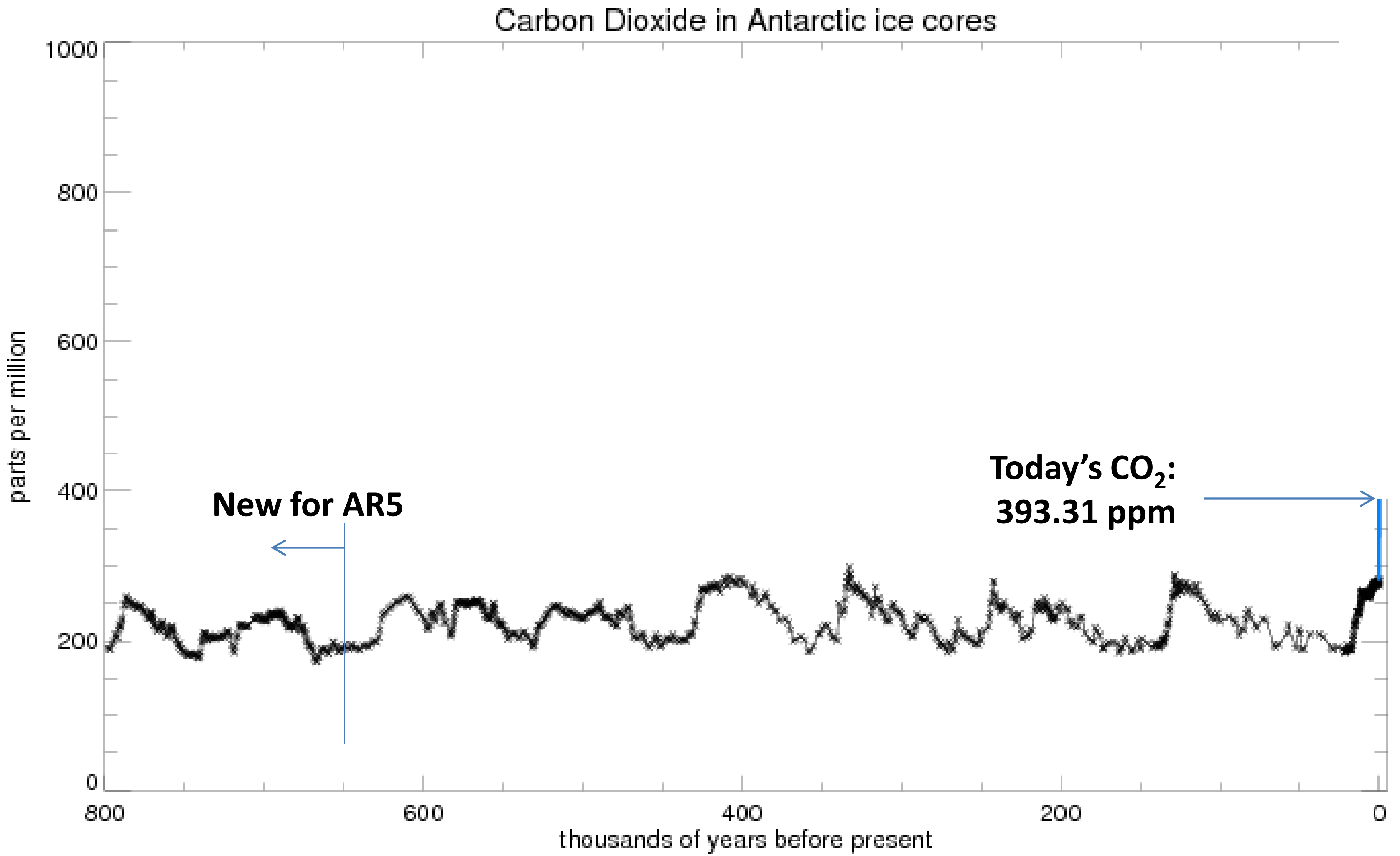

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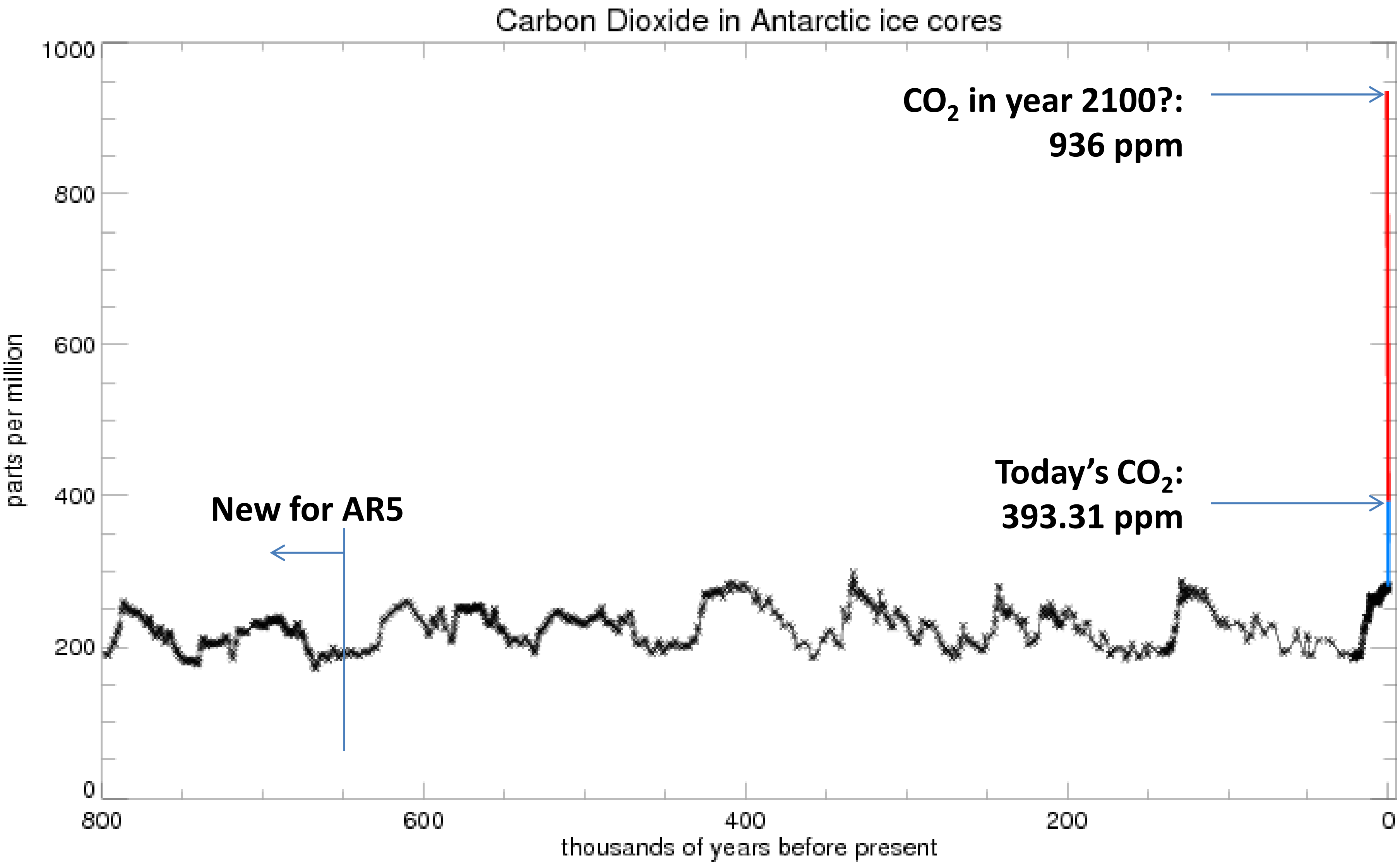

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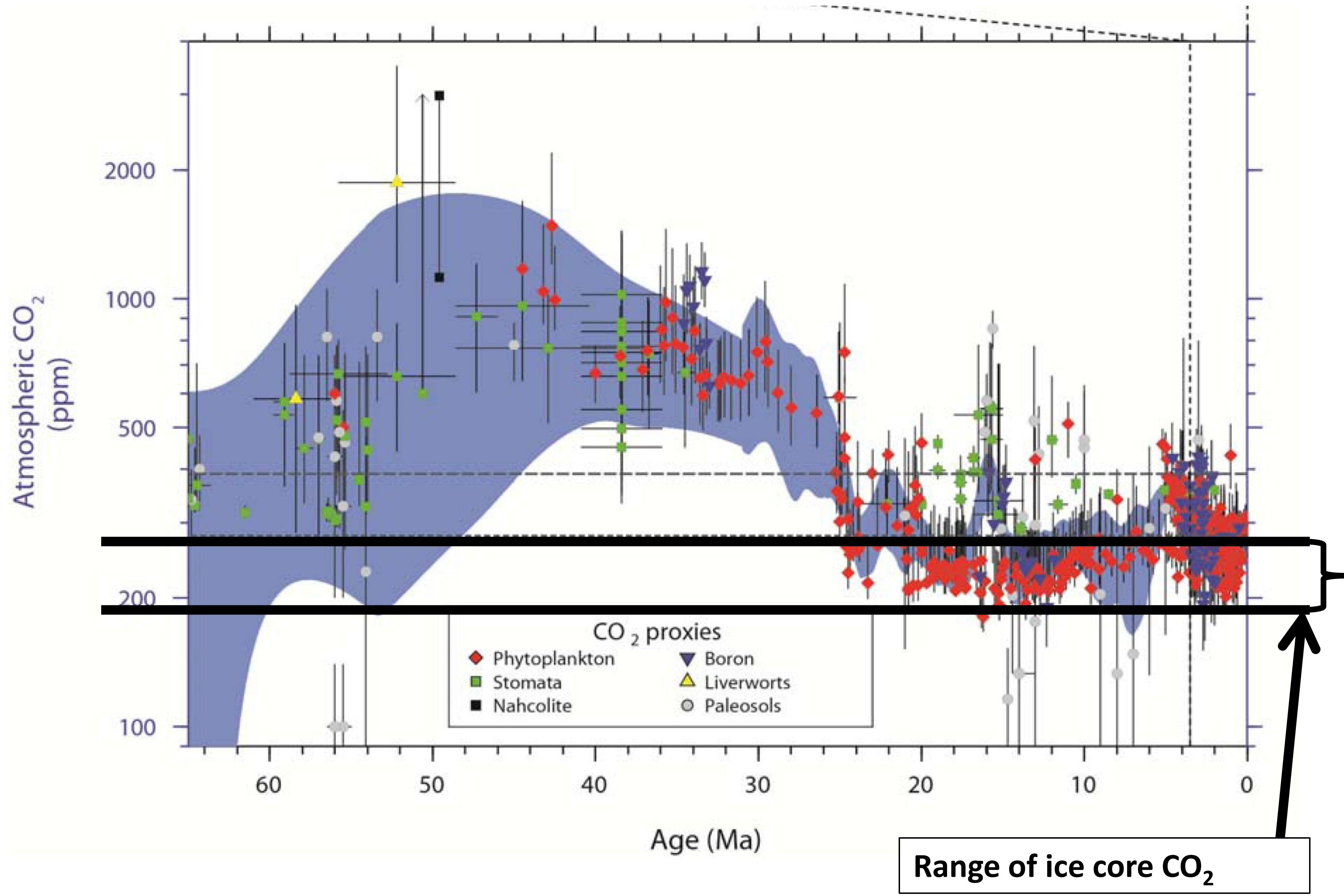

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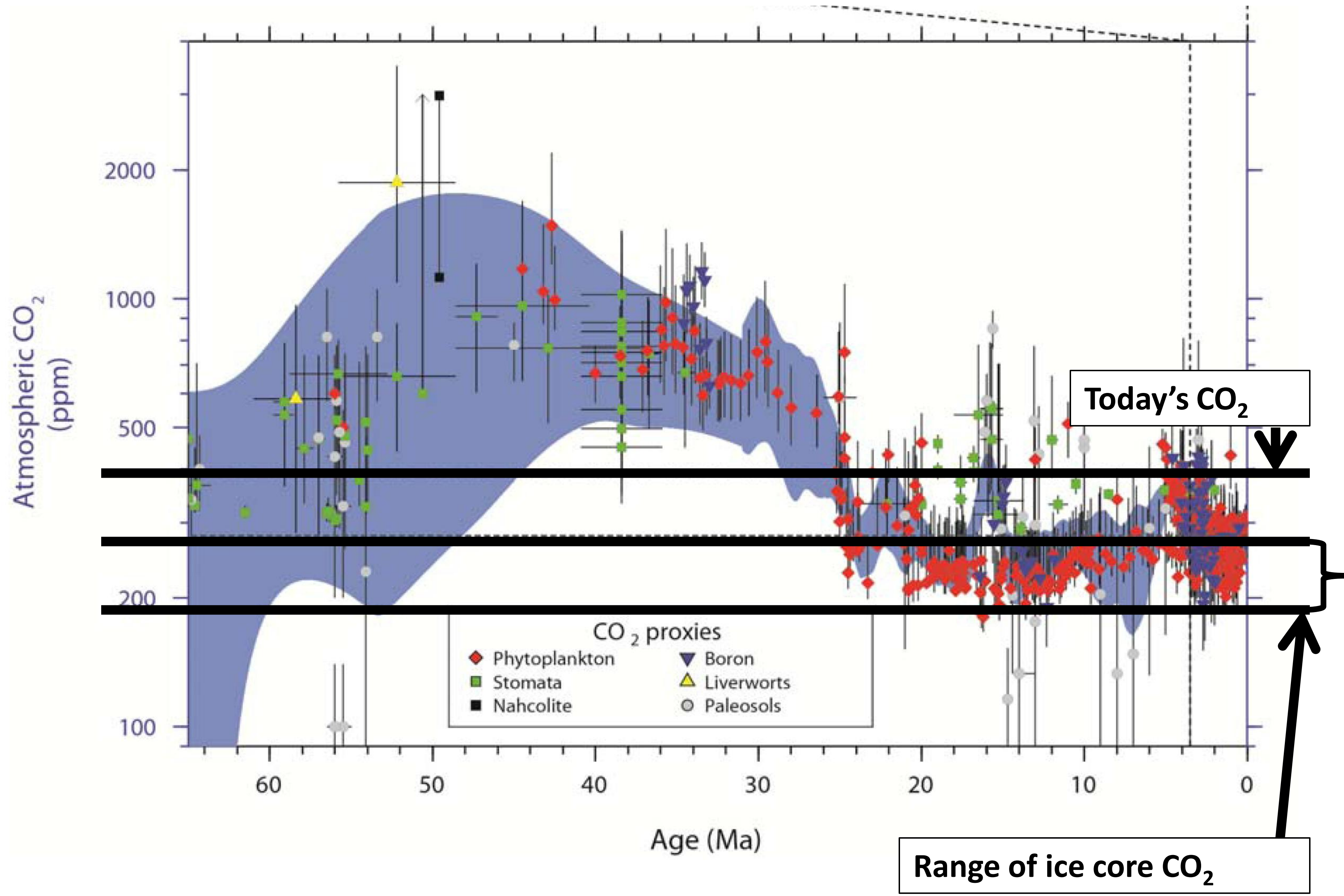

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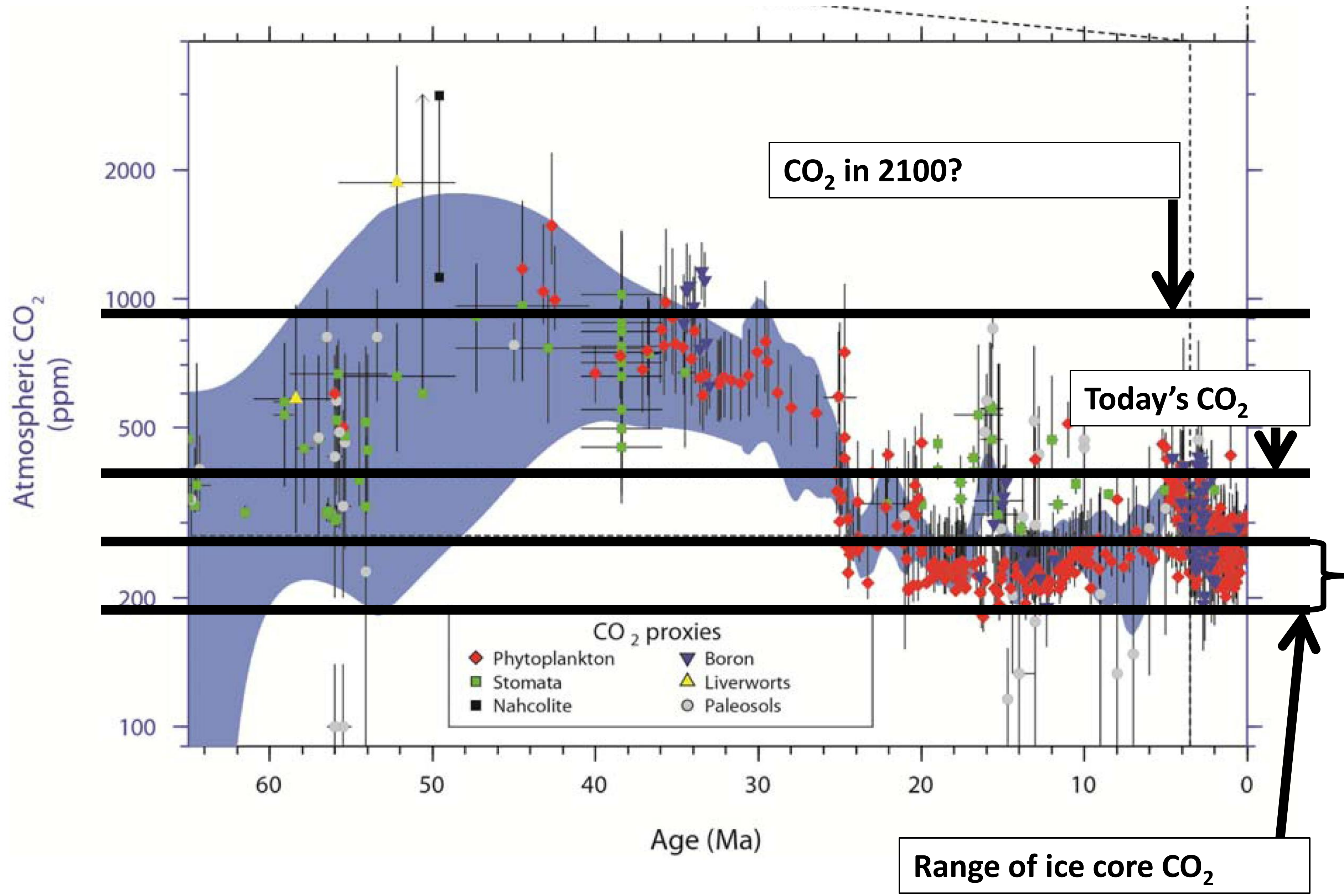

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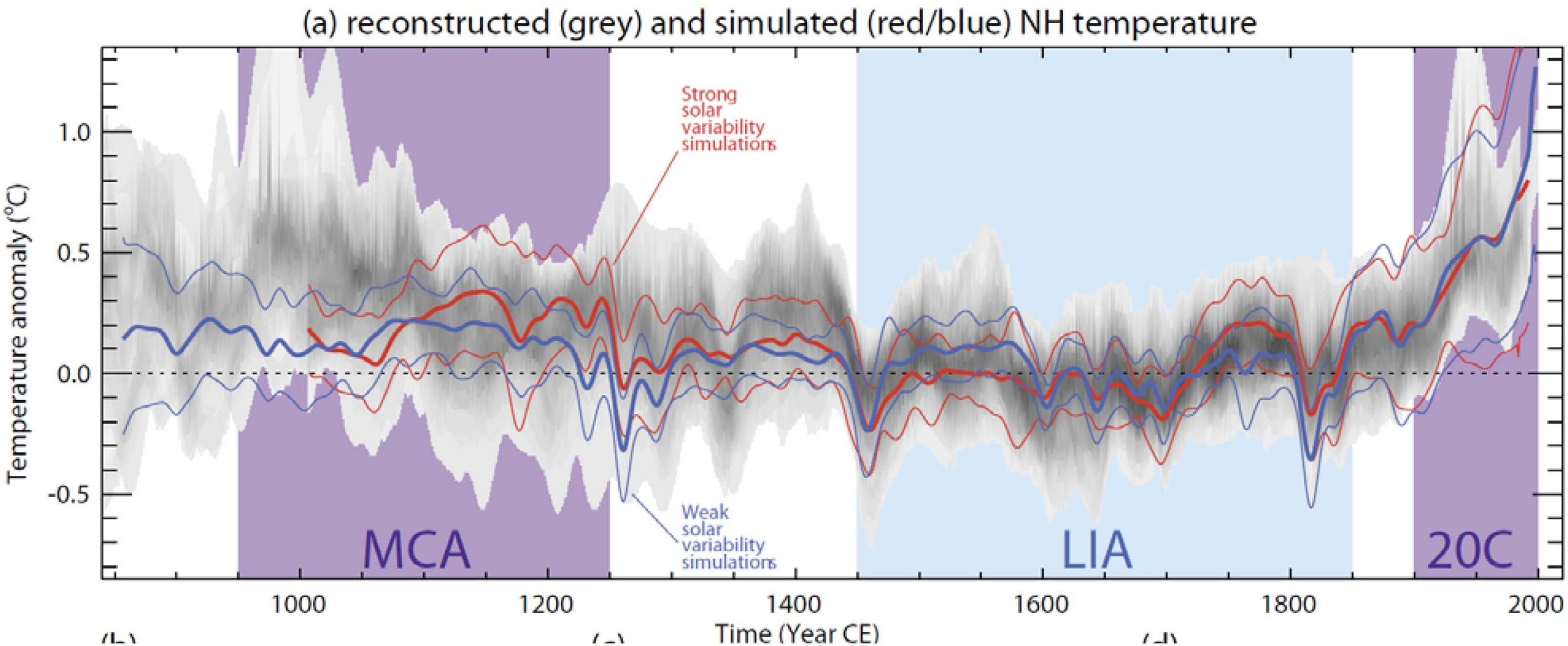
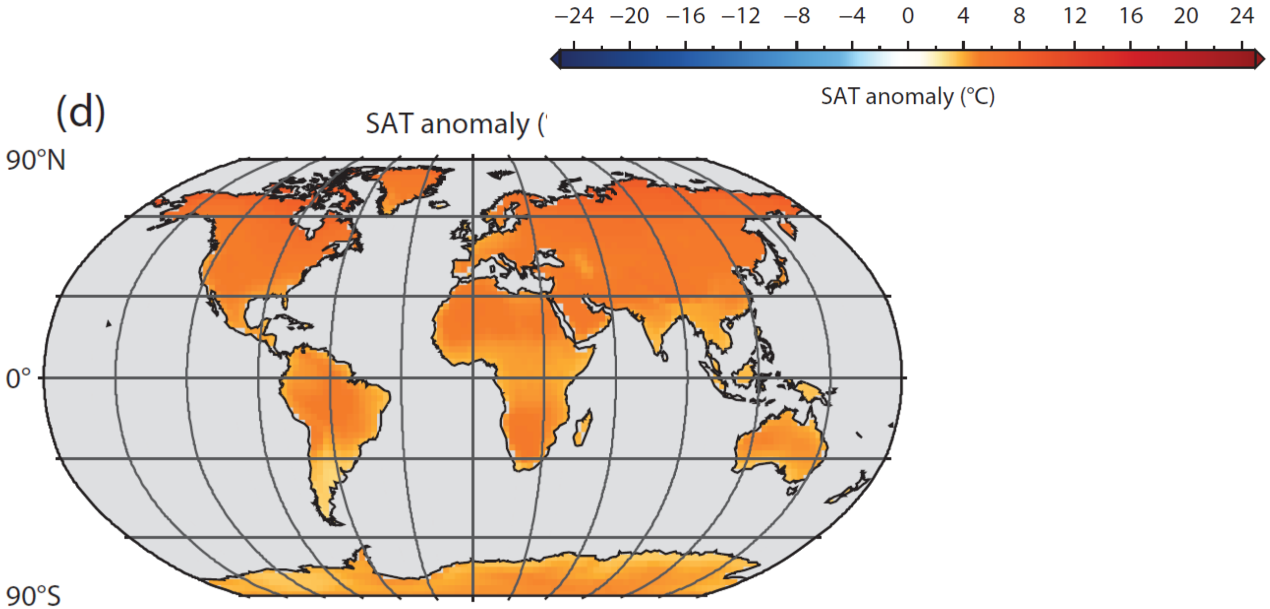
The ‘Hockey Stick’ curve



(2) To provide an independent test of the models which are used to predict future climate.



Temperature change, 2100?

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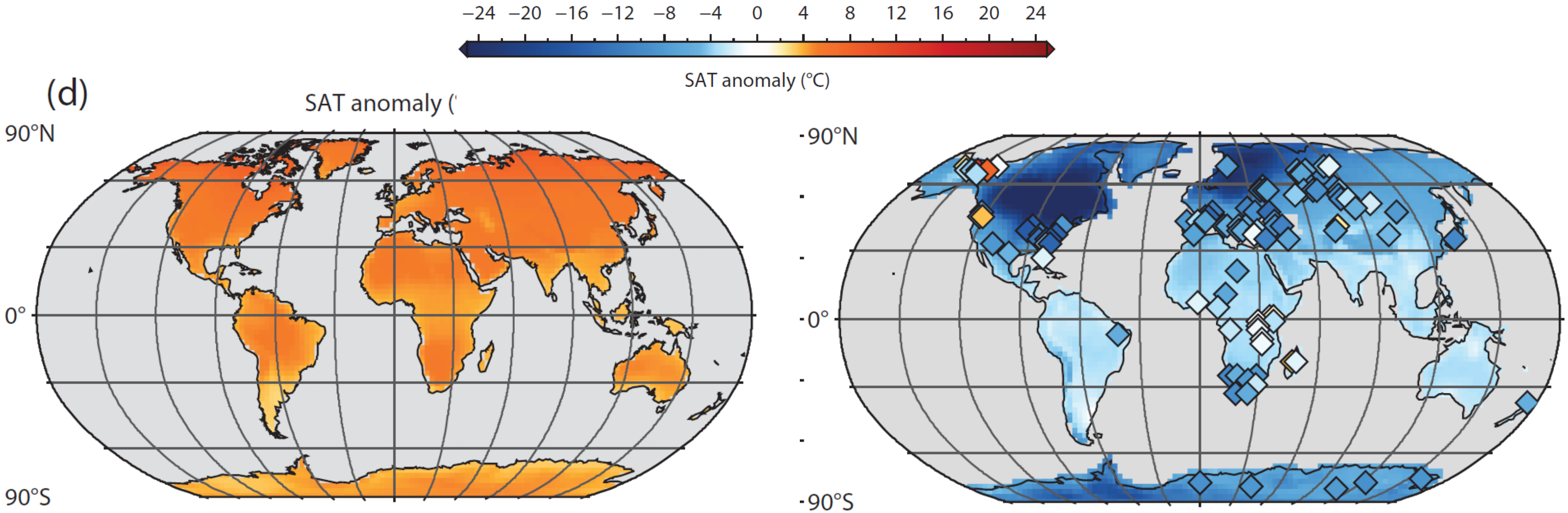

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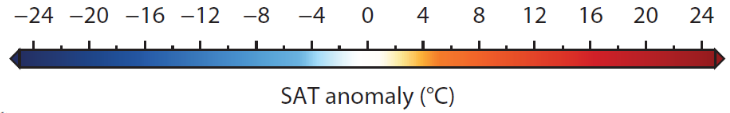

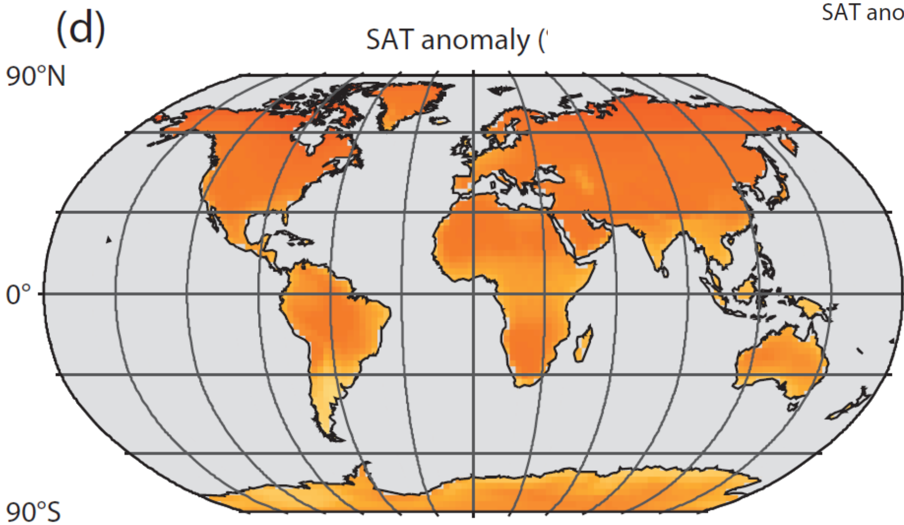

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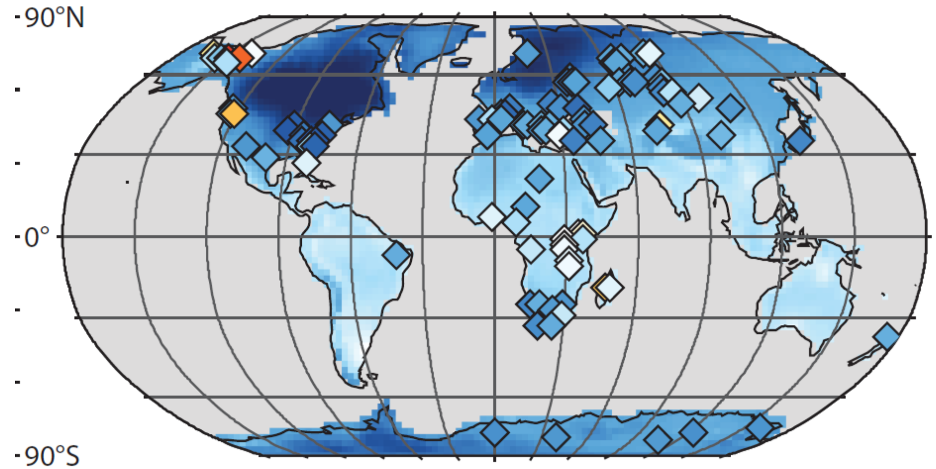

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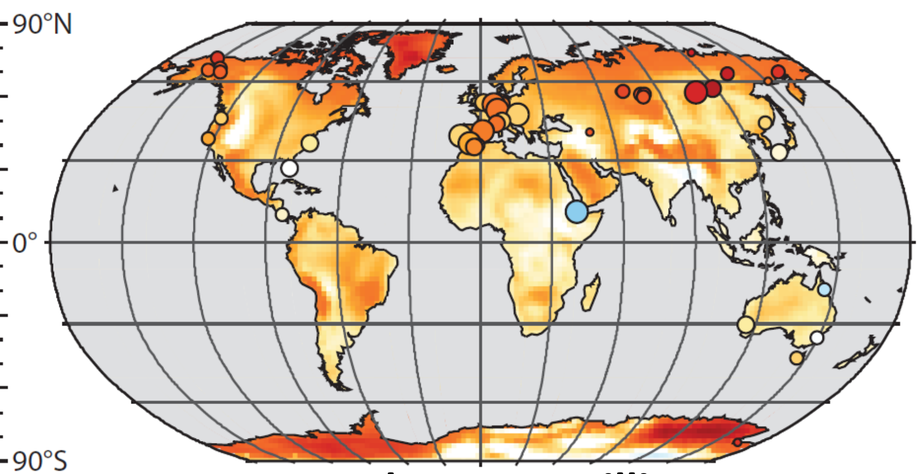

Temperature change, 3 million years ago, The ‘mid-Pliocene’.

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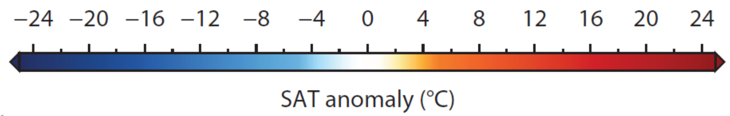

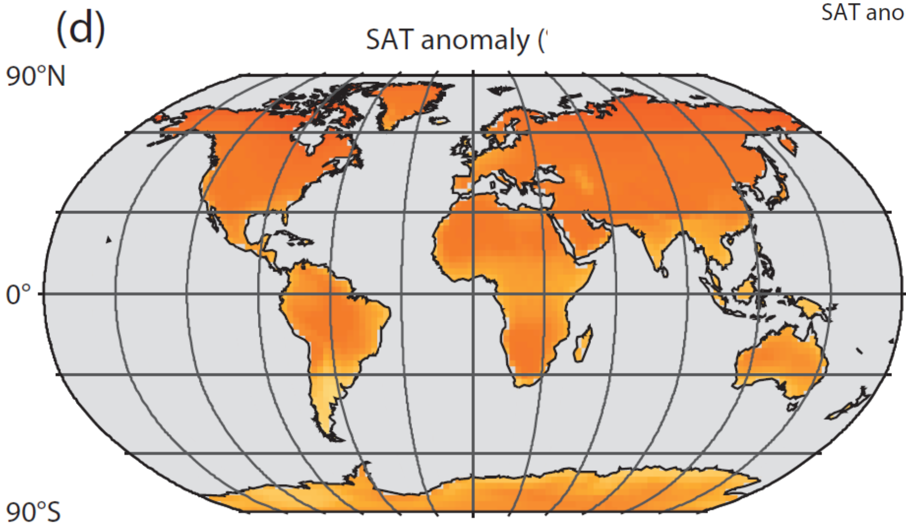

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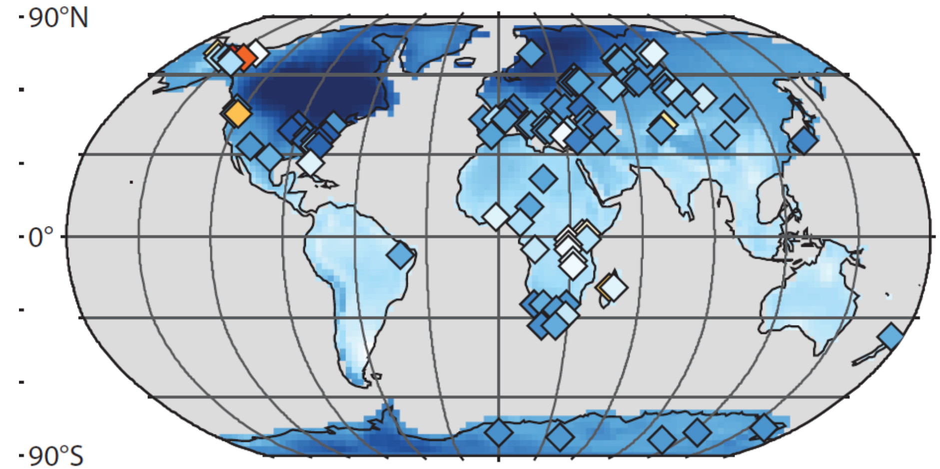

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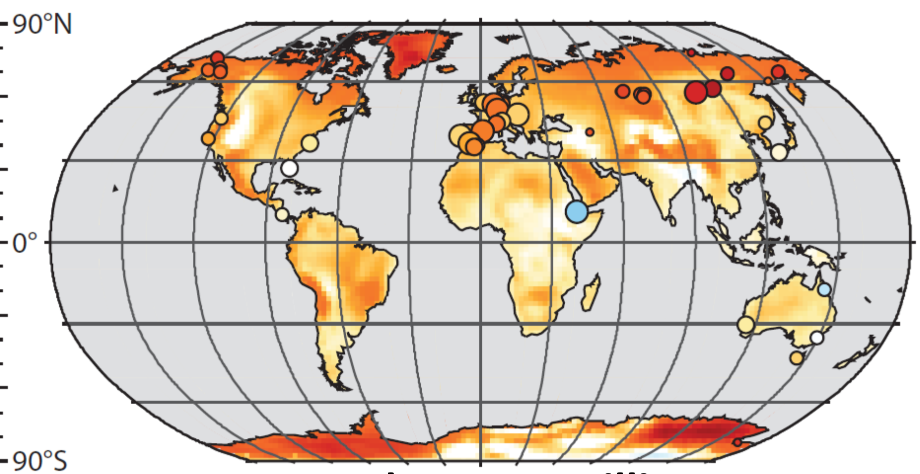

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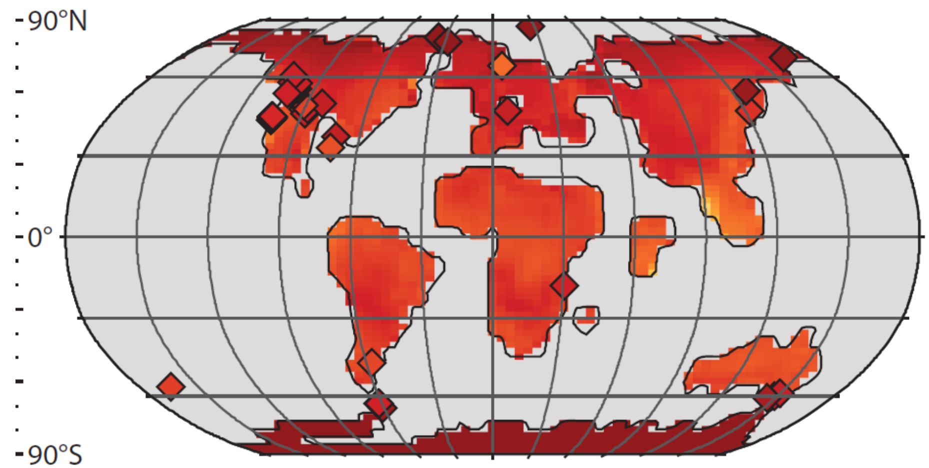

Temperature change, 55 million years ago, The 'Early Eocene'.

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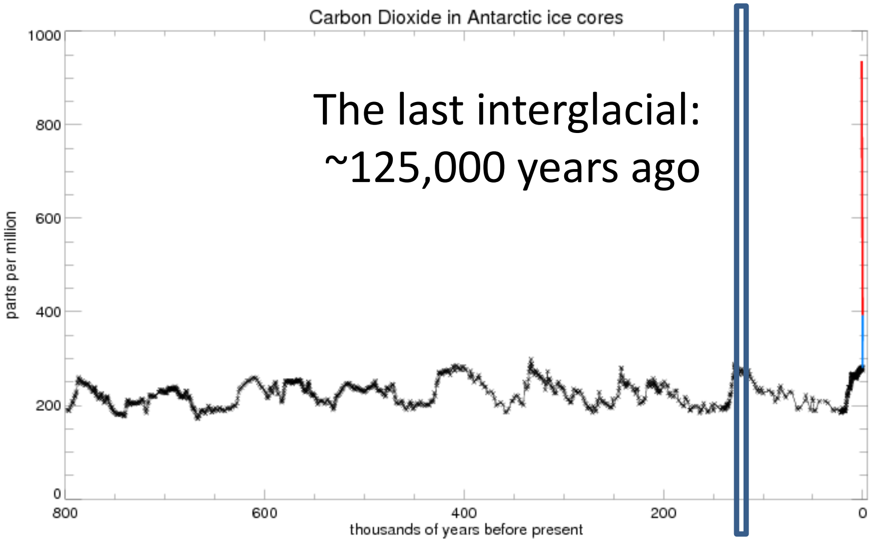

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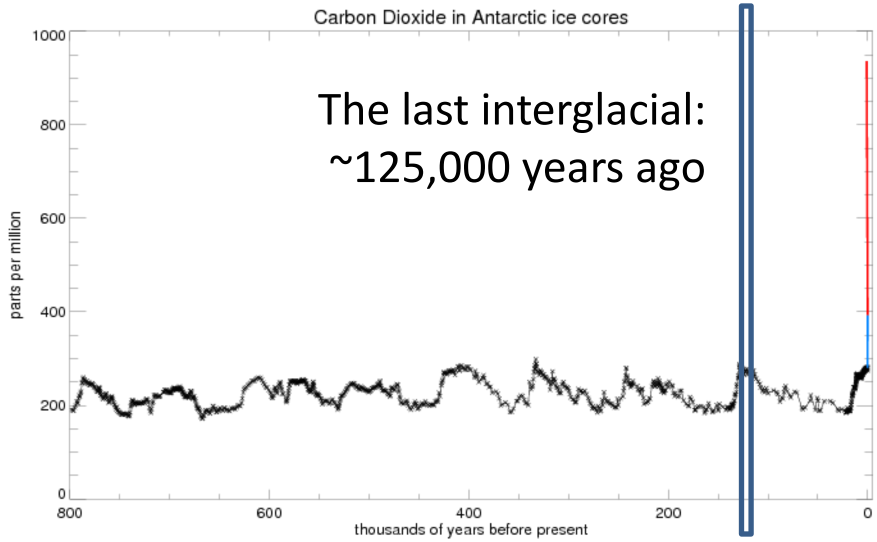

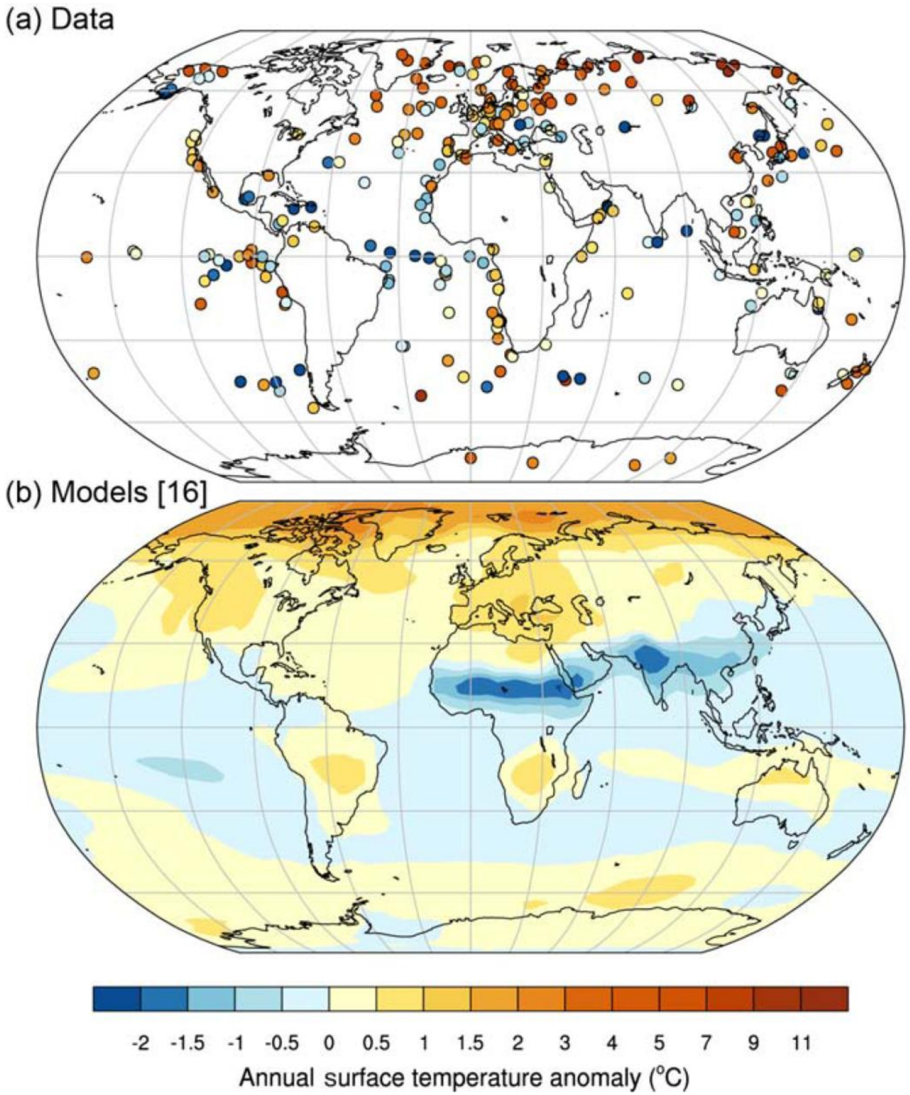

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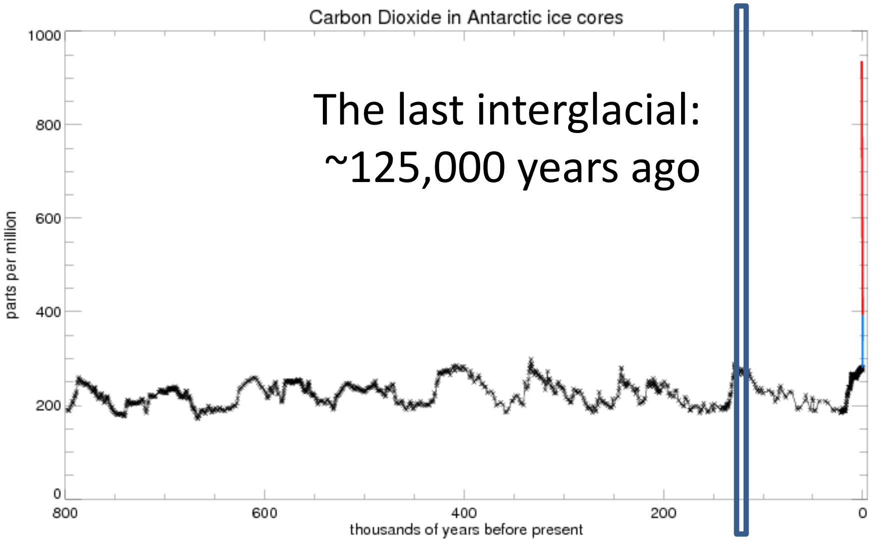

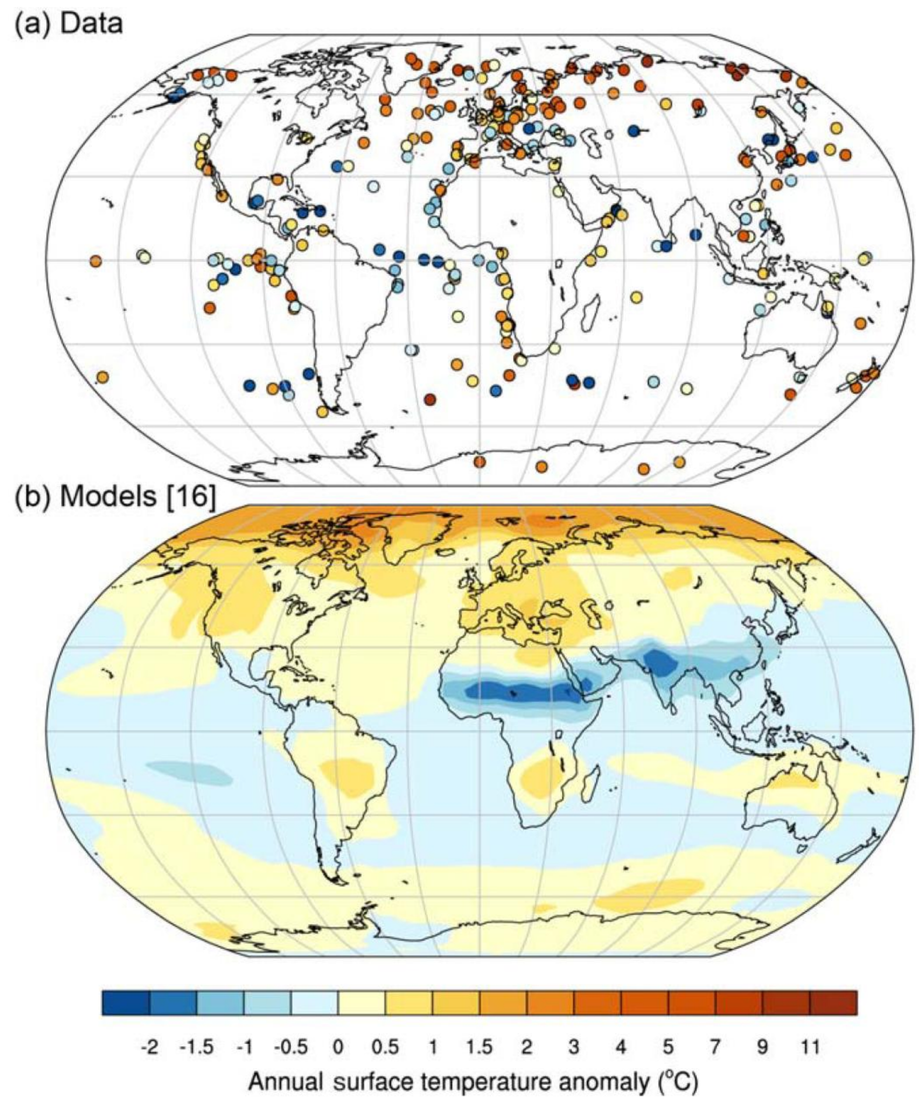

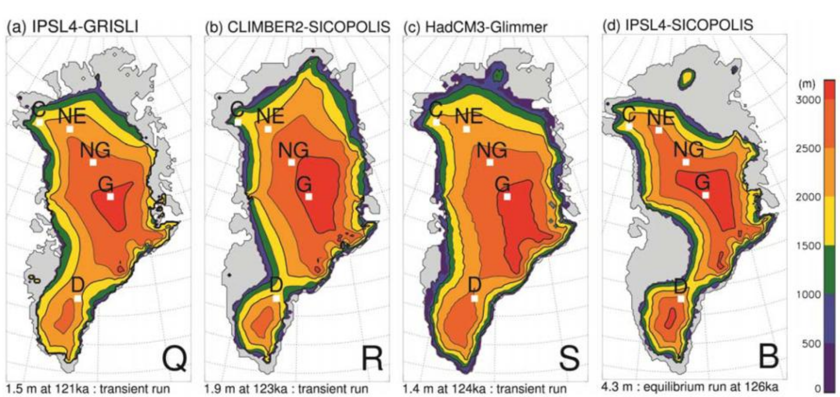

(3) To document components of the system for which the instrumental record is too short.

- "Climate sensitivity" is usually defined as the global mean temperature change given a doubling of CO_2.
- Useful metric
- Can be estimated using models, which have strengths and weaknesses.
- Consideration of uncertainties is essential.

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- **AR5: "**likely in the range 1.5°C to 4.5°C with high confidence, extremely unlikely less than 1°C (high confidence) and very unlikely greater than 6°C (medium confidence).

BUT.....

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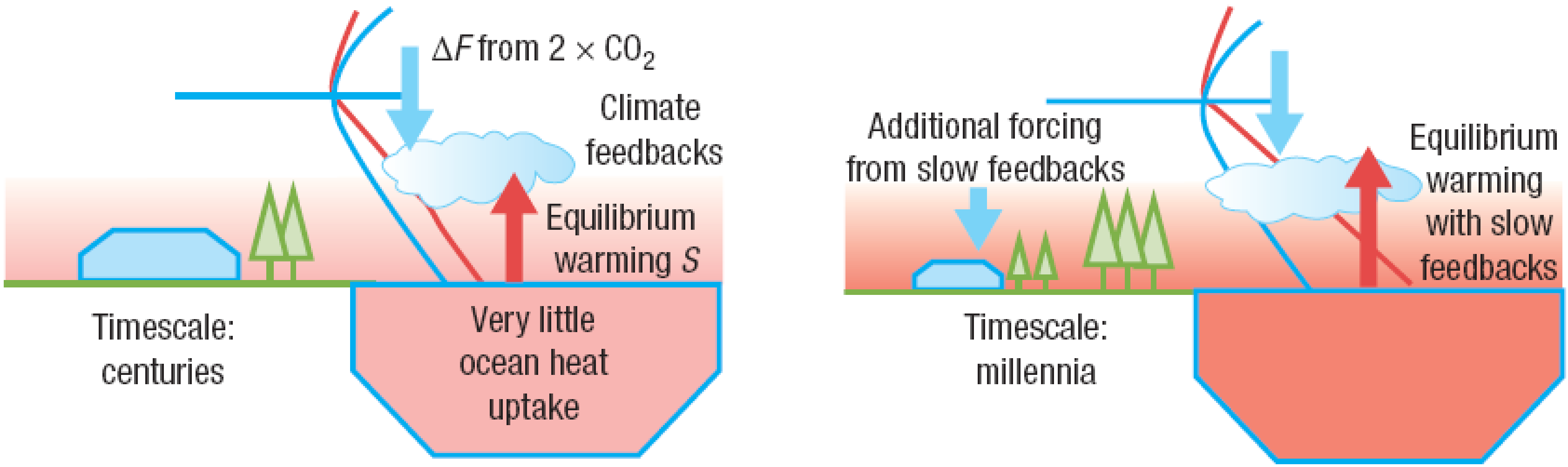
models neglect many processes….



EARTH SYSTEM SENSITIVITY – long-term response to sustained elevated CO_2 concentrations, including all feedbacks.

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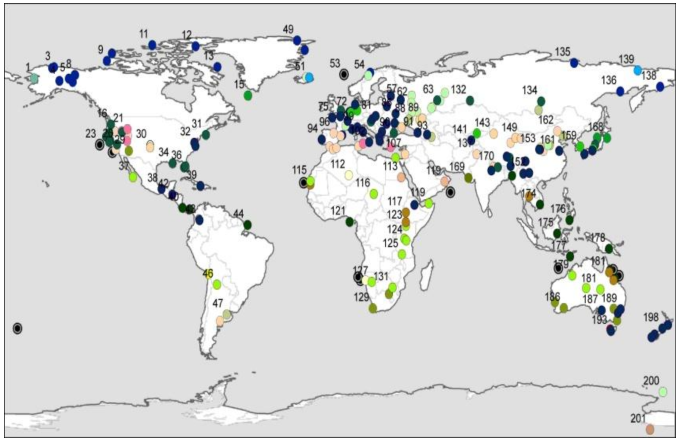
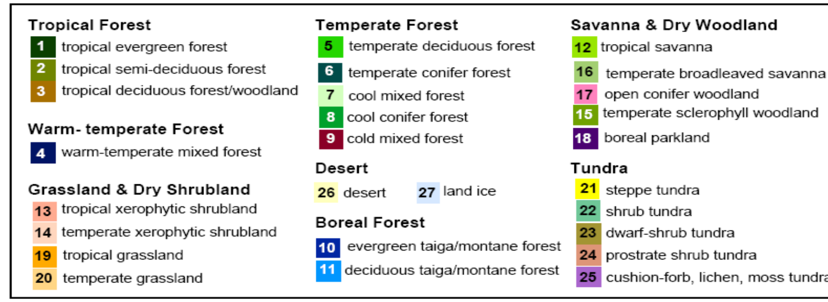
Vegetation from palaeobotanical (e.g. pollen) data





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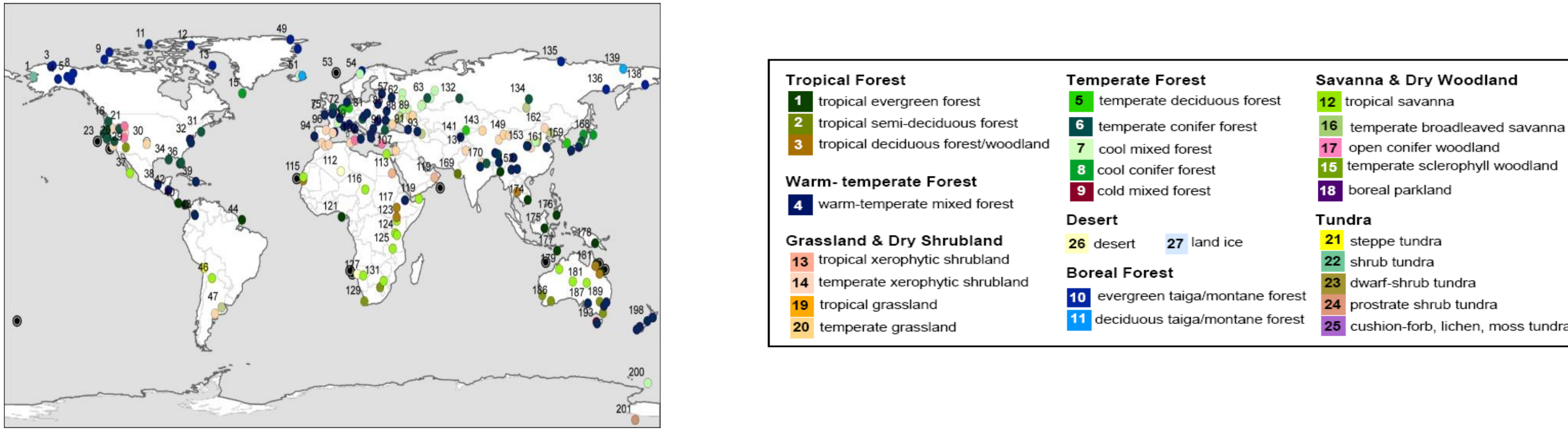
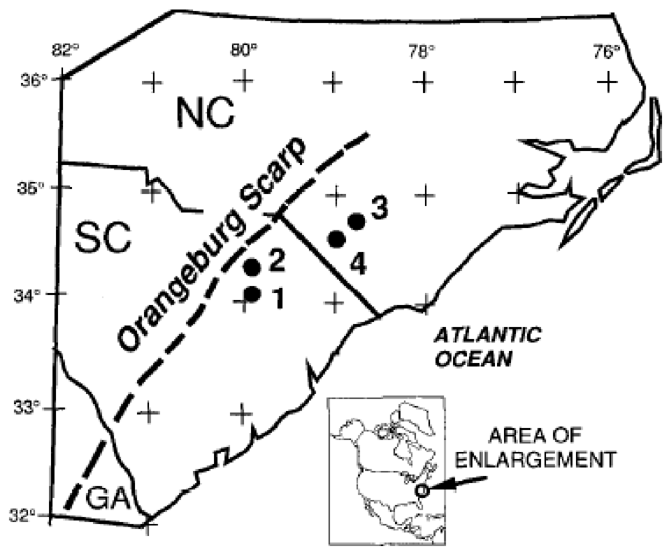
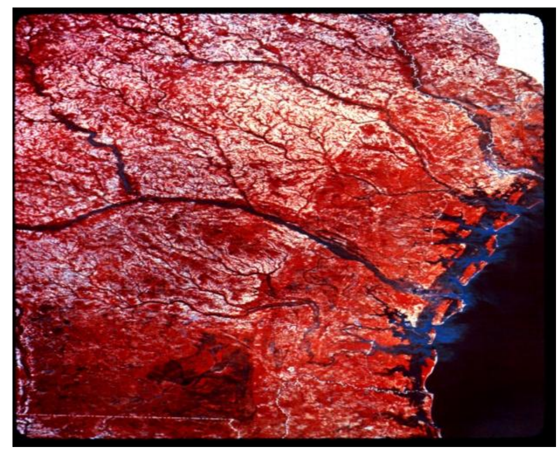


Sea level from geological (e.g. Ancient shoreline) data

Figure 1. Location of Orangeburg scarp and position of cores and outcrops analyzed for marine microfossils. 1—LB 173, D of Cronin (1988), SC-76 of Cronin (1981), lat 34°19′45″N, long 79°58′00″W; 2—LB 179, K of Cronin (1988), SC-65 of Cronin (1981), 34°01′30″N, 79°59′00″W; 3—Robeson Farm, C of Cronin (1988), NC-27 of Cronin (1981), 34°42′39″N, 78°44′16″W; 4—Lumber River, B of Cronin (1988), NC-21 of Cronin (1981), 34°35′35″N, 78°58′53″W. NC = North Carolina, SC = South Carolina, GA = Georgia.





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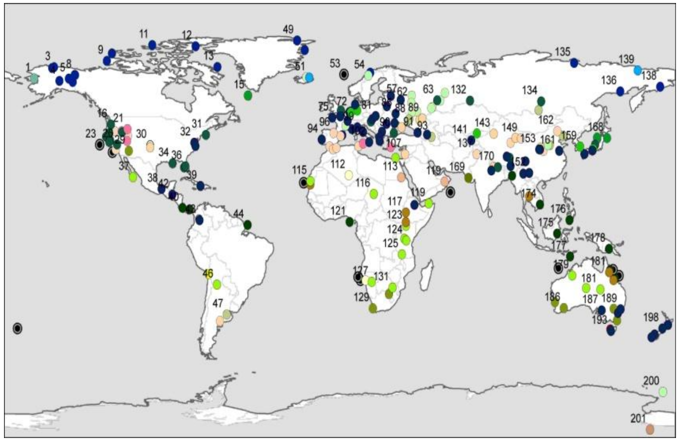


Tropical Forest
1 tropical evergreen forest
2 tropical semi-deciduous forest
3 tropical deciduous forest/woodland

Warm- temperate Forest
4 warm-temperate mixed forest

Grassland & Dry Shrubland
13 tropical xerophytic shrubland
14 temperate xerophytic shrubland
19 tropical grassland
20 temperate grassland

Temperate Forest
5 temperate deciduous forest
6 temperate conifer forest
7 cool mixed forest
8 cool conifer forest
9 cold mixed forest

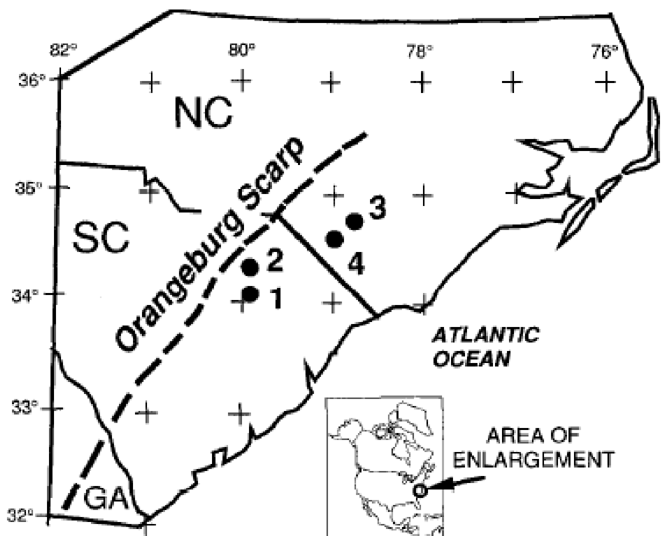
Desert
26 desert
27 land ice

Boreal Forest
10 evergreen taiga/montane forest
11 deciduous taiga/montane forest

Savanna & Dry Woodland
12 tropical savanna
16 temperate broadleaved savanna
17 open conifer woodland
15 temperate sclerophyll woodland
18 boreal parkland

Tundra
21 steppe tundra
22 shrub tundra
23 dwarf-shrub tundra
24 prostrate shrub tundra
25 cushion-forb, lichen, moss tundra

Sea level from geological (e.g. Ancient shoreline) data



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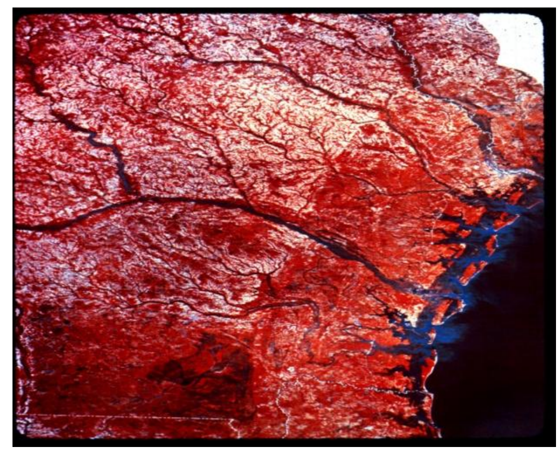
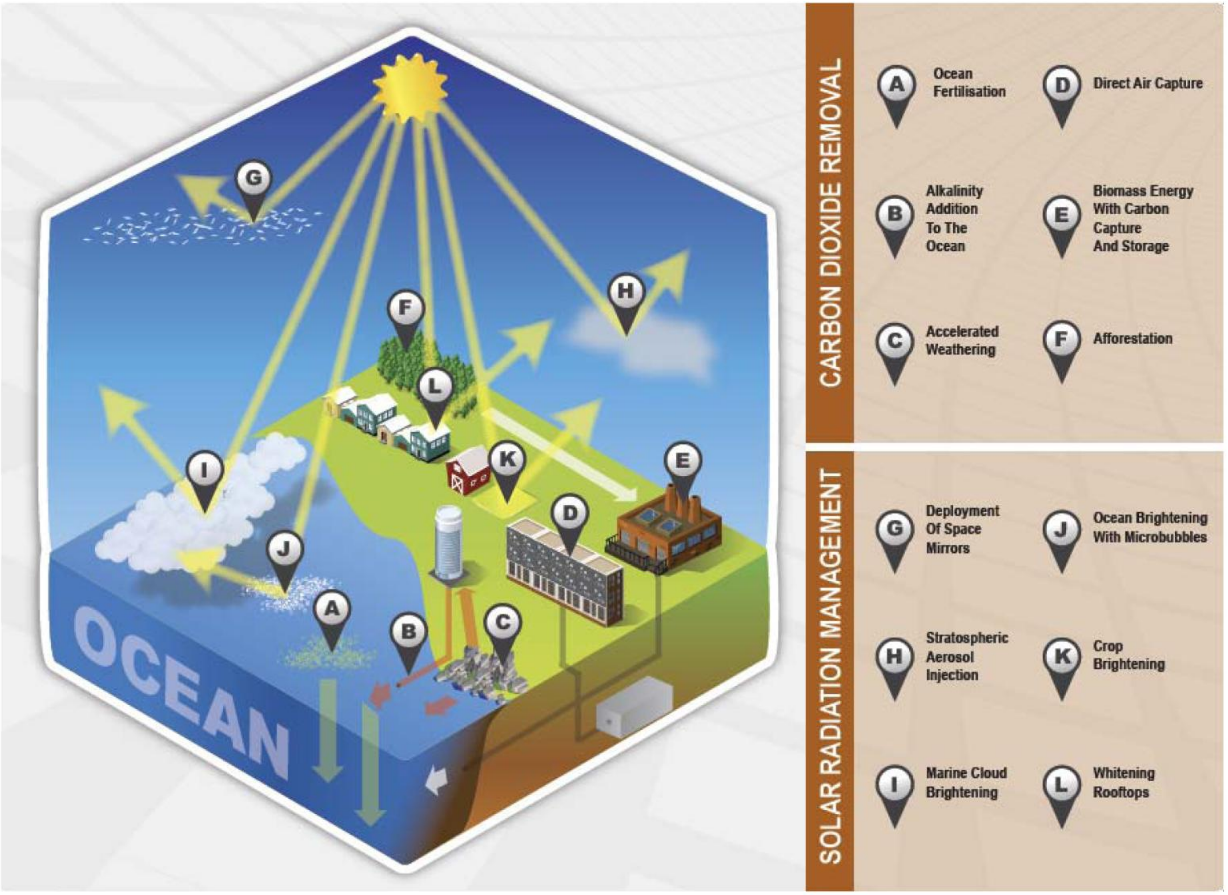


➢ **“Earth system sensitivity over millennia timescales including longterm feedbacks ...could be significantly higher than CS.”**

Geoengineering

Chapter 7: Clouds and Aerosols

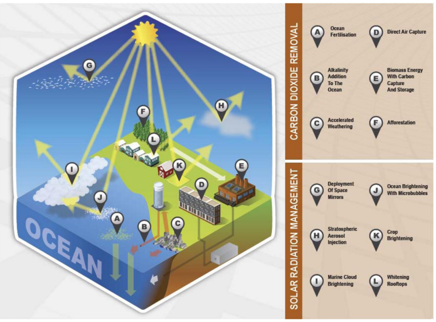


"CDR"

"SRM"

"Geoengineering refers to a broad set of methods and technologies that aim to deliberately alter the climate system in order to alleviate the impacts of climate change".

Geoengineering



- **CDR methods could provide mitigation of climate change if CO_2 can be reduced, but there are uncertainties, side effects and risks, and implementation would depend on technological maturity along with economic, political and ethical considerations.**

- **SRM remains unimplemented and untested but, if realisable, could offset a global temperature rise and some of its effects....Numerous side effects, risks and shortcomings from SRM have been identified.**