

PACIFIC ISLANDS CLIMATE OUTLOOK FORUM-19

20 - 21 OCTOBER, 2026

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PACIFIC REGIONAL CLIMATE CENTRE NETWORK

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PICOF-19

Looking Forward Long-Term: Rainfall and Air Temperature

Andrew King and Leanne Webb
University of Melbourne and CSIRO

Looking Forward Long-Term: Rainfall and Air Temperature

- IMPORTANT MESSAGE
- **Overshooting 1.5 deg C: What does this mean for the Globe and the Pacific region?**
  - **Dr Andrew King, University of Melbourne**

- FOLLOWED BY
- Looking Forward Long-Term: Rainfall and Air Temperature
- Future ENSO
  - Dr Leanne Webb, CSIRO

History: ‘1.5 To Stay Alive’

- In 2015, Tony de Brum, the foreign minister of the Marshall Islands stated: **For The Marshall Islands, The Climate Goal Is '1.5 To Stay Alive’.**
- The **‘High Ambition Coalition’** (more than 100 countries) secured a shared temperature goal in the Paris Agreement, for countries to limit global warming to 1.5°C above the long-term average.
- Drawing on scientific assessments stating 1.5°C warming is a key threshold for the survival of vulnerable / low-lying Pacific Island states/ atolls and the ecosystems they depend on, such as coral reefs.



Current perception: ‘1.5 To Stay Alive’

Expectation

Now a shared & well-established aspiration for Pacific Islanders



acific can make a ..

With One Voice, Pacific nations take 1.5 to stay al...

1.5 to stay alive—the threshold - The EarthView

1.5 Stay Alive (2015): Where ...

Climate change in the Pacific: “The time is now” to avoid catastrophe ...

‘1.5 to stay alive’ and what it means for u...

With One Voice, Pacific nations take 1.5 to stay alive message to COP2...

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ooming El Niño could give a preview of life at 1.5C ...

Film DVD 1.5 Stay Alive: Science ...

A looming El Niño could give us a preview of life at 1.5C of warming ...

1.5 to Stay Alive

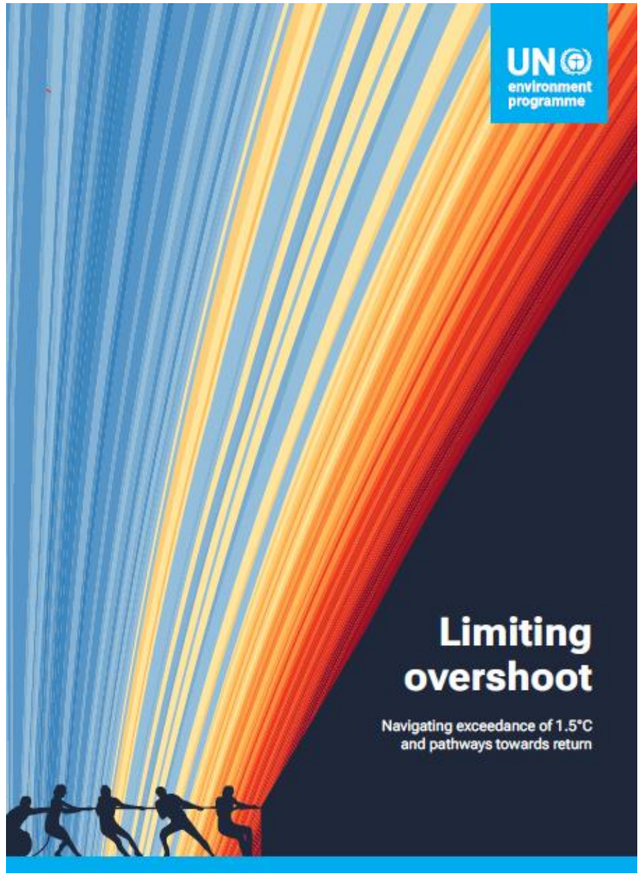
1.5 Stay Alive (2015) - Filmin...

Pacific Islands launch survival tips to teach the world how to survive ...

Ear cha

New report (Sept 2026): Navigating exceedance of 1.5°C and pathways towards return

- ‘While the international community has made progress on climate change, global action to cut greenhouse gas emissions has **not been fast enough to avoid global warming crossing 1.5°C above pre-industrial levels** in the next few years.’
- ‘Even an optimistic scenario of current government pledges (full implementation of all national climate plans plus meeting additional net-zero targets) puts expected peak temperature rise at 1.8°C.’



URL: https://www.unep.org/resources/limiting-overshoot-navigating-exceedance

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Overshooting 1.5ºC: What does this mean for the Globe and the Pacific region?

Andrew King

University of Melbourne

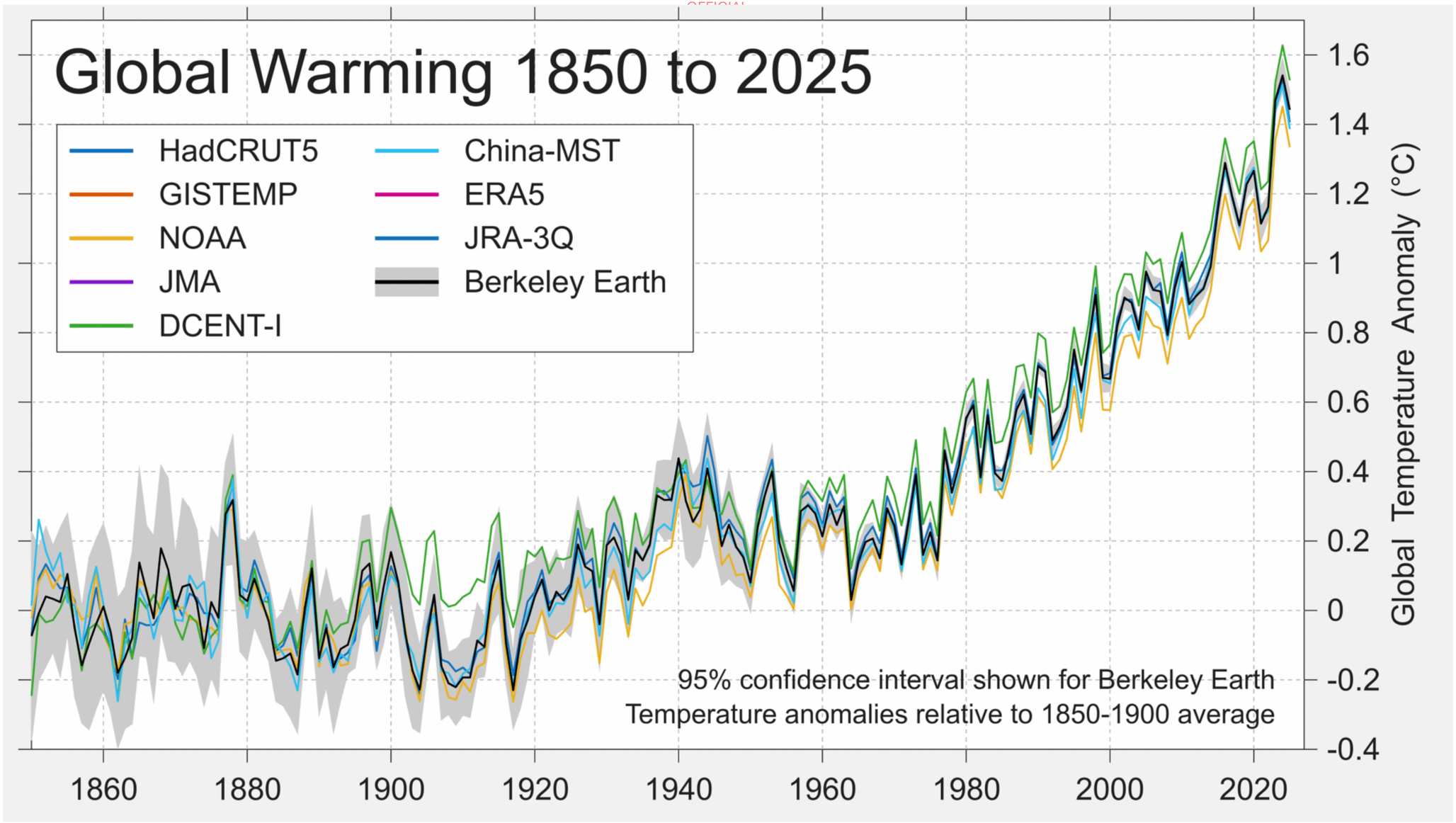
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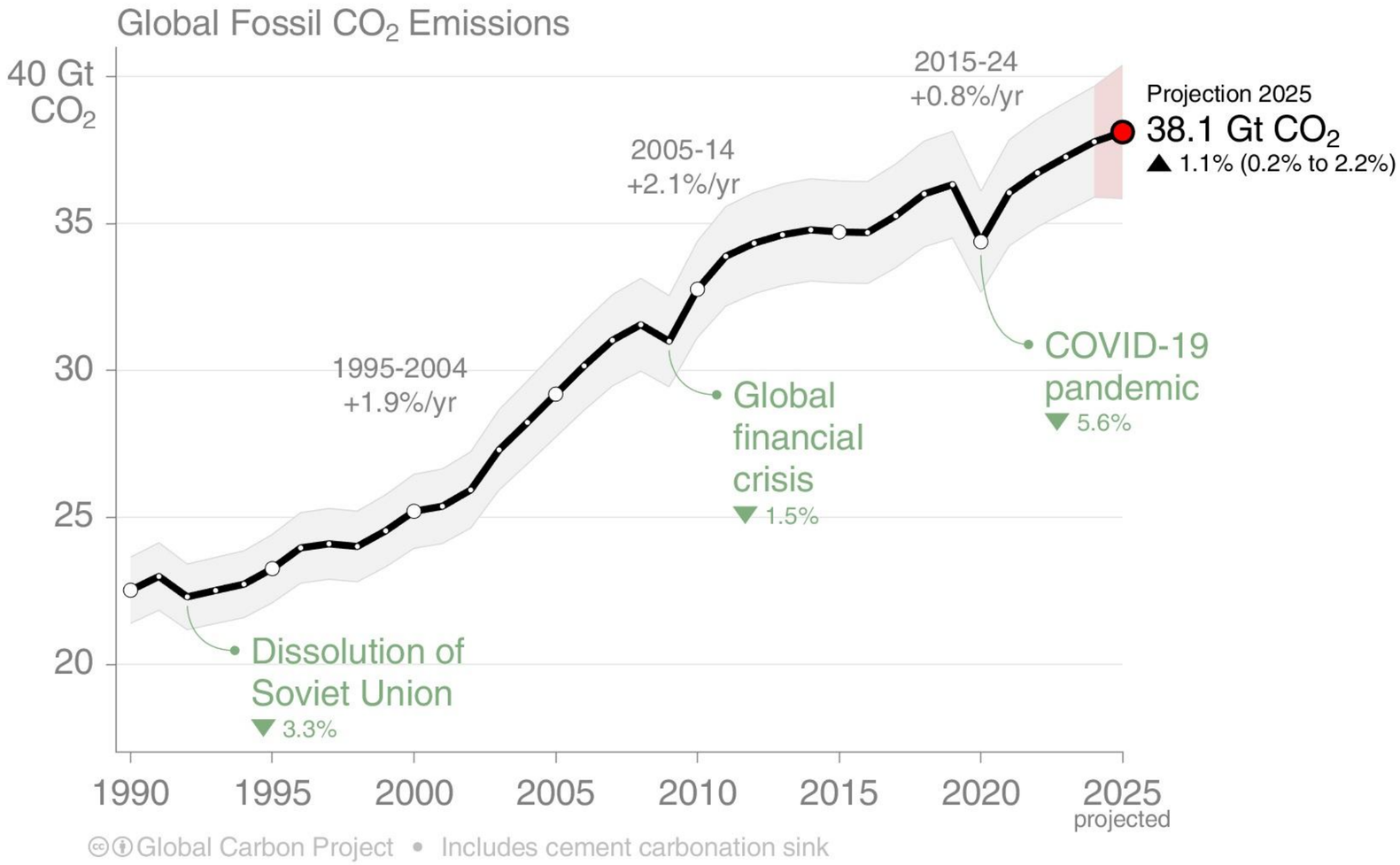


The world is warming rapidly and already close to the 1.5ºC mark

Source: Berkeley Earth

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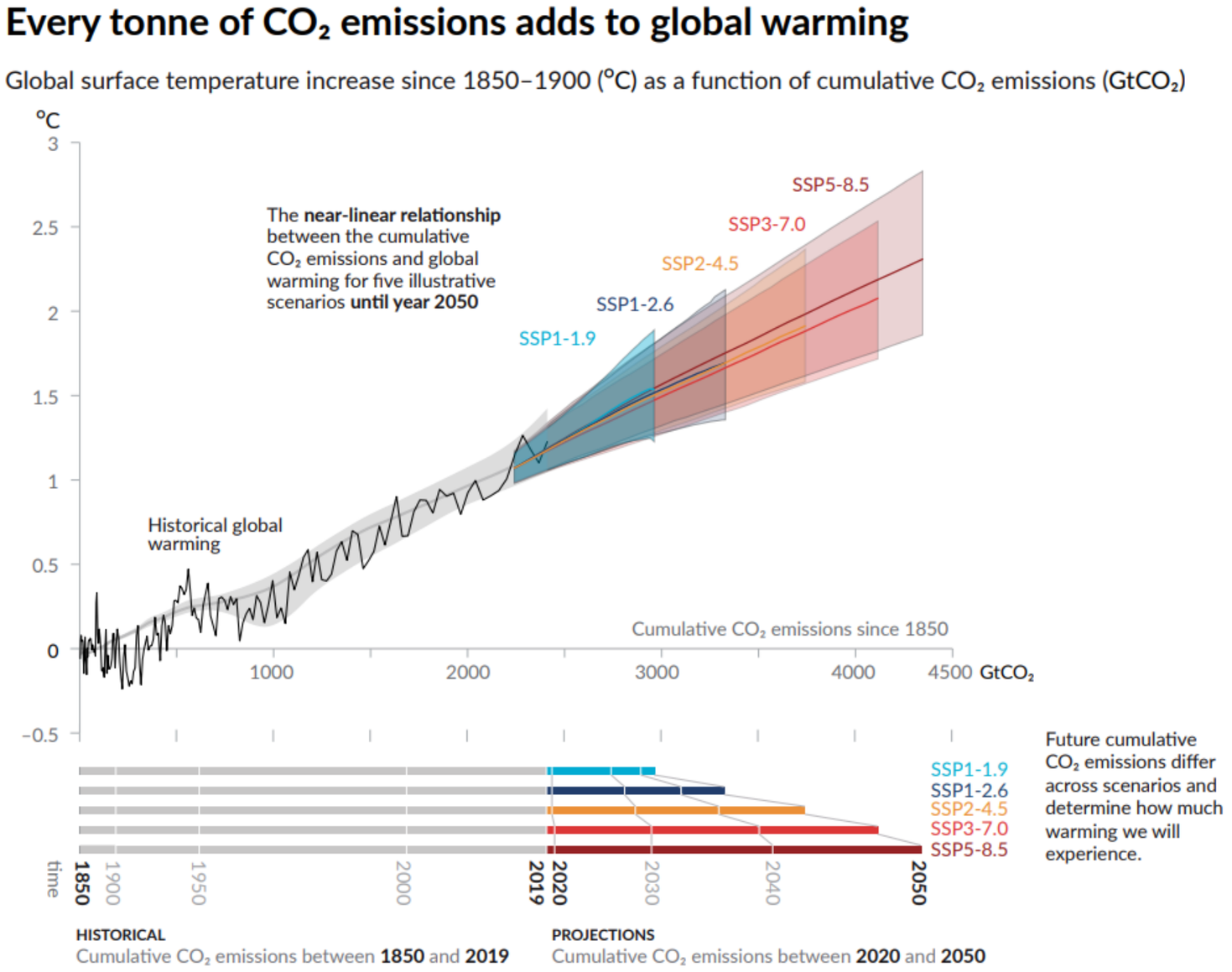
Global greenhouse gas emissions at record levels



Source: Global Carbon project

- Given global greenhouse gas emissions remain at record high levels, accelerated warming is to be expected.

The more humanity emits, the more the world warms



- There is a near-linear relationship between cumulative emissions and global warming.
- At least in the medium-term, every tonne of emissions causes about the same amount of warming.

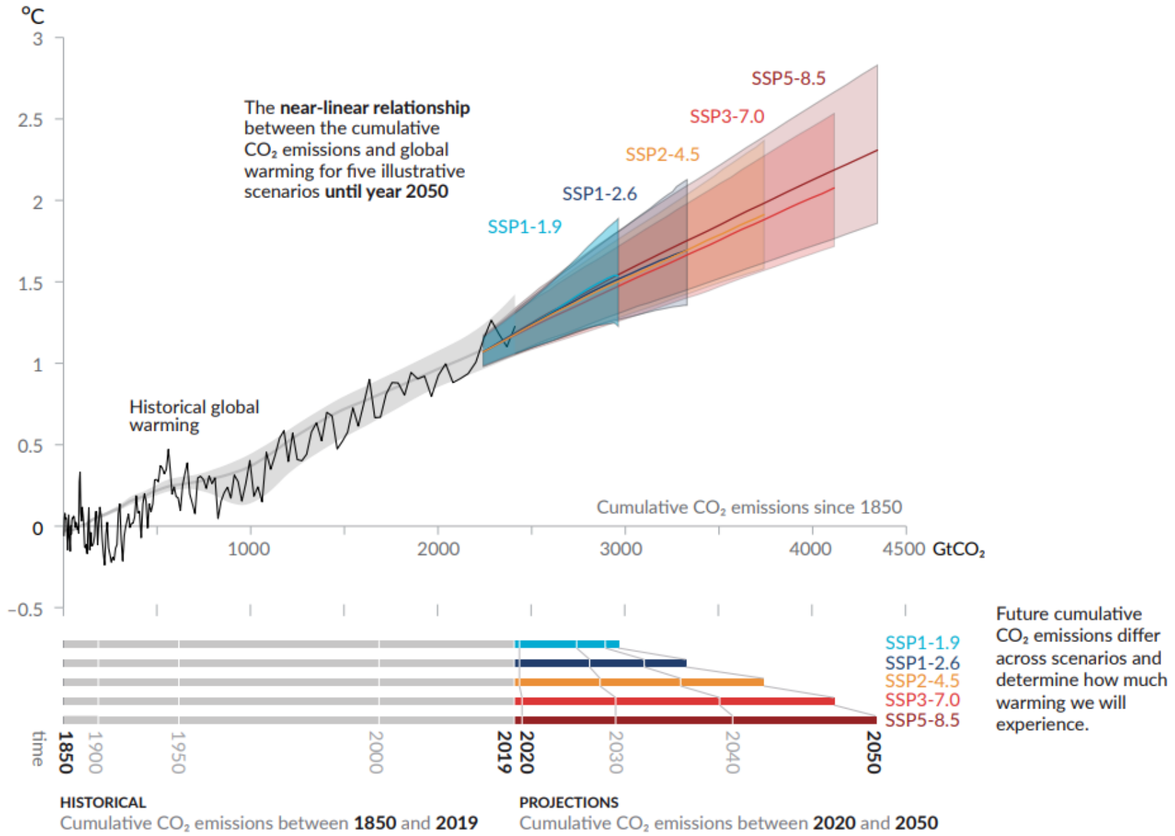
Source: IPCC AR6 WG1 SPM

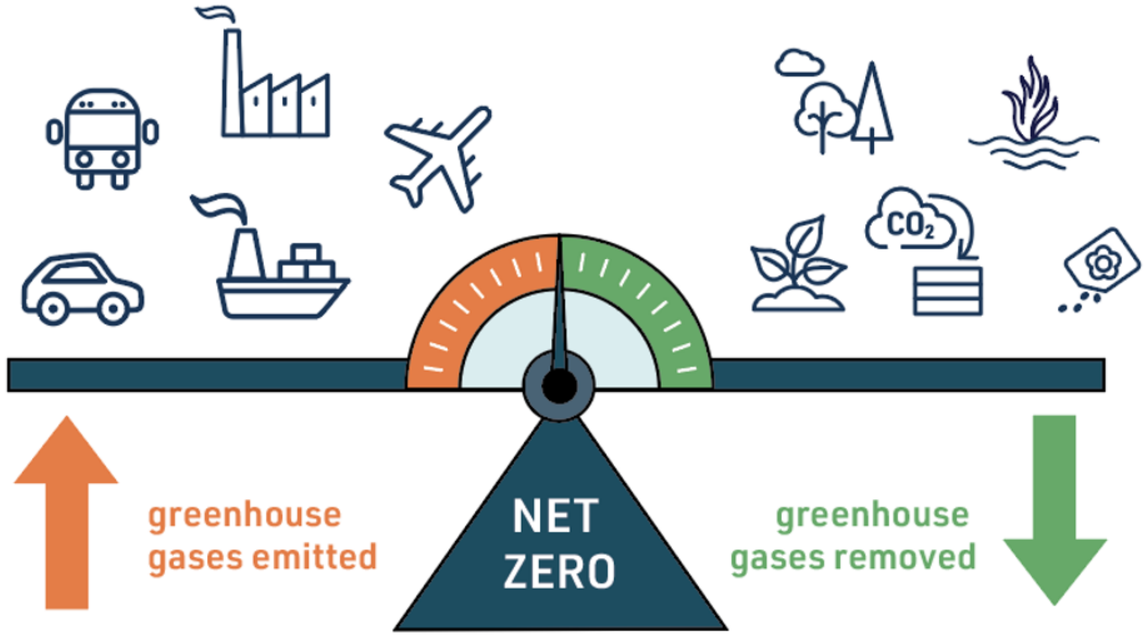
The more humanity emits, the more the world warms

- We need to reach net-zero emissions to halt global warming and net-negative emissions to start cooling the planet back down.

Every tonne of CO_2 emissions adds to global warming

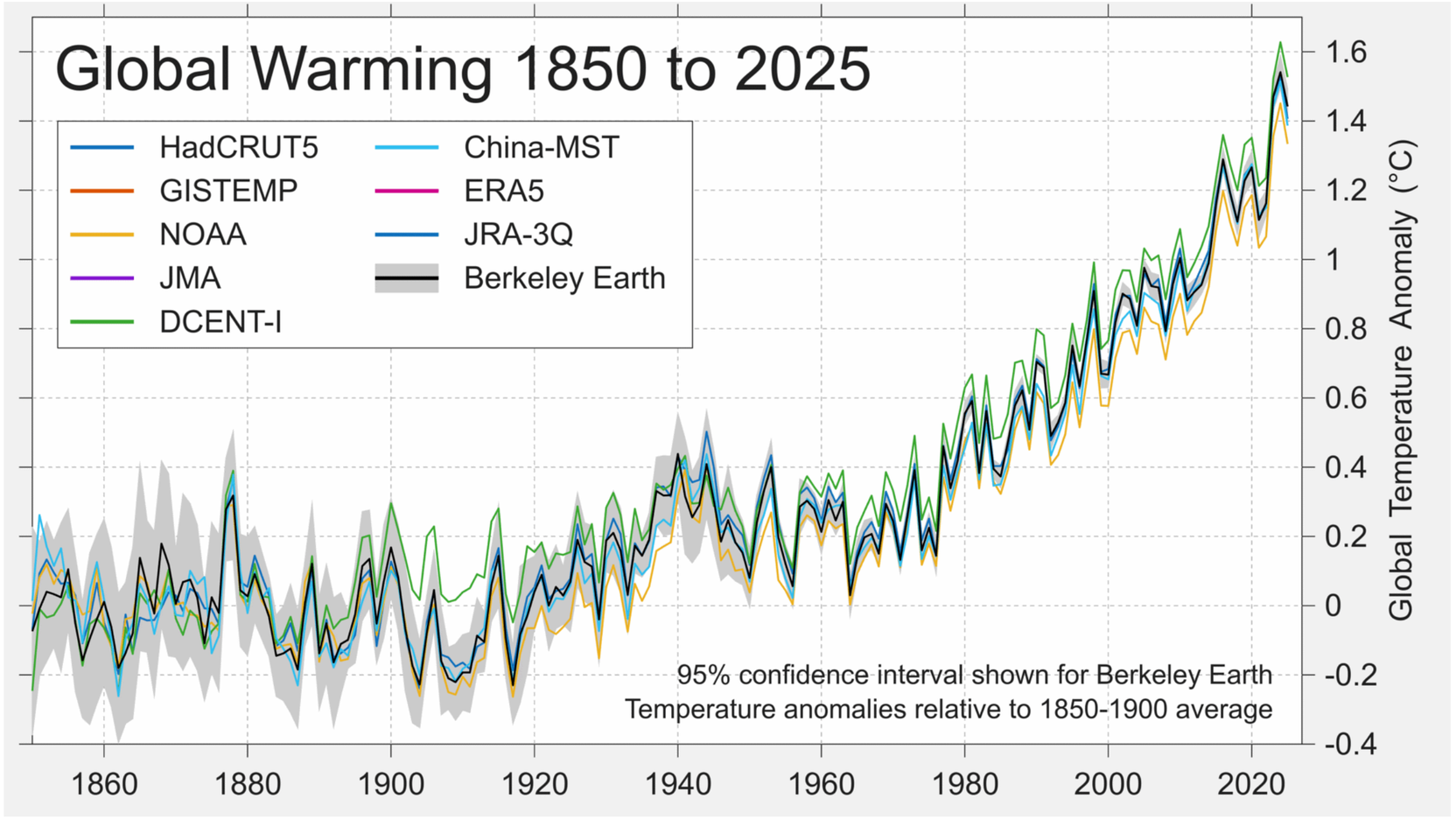
Global surface temperature increase since 1850–1900 (°C) as a function of cumulative CO_2 emissions ($GtCO_2$)





Sources: IPCC AR6 WG1 SPM, ARC Centre of Excellence for Climate Extremes

The more humanity emits, the more the world warms



- A year above 1.5oC doesn't in itself mean that we have failed to limit warming in line with the Paris Agreement.
- But, having a year exceed 1.5^{o}C coupled with the high rate of emissions and warming means we are likely entering a period above the warming limit we were aiming to stay below.

Source: Berkeley Earth

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The inevitability of crossing 1.5ºC

Brief Communication | Open access | Published: 10 February 2025

Twelve months at 1.5 °C signals earlier than expected breach of Paris Agreement threshold

Alex J. Cannon

Nature Climate Change **15**, 266–269 (2025) | Cite this article

40k Accesses | **8** Citations | **936** Altmetric | Metrics

Brief Communication | Open access | Published: 10 February 2025

A year above 1.5 °C signals that Earth is most probably within the 20-year period that will reach the Paris Agreement limit

Emanuele Bevacqua, Carl-Friedrich Schleussner & Jakob Zscheischler

Nature Climate Change **15**, 262–265 (2025) | Cite this article

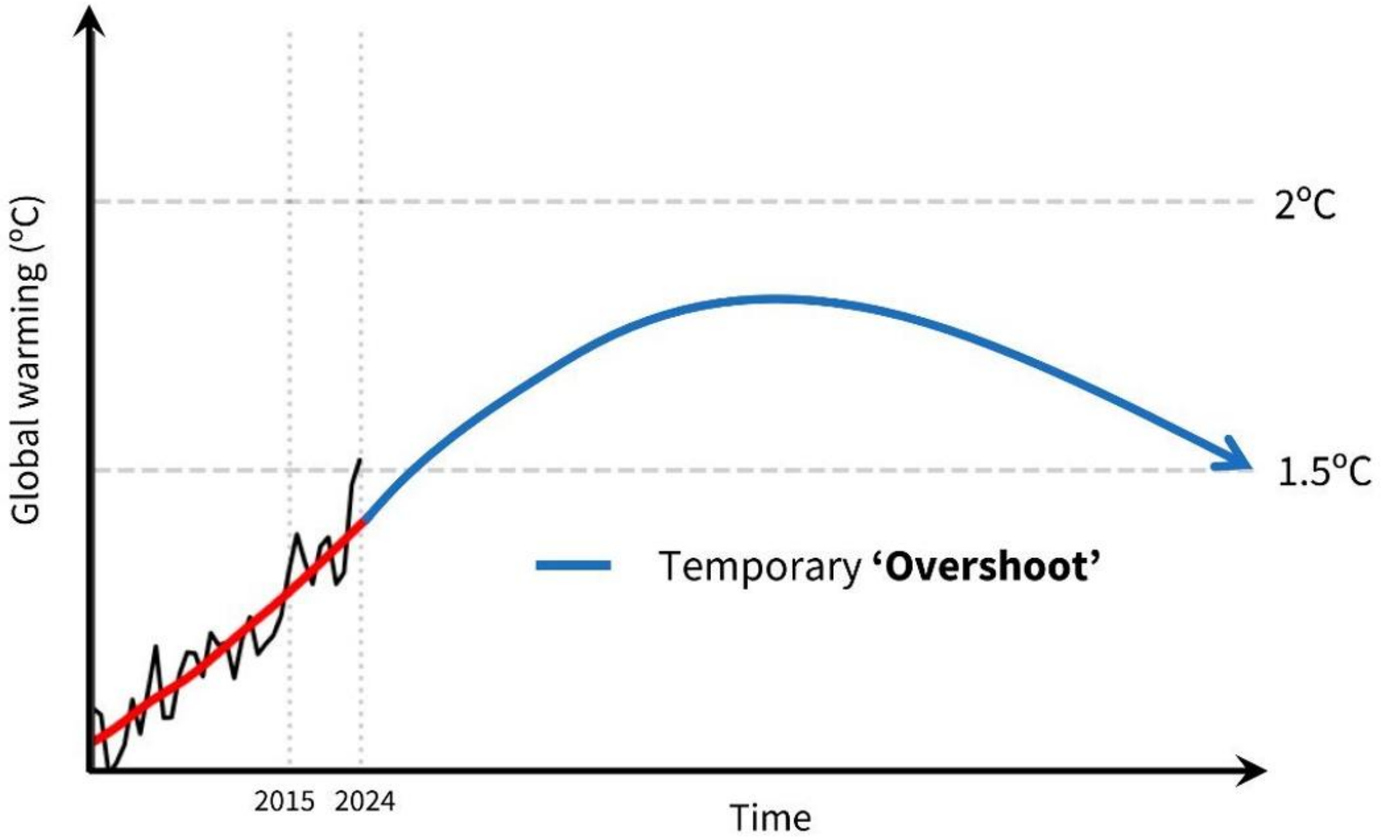
66k Accesses | **18** Citations | **1287** Altmetric | Metrics

- A pair of studies published last year illustrated that we are on track to reach a 1.5ºC warming level.
- Given we are so close to 1.5ºC global warming and we have ongoing high greenhouse gas emissions, there is an inevitability that we will temporarily surpass, i.e. ***overshoot***, the target limit for global warming under the Paris Agreement.

Source: Nature Climate Change

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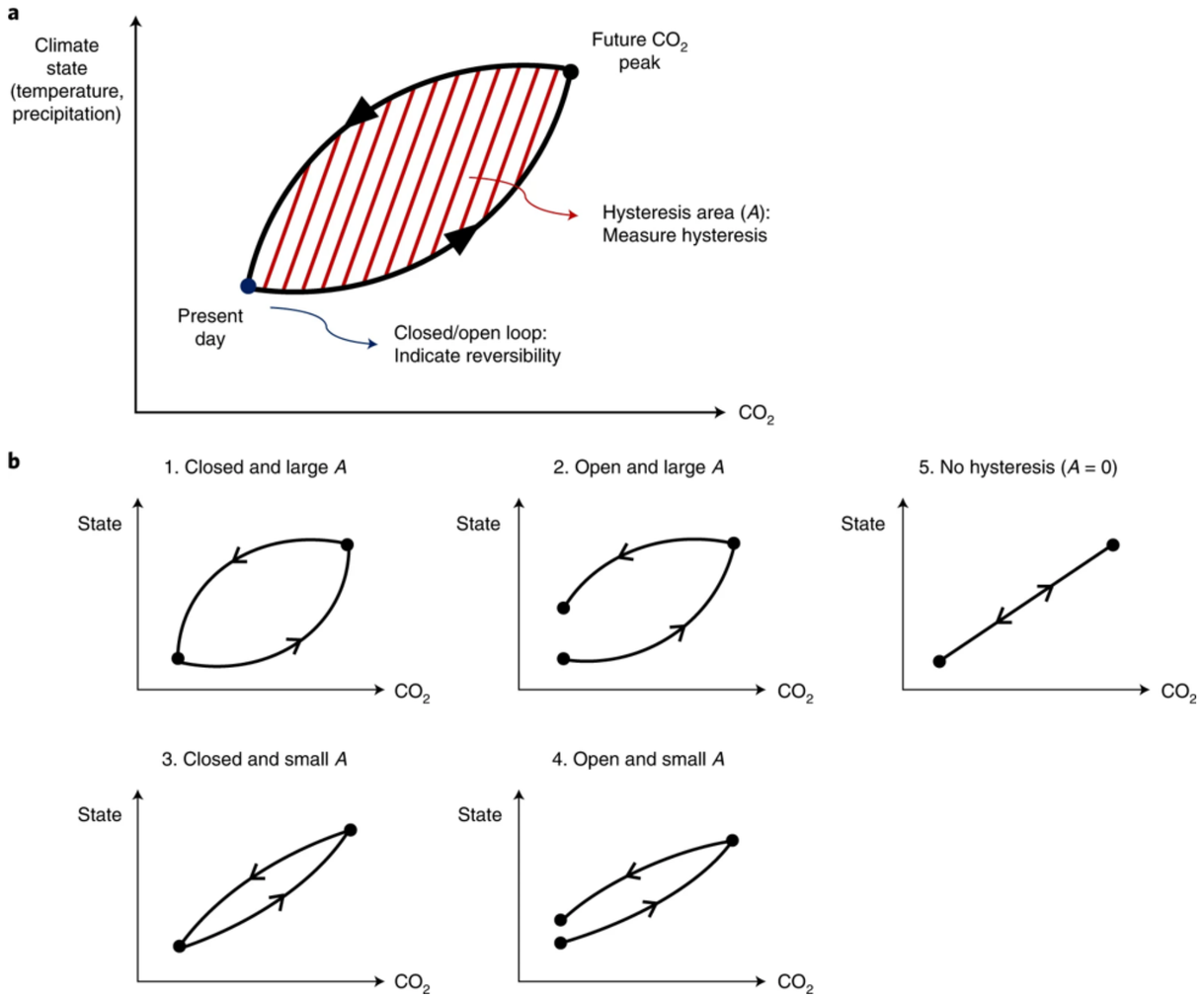
The implications of overshoot depend on humanity's next steps



- Overshoot is inevitable, but the consequences of overshoot will depend on a few factors.
- The longer we stay above 1.5°C and the higher the peak level of global warming are likely to worsen climate impacts in the short and long-term.
- Currently, we don't have enough information to understand the impacts of overshoot comprehensively.

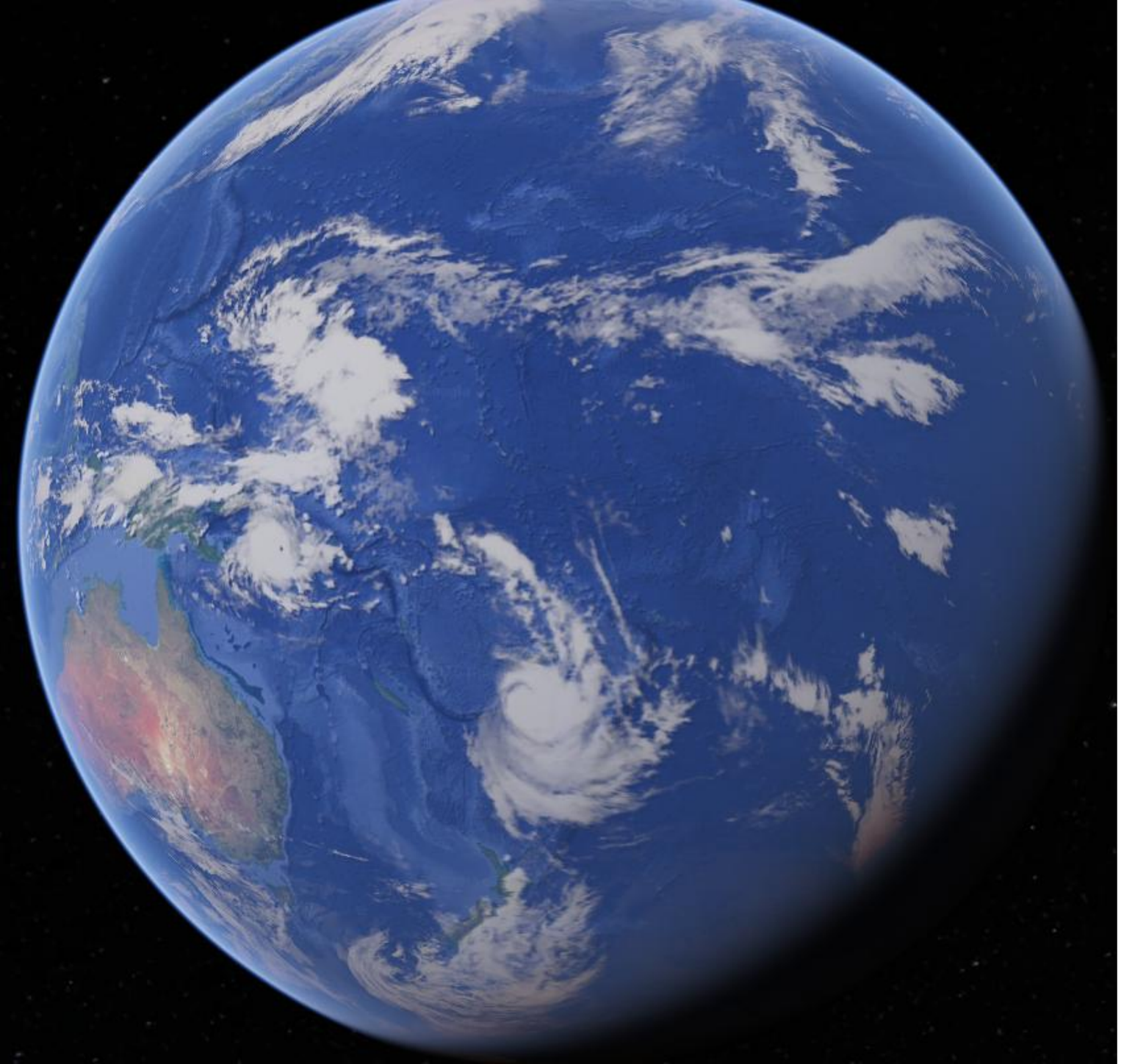
Source: Spencer Clark

The implications of overshoot depend on humanity's next steps



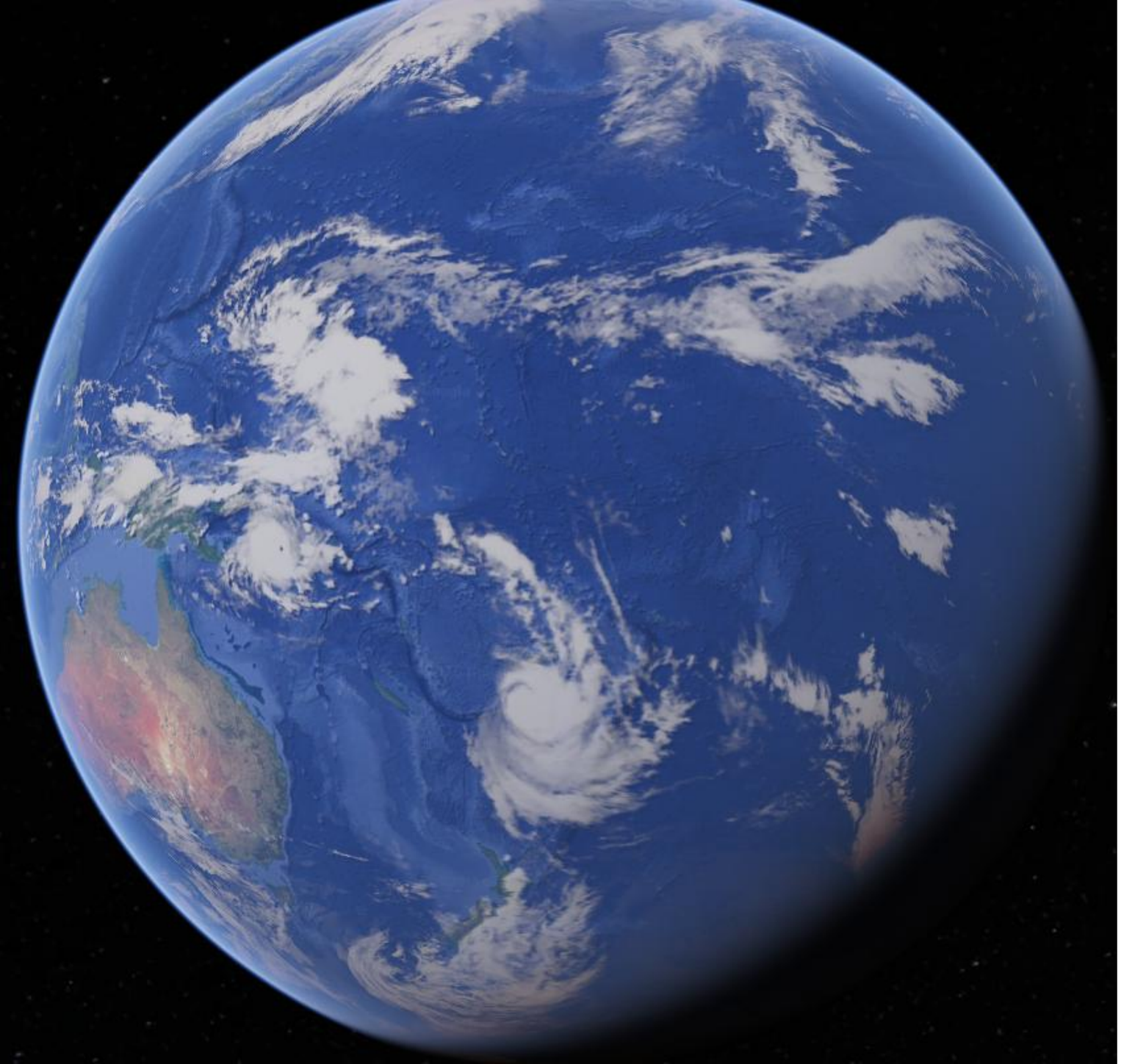
- While global temperature has a near linear relationship with cumulative greenhouse gas emissions, this isn't true for all aspects of the Earth system.
- Many aspects of the climate are likely to experience ***hysteresis***.
- This means taking different pathways to getting back to 1.5°C will affect the behaviour of those climate variables for centuries to come.

Source: Kim et al. (2022)



What does this mean for the Pacific?

Source: Google Earth



What does this mean for the Pacific?

- Unfortunately, sea level rise will be greater if we have a larger, longer overshoot.
- Sea level rise will continue until we bring global temperatures back down towards pre-industrial levels.
- Ocean warming and acidification worsen with overshoot.
- Antarctic sea ice extent would also decrease more if we have greater overshoot.
- More modelling is needed to understand the effects of overshoot on El Niño/La Niña, tropical cyclones and the South Pacific Convergence Zone.

Source: Google Earth

Summary

- Overshoot is increasingly inevitable, but the consequences of overshoot depend on what humanity does next.
- Greater emissions reduction now will have long-term benefits for many centuries to come.
- There's still a lot we don't know about overshoot but we know enough to say that limiting its peak and duration is critical.

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Looking Forward Long-Term: Rainfall, temperature and future ENSO

Leanne Webb
CSIRO

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Looking Forward Long-Term Rainfall and Air Temperature

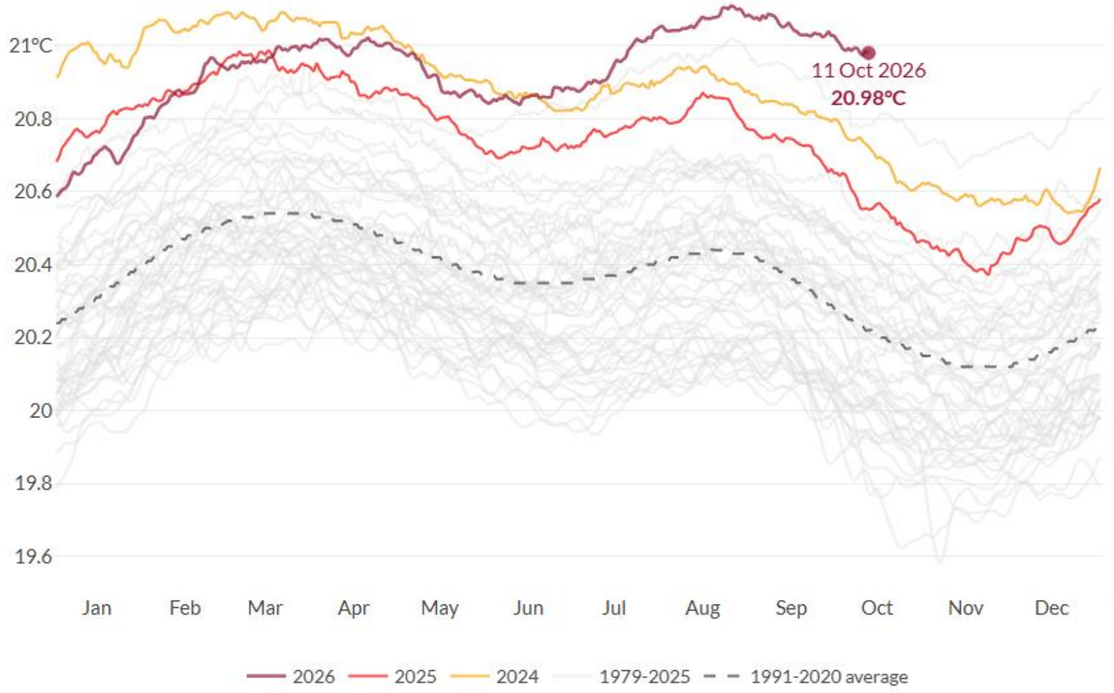
- As increasing greenhouse gases trap more outgoing radiation, more energy remains within the global climate system:
  - Warmer, more hot days and nights, more high temperature extremes
  - Fewer cold days
  - More marine heat waves / coral bleaching
  - Increased sea level due to thermal expansion/ glacier - ice melt
  - Coastal inundation is exacerbated by sea level rise
  - Warmer air, more moisture holding capacity…extreme precipitation events are likely to become more intense.
  - Changed rainfall patterns
- And in addition to this background change, we have climate variability….
  ……mainly driven by ENSO in the Pacific region

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Absolute | Anomalies

Sea surface temperature (60°S-60°N)

Daily average • Data: ERA5



Credit: C3S/ECMWF

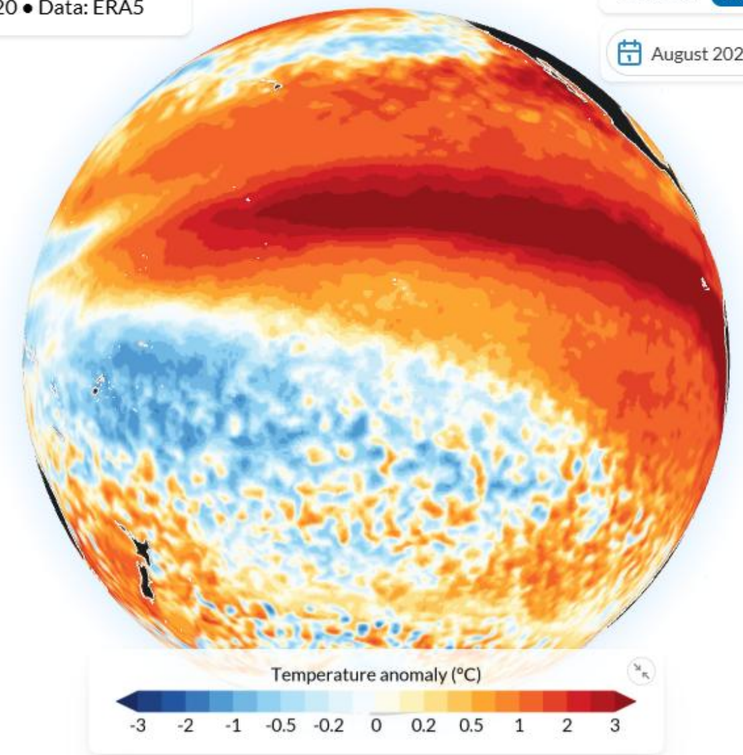
Absolute | Anomalies

Sea surface temperature anomaly

Baseline: 1991-2020 • Data: ERA5

Daily 2023-2026 | Monthly 1979-2026 | Annual 1979-2025

August 2026



Credit: C3S/ECMWF

Climate Pulse - Near real-time updates of global climate variables

Some recent stronger El Niño events

- During very strong El Niño events, such as in 1997/8 and 1982/3, the dominant rainfall bands; the SPCZ and ITCZ, moved towards the equator and merged into one convergence zone.
  - This led to lower-than-normal rainfall in Nauru and the western part of Kiribati (Gilbert Islands) rather than the above-average rainfall that El Niño normally brings.
  - In many countries (including FSM and the southern Marshall's in the north-west, and Samoa, Niue and the southern Cook Islands in the south-west Pacific) the rainfall in these extreme El Niño years was much lower than normal, and it was significantly drier than other El Niño years.
- It will be interesting to see how this 2026/7 El Niño unfolds.

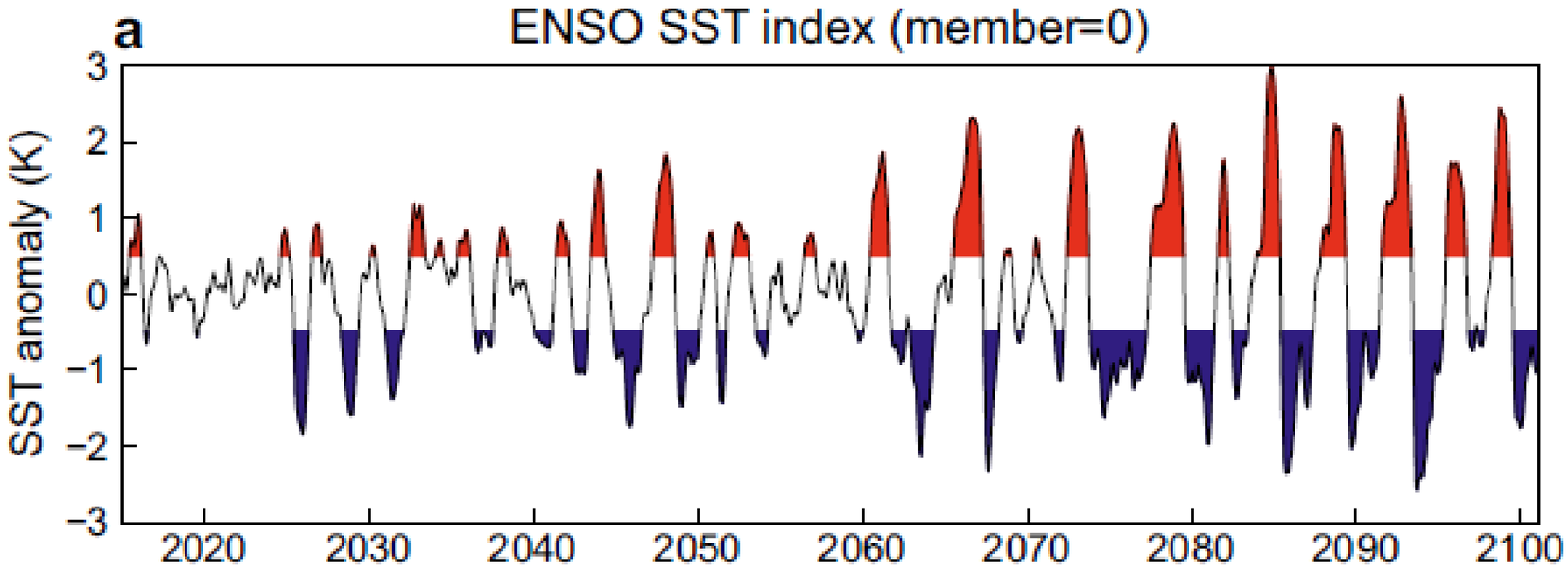


PACCSAP, 2015 Adventures of the Climate Crab | Pacific Climate Change Science | Pacific Climate Change Science

Future El Niño-Southern Oscillation

Despite the profound influence of the ENSO on the global climate system its response to greenhouse warming **remains uncertain**.

- One recent study indicates a projected increase in ENSO SST variance as well as in ENSO regularity, i.e., a tendency from an intermittent to a more cyclic ENSO behaviour (Steuker et al. 2025)

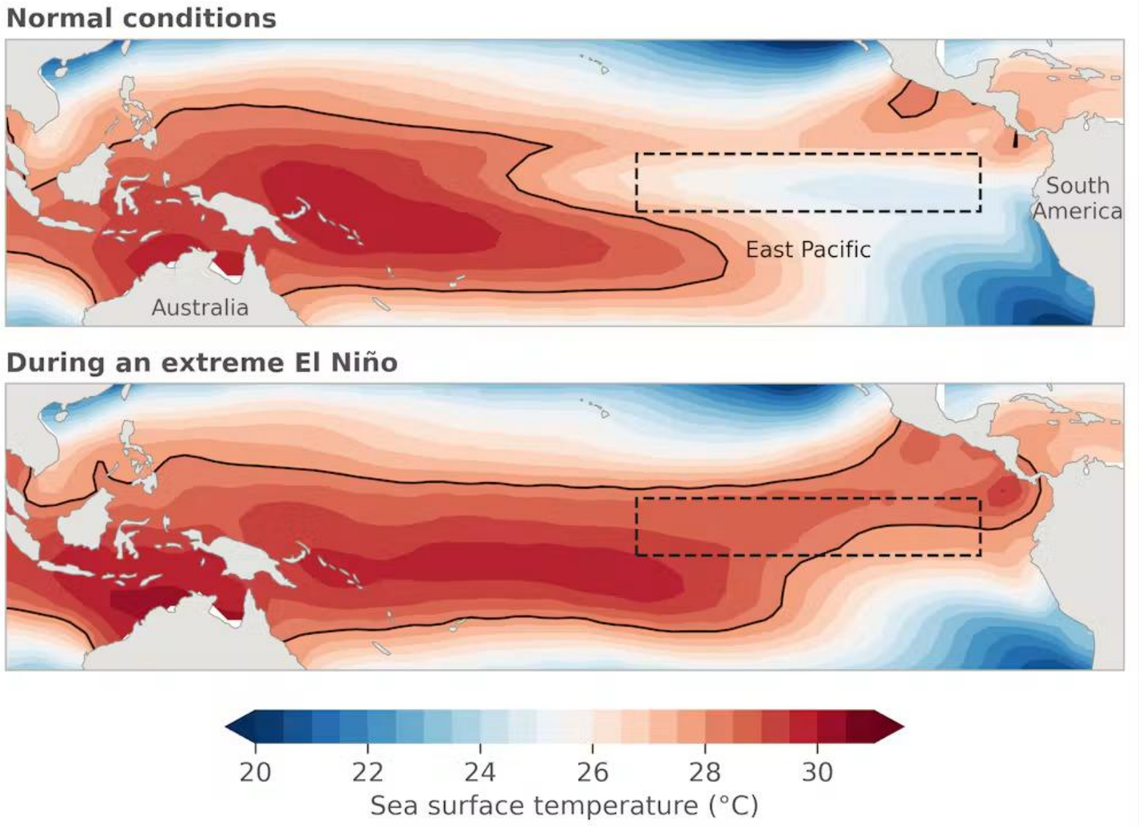


https://doi.org/10.1038/s41467-025-64619-0

Future El Niño-Southern Oscillation

Another recent study (Sengupta et al 2026):

- Under continued warming, climate models show the eastern Pacific warming faster than the west, reducing the temperature difference that creates the ‘typical’ El Niño / La Niña weather characteristics *
- Under these circumstances, the ‘mean-state’ of the Pacific Ocean becomes more ‘El Niño-like’
- Modelling is indicating this ‘mean-state/ El Niño-like’ pattern will persist for centuries, rather than recovering, even after emissions reach net zero.
- Under these conditions, a sustained equatorward shift of the tropical convergence zones and elevated frequency of extreme El Niño events, well above pre-industrial levels, is projected.
- In this study, changes in ENSO amplitude are less robust, non-monotonic and model-dependent.



*Scientists are yet to observe this happening, with the eastern Pacific even cooling in recent decades.

Extreme El Niños are coming. Reaching net zero sooner means facing fewer of them

Future El Niño-Southern Oscillation

Despite the profound influence of the ENSO on the global climate system its response to greenhouse warming **remains uncertain**.

We do know:

- In future, there may be more extreme El Niños and La Niñas.
- While TC occurrence is projected to decrease over the south-west Pacific region, more TCs are projected during future El Niño events compared with historical El Niño conditions, with fewer TCs during future La Niña events compared with historical (Chand et al, .
- An increase in the variability of SST will translate to an increase in the frequency and magnitude of marine heatwaves.
- It is likely that greenhouse warming will enhance El Niño related sea level extremes, potentially leading to coastal flooding occurring sooner than expected due to sea level rise alone.

In the Pacific, continued climate changes are likely to exacerbate existing challenges such as food and water insecurity, displacement of coastal communities, and damage to infrastructure and ecosystems.
Adaptation strategies such as strengthening infrastructure and building resilience in vulnerable communities can help Pacific countries cope with the impacts of climate change.

Summary

- Overshoot of 1.5 deg C is increasingly inevitable, but the consequences of overshoot depend on what humanity does next.
- Greater emissions reduction now will have long-term benefits for many centuries to come.
- There's still a lot we don't know about overshoot but we know enough to say that limiting its peak and duration is critical.
- As increasing greenhouse gases trap more outgoing radiation, the climate system is responding accordingly e.g. warmer, increasing sea levels, changed/ more extreme rainfall
- Projections indicate an elevated frequency of extreme El Niño events across many studies.
- Despite the profound influence of the ENSO on the global climate system its response to greenhouse warming **remains uncertain**.

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Contact

andrew.king@unimelb.edu.au

leanne.webb@csiro.au



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