



Past and Future Climate – Present Weather

Week 10

Climate episodes in the last few millennia

Terry Hart

Dates

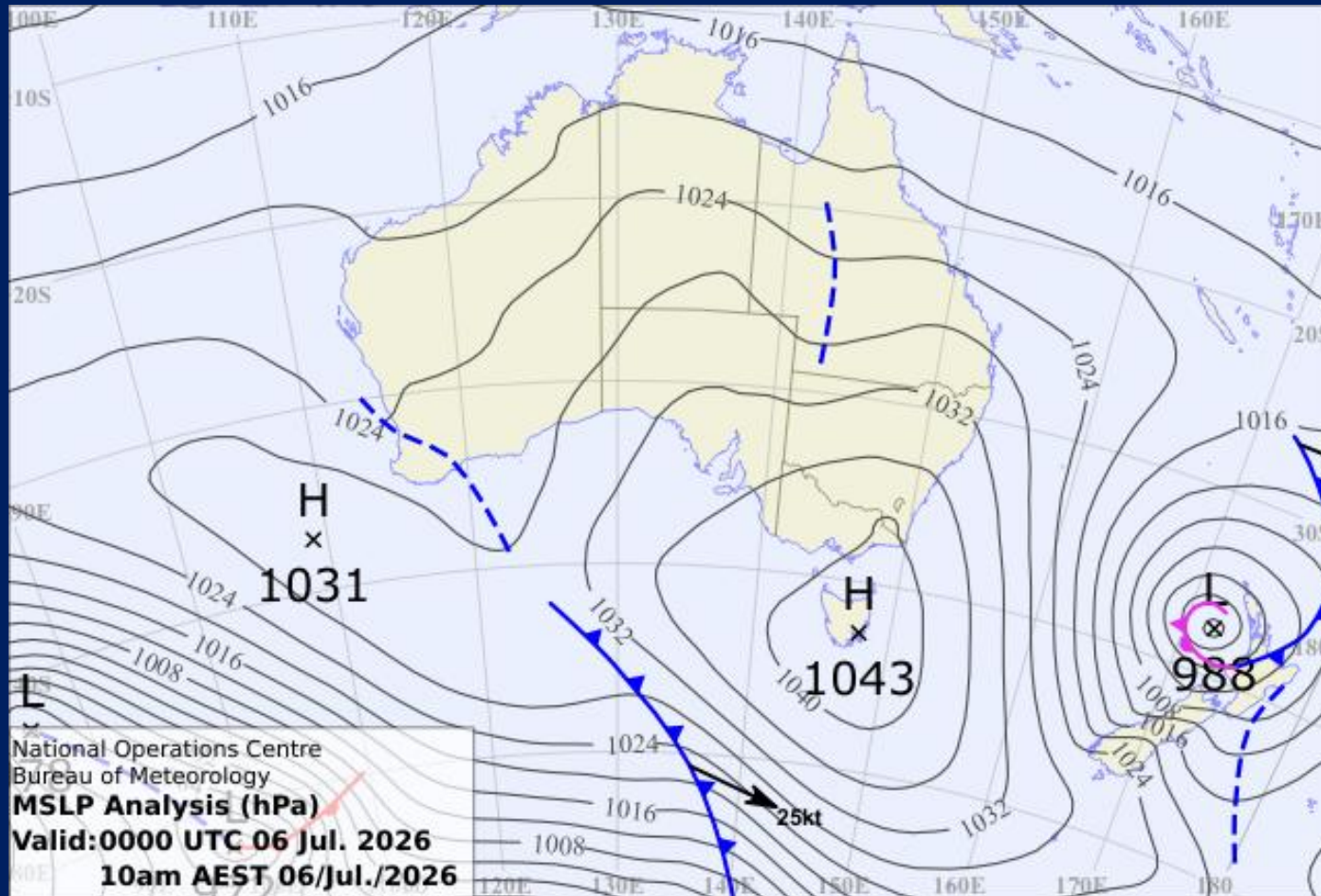
Term 3

23 July	The last few thousand years
6 August	Carbon dioxide and climate
20 August	TBA
3 September	Away
17 September	Away

Suggestions for 2027?

New all-time Australian air pressure record under intense winter weather system

By ABC meteorologist Tom Saunders



“At 9:50am, the weather station in the small town of Ouse, 67 kilometres north-west of Hobart, recorded an air pressure of 1044.5 hectopascals — exceeding the previous national record of 1,044.3hPa at Launceston on June 7, 1967.”

Heat Dome Broils the Western U.S.

IMAGE OF THE DAY FOR JULY 15, 2026

A ridge of high pressure fueled record-breaking temperatures in Montana, Utah, and Wyoming on July 12, 2026.

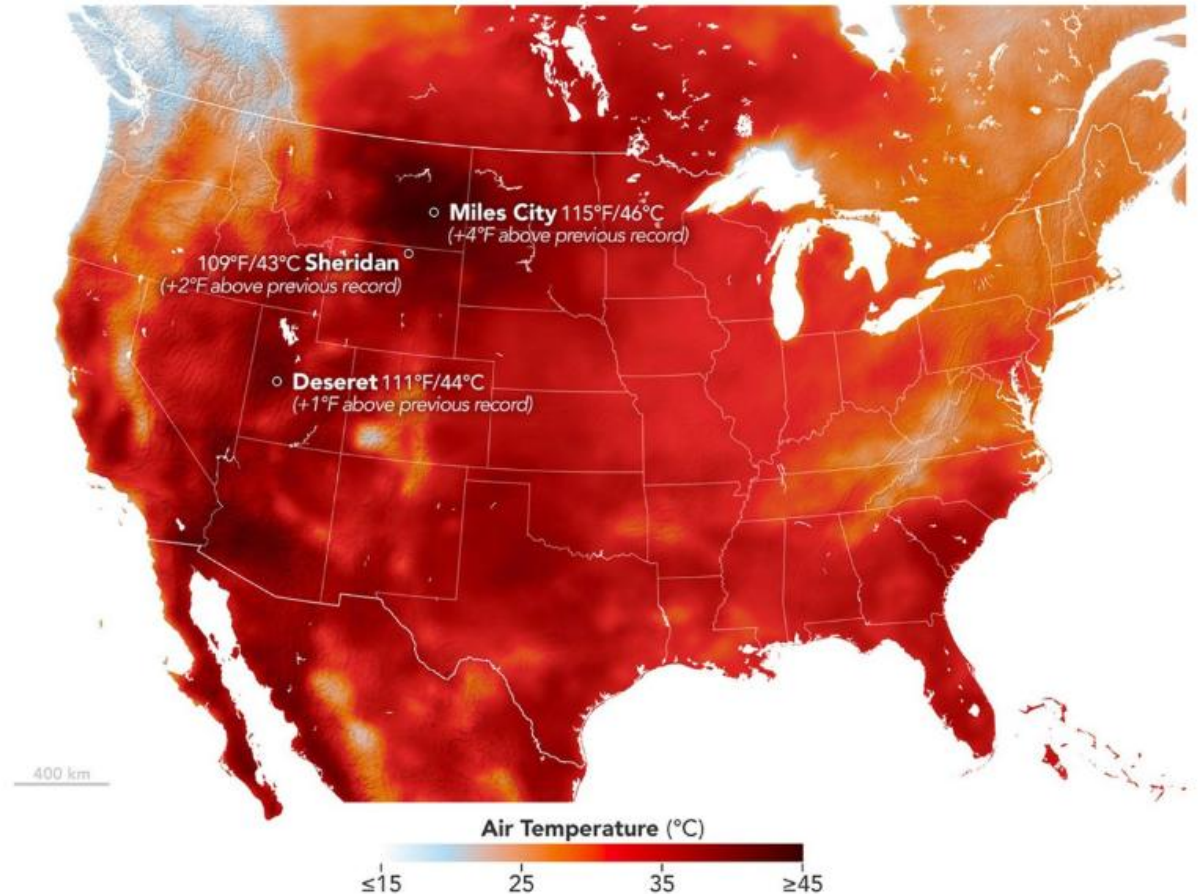
NASA Earth Observatory

JUL 15, 2026

ARTICLE



VIEW MORE IMAGES OF THE DAY:



Temperatures soared in the Western U.S. on July 12, 2026, as shown in this map of modeled air temperatures from the [GEOS](#) (Goddard Earth Observing System). Numerous weather stations in Montana, Utah, and Wyoming recorded their highest temperatures since record-keeping began.
NASA Earth Observatory/Michala Garrison

<https://science.nasa.gov/earth/earth-observatory/heat-dome-broils-the-western-u-s/>

Temperature Forecast Analysis for Summer 2025-26

July 2026

Figure 2 Weekday maximum daily estimated operational demand against maximum dry bulb temperature (left) and the percentage change in operational demand for a 1°C under-forecasting error (right) for each NEM and WEM region

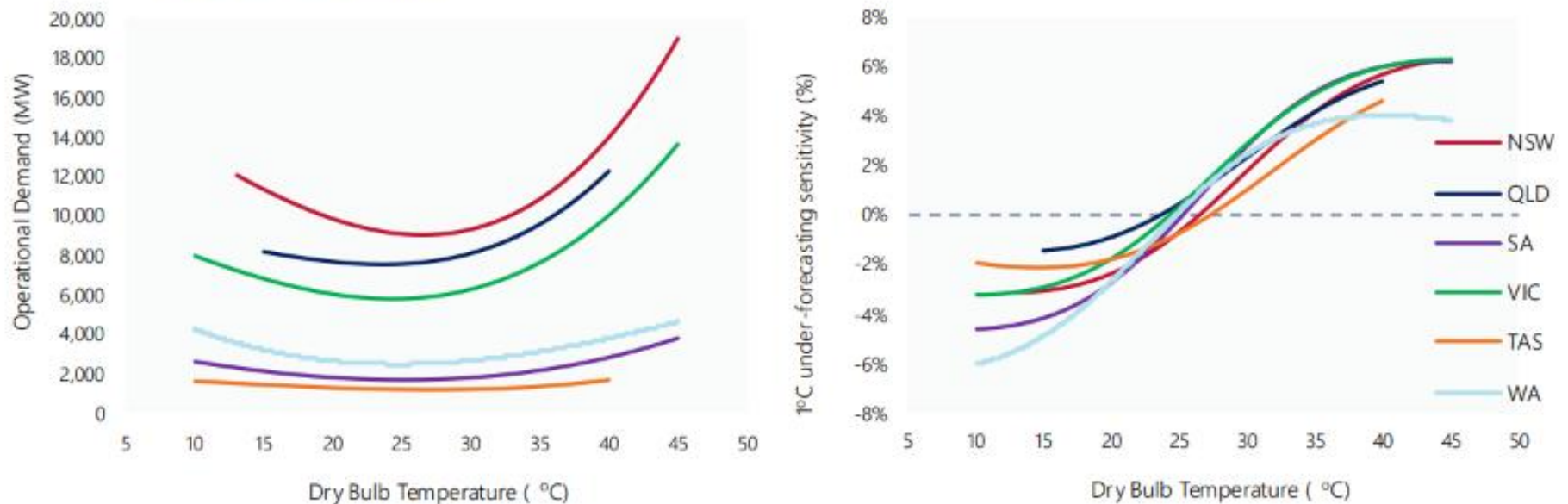
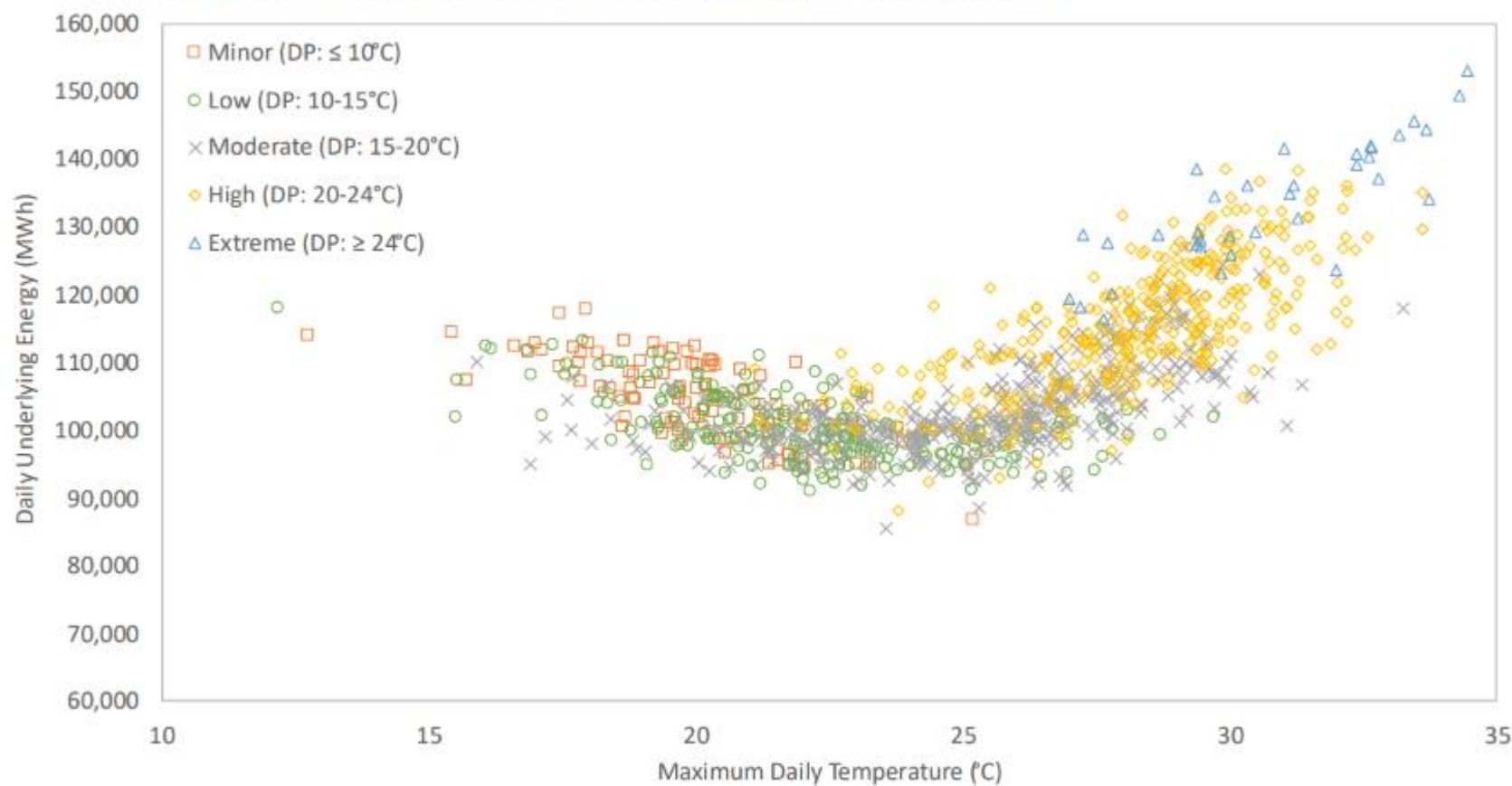


Figure 6 Weekday maximum underlying daily energy against maximum daily dry bulb temperature for different dew point buckets for southern Queensland from 2021 to March 2026



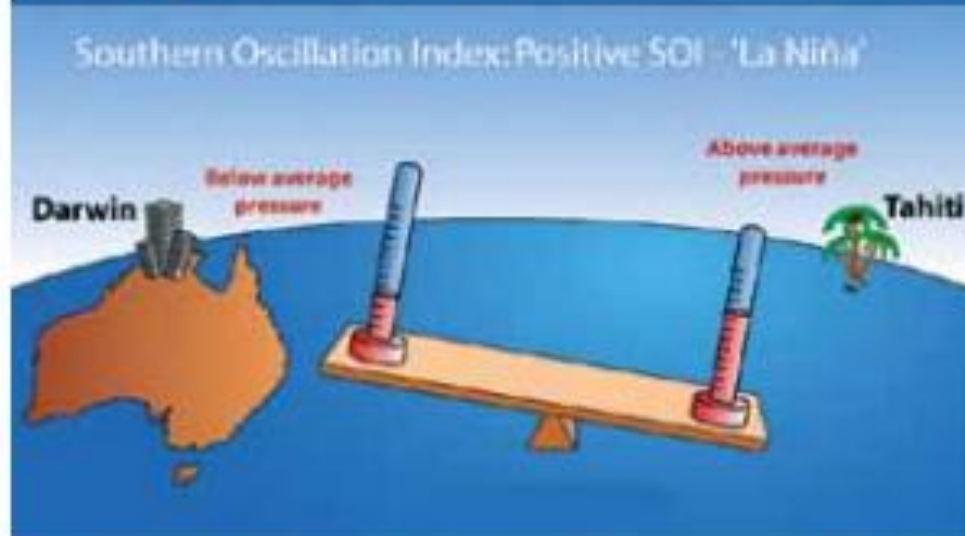
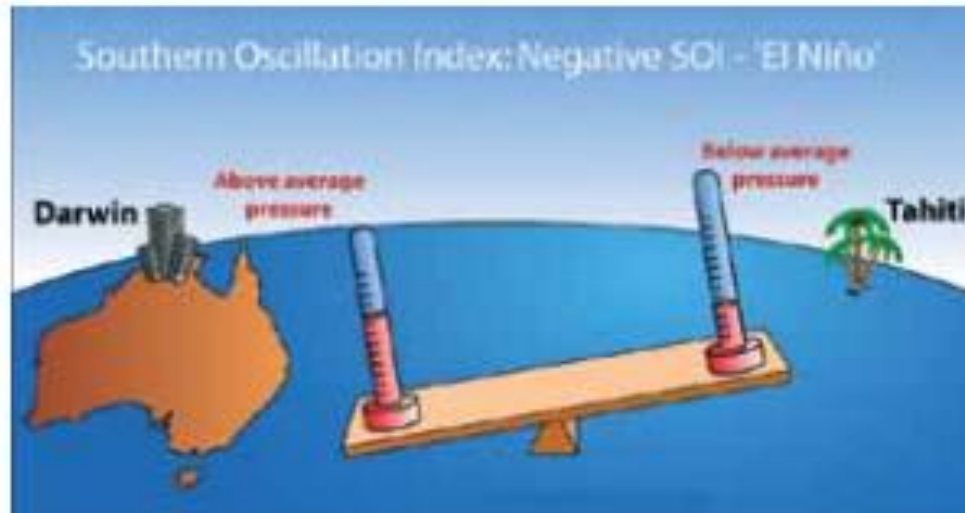


Figure 3.1. The Southern Oscillation is a see-saw of atmospheric pressure between the Indonesian region and the east equatorial Pacific.



Southern Oscillation Index:

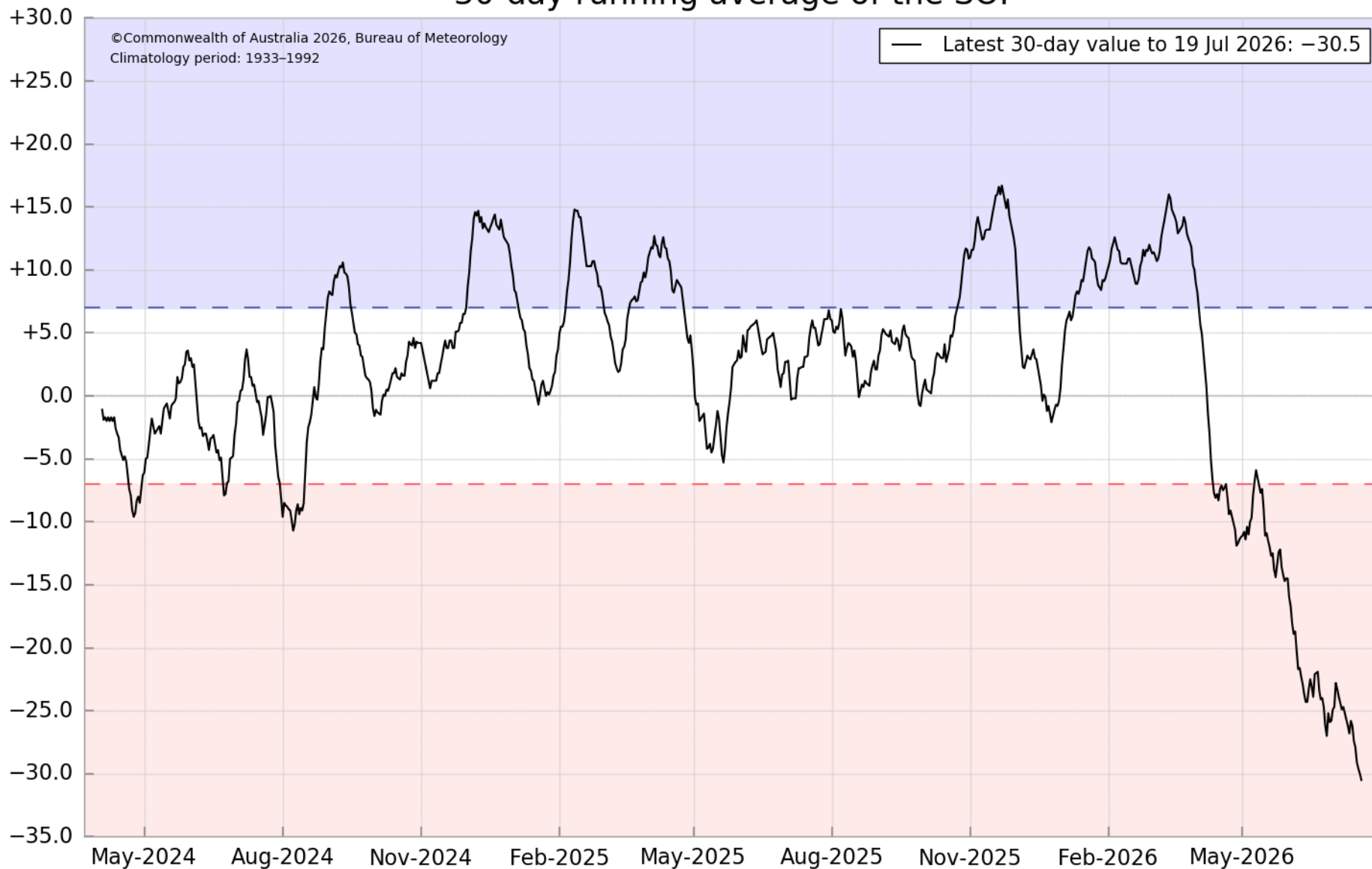
Tahiti (Papa'ete): $17^{\circ}40' \text{ S } 149^{\circ}25' \text{ W}$

Darwin: $12^{\circ}28' \text{ S } 130^{\circ}51' \text{ W}$

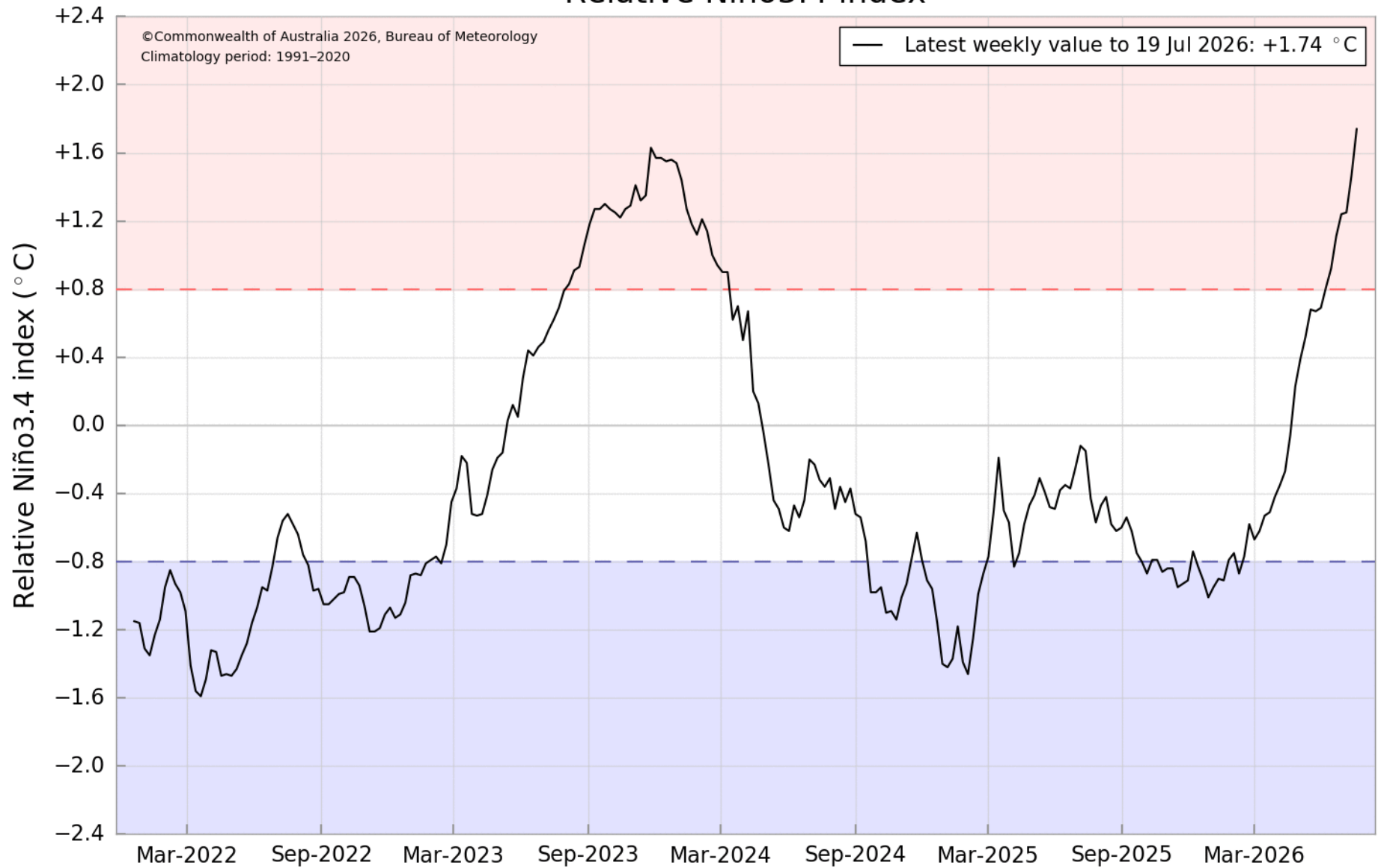
Sea Surface Temperature Indices:

The Bureau cites sustained monthly Niño3 or Niño3.4 values above $+0.8^{\circ}\text{C}$ as being associated with El Niño, and values below -0.8°C being associated with La Niña.

30-day running average of the SOI



Relative Niño3.4 index



El Niño declared by BOM and it could become the strongest on record

By ABC meteorologist Tom Saunders

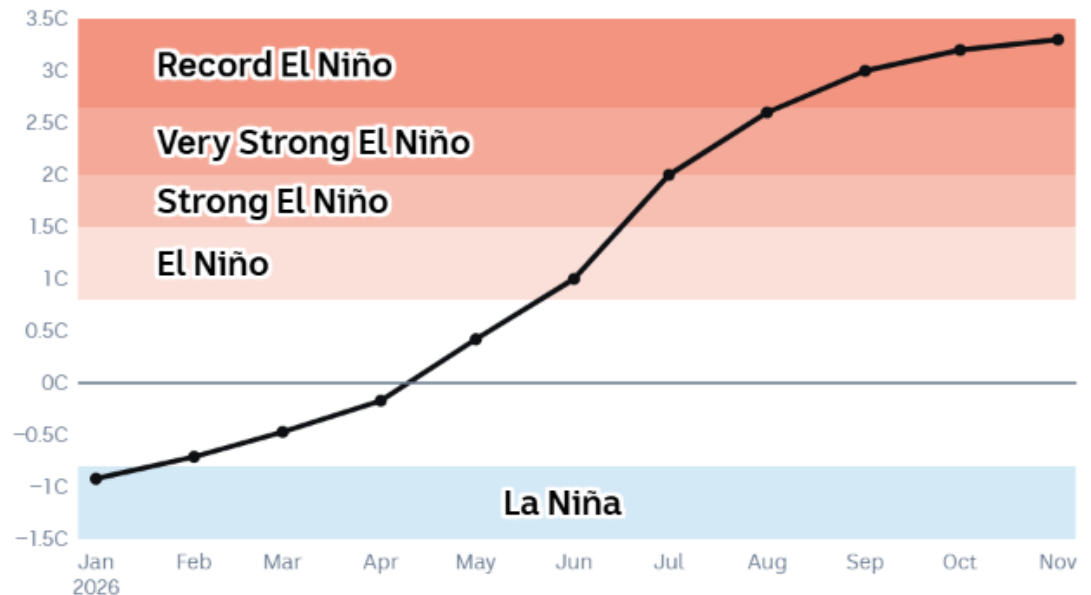
Weather Forecasts

4h ago

The BOM's seasonal model, called ACCESS-S, is tipping an all-time record later in the year with a peak warming in excess of 3C above normal, comfortably above the previous post-1900 high of 2.65C from November 1902.

NINO3.4 Analysis and Forecast

Analysis to June, ACCESS-S model from July



Forecast mean of 99 member ensemble

Source: BOM

Thankfully though for Australia, there is only a very weak relationship between the strength of the Pacific warm signal and the local impacts, so a record event does not mean a record drought.

<https://www.abc.net.au/news/2026-06-16/nsw-bureau-of-meteorology-declares-el-nino-weather/106776598>



Long-range forecasts – weeks, months and seasons

Issued Thursdays, one and two week forecasts issued daily

Archive

Download

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Overview – Climate indicators



Overview



Summary



Climate indicators



Video



Rainfall



Temperature



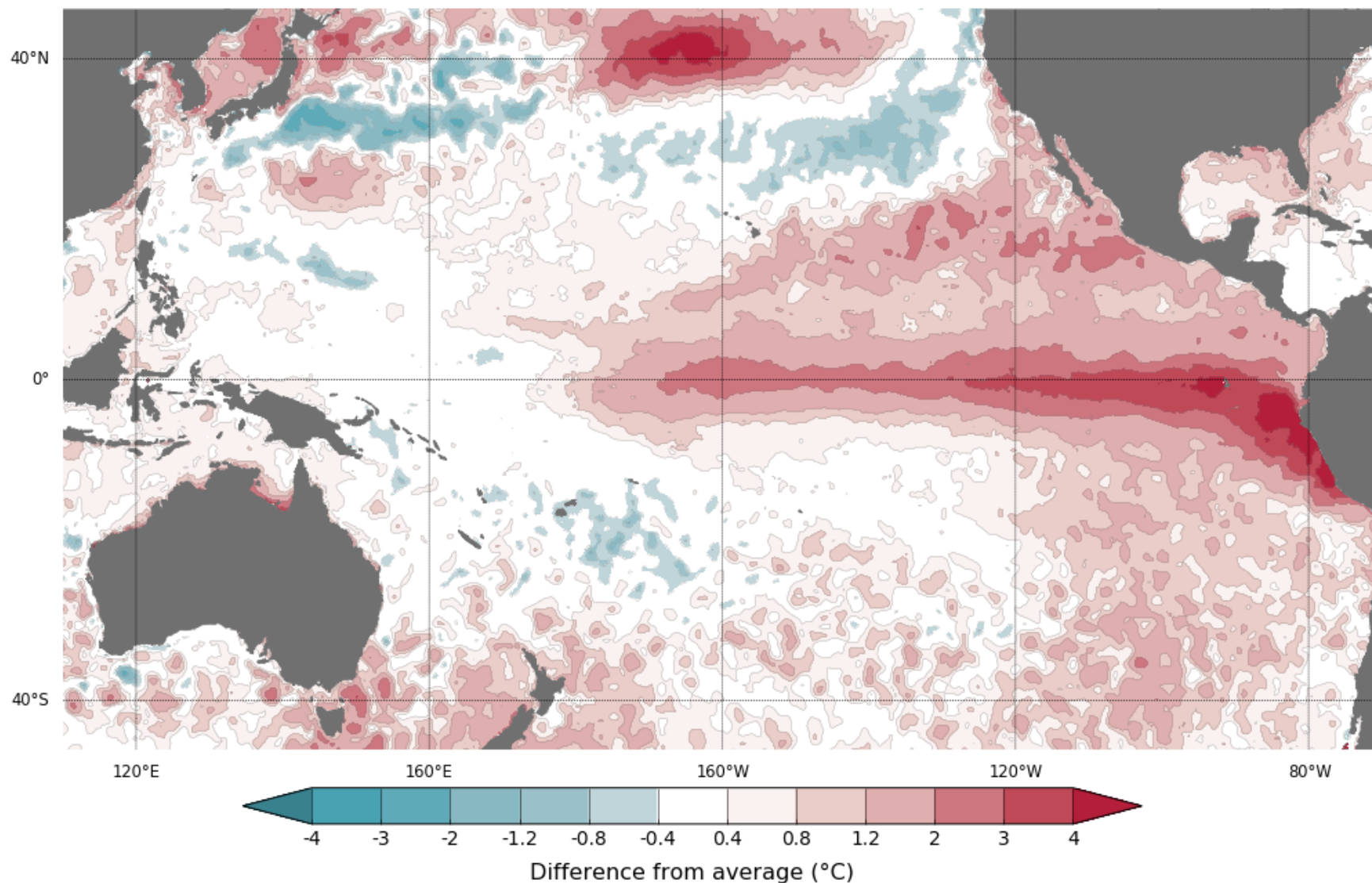
We use our long-range model, ACCESS-S, to forecast up to four months ahead. It simulates how the atmosphere and oceans may change, using millions of observations from satellites, land stations, and ocean instruments.

We also track global climate indicators to help understand long-term weather patterns. These mainly reflect how the ocean and atmosphere interact.

Current climate indicators:

- El Niño is underway. Sea surface temperatures (SSTs) in the central tropical Pacific are above El Niño thresholds, and atmospheric indicators are consistent with an established event. Ocean-atmospheric coupling (when the ocean and atmosphere act to reinforce the El Niño state) is likely to sustain El Niño through until at least summer.
- All models, including the Bureau's, forecast the tropical Pacific to continue warming into the southern hemisphere spring. Forecasts are pointing towards a strong to very strong El Niño event, based on the extent of warming in the central tropical Pacific. A strong El Niño signal in the Niño3.4 region does not necessarily mean strong impacts on Australia's climate; ENSO is only one of many factors that can influence Australia's seasonal weather and climate.
- The Indian Ocean Dipole (IOD) is neutral. Models suggest a positive IOD event is likely to develop over the southern hemisphere winter and persist into spring. However, there is large variation in the timing and strength of this potential event, with neutral IOD conditions also remaining a possible outcome.
- The Southern Annular Mode (SAM) index is trending back to neutral after a prolonged positive phase since late May. Long-term NOAA data shows the June monthly average was the second-highest on record for June and the fourth-highest for any month (since 1979).
- The SST analysis for the week ending 12 July 2026 shows waters are average to above average

Difference from average sea surface temperature observations 6 July to 12 July 2026

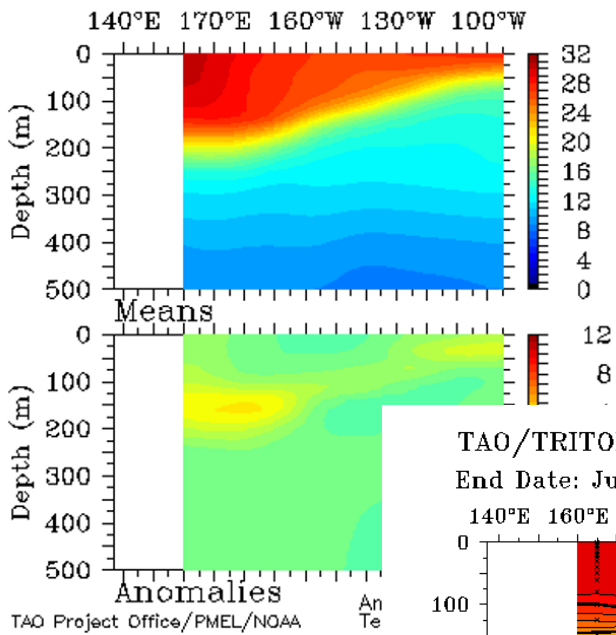


Data: GAMSSA SST
Climatology baseline: 1991 to 2020
© Commonwealth of Australia 2026, Australian Bureau of Meteorology

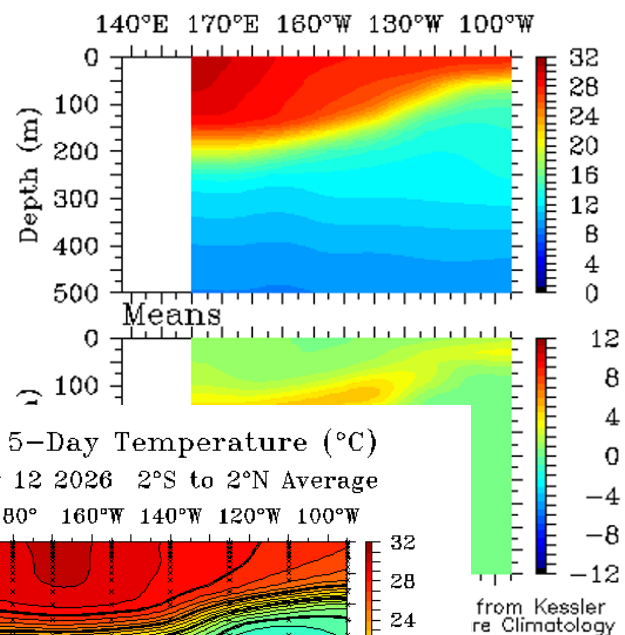
<http://www.bom.gov.au/climate>

Weekly average: 12 July 2026
Created: 13/07/2026

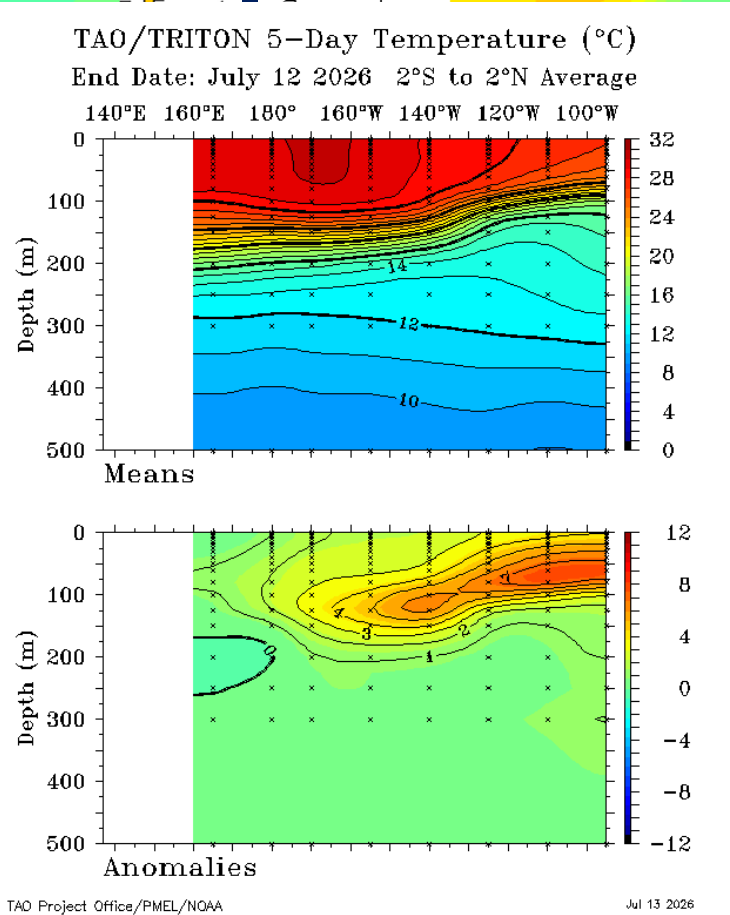
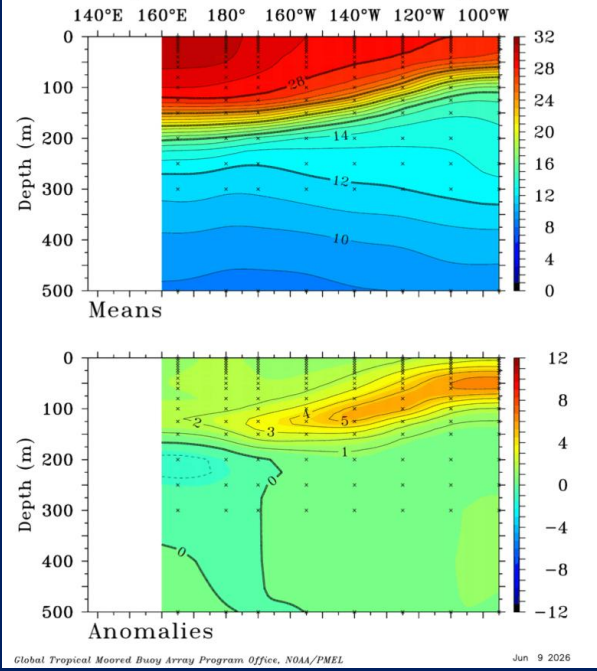
Mar 2026 2°S to 2°N Average
Monthly TAO/TRITON Temperature (°C)



Apr 2026 2°S to 2°N Average
Monthly TAO/TRITON Temperature (°C)



Monthly Mean TAO/TRITON Temperatures (°C)
May 2026 2°S to 2°N Average



March 2026

May 2026

Subjectively, no: I think it is the downstream (in south easterlies in the Tasman) effect of the actual cold anomalies in the boomerang.

The most recent El Nino 2023-2024 also did not have the cold boomerang pattern, and also did not have measurable impact on Australian rainfall

cheers

John McB

On 9 Jul 2026, at 10:19 PM, 'Michael Coughlan' via BOM Buffers <bom-buffers@googlegroups.com> wrote:

John,
Rather than the presence of "cold anomalies" *per se* in the Western Pacific, wouldn't the east-west temperature gradient be the driving factor?
MikeC

On 9 Jul 2026, at 9:28 pm, 'John Leonard McBride' via BOM Buffers <bom-buffers@googlegroups.com> wrote:

Well my first thought is that the eastern Pacific equatorial warm area is well developed.
However the western pacific response of sst anomalies of the opposite sign, cold anomalies in the boomerang or horseshoe pattern, is absent.

According to a view we proposed in a paper long, long ago (McBride, Haylock and Nicholls, Jnl of Climate 2003), it is that upstream cold sst boomerang anomaly area that is a major influence on the El-Nino associated droughts in Australia.

In that case, from the current SST pattern, I would not expect this El Nino to have much influence on Australian weather.

I'll get out of your way, and perhaps to bed early to watch the France-Morocco World C up Quarter Final match
John McB

1 SEPTEMBER 2003

MCBRIDE ET AL.

2905

Relationships between the Maritime Continent Heat Source and the El Niño–Southern Oscillation Phenomenon

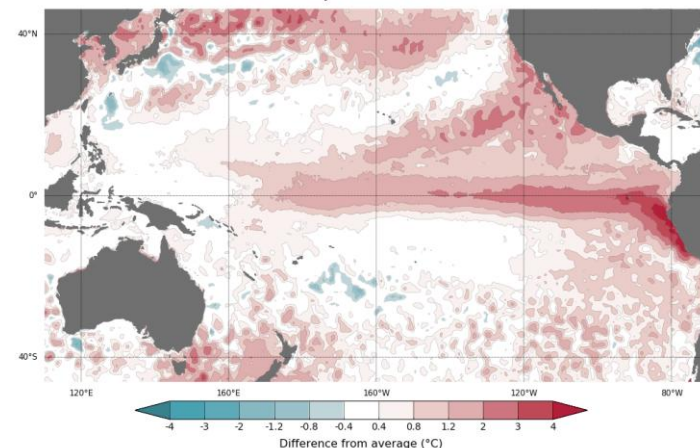
JOHN L. MCBRIDE, MALCOLM R. HAYLOCK, AND NEVILLE NICHOLLS

Bureau of Meteorology Research Centre, Melbourne, Australia

(Manuscript received 26 November 2001, in final form 16 January 2003)

ABSTRACT

Difference from average sea surface temperature observations
June 2026



1 week

2 week

1 month

3 month

August

1 week

2 week

1 month

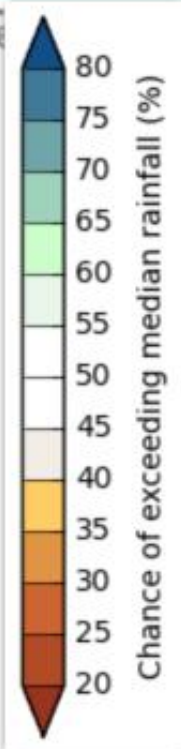
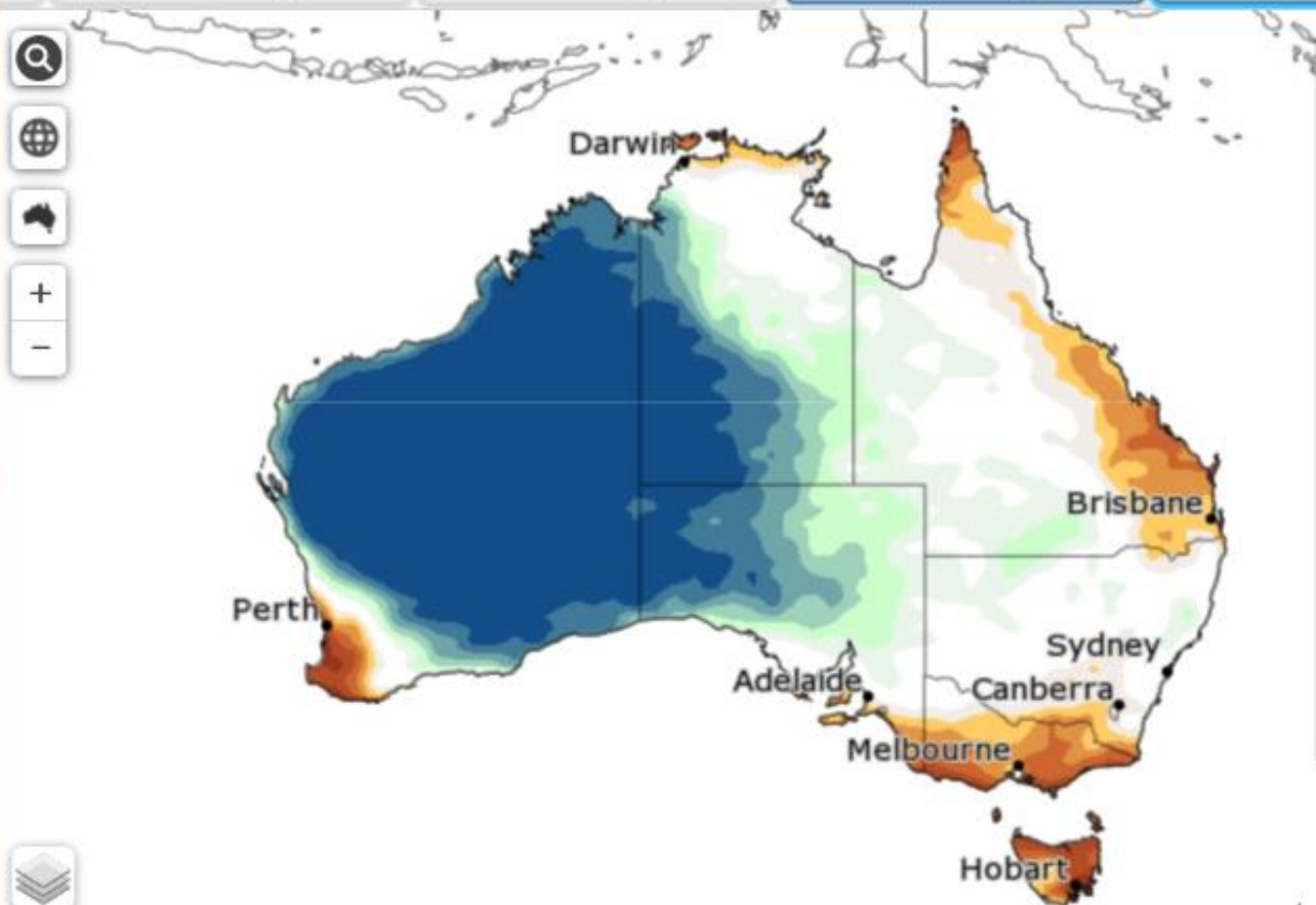
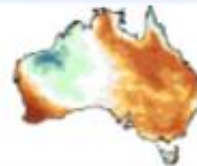
3 month

August

September

August to October

September to Novem...





San Diego

Scientists fear seabird die-off as El Niño looms: 'We don't know how bad this will get'

Many seabirds are starving to death as a marine heat wave lingers off California and fish seek deeper, cooler waters

The Guardian 2 July 2026

"Many seabirds, including California brown pelicans, loons and grebes, starved to death in recent months as record-setting ocean temperatures decreased the band of cold, nutrient-rich surface water where krill, anchovies and sardines thrive near the shore."

"Die-offs of seabirds occur periodically, and not all the seabird deaths off California this year are tied to the marine heat wave."

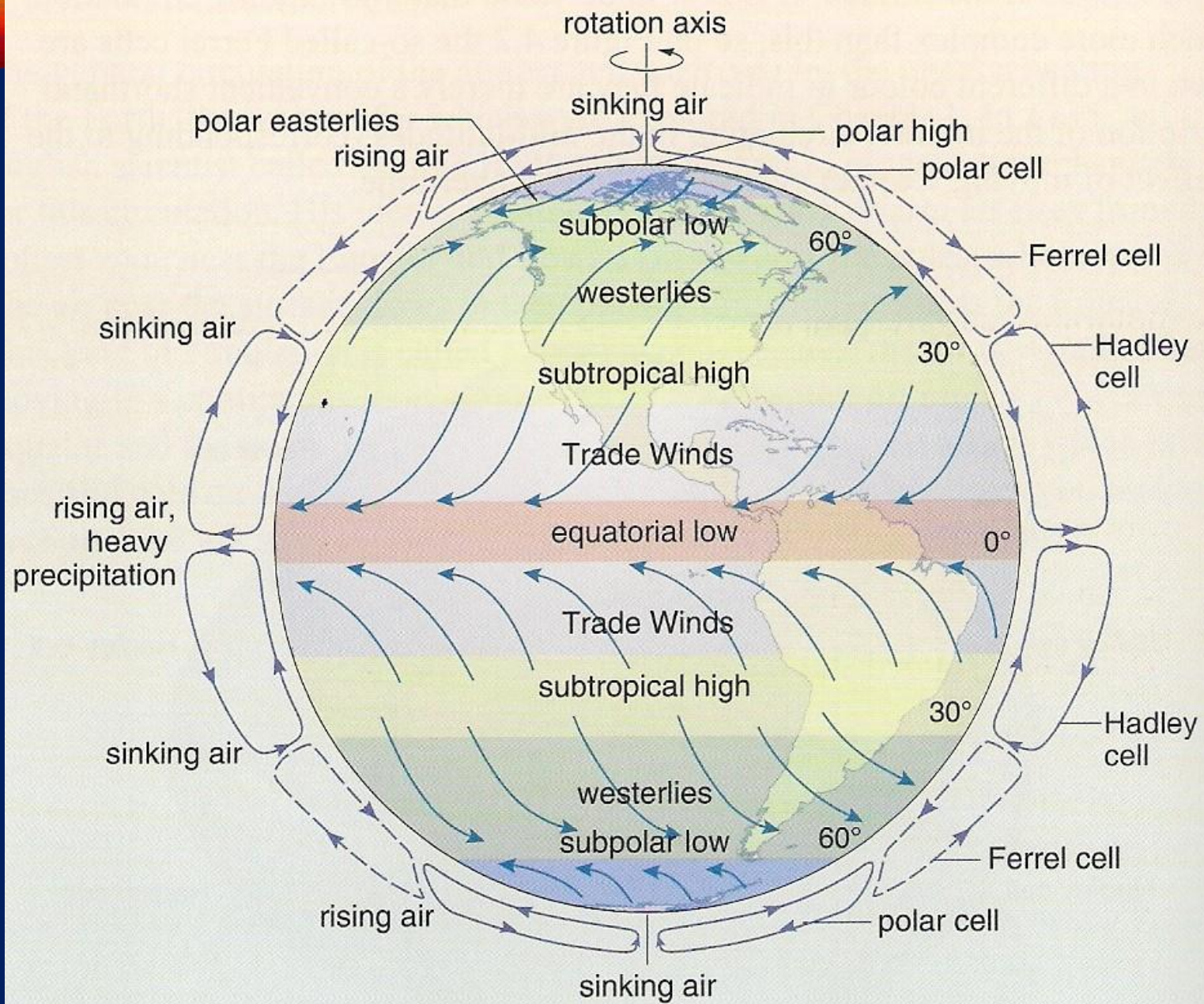
Claire's question

Most of our weather comes from the west. How does El Niño/ La Niña affect that?

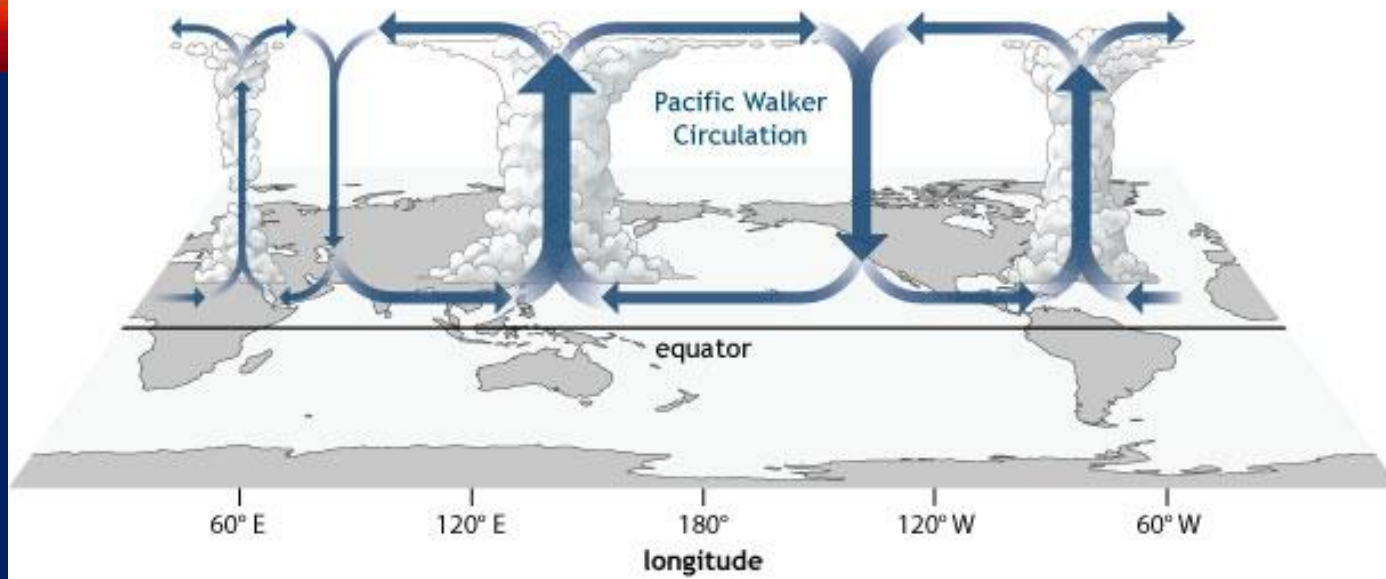
It is like a background effect superimposed on how the weather systems passing through our area.

e.g. In an El Niño high pressure systems are “encouraged” over eastern Australia while fronts tend to be weaker.

It doesn't mean we can't have floods even in an El Niño (e.g. 1987).

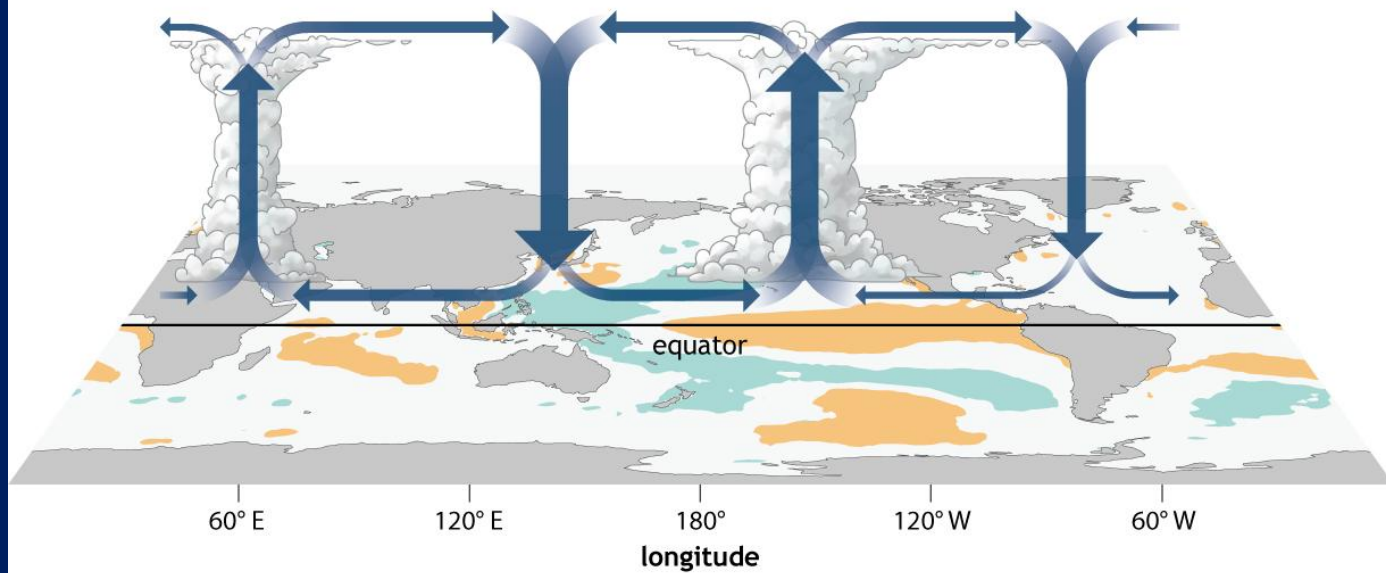


Neutral conditions

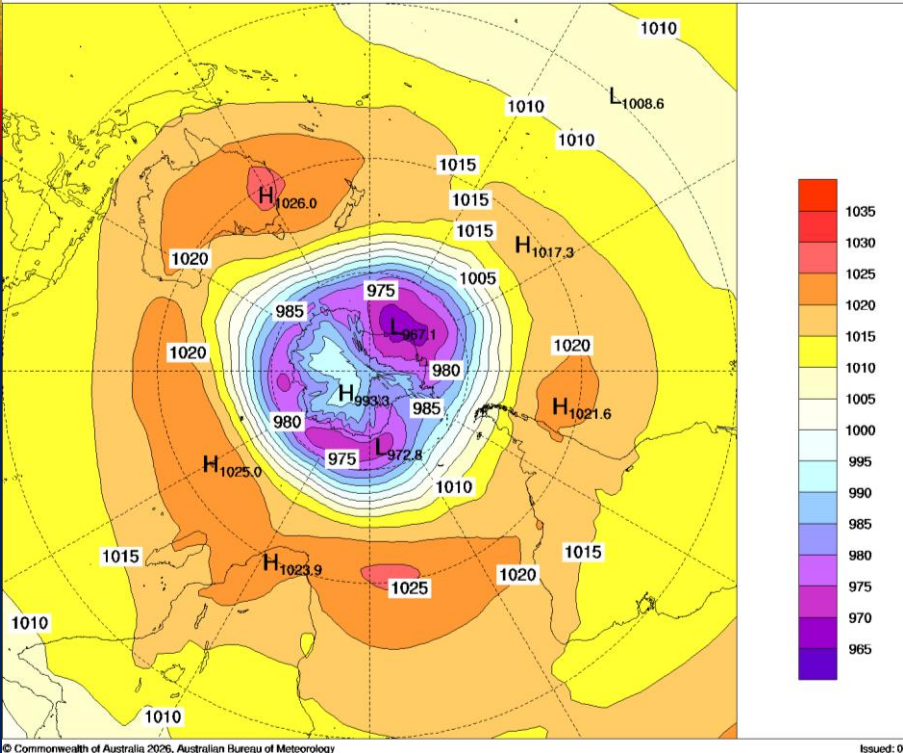


NOAA Climate.gov

El Niño conditions



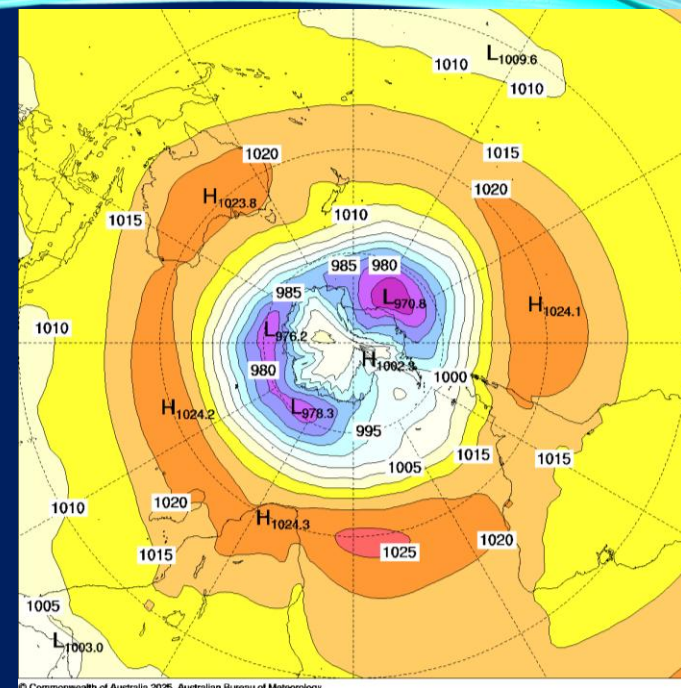
NOAA Climate.gov



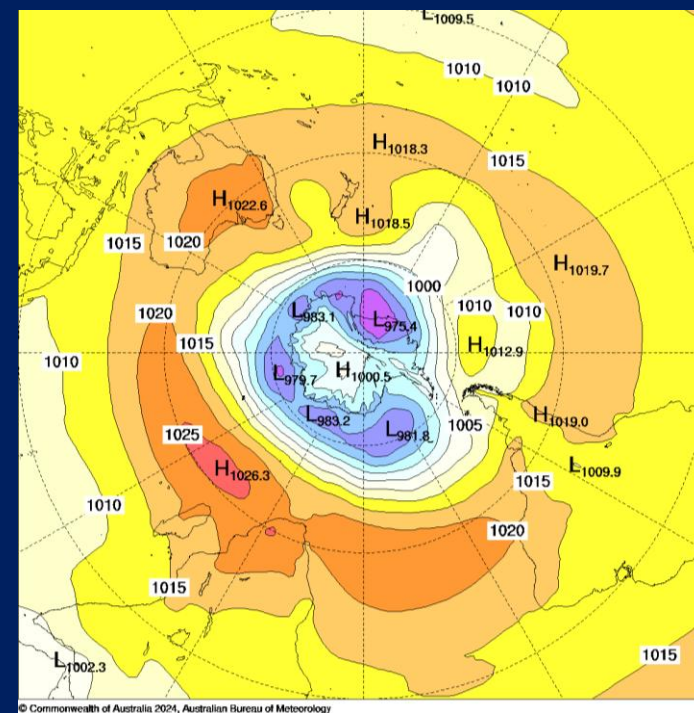
June 2026

Monthly Average Mean Sea Level Pressure

2025



2024

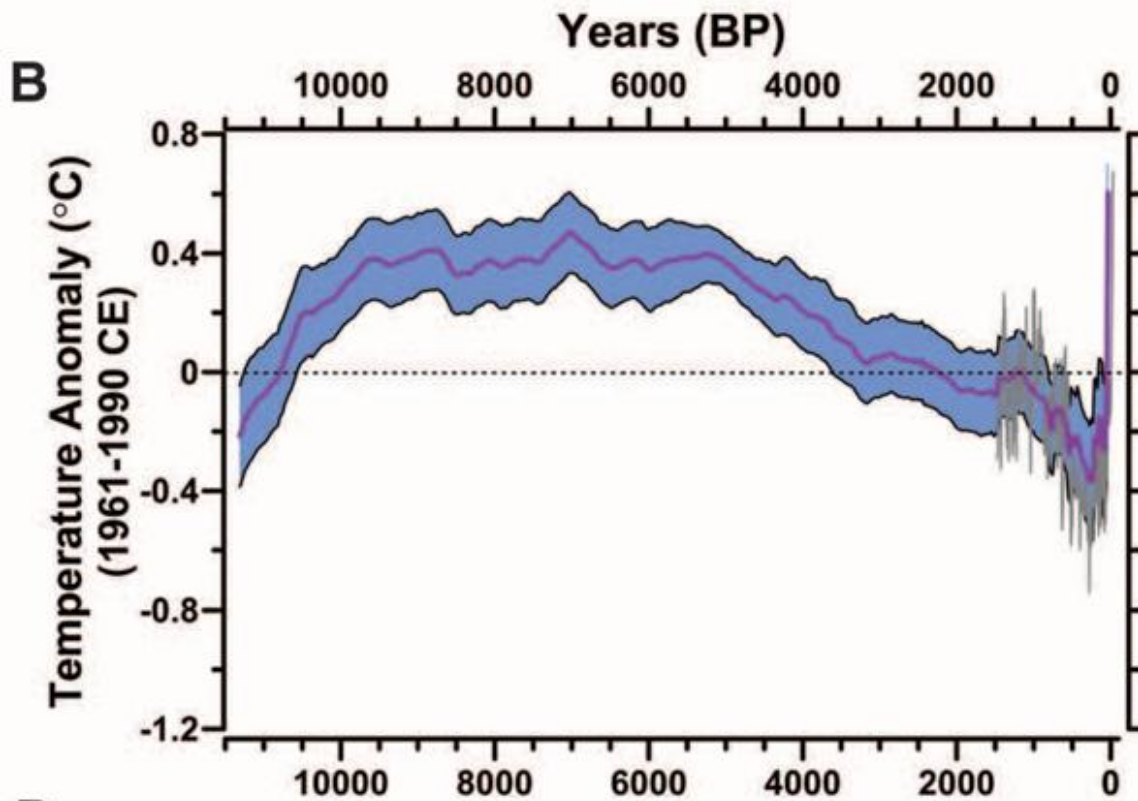


Climate impacts on human societies

- Some history studies consider the potential role of short-term climate variations on human societies.
- Some (like the Ice Ages) are global, but some are more localised.
- Some may be global, but the impact can vary around the world.

Some examples:

- Weakening and Collapse of Akkadian and other civilisations around 2200 BCE
- Collapse of late Bronze Age civilisations (around 1180-1175 BCE)
- Roman Climate Optimum
- Medieval Warm Period
- Little Ice Age.



A closer look at
the **global average**
temperatures of
the past 11,000
years

(Marcott et al.
(2013))

- About 0.6°C of warming from the early Holocene (11,300 yr B.P.)
- A plateau from 9500 to 5500 years ago (Before the Present (B.P.))
- Long-term 0.7°C cooling reaching a minimum in the Little Ice Age (500 – 100 yr B.P.)
- The largest changes occurred in the North Atlantic region.
- After the early warming the tropics were quite constant.
- The Southern Hemisphere actually cooled slightly from 11,000 to 7,000 years ago and was fairly constant after that.

Akkadian and other civilisations

The Akkadian Empire was established around 2334 BCE, perhaps the first empire in world history, succeeding the long-lived city-states of Sumer. Centered on the city of Akkad and its surrounding region in modern-day Iraq. (ruins of city not yet located.)

Map of the Akkadian Empire (brown) and the directions in which military campaigns were conducted (yellow arrows).

- a planned economy supported by agriculture, taxation, and conquest
 - developments in art, technology, and long-distance trade, including connections with the Indus Valley
 - First “emperor” was Sargon.
- 
- The map shows the Akkadian Empire in brown, covering a large area of Mesopotamia. Yellow arrows indicate military campaigns: one pointing west towards Ebla, and two pointing south-east towards the Persian Gulf region. Various cities and regions are labeled, including SUBARTUM, Ebla, Nabada, Urkish, Shekhna, Mardaman, Nagar, Ninive, Assur, Gasur, LULLUBUM, Akkad?, Sippar, Kish, Nippur, Umma, Uruk, Eridu, Sumer, Girsu, Lagash, Pashime, Suse, AWAN?, ELAM, Anshan, MARHASHT?, DILMUN, and MAGAN. The word 'Wikipedia' is written in the lower-left corner of the map area.
- Rain in winter/spring from westerly wind systems and dry at other times.
 - Rain-fed agriculture in northern lowlands and plateaus but rain also needed for flow in the Tigris and Euphrates rivers.
 - collapsed around 2154 BCE due to a combination of internal unrest and severe environmental and economic stress.
 - a major drought led to crop failures, famine, and population displacement – refugees from the drier regions to the towns along the Tigris and Euphrates.
 - The extended drought - associated with the **4.2-kiloyear climate event?**



International Chronostratigraphic Chart

This page contains the latest version of the International Chronostratigraphic Chart (v2026-06) which visually presents the time periods and hierarchy of stratigraphic names of Earth's geological history. It is available in multiple languages.

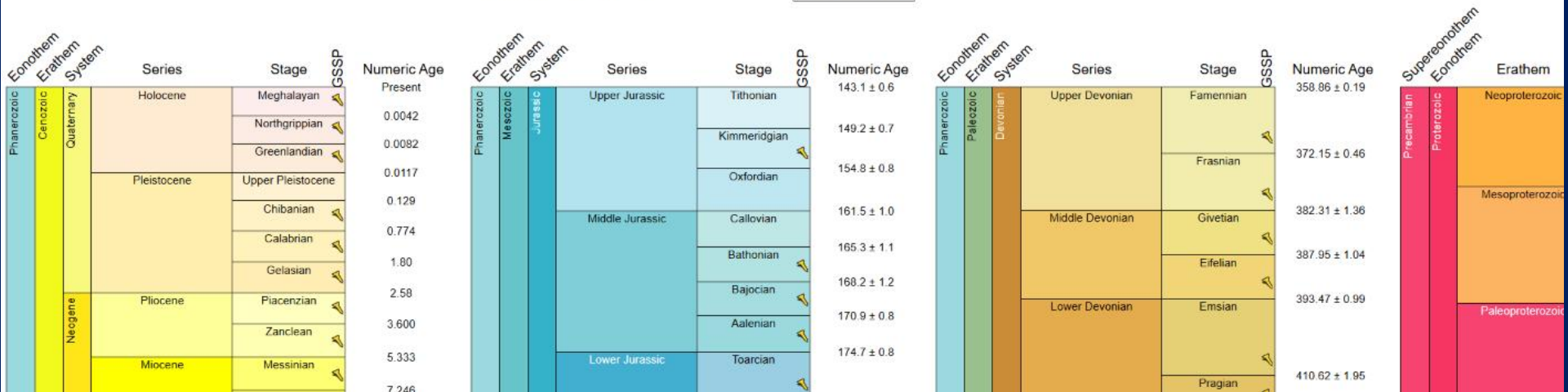
If you are looking for older versions or other supporting material, please see the [Supplementary Chart Information](#) page.

Language:

Scaling:

Column Headings:

Download:



Eonothem	Erathem	System	Series	Stage	GSSP	Numeric Age
Phanerozoic	Cenozoic	Quaternary	Holocene	Meghalayan	📍	Present
				Northgrippian	📍	0.0042
				Greenlandian	📍	0.0082
			Pleistocene	Upper Pleistocene		0.0117
				Chibanian		0.129

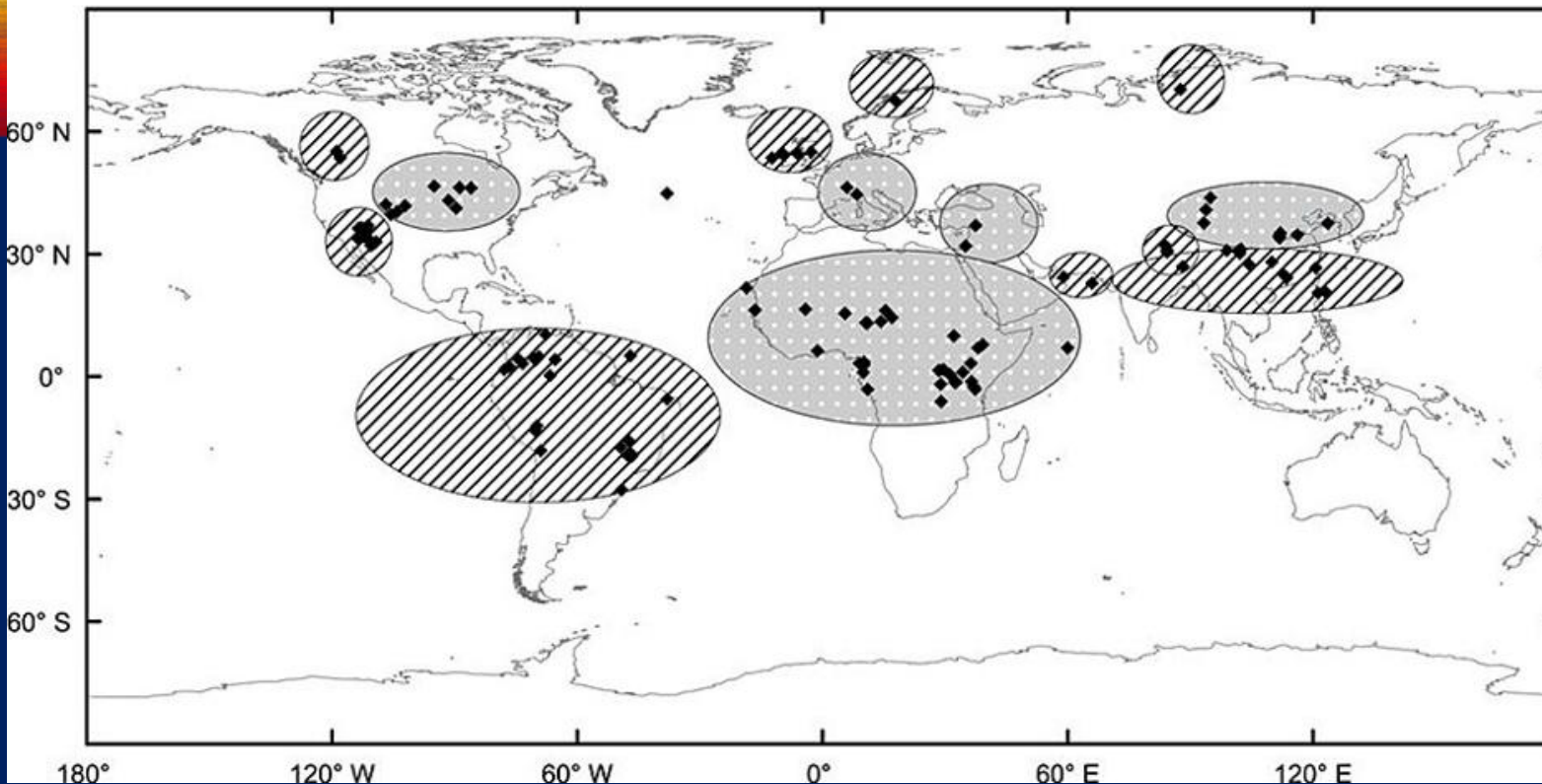
The 4.2-kiloyear event (the 4.2 ka event) defines the beginning of the current **Meghalayan stage of the Holocene**.

The GSSP is a specific depth in a speleothem from 7 km long Mawmluh Cave in the northeastern Indian State of Meghalaya.

- Evidence from North Africa, the Middle East, India and mid-continental North America
- Glacier advances - western Canada and Iceland
- Italian cave flowstone
- Kilimanjaro and Andean glacier ice
- Sodium chloride in Greenland ice cores indicating less sea ice and more summer-like conditions in the North Atlantic.

Quaternary								
SubSeries	Stage	Age (Ma)	GSSP Location	Latitude, Longitude	Boundary Level	Correlation Events	Status	Reference
Phanerozoic Eonothem								
Cenozoic Erathem								
Quaternary System								
Holocene Series								
Upper	Meghalayan Stage	4,250 yr b2k (before 2000 CE)	Mawmluh Cave, Meghalaya, India	2502622°N 91.7150°E	depth 7.45 mm in the speleothem KM-A	Climatic - 4.2 ka event	Ratified 2018	Episodes 2018; 41: 213-223. (PDF)

Global Boundary Stratotype Sections and Points (GSSP)



4.2 ka event

Hatched areas:
wet conditions
or flooding

Dotted areas:
drought or
dust storms.

It has been hypothesized **as a factor** in the collapse of the Old Kingdom in Egypt, the Akkadian Empire in Mesopotamia, the Liangzhu culture in the lower Yangtze River area and may also have initiated the collapse of the Indus Valley Civilisation.

Possible Causes:

- Weakening of the Atlantic Circulation (AMOC)
- Southward movement of the Inter-tropical Convergence Zone (ITCZ)
- ENSO?
- Iceland volcanoes (but low sulphur content is not typical of these volcanoes)

“For Mesopotamia, collapses of empires and kingdoms such as Sargon’s Akkad ... often just meant a switch back to more autonomous city-states and localised forms of collective governance. Emperors usually had little interest in local matters such as resolving disputes and organising the day-to-day running of the city, leaving those to local government. This was far from a dreadful outcome. The Akkadian Empire was a predatory, militaristic juggernaut that many would have been delighted to see fall apart. “

*Goliath’s Curse – The history and future of Societal Collapse.
Luke Kemp (Penguin/Viking 2025) (p. 178).*

A few quotes:

Many historical cases of collapse (of a state) may have been a net benefit for many of its citizens.

The average lifespan of a state is 326 years. (based on their historical database).

Many factors may be involved in a society’s collapse:

“When sorrows come, they come not single spies, but in battalions.” (Hamlet)

A side- track:

Are we in a new series beyond the Holocene - the Anthropocene?

On 4 March 2024 the International Commission on Stratigraphy (ICS) voted against formally declaring the **Anthropocene** as a chronostratigraphic unit in the geological history of the Earth.

It had been proposed that human-made markers, among them radionuclides, in sediments from Lake Crawford in Canada could be used as a “golden spike” to pinpoint the chronological divide between the Holocene and the Anthropocene.

Joint statement by the IUGS and ICS on the vote by the ICS Subcommittee on Quaternary Stratigraphy

“Despite its rejection as a formal unit of the Geologic Time Scale, the Anthropocene will nevertheless continue to be used not only by Earth and environmental scientists, but also by social scientists, politicians and economists, as well as by the public at large. It will remain an invaluable descriptor of human impact on the Earth system.”

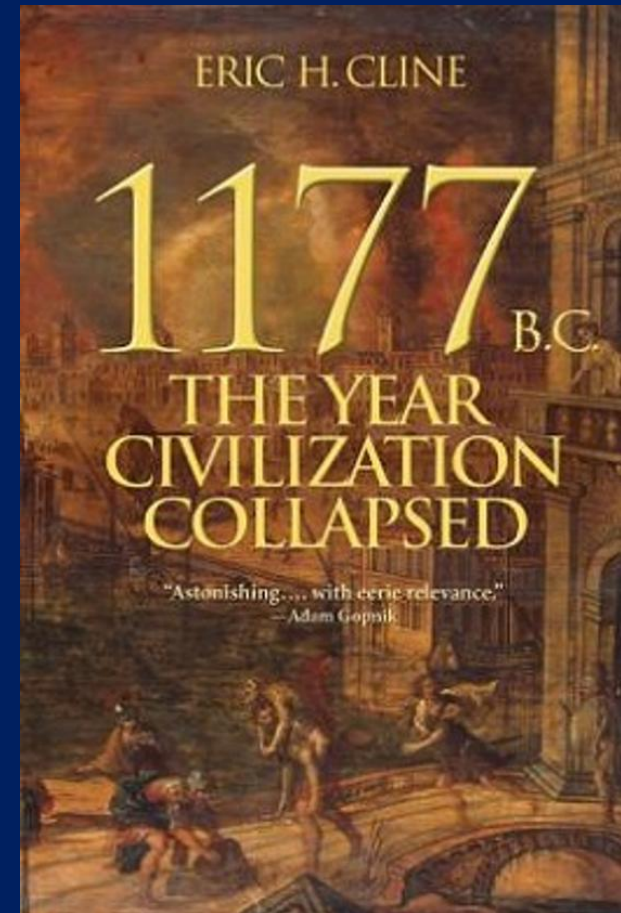
The Late Bronze Age eastern Mediterranean (c. 1500–1200 BCE)

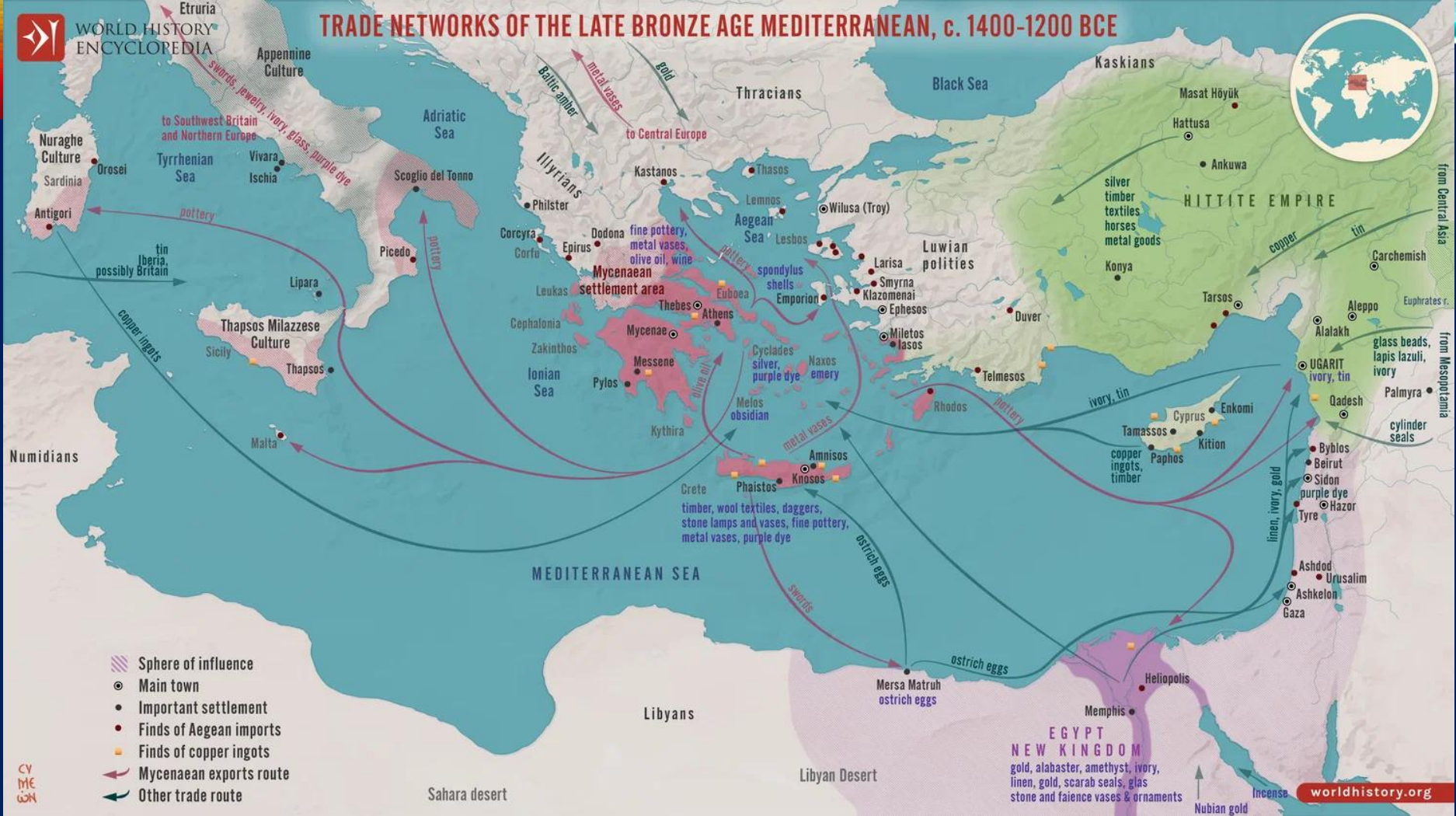
- unprecedented level of diplomatic and commercial interdependence among regional powers.
 - New Kingdom Egypt
 - Hittite Empire
 - the Kassite rulers of Babylon
 - Mycenaean states.
- Circulation of strategic resources:
 - tin for bronze production
 - copper from Cyprus
 - grain from the Nile Valley
 - textiles and luxury goods.

This dense web of connectivity also generated fragility.

Late Bronze Age Collapse about 1200 BCE due to:

- internal instability
- shifting trade patterns
- environmental pressures – drought, earthquakes
- riots associated with food shortages
- external invasions (including the Sea Peoples).





Map of Trade Networks of the Late Bronze Age Mediterranean

Empires, Merchants, and Maritime Routes of the Ancient World



by **Simeon Natchev**
published on 19 November 2021

- The Sahara region had been drying out during middle Holocene
- Around 1200 BCE there seems to have been a period of low rainfall (lasting 150-300 years) across the Eastern Mediterranean, Middle East and northern Africa although it was **not universal**.
- Evident in proxies across the region:
 - Pollen and charred plant remains
 - low water levels in Sea of Galilee and Dead Sea, low flows in the Nile
 - lower sea temperatures in Mediterranean.
- written reports and records – e.g. clay tablets
 - desperate messages
 - Hittite king begged Pharaoh for grain *“It is a matter of life or death”* and the Pharaoh Merneptah did send grain.
 - Babylon and Assyria and even Egypt – crop failure, food shortages.
 - Egypt – strikes of workers – inflation with grain prices increasing 8 fold.
- 1225- 1175 BCE “earthquake storm” – above Richter 6.5 magnitude.
- **The drought seems to have been regional rather than global.**
- Drought may have been a factor – rising inequality leading to wars and disturbances may have frayed the interdependent trade
- some civilisations did survive through it even if re-organised.

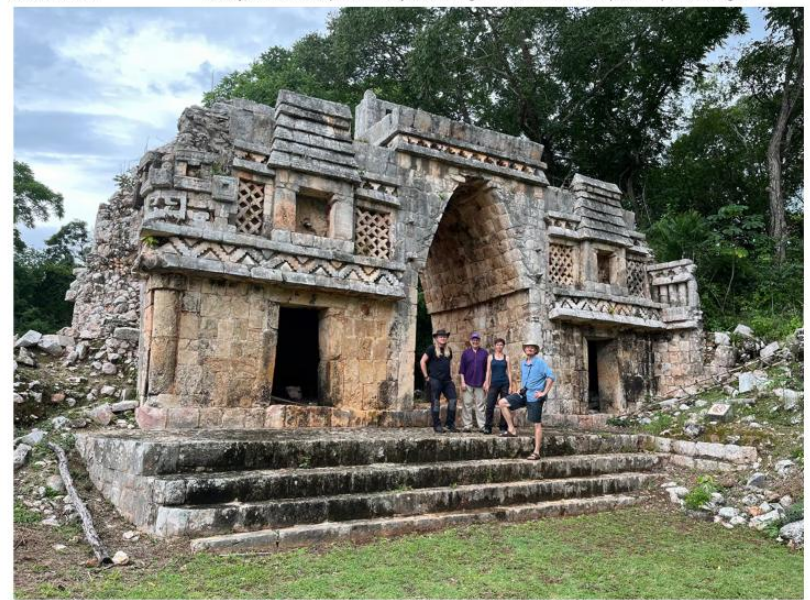
The Mayan civilization experienced 44 years of drought in its last two centuries

Analysis of a stalagmite reveals that some extreme events lasted for more than a decade



(From René).

The central part of the Tzabnah Caves, where there are several stalagmites used to determine when droughts occurred and how long they lasted.
MARK BRENNER



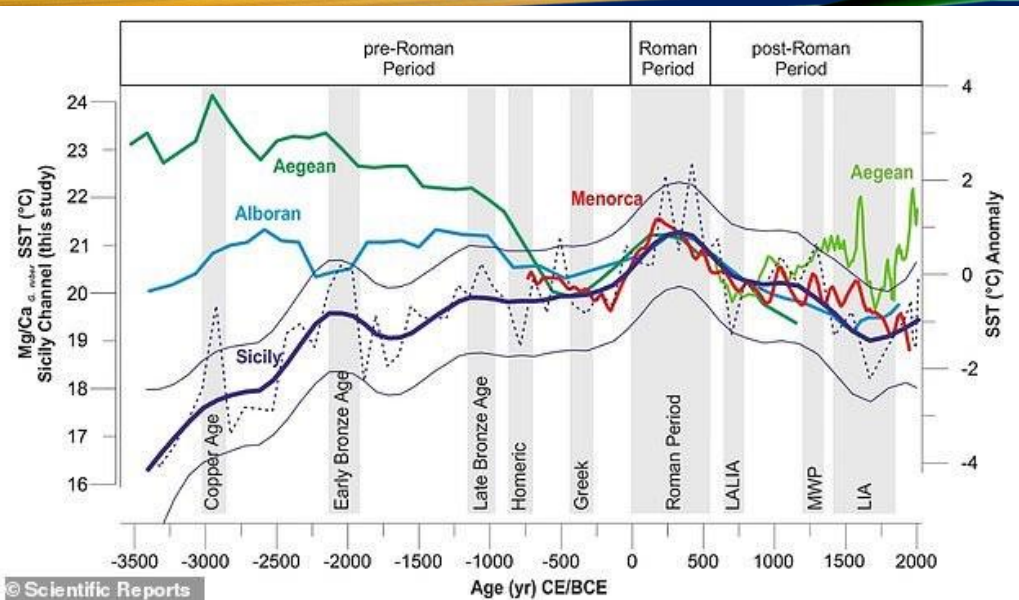
Several of the authors of the study of the stalagmite in Labna, one of the cities abandoned after several events of extreme drought.
MARK BRENNER

https://english.elpais.com/science-tech/2025-08-13/the-mayan-civilization-experienced-44-years-of-drought-in-its-last-two-centuries.html#?prm=copy_link

“Between 870 and 1100 CE, there were eight extreme droughts on the Yucatán Peninsula, one of the core areas of Mayan civilization.

“They define an extreme drought as three or more consecutive years with the dry season extended by at least three months, or even years with no rainy season at all.

“The longest event occurred from 929 CE - rainfall remained low for 13 years - the longest drought on record, both from pre-Columbian times and later centuries.”



Roman Warm Period (Roman Climatic Optimum) 250 BCE – 400 CE ?

Seems to have been a period of stable climate in the Mediterranean:

- Warm summers, mild, rainy winters, productive for crops (esp. grain as the basis for the wealth of the empire)
- N Africa still dry but Nile regular.
- Occasional harsh winters.

Regular flows in the Nile allowed the Romans to collect grain from Egypt – the breadbasket for the empire.

Unusually low level of volcanic activity generally

- Major volcanic episode (43 BCE) powerful explosion of Okmok volcano in the Aleutian Islands – reducing sunshine leading to cooler temperatures and reduced crops.



SSTs records from the Sicily Channel (thick dark blue line, Mg/Ca) and other sites.

[nature](#) > [scientific reports](#) > [articles](#) > [article](#)

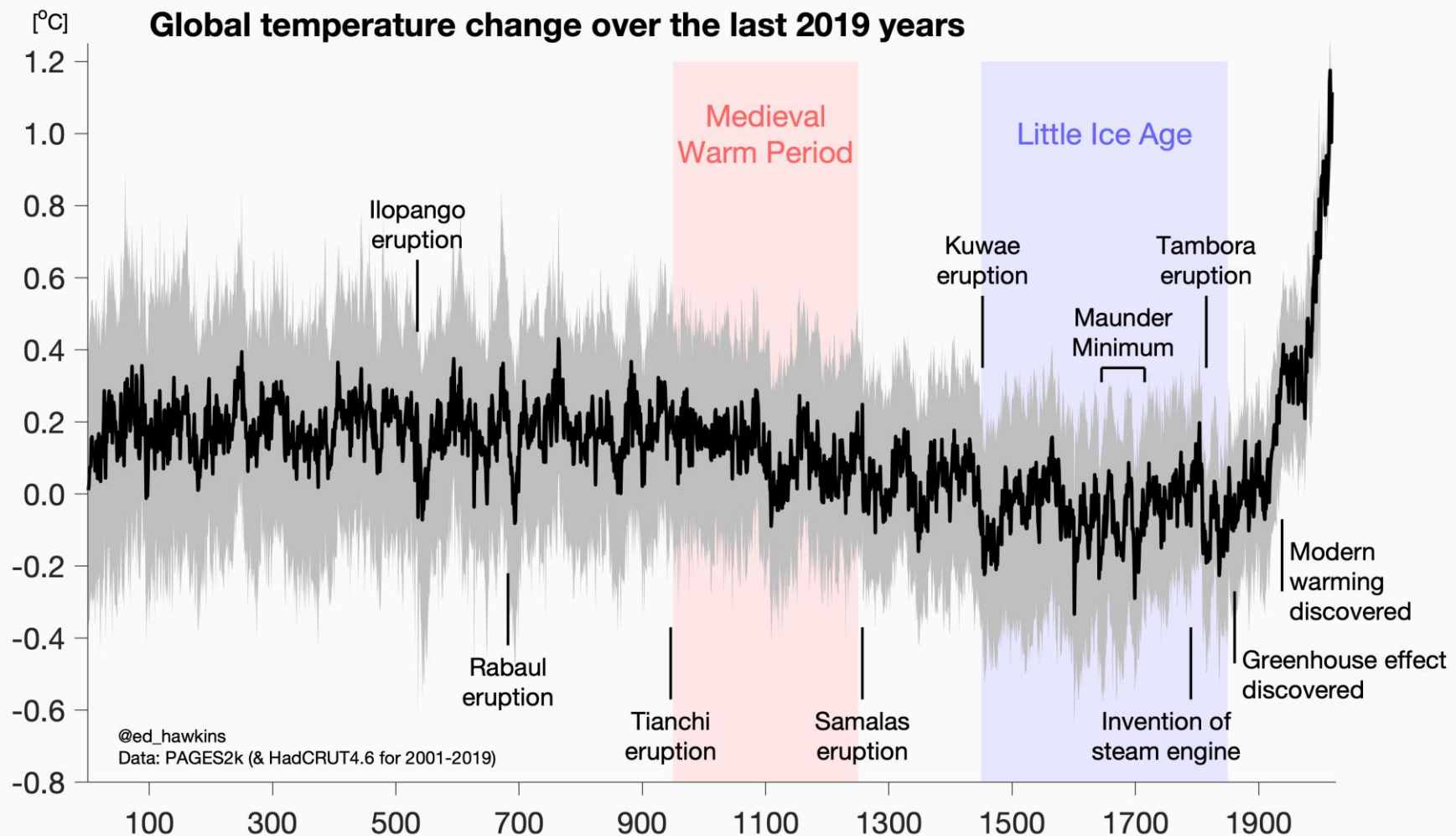
Article | [Open access](#) | Published: 26 June 2020

Persistent warm Mediterranean surface waters during the Roman period

G. Margaritelli , I. Cacho, A. Català, M. Barra, L. G. Bellucci, C. Lubritto, R. Rettori & F. Lirer

[Scientific Reports](#) 10, Article number: 10431 (2020) | [Cite this article](#)

<https://www.nature.com/articles/s41598-020-67281-2>



Reconstruction of **global temperature** going back to the year 1 CE thanks to the work of the PAGES2k team from a wide variety of proxy records such as tree rings, cave deposits, corals, etc.

<https://web.archive.org/web/20200202220240/https://www.climate-lab-book.ac.uk/2020/2019-years/>

Medieval Warm Period (950 – 1250 CE)

(Medieval Climate Anomaly)

- Most consistent signal in North Atlantic and Europe
 - Summers generally warm, crops good and few serious famines
 - Vineyards in England as far north as York (54°N)
 - area under agriculture expanded, landowners prospered, including to higher altitudes.
- Sea-ice retreated
 - Vikings travelled further north and west
 - settlements in southern Greenland and Iceland, and North America
- Consequence: Money for Crusades and cathedrals!
- Possible Causes:
 - Few significant volcanic eruptions
 - North Atlantic Ocean circulation.
- **Note:**
 - the warming seems to have been confined to the North Atlantic
 - Global average cooled, rather than warmed.