

Past and Future Climate – Present Weather

Week 7

Climate in the time of human evolution

Terry Hart

Dates

Term 2

21 May

Climate – Climate in the time of Human Evolution

28 May

Geology

4 June

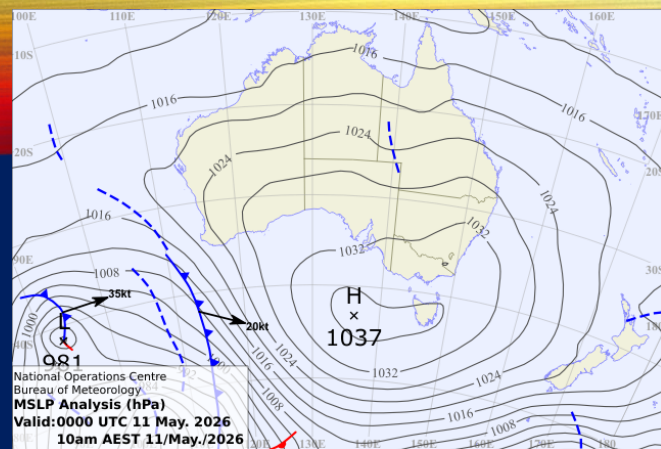
Climate – The Holocene (“Recent” Past)

11 June

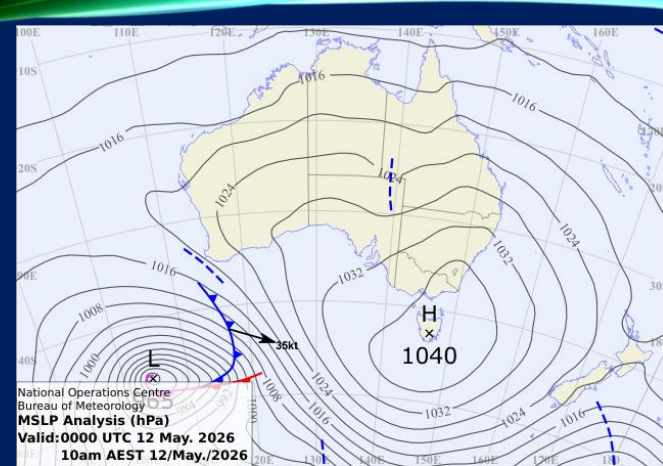
Geology

18 June

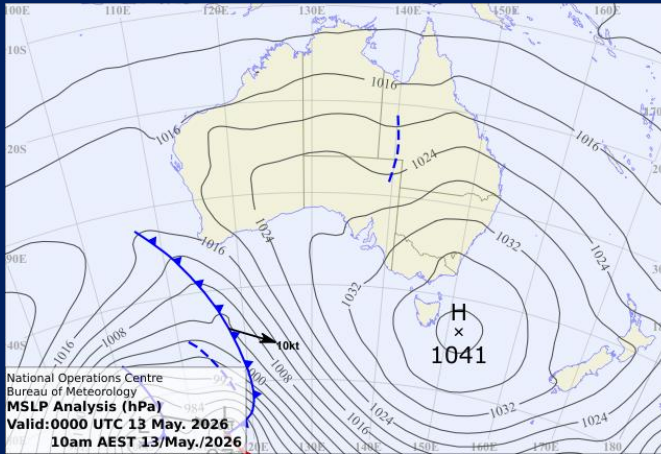
Climate – El Niño/La Niña



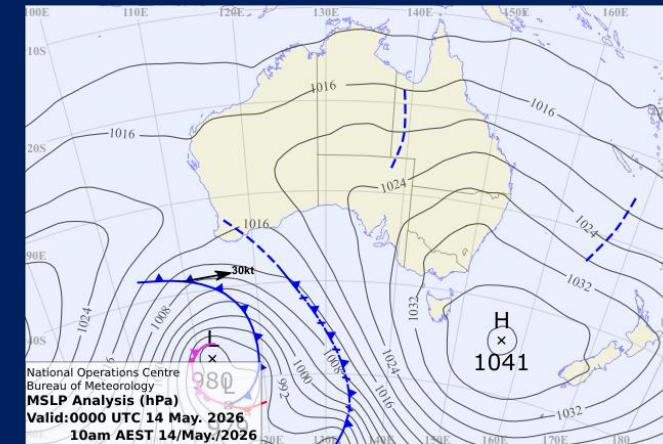
Monday
11 May



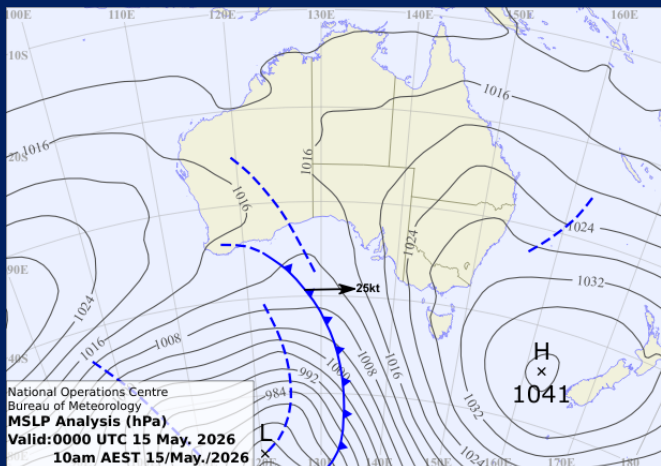
Tuesday
12 May



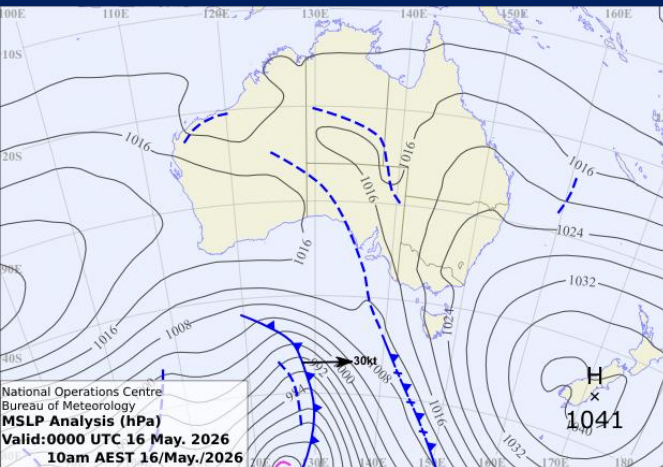
Wednesday
13 May



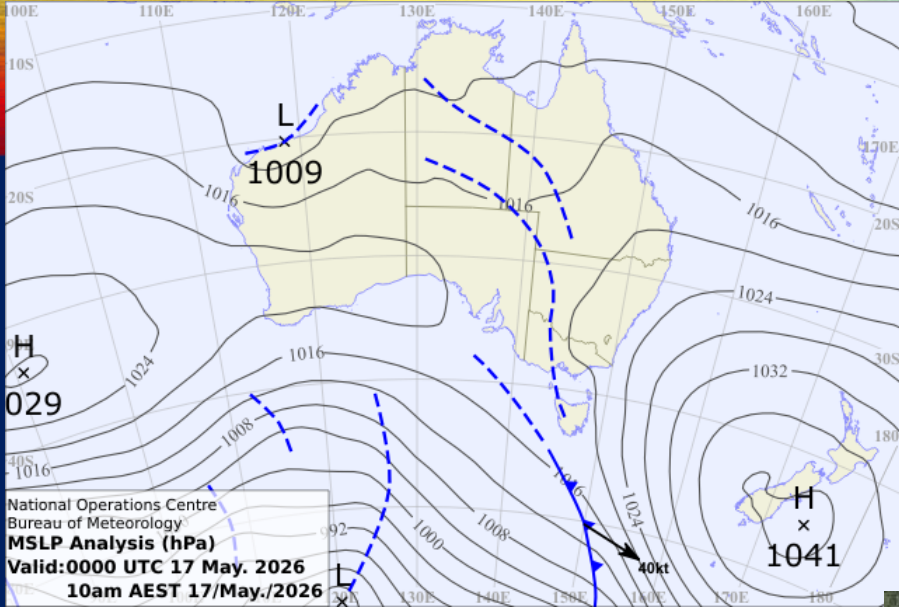
Thursday
14 May



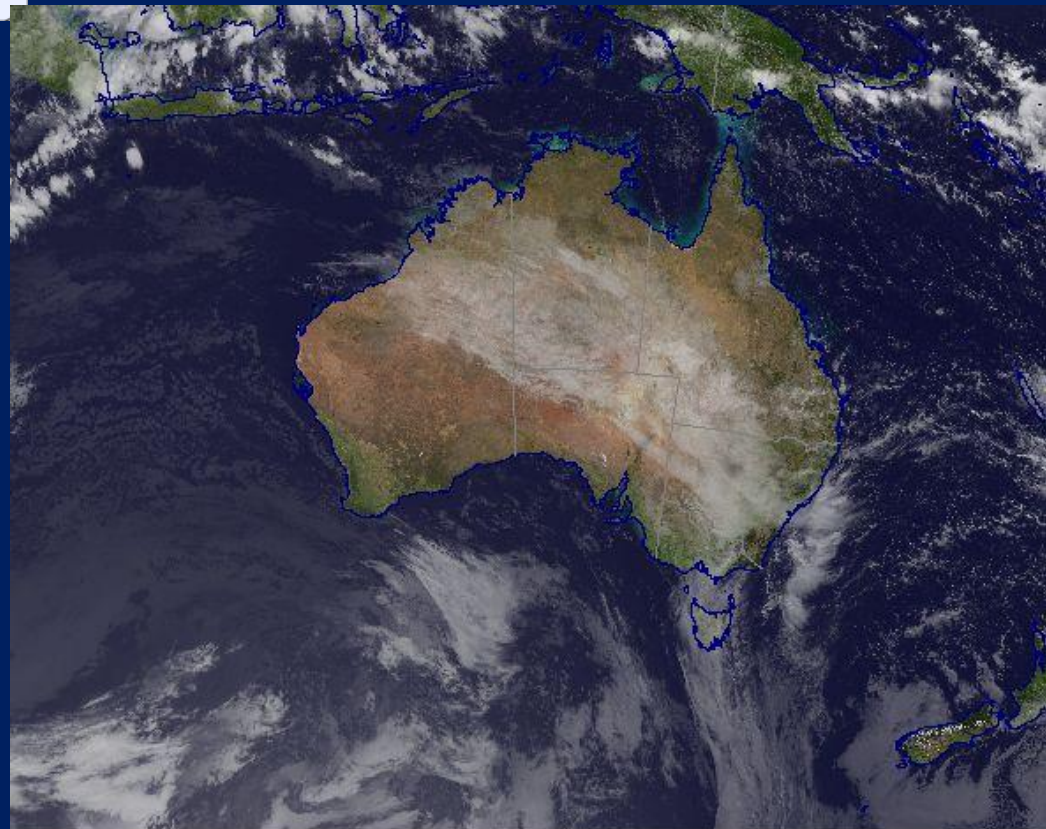
Friday
15 May

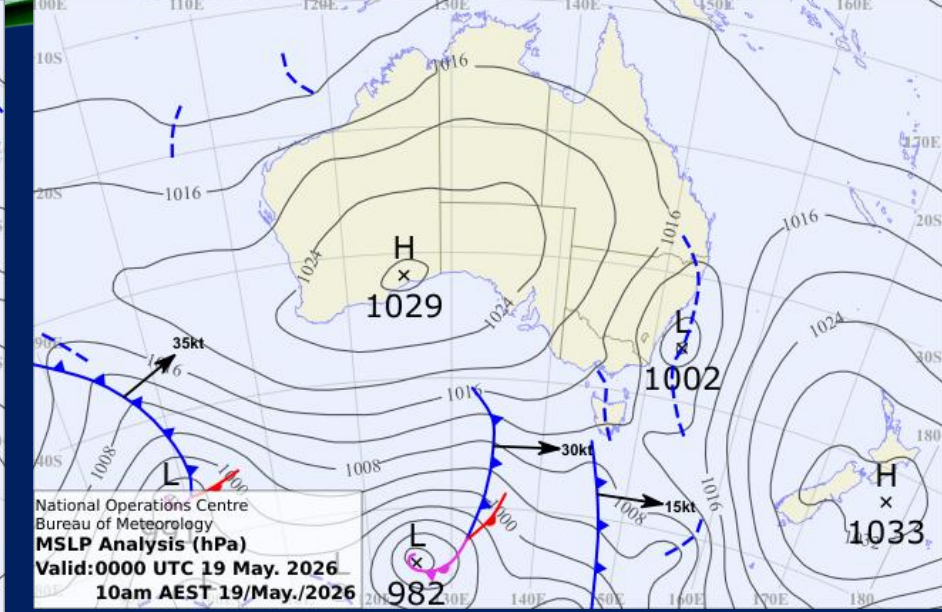
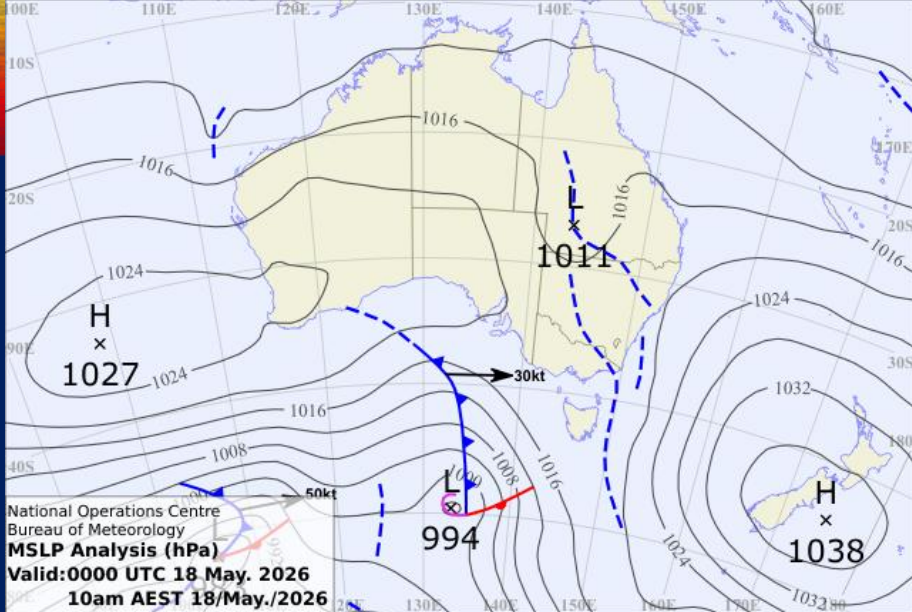


Saturday
16 May

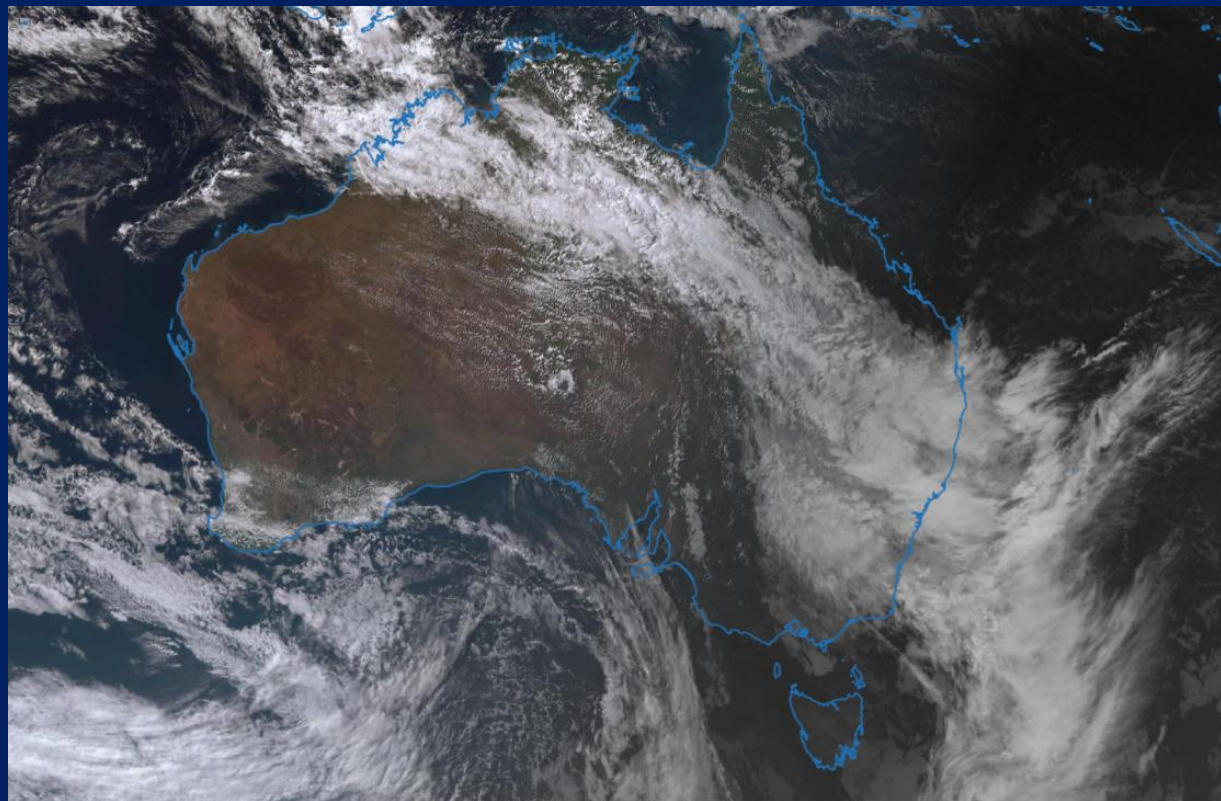


Sunday
17 May





4.40 pm Monday
 18 May



News

Home > Weather News > 200 millimetres in two days soaks southeast Queensland, northeast NSW



200 millimetres in two days soaks southeast Queensland, northeast NSW

BEN DOMENSINO
TODAY, 6:52 PM AEST

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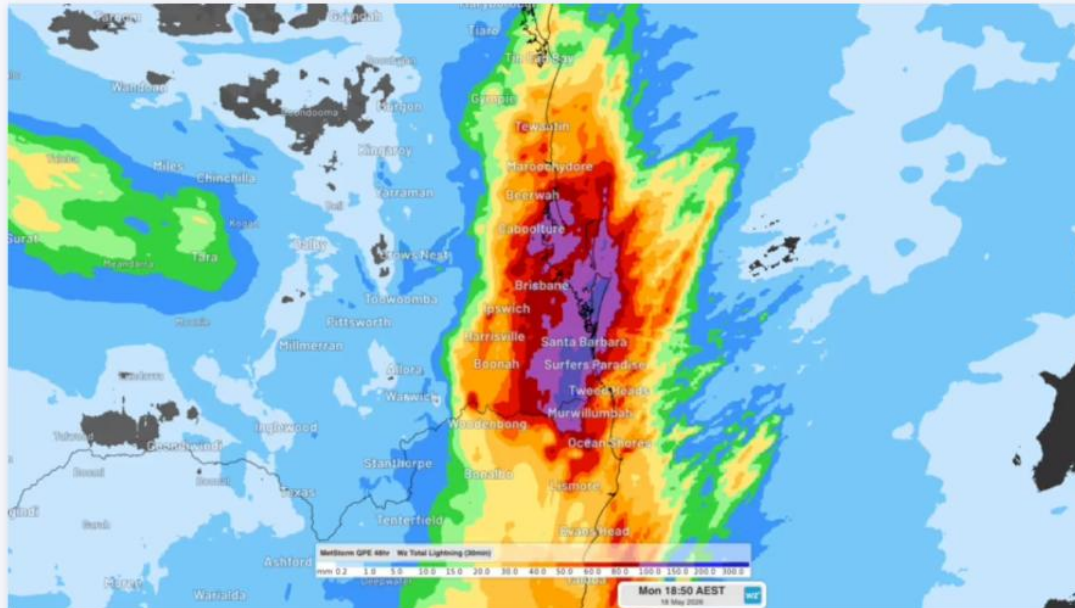


Image: Estimated rainfall over southeast Qld and northeast NSW during the 48 hours ending at 6:50 pm AEST on Monday, May 18, 2026. Source:

<https://www.weatherzone.com.au/news/200-millimetres-in-two-days-soaks-southeast-queensland-northeast-nsw/1891361>

Flooding rapidly developed across parts of southeast Queensland on Monday following more than 240 mm of rain in the last two days.

A near-stationary low pressure trough being fed with moisture-laden winds caused persistent and heavy showers over southeast Qld and northeast NSW on Sunday and Monday.

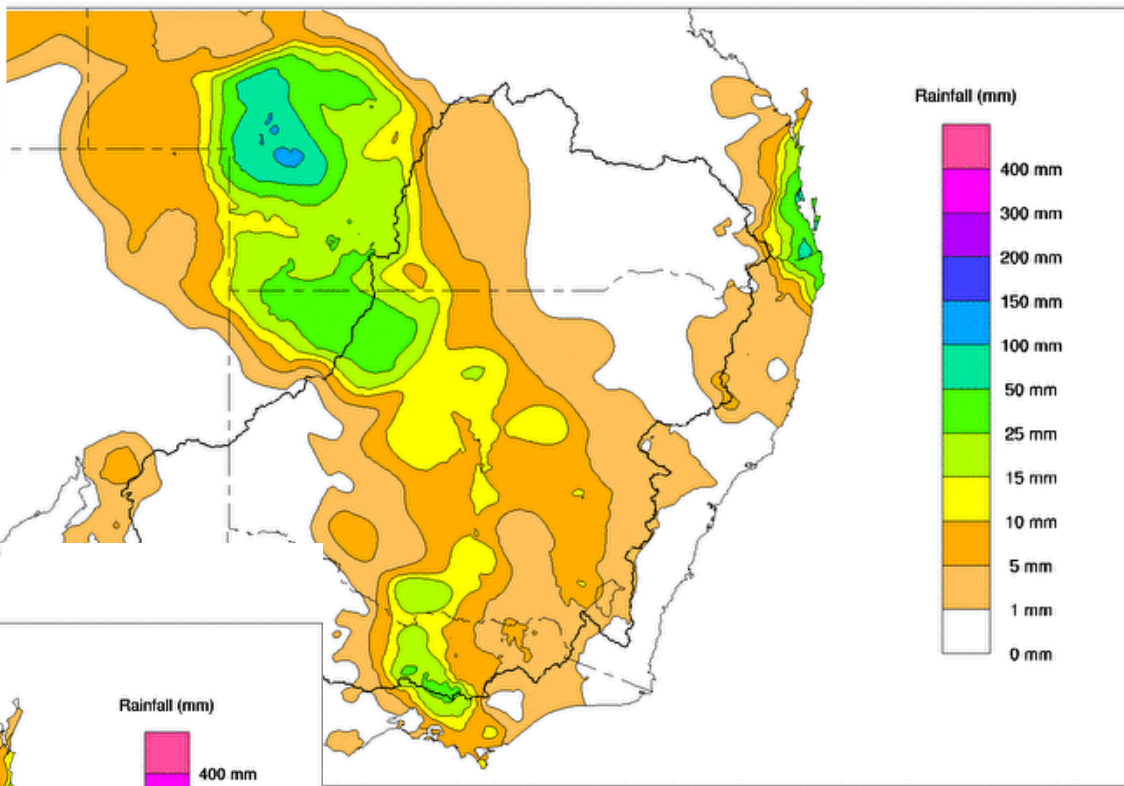
Rain gauges on either side of the border collected more than 200 mm across the two-day period.

Stranded school students rescued from national park as deluge drenches Gold Coast

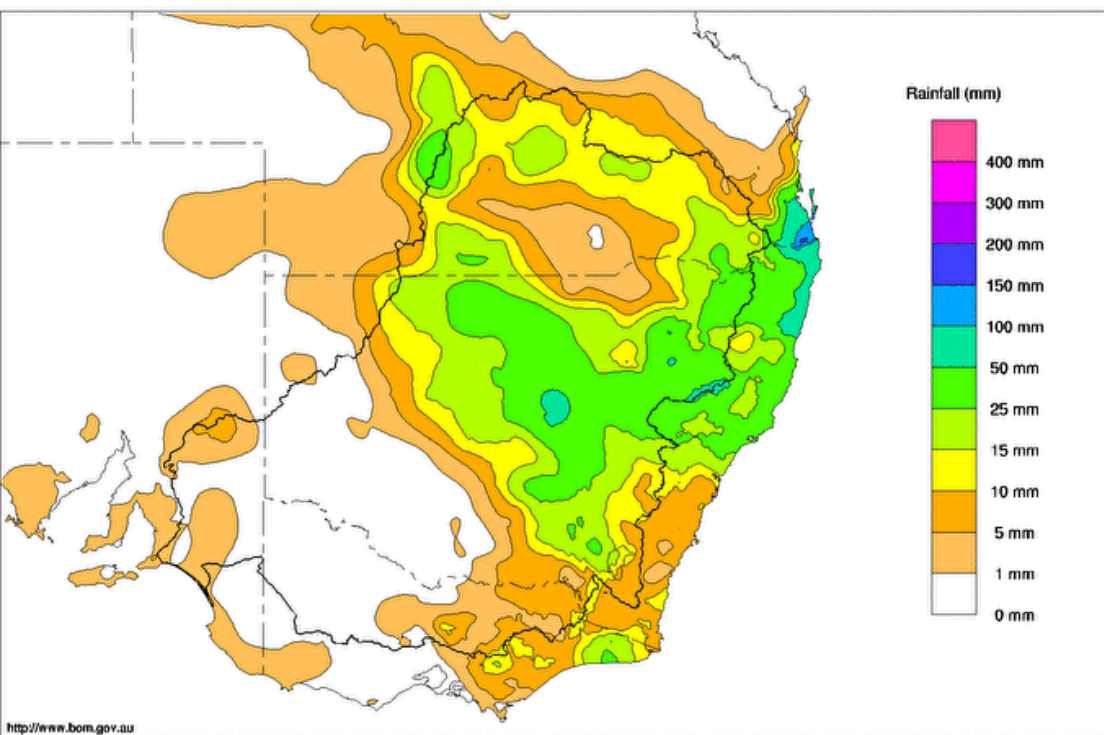
By Emily Dobson ABC Gold Coast Floods

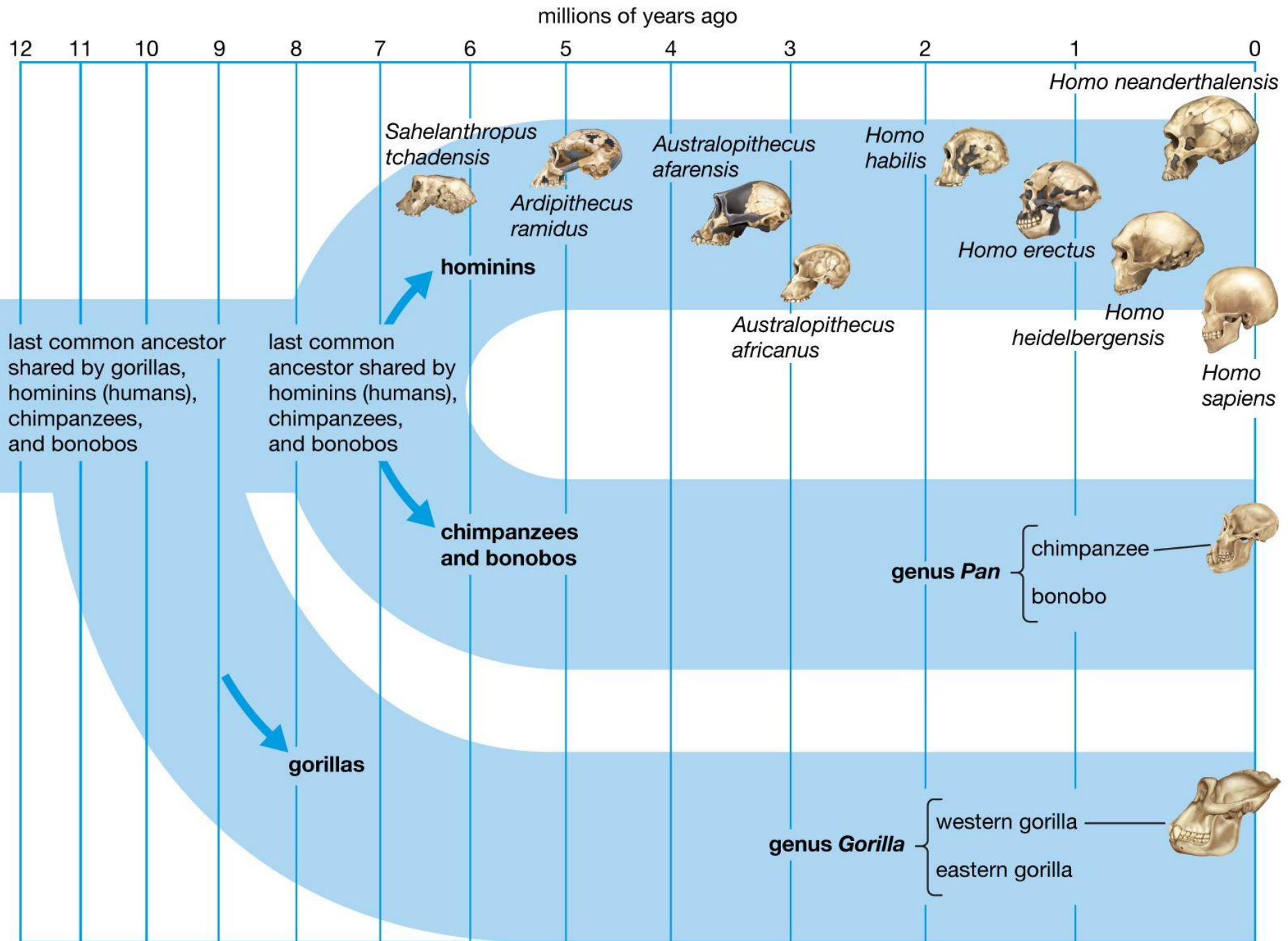


Murray-Darling Rainfall Totals (mm) 19th May 2026
Australian Bureau of Meteorology

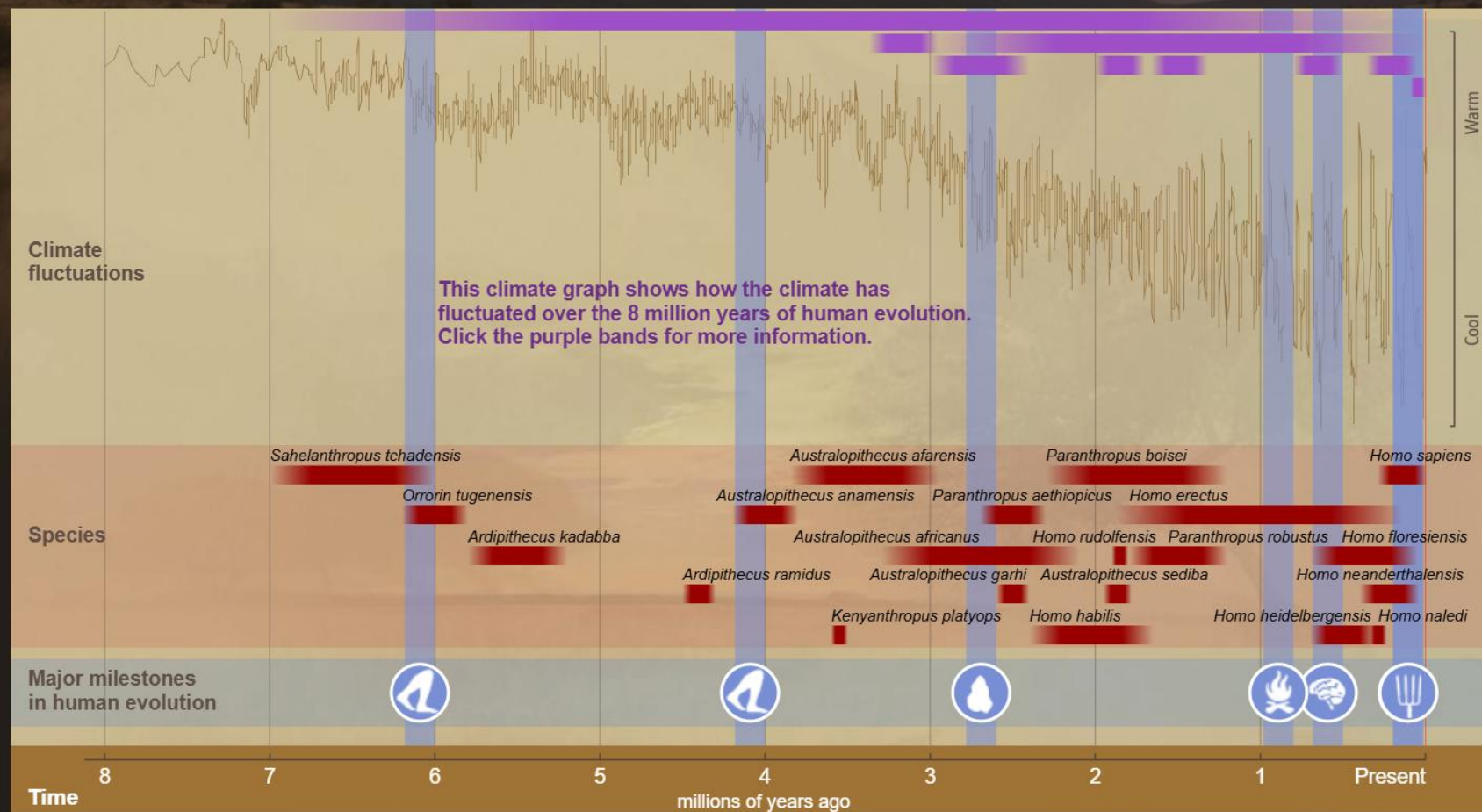


Issued: 18/05/2026





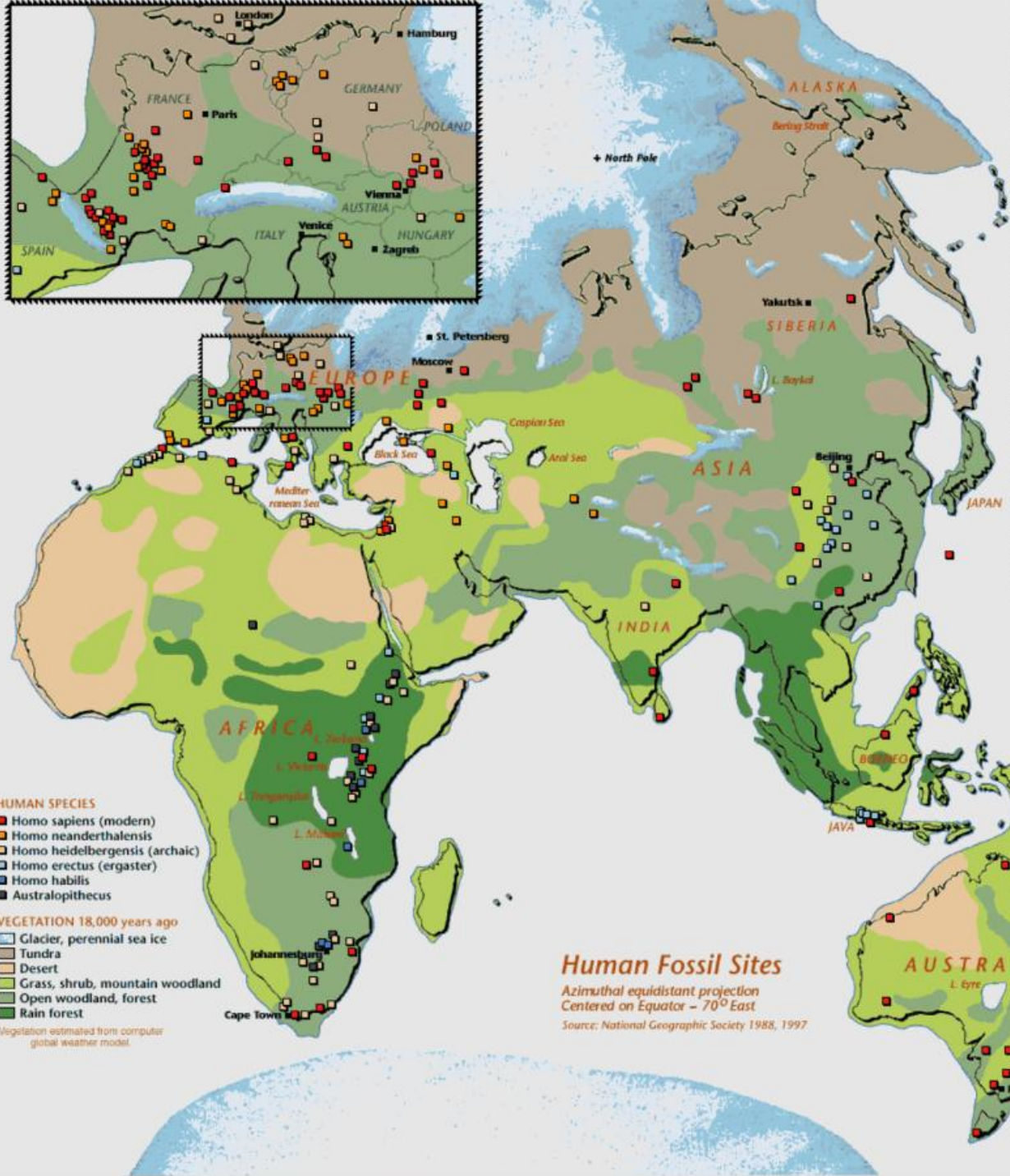
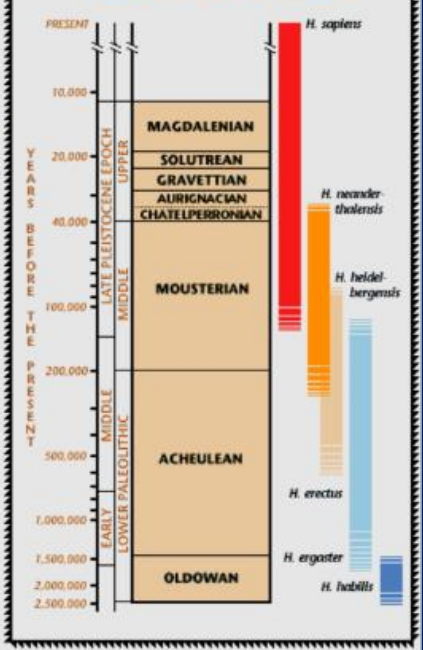
Human Evolution Interactive Timeline



magnifier

During the period of human evolution, the Earth's climate has fluctuated between warm and cold. Some of the most important milestones in human evolution occurred during times of greatest fluctuations. Explore the relationship between climate and human evolution more deeply by magnifying the timeline.

Paleolithic Periods



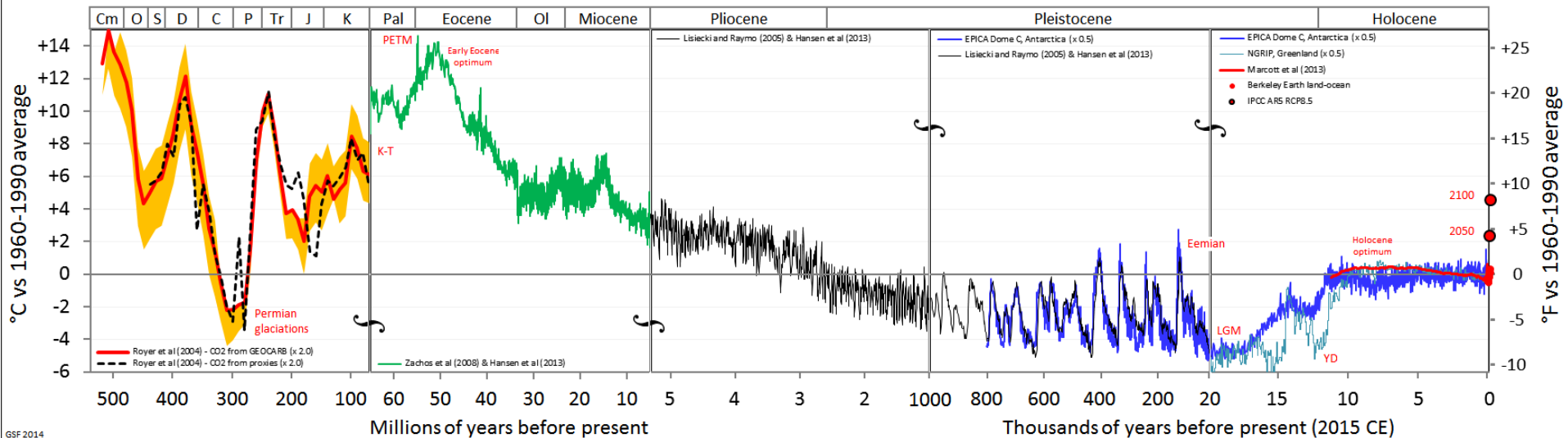
- HUMAN SPECIES**
- Homo sapiens (modern)
 - Homo neanderthalensis
 - Homo heidelbergensis (archaic)
 - Homo erectus (ergaster)
 - Homo habilis
 - Australopithecus
- VEGETATION 18,000 years ago**
- Glacier, perennial sea ice
 - Tundra
 - Desert
 - Grass, shrub, mountain woodland
 - Open woodland, forest
 - Rain forest

Vegetation estimated from computer global weather model.

Human Fossil Sites

Azimuthal equidistant projection
Centered on Equator - 70° East
Source: National Geographic Society 1988, 1997

Temperature of Planet Earth



Time is plotted forward to the present, taken as 2015 CE.

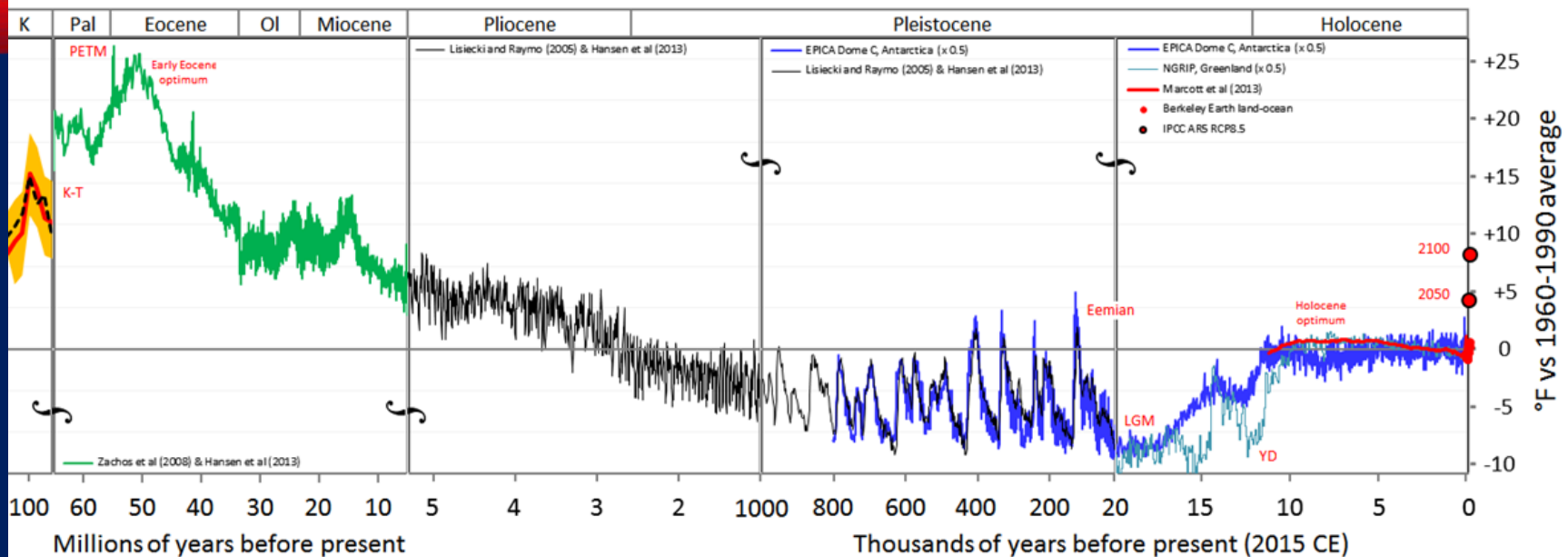
Note that the scale expands towards the present. There are five separate linearly scaled segments, expanding by about an order of magnitude at each vertical break.

Surface air temperature is plotted as anomalies (differences) from the average over the reference interval 1960–1990 (which is about 14°C)

https://commons.wikimedia.org/wiki/File:All_palaeotemps.png#Data

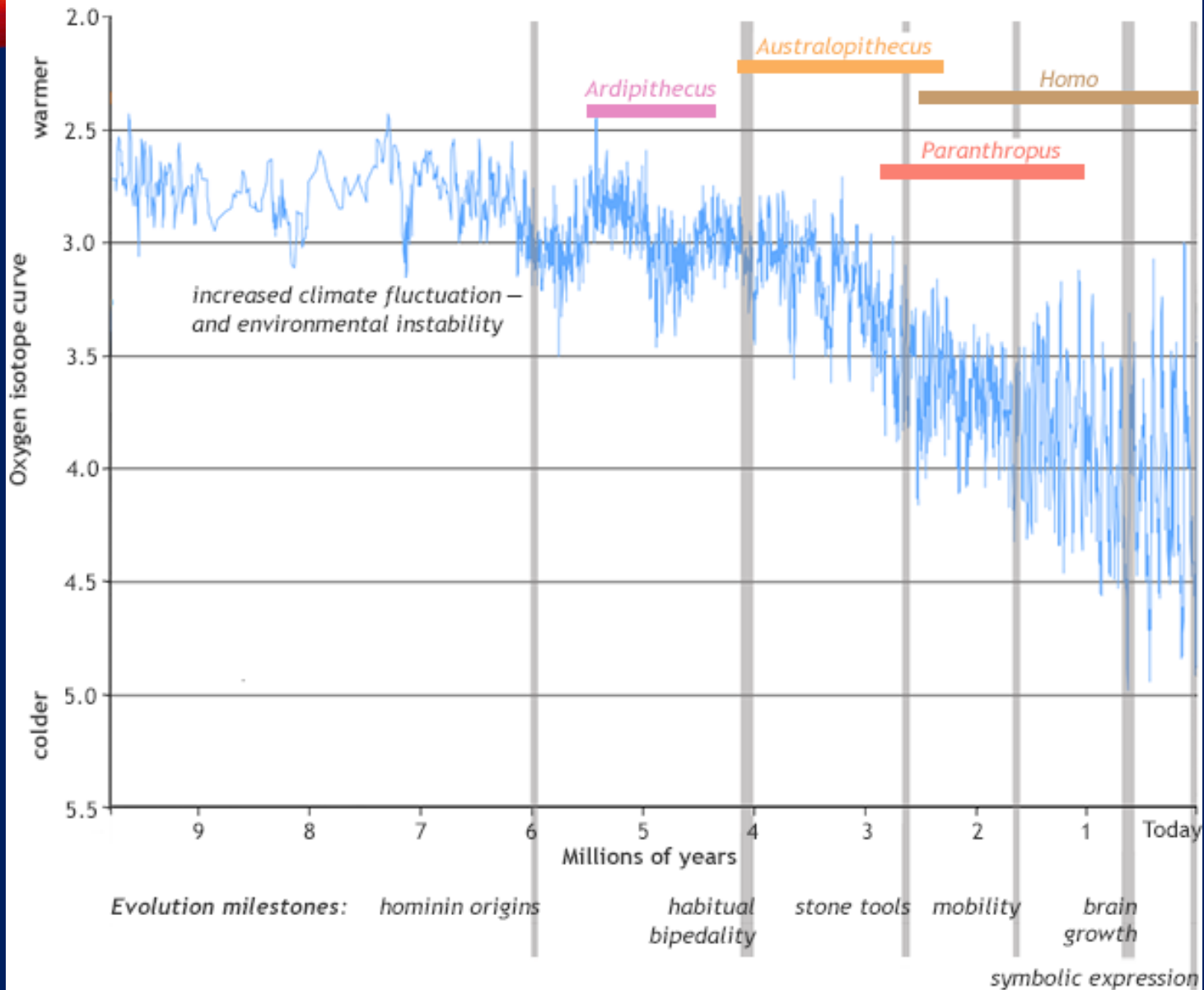
Figure prepared by Glen Fergus.

Temperature of Planet Earth



- Cooling from around 4 Mya, faster after 3 Mya.
- Ice first appears in Greenland around 5 Mya and on America, Russia and Europe from 2.5 Mya, the start of the Ice Age. (There had been ice in Antarctica millions of years before that).
- Large variations related to variations in the earth's orbit (Croll-Milankovic cycles)
 - about every 40,000 years before 1 Mya
 - After 1 Mya even stronger and about every 100,000 years.
- Last Glacial Maximum (26,000 – 20,000 years ago) – then a general increase in temperature leading to a stable period since about 12,000 years ago.

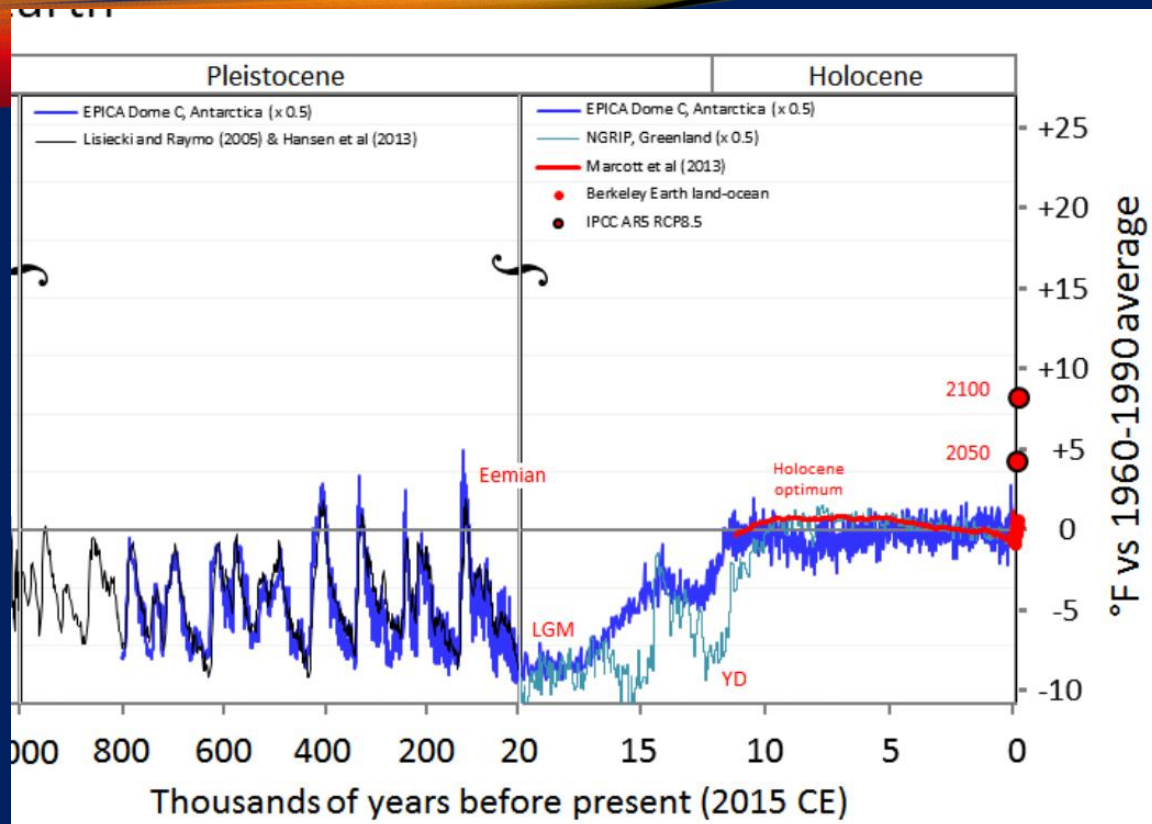
Climate change and human evolution milestones



- Movement of the land masses (plate tectonics) – a factor in the distant past.
- However, not much changed in the past 7 million years apart from the closure of the Isthmus of Panama 3-5 million years ago.
- The Central American Seaway had allowed movement of warm tropical water between the Pacific and Caribbean.
- Closure forced ocean currents into a new path intensifying the warm Gulf Stream current and a deep return current to Antarctica.



Figure 3B.4.3 Formation of the Isthmus of Panama changed ocean currents. Left: Before the Isthmus formed there was a single tropical ocean between North and South America that had relatively uniform conditions of temperature and nutrients. Right: The formation of the isthmus created two different oceans. The Caribbean became warmer and saltier which created a strong Gulf Stream current taking heat and moisture into the North Atlantic. Source: Smithsonian Tropical Research Institute (n.d.) CC BY-NC. Found [here](#).



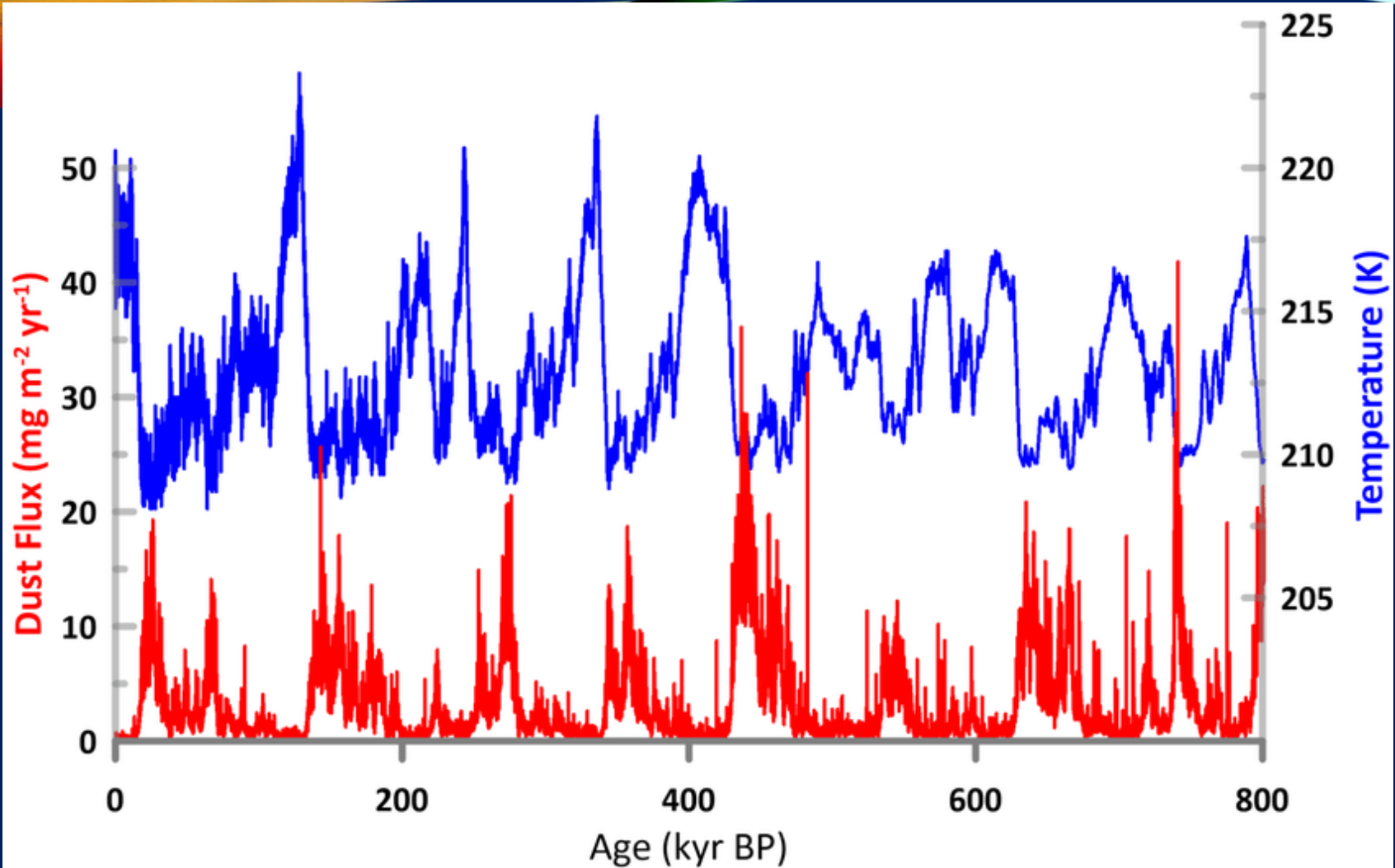
Looking more closely at the last million years

- Ability to light and control fire
- Increase in brain size.

- The Pleistocene (Ice Age) epoch should really be called the **Ice Ages**
 - rapid variations in climate, varying from around 5°C colder than today to around 2°C warmer than today.
- The warm periods are relatively short compared with the colder periods.
- In the period since 20,000 years ago – the dark blue line is from an Antarctic ice core, while the teal colour is from a Greenland ice core.

What do we know about the climate during the Ice Ages?

- The glacial periods appear to have been dry and windy (as evident in dust content in sediment cores) implying aridity.
- Cold air cannot hold as much moisture as warm air, so overall the rainfall rate decreases. The water is locked away in the ice sheets rather than in the air.
- So, some rainforests changed to less dense woodland or even savannah and grassland - due to dryness as much as the cold.
- But ice sheets need moisture as well as cold to form so the lower moisture content in the air limited where the ice sheets formed.



Temperature (blue) and dust flux (red) from the European ice core at Dome C high on the Antarctic Plateau

Lovejoy, Shaun & Lambert, Fabrice. (2019). Spiky Fluctuations and Scaling in High-Resolution EPICA Ice Core Dust Fluxes. *Climate of the Past Discussions*. 1-33. [10.5194/cp-2018-171](https://doi.org/10.5194/cp-2018-171).

Implications and Hypotheses

Some writers propose that the **rate of evolution** increased around the start of the Pleistocene (2.5 Mya) and that the changing climate was a factor.

- Before the Pleistocene – the grasslands of East Africa did not exist. As the area of forests diminished did that cause the early hominins to spend more time on the ground and develop bipedalism?
 - Australopithecines – bipedal but kept their tree-climbing ability.
- Biologist Ernst Mayr proposed that new species often evolve when some small subset of an existing population becomes isolated from the rest of the species.
 - The changing climate affected plants and animals also. So, environmental changes or perhaps a climate-related catastrophe may have resulted in such isolated sub-groups.
- The climate changes became increasingly extreme – intervals sometimes warmer than today alternated with episodes of intense cold with immense glaciers.
 - The speed of climate change forced people to change their way of life relatively quickly. (*John Hoffecker in Fagan (Ed.)*)
- The see-sawing climate may have favoured a more adaptive species?
 - Perhaps Australopithecines were not so adaptable allowing the Homo species to emerge.



Climate Change and Human Evolution

This video explores the link between climate change and human evolution.

<https://humanorigins.si.edu/multimedia/videos/climate-change-and-human-evolution>



What does it mean to be human?

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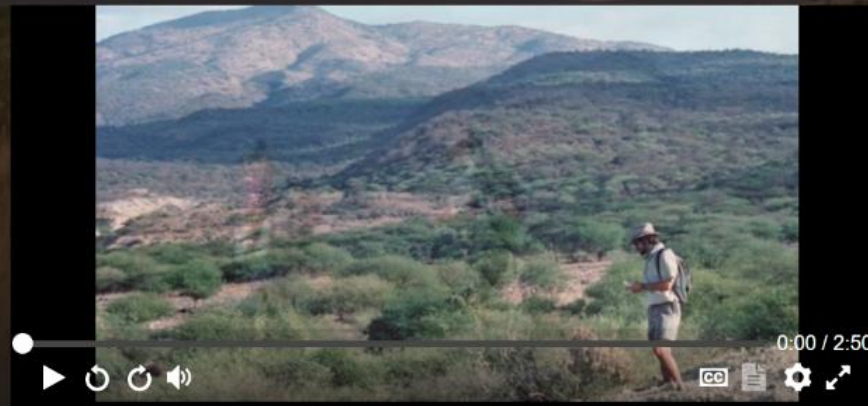
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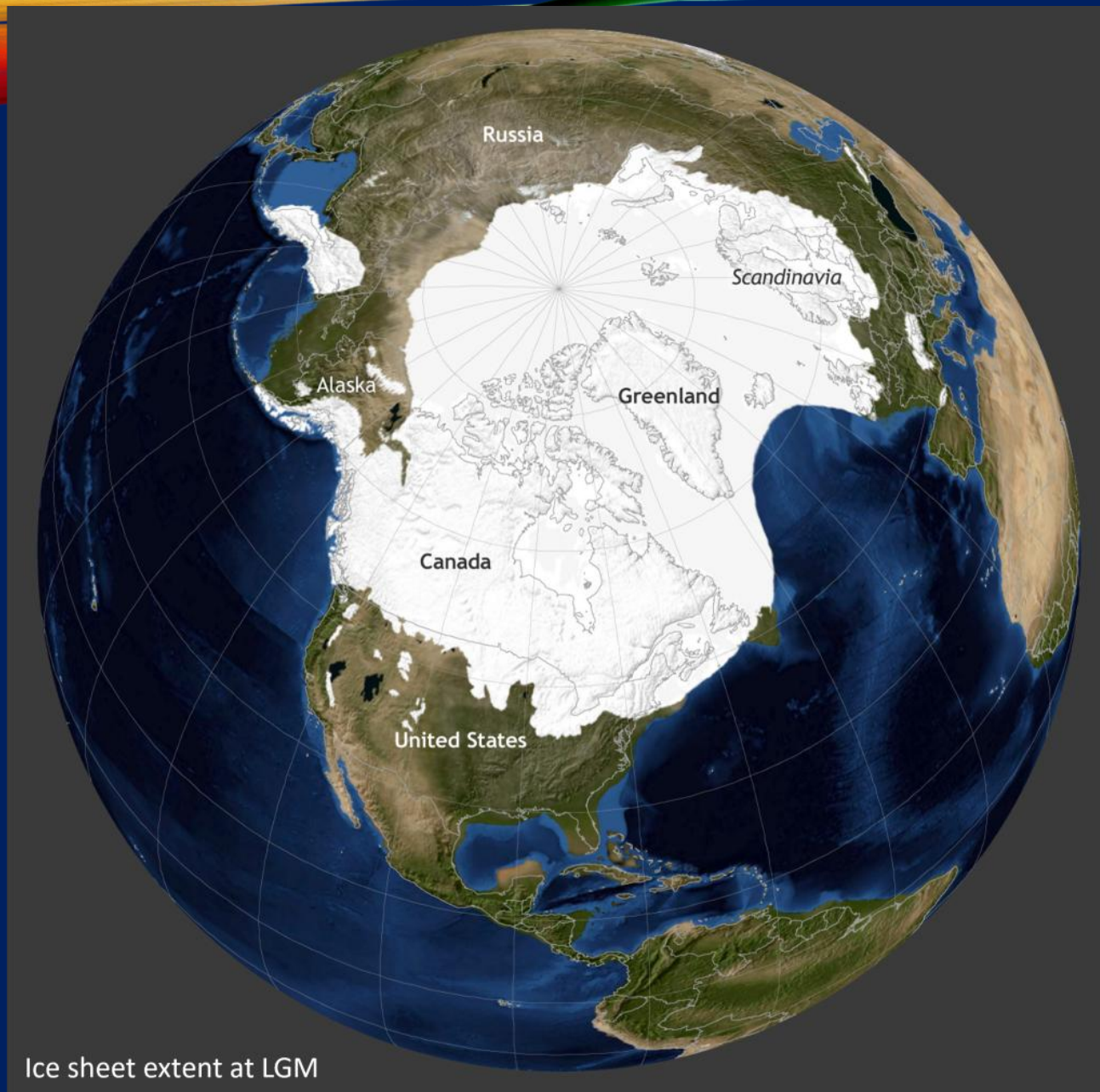
Survivors of Changing Environment.pdf

Dr. Rick Potts talks about his research on early human adaptability to climate change in Africa and China.

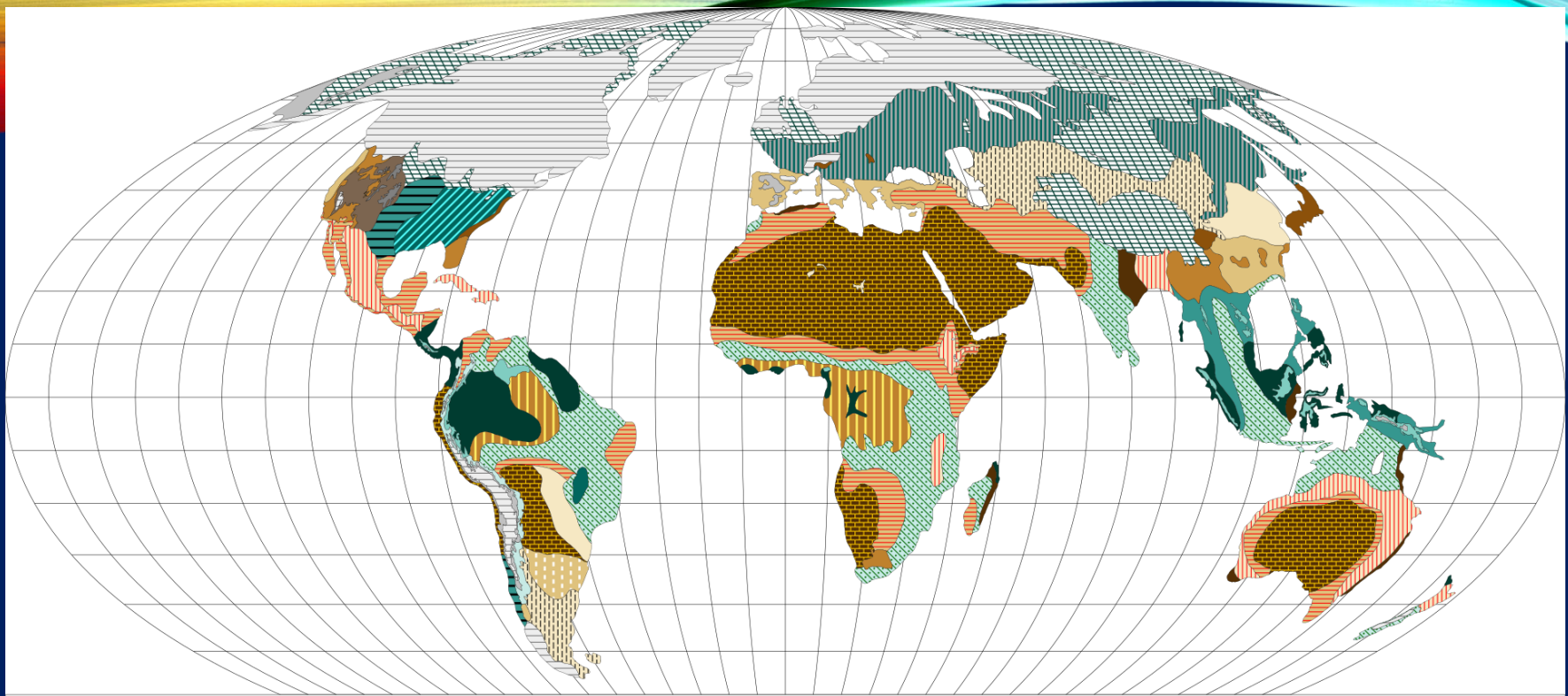
<https://humanorigins.si.edu/multimedia/videos/survivors-changing-environment>

The Last Glacial Maximum (26,000-20,000 years ago):

- Approximately 8% of Earth's surface was covered by ice.
- Global sea levels fell by about 125 meters compared to present levels creating **land bridges that do not exist today.**
- Average global temperatures were about 6 °C colder than today.
- Most regions experienced significant cooling and reduced moisture levels.
- Areas such as the Sahara Desert expanded, while rainforests, particularly in regions like West Africa, diminished significantly.
- Flora were greatly affected, with many regions seeing a shift from forests to grasslands and deserts.



Ice sheet extent at LGM



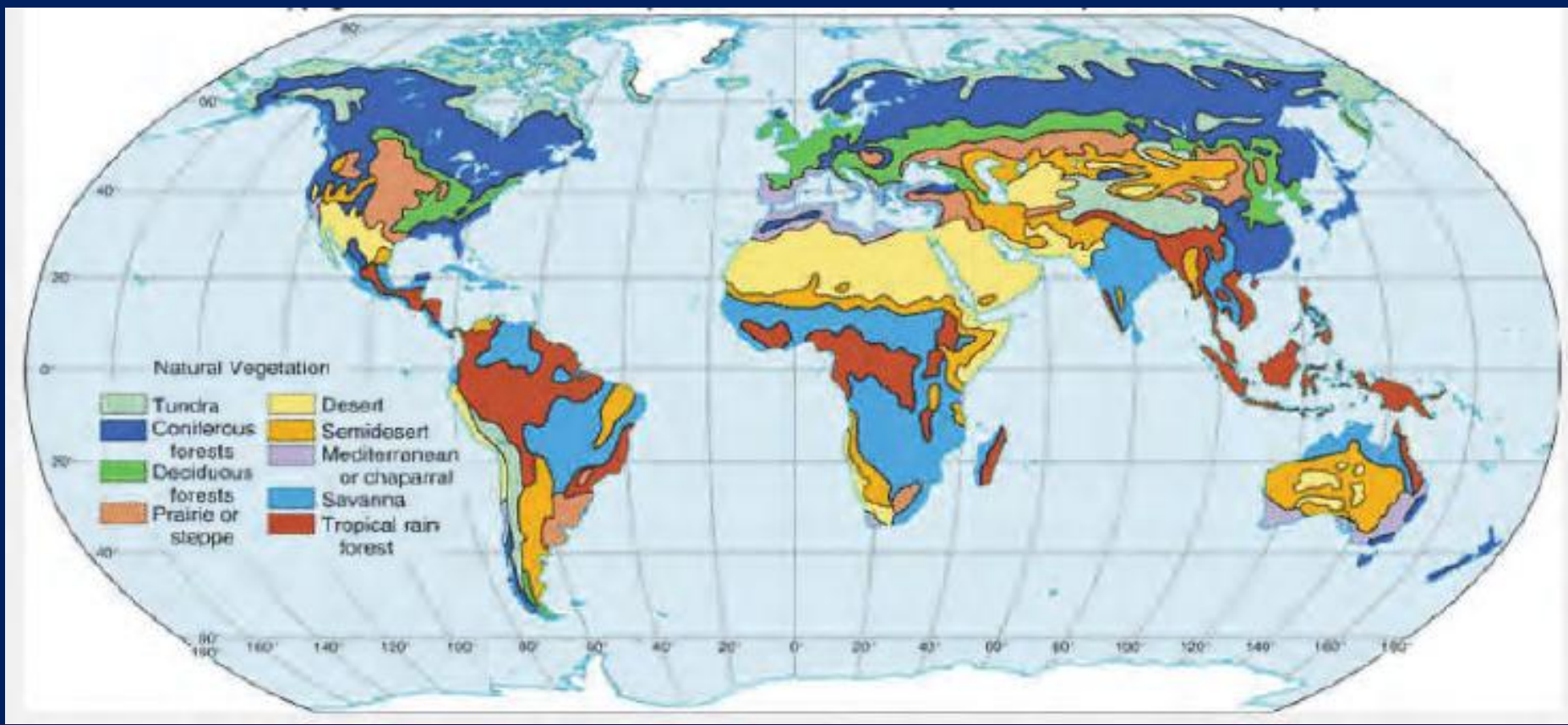
Last Glacial Maximum Vegetation



Source: http://intarch.ac.uk/journal/issue11/rayadams_toc.html

(CC BY 3.0)

By Locoluis - Map generated from shapefile published by Ray, N. and J. M. Adams. 2001, "A GIS-based Vegetation Map of the World at the Last Glacial Maximum (25,000-15,000 BP). Internet Archaeology 11." Source: http://intarch.ac.uk/journal/issue11/rayadams_toc.html, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=42569666>



Perhaps significant for the evolution of humans in Africa:

Greening of the Sahara Desert

- Tropical Africa has a monsoonal climate in which rainfall is driven by the temperature difference between the land and ocean, called the **West African Monsoon**.
 - Equatorial region has rainfall around 2000 mm/year resulting in rainforest
 - To the north are bands of savannah as the average rainfall decreases
 - The Sahara Desert – almost no vegetation apart from wadis and oases.
- However:
 - Records of early humans including rock art
 - Bones of animals such as buffalo, giraffes, hippos and crocodiles – some of which require year-round water.
- There appear to be **Green Sahara Periods** or **African Humid Periods**.
 - Most recent was 12,000 – 5,000 years ago and the cave art seems to date from this period.
 - Research suggests that there have been over 230 Green Sahara Periods in the last 8 million years.
 - The savannah moves northward by 1,000 km in weak events and up to 2,000 km in strong events.

The Greening of the Sahara: Past Changes and Future Implications

Francesco S.R. Pausata,^{1,*} Marco Gaetani,² Gabriele Messori,^{3,4} Alexis Berg,⁵ Danielle Maia de Souza,⁶ Rowan F. Sage,⁷ and Peter B. deMenocal⁸

¹Centre ESCER (Etude et la Simulation du Climat a; l'Echelle Regionale) and GEOTOP (Research Center on the Dynamics of the Earth System), Department of Earth and Atmospheric Sciences, University of Quebec in Montreal, Montreal, QC, Canada

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³Department of Earth Sciences, Uppsala University, Uppsala, Sweden

⁴Department of Meteorology and Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden

⁵Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA, USA

⁶Department of Strategy and Social and Environmental Responsibility, University of Quebec in Montreal, Montreal, QC, Canada

⁷Department of Ecology and Evolutionary Biology, University of Toronto, Toronto, ON, Canada

⁸Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY, USA

*Correspondence: pausata.francesco@uqam.ca

<https://doi.org/10.1016/j.oneear.2020.03.002>

<https://www.sciencedirect.com/science/article/pii/S2590332220301007#fig2>

“African Humid Periods (AHP) had important implications for the evolution and migration patterns of early humans. Some AHPs, such as the one during the last interglacial (128,000–122,000 years ago) experienced an increase in rainfall across northern Africa and the Arabian Peninsula, sufficient to establish a continuous “vegetated corridor” across today’s hyper-arid Sahara region.

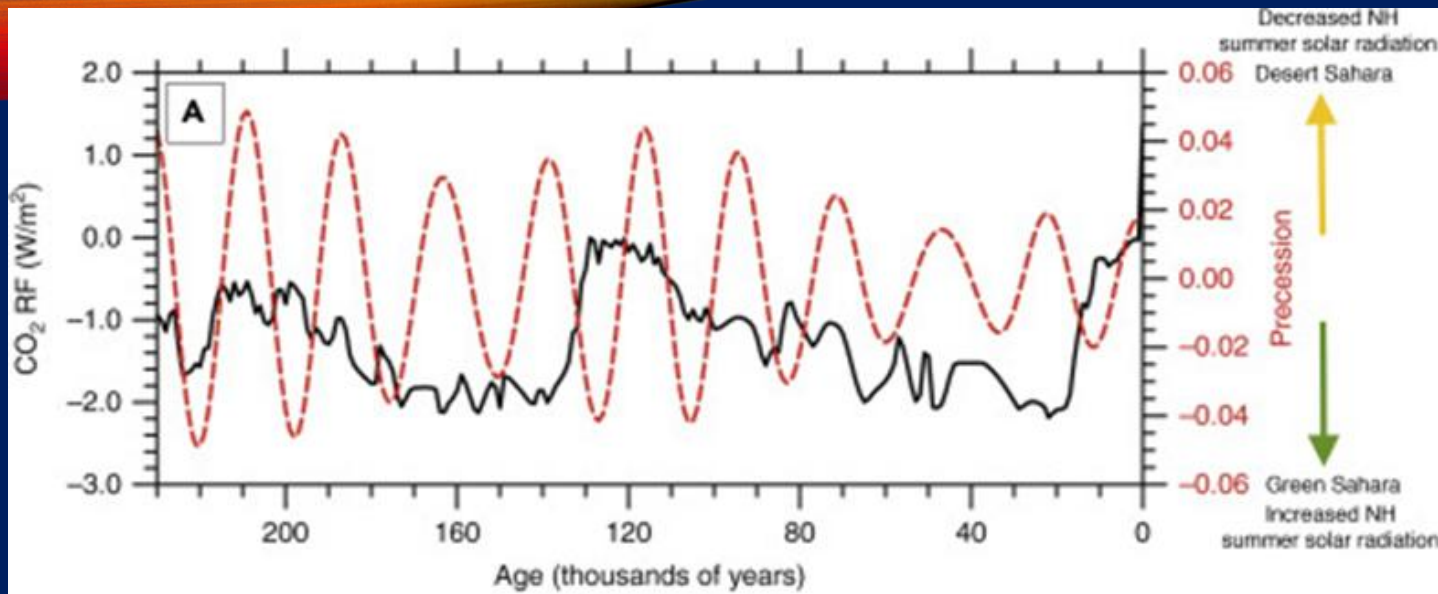
Such corridors have been proposed as plausible northward migration routes for archaic and anatomically modern humans out of Africa.”

What caused the African Human Periods:

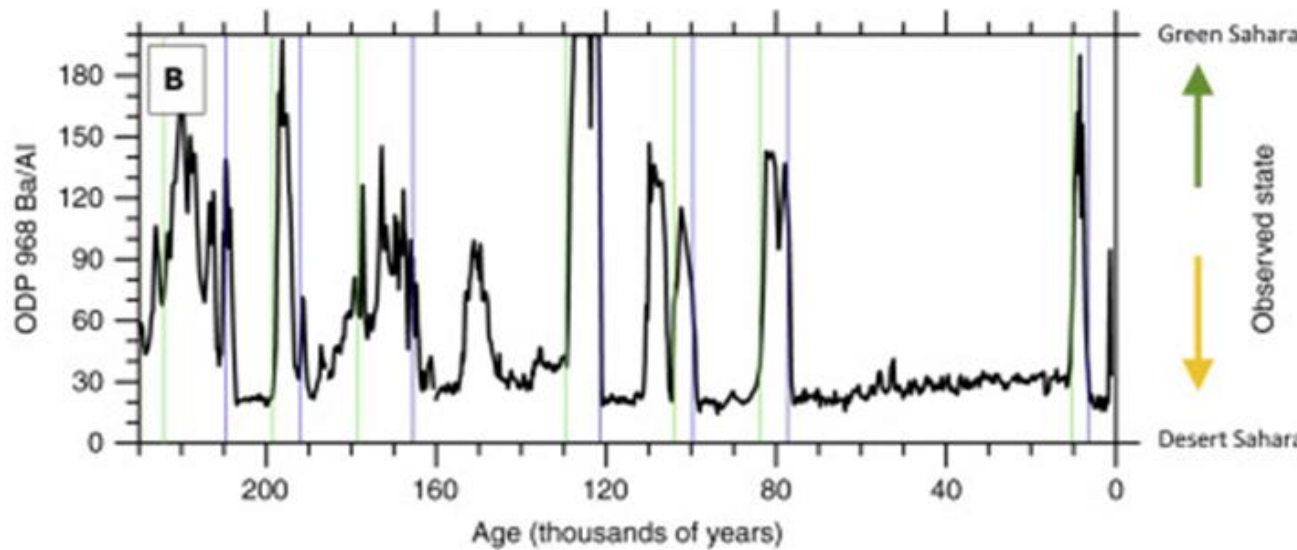
- Variations in how much solar energy is received over northern Africa due to changes in the earth's orbit (**Croll-Milankovic cycles**)
- a cycle of around 21,000 years due to precession of the earth's axis appears to be the main pace-maker
- the 100,000-year cycle of eccentricity (ellipticity) modulates how intense the variations are
- Each event had a peak lasting 4 – 8,000 years and faded away in 2-3,000 years
- Evidence of abrupt local changes – one or two centuries.

The variations in energy from the sun are too small on their own and need feedback mechanisms:

- Extra vegetation due to higher rainfall is darker than desert and so absorbs more solar energy, heating the land further
- Ice-reflectivity feedback
- interrelated but distant effects such as changes on sea surface temperature in the Atlantic, or ENSO events in the Pacific.



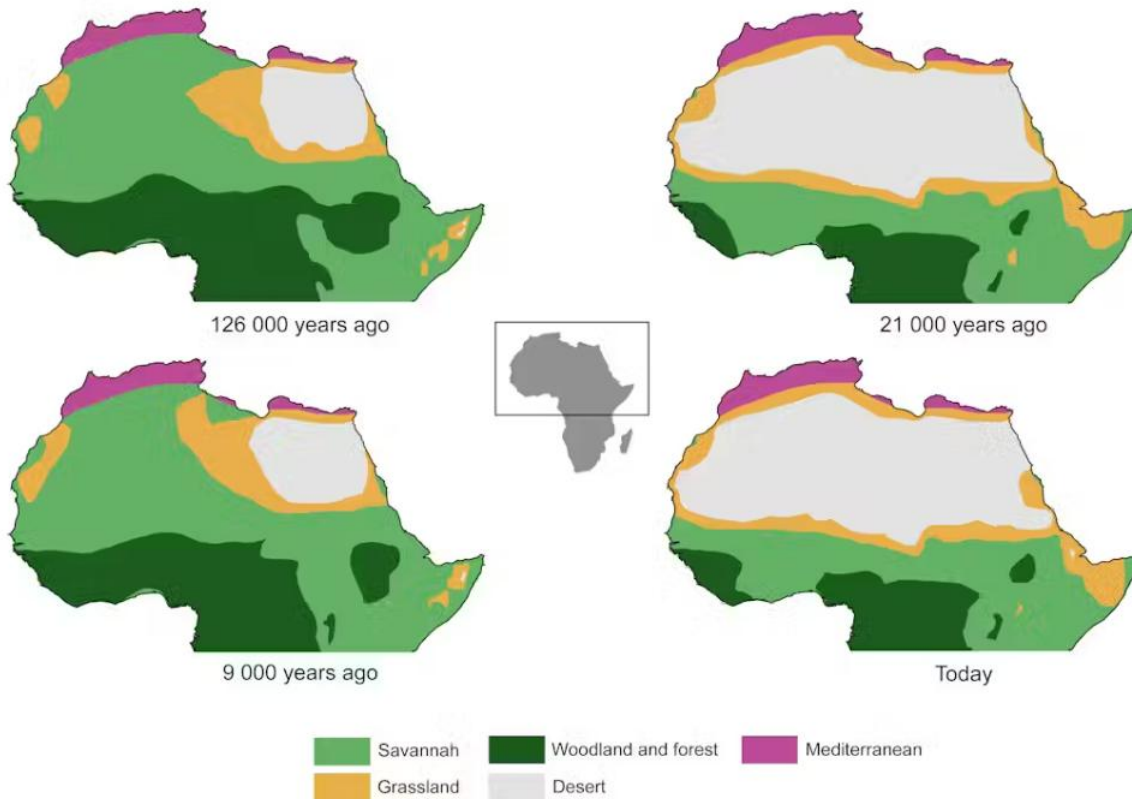
A. Variations in Precession (red line). Low values favour a Green Sahara due to increased solar radiation in the northern hemisphere.



B. A proxy measurement of the West African Monsoon.

F.S.R. Pausata et al. 2020

<https://www.sciencedirect.com/science/article/pii/S2590332220301007#fig2>



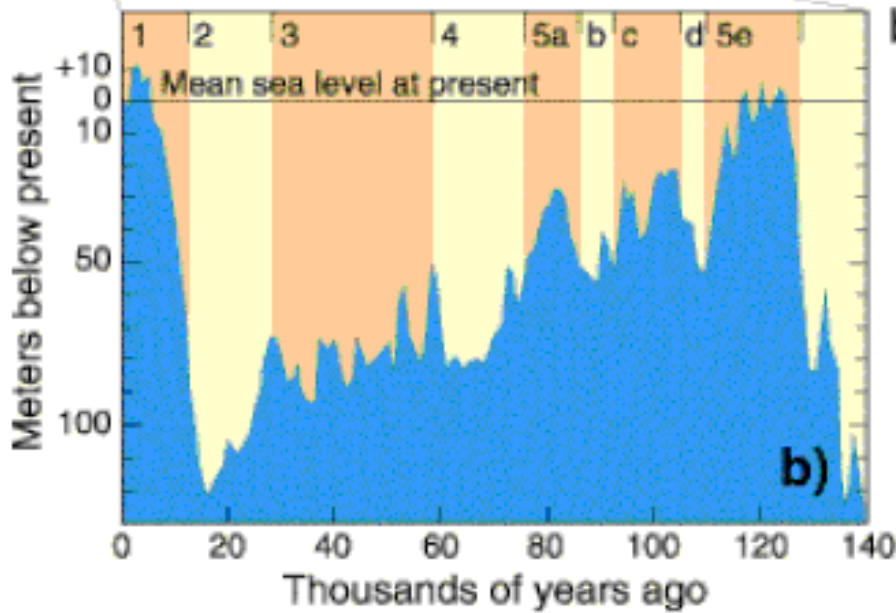
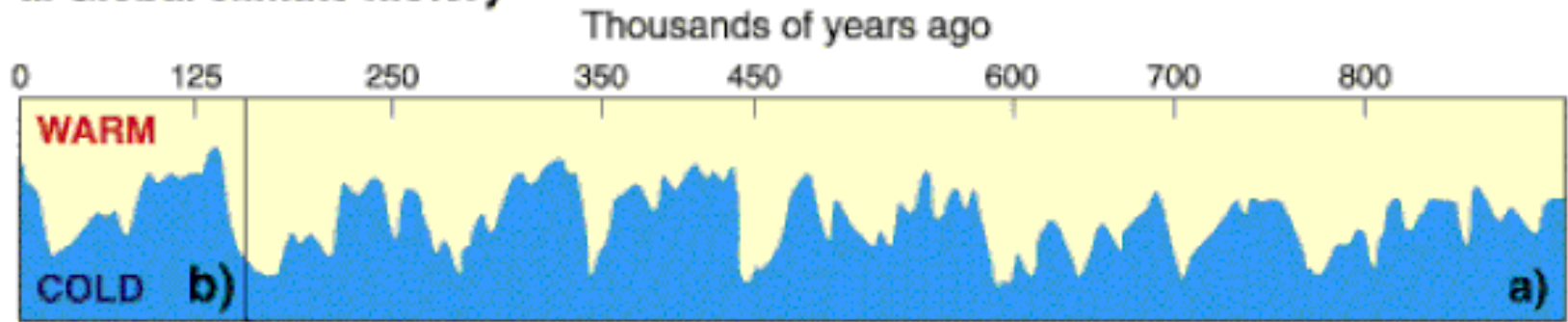
Implications of Green Sahara Periods for hominin evolution :

- Opportunities for expansion followed by crises associated with return of desert conditions may have shaped evolution
- Ending of the green periods may have led to habitat fragmentation and isolating small populations (conducive to genetic drift or extinction)
- Easier movement of humans and animals from East Africa to North Africa
- Easier paths for migration to Eurasia.

Questions and Speculation

- Did the move to the grasslands change the diet of the hominids from Vegetarian to meat-eaters hunting on the plain?
- Did the migration streams from Africa “turn right” due to the cold climate and ice sheets in Europe and only migrate to Europe later?
- Did the Ice Ages in Europe fragment the remaining Neanderthals to non-viable size?
- Chimpanzees have not changed – why us?
- Did agriculture (land clearing, burning, over-grazing) affect the climate?
 - Charney mechanism for the Sahel drought in the 1960s-1970s.

a. Global climate history



b. Late Quaternary sea-level history

Sea Level Changes

Creation of major land bridges due to lower sea level.

- Bering Strait – connecting Russia and Alaska
- North of Australia – and Bass Strait.

DOGGERLAND

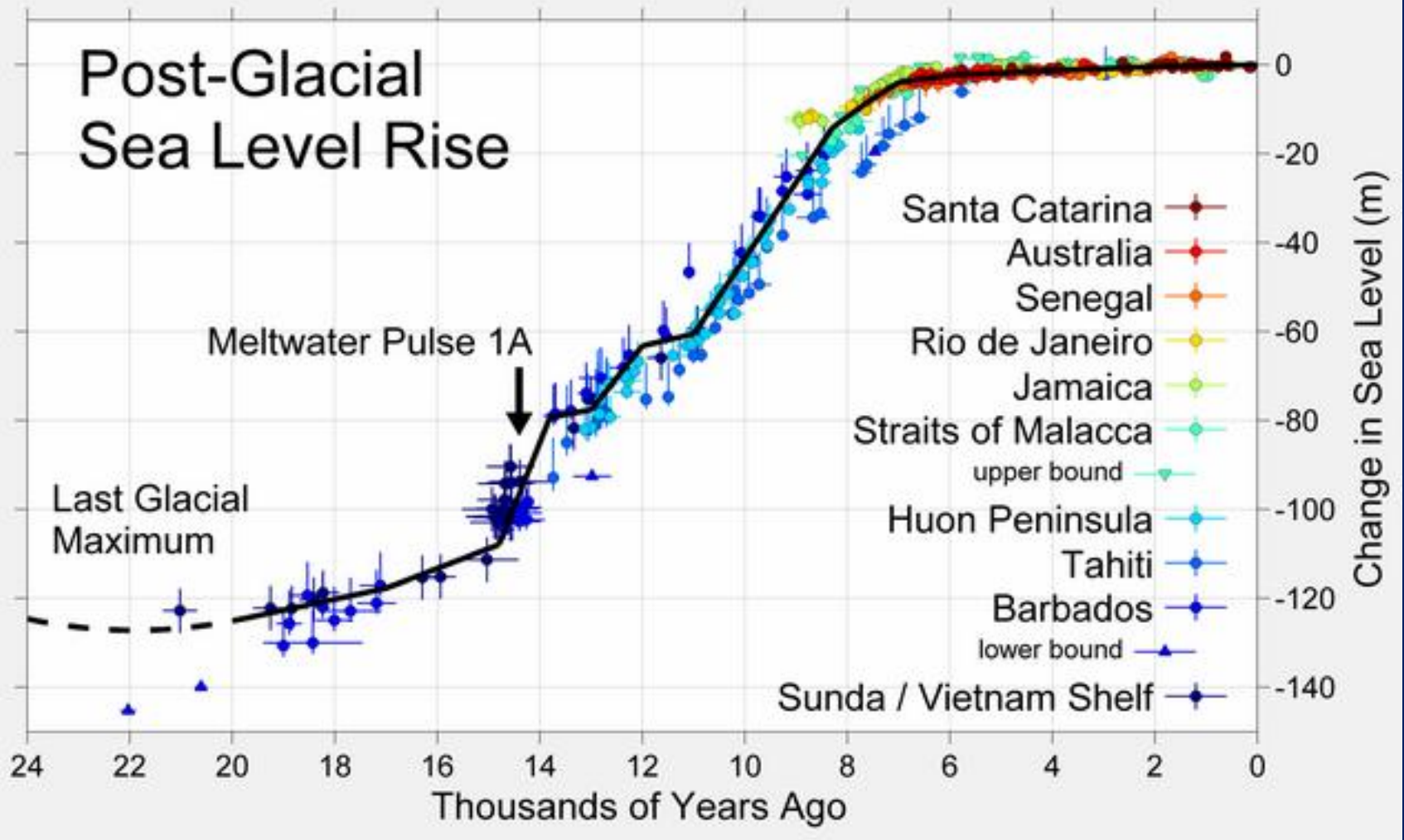
Earlier Holocene



**UK and NW Europe
at the end of the
Ice Age.**

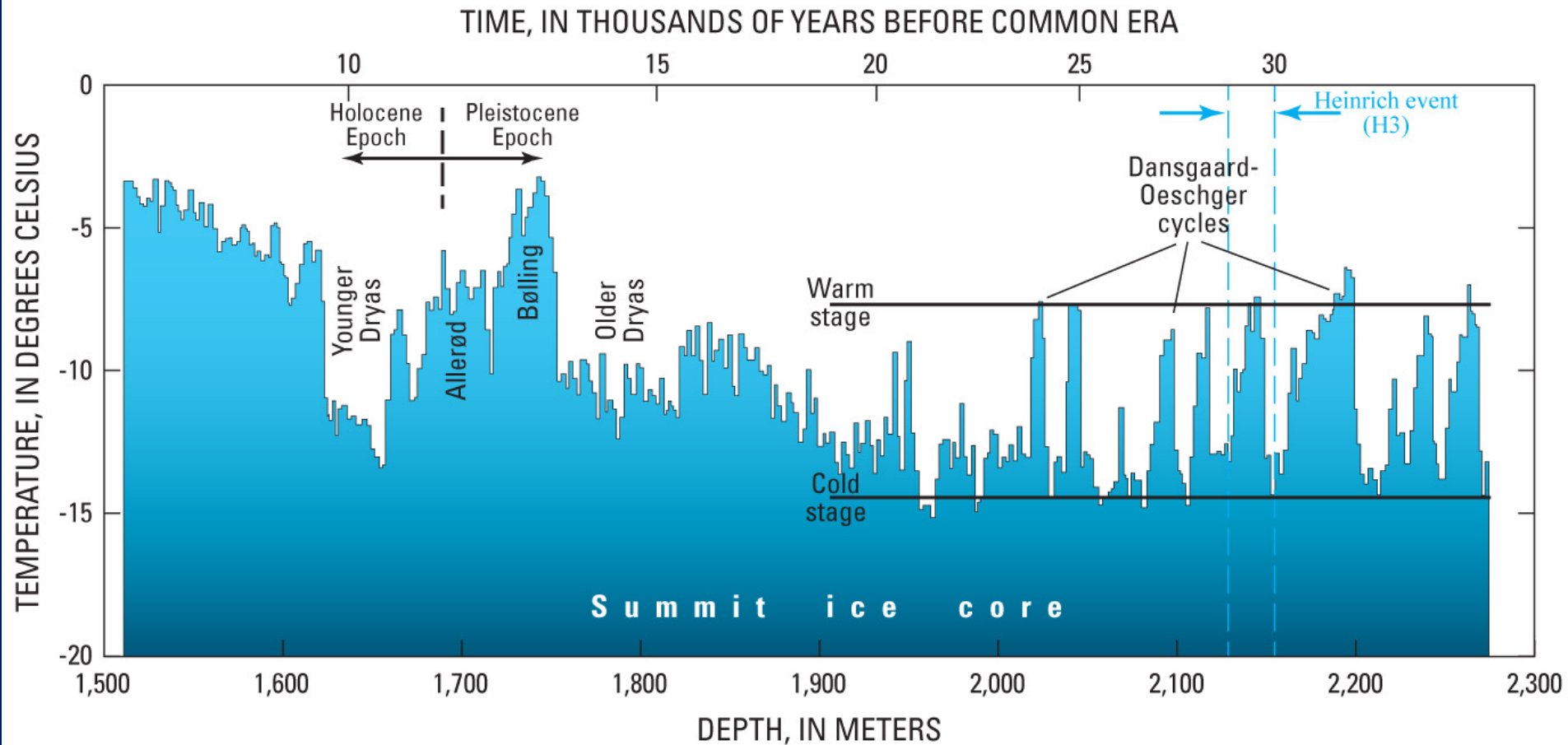
English Channel
formed in the early
Holocene as sea
levels rose.

Human artefacts
and Mammoth
skulls, tusks and
bones found on the
seabed in the
English Channel.



- Sea level rise – 120 m in about 12 thousand years (i.e. about 1 metre/Century)
- Some faster rates based on analysis of coral reefs:
 - Meltwater Pulse 1A about 14.5 Ka – 13.5 m in 300 years (4.5 m/century).

There was a sudden cool period (12,900 – 11,700 ya) evident in the Greenland ice core. This is called the Younger Dryas and occurred about the same time as the development of agriculture – coincidence?.



Holocene: “entirely new”

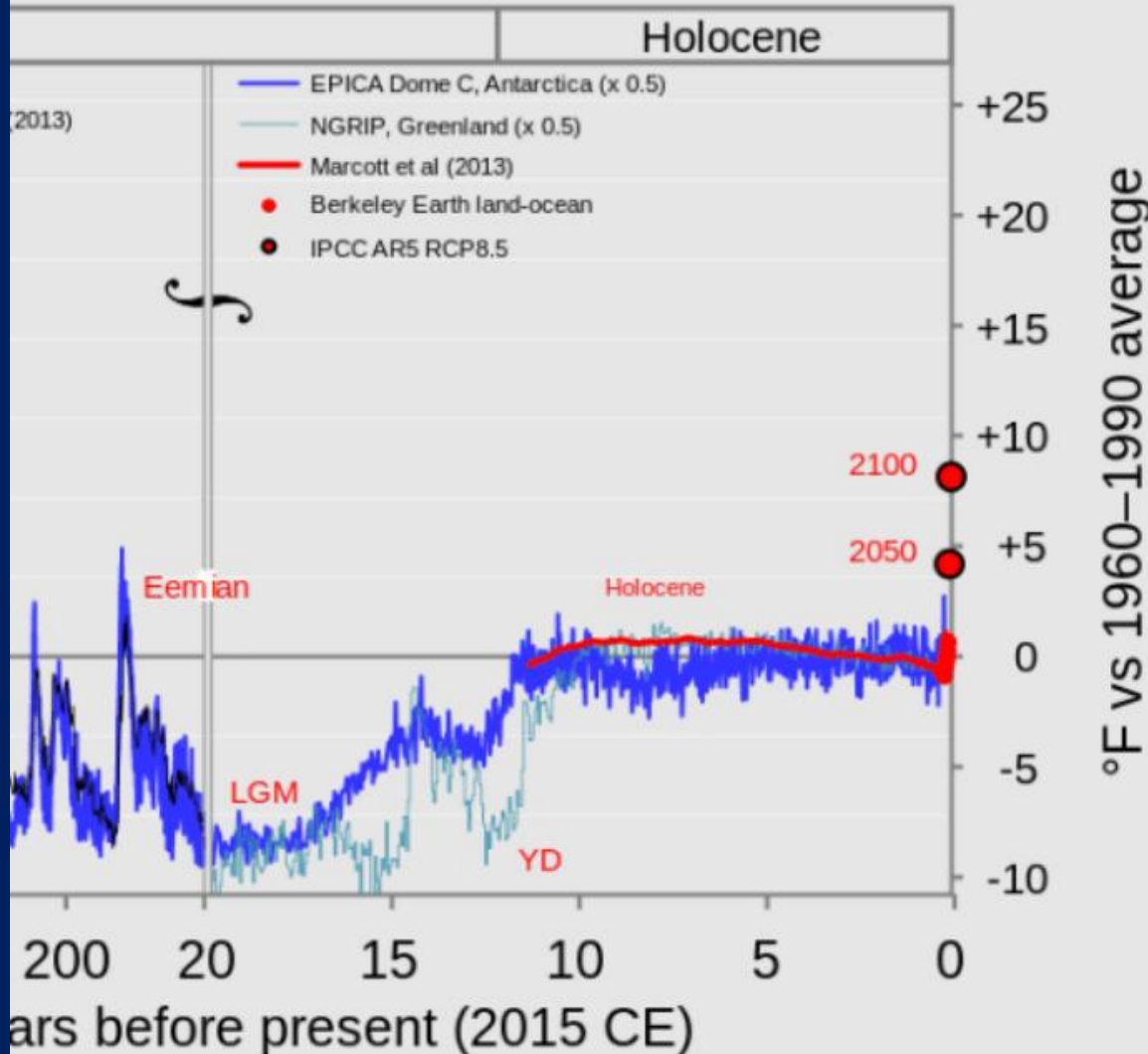
Although the graph looks quite flat there were some variations.

Note the difference in the temperature measurements from Antarctica (dark blue) and Greenland (teal).

9,000 -5,500 ya

Holocene Climatic Optimum

- Global temperatures about 0.7 °C warmer than typical for the Holocene
- polar regions about 4 °C warmer
- North America and Europe about 2 °C warmer.



Possible short-term catastrophes:

(a) Volcanic eruptions – causing layers of dust and aerosols in the atmosphere which can lead to cooler temperatures.

Lake Toba (Sumatra) around 74,000 yeas ago.

- Largest known eruption on earth for at least 25 million years. In some estimates the eruption caused a severe global volcanic winter of six to ten years and contributed to a 1,000-year-long cooling episode. However, it is hard to detect that among the many other temperature variations.
- The air-fall of this eruption blanketed the Central Indian Ocean Basin in 10 cm of ash and the Indian subcontinent in a layer of 5 cm ash.
- *Some genetic studies suggest that the Toba catastrophe nearly wiped out the human race with only about 1,000 to 10,000 breeding pairs of people surviving. Some animals also experienced population crashes around the same time and there were significant impacts on vegetation.*
- https://en.wikipedia.org/wiki/Youngest_Toba_eruption#Toba_catastrophe_theory



- However, other research shows continuity of archaeological evidence across the ash layer and points out that the Denisovans and Neanderthals survived through the event also.
- So, there may have been some adaptation required, but perhaps not the severe genetic bottleneck.



Lake Toba

December 1971







Possible short-term catastrophes:

(b) Magnetic pole reversals (Wikipedia)

The direction of the earth's magnetic field has changed around 183 times in the last 83 million years (on average every 450,000 years).

Laschamps event, also termed the Adams event, was a **geomagnetic excursion** (a short reversal of the Earth's magnetic field) that occurred between 42,200 and 41,500 years ago, during the Last Glacial Period.

- during the transition, Earth's magnetic field declined to a minimum of 5% of its current strength.
- It was reversed for about 440 years at about 25% strength.
- geomagnetic anomalies found in lava flows near Clermont-Ferrand, France in the 1960s
- radiocarbon dating of a fossilized kauri log found in a swamp in 2019 and dating back more than 42,000 years.

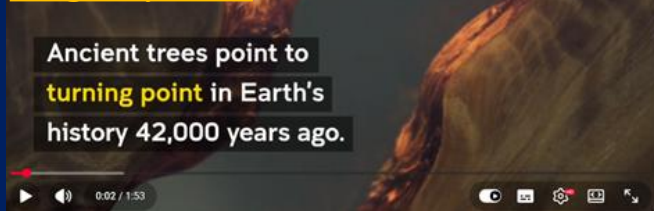
The magnetic field normally deflects high-energy charged particles from the solar wind and cosmic rays.

When it weakens, more of these particles penetrate deeper into the atmosphere and break apart molecules in the upper atmosphere and generate reactive compounds that destroy ozone.

Some researchers claim that there were major climate impacts.

e.g. UNSW study:

<https://www.youtube.com/watch?v=NSiq4MyLQ0o>



They claim that the loss of the geomagnetic shield contributed to the extinction of Australian megafauna, the extinction of the Neanderthals and the appearance of cave art.

APRIL 10, 2025

Earth's magnetic pole shift: Sunscreen, clothes and caves may have helped Homo sapiens survive 41,000 years ago

by University of Michigan

✓ Editors' notes

The GIST Add as preferred source



Credit: CC0 Public Domain

Ancient Homo sapiens may have benefited from sunscreen, tailored clothes and the use of caves during the shifting of the magnetic North Pole over Europe about 41,000 years ago, new University of Michigan research shows.

“Around the same time, Homo sapiens appear to have started making tailored clothing and using ochre, a mineral that has sun-protective properties when applied to the skin, with greater frequency.... Neanderthals, on the other hand, appear to have lacked these technologies and disappeared around 40,000 years ago”.

Counter arguments:

The Neanderthals and Denisovans may have lived later than 42,000 years ago.

Others are sceptical.

<https://www.science.org/doi/10.1126/science.371.6531.766>

<https://phys.org/news/2025-04-earth-magnetic-pole-shift-sunscreen.html>

Useful references:

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