

Tropical cyclones and climate change

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Tropical cyclones are extreme weather events which usually occur in summer and early autumn. These storms form as low-pressure weather systems over tropical oceans, bringing strong winds, intense rainfall, large waves and coastal storm surges. Their strength and size means they can threaten lives and damage property across wide areas.

Australia has recently experienced the first cyclone to impact southeast Queensland in more than 50 years. Cyclones have usually occurred in northern Queensland and in tropical waters off Australia's coast. It is uncommon for these storms to occur as far south as Cyclone Alfred did.

Cyclone Alfred has raised questions about the role of climate change in affecting the frequency, severity and impacts of extreme weather events.

Was Cyclone Alfred unusual?

A cyclone is a very concentrated storm that rotates in a cyclical pattern, feeding on itself to build power. Cyclones typically break apart and lose power as they drift towards the earth's north or south poles, because of wind patterns. This means that tropical storms tracking along the Queensland coast tend to get weaker and steer out to sea, especially by the time they reach Brisbane's latitude.

In Alfred's case, the cyclone did not break apart where such storms usually do. Because of atmospheric and ocean conditions, it turned inland and made landfall at Moreton Island as a Category 1 storm. When cyclones pass through major population centres, this amplifies their risks to life and property.

Scientists will need time to assess why Alfred appears to have behaved unlike most other cyclones in the region. There is more to learn about how the warming atmosphere and oceans play a role in modifying storms and making them behave differently from those in the past.

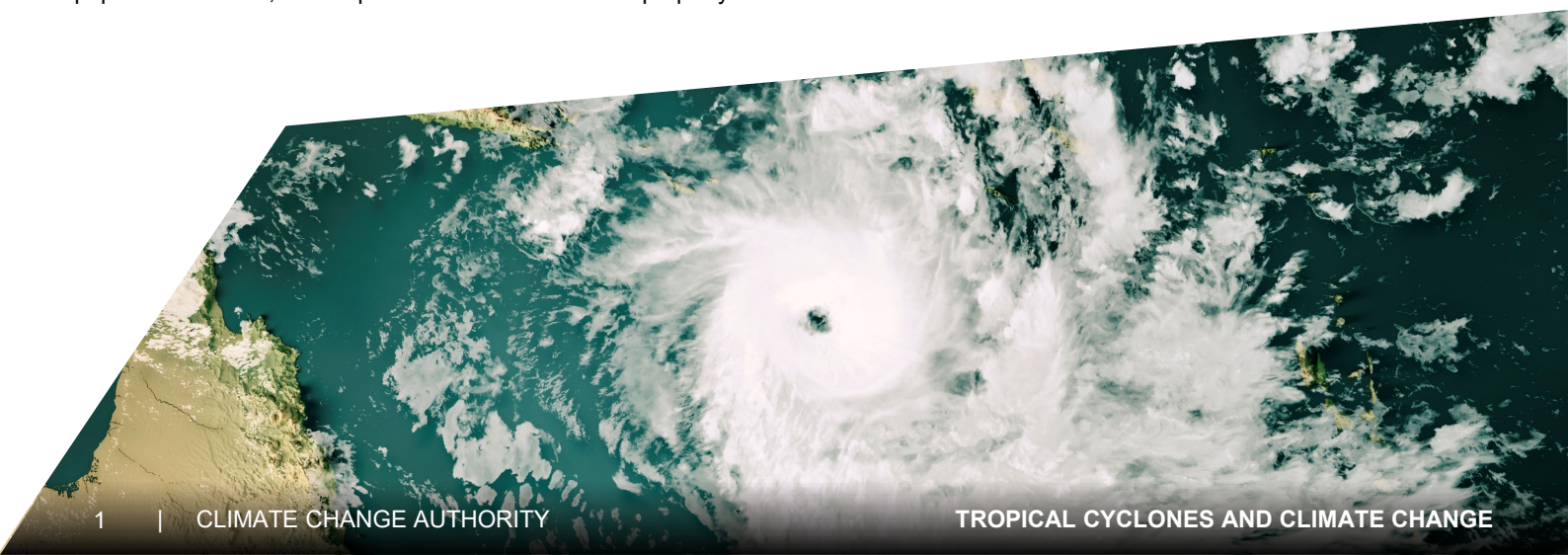
How is climate change affecting cyclones?

Our atmosphere, land and oceans are warming, primarily due to greenhouse gas emissions from human activities. Scientists have confirmed 2024 was the hottest year on record globally.¹ The latest State of the Climate report shows Australia's average land surface temperature has increased by about 1.5 degrees Celsius (°C) since 1910.²

The oceans around Australia have warmed by about 1.1 °C since 1900. Recent increases in sea surface temperatures have 9 of the 10 warmest years on record occurring since 2010.²

These warming trends are having wide-ranging effects on global weather, including the characteristics and impacts of cyclones.

For example, a warmer atmosphere can hold more water vapour than a cooler one, leading to heavier rainfall.³ Warmer oceans can also provide more energy for tropical storms and cyclones⁴, while potentially expanding the area of ocean over which tropical cyclones can form.⁵



What does science say about future cyclone risks?

Anticipating the future frequency, severity, locations and impacts of tropical cyclones and other types of extreme weather is a high priority for climate researchers.

It is difficult to predict these complex weather events, but some clear patterns and risks have emerged from decades of research in Australia and globally:

- **More intense rainfall** – When cyclones do happen, they will bring heavier rainfall that drops large amounts of water onto affected areas quickly, increasing the risk of flash flooding.
- **More coastal flooding** – As sea levels rise, the risk of major flooding for communities in coastal areas will continue to increase because cyclone storm surges can push large amounts of water inland.
- **Increasing storm intensity and impacts** – a greater *proportion* of tropical cyclones are likely to be severe storms, drawing damaging power from a warmer atmosphere and oceans.
- **Fewer total tropical cyclones** – modelled projections indicate a lower absolute *number* of tropical cyclones in future, however those that do occur are likely to be more severe.⁶

Cyclones which affect built-up areas put more lives at risk and cause more economic damage.⁷ More Australians now live along our coasts in denser communities, and this trend is expected to continue as the population keeps growing.

Climatic trends may mean cyclones travel farther south more often in the future, as Cyclone Alfred did. This would amplify the risks and costs to more communities, properties and infrastructure.

Climate change is not just a distant risk but a pressing reality here and now for many Australians.

The best way to stop impacts getting worse and worse is to stop further climate warming. And the best way to halt warming is to reduce greenhouse gas emissions as much and as quickly as possible.

With scientists predicting growing impacts even with current climatic trends and the emissions that have already occurred, improving the resilience of communities and our built environment is of utmost importance.

Rapid emissions reductions and innovative adaptation measures are both critical to Australia weathering the kinds of storms we face and realising a prosperous and resilient future.

¹ World Meteorological Organization. (2025). 'WMO confirms 2024 as warmest year on record at about 1.55°C above pre-industrial level'. WMO Website. Accessed 07 March 2025 from <https://wmo.int/news/media-centre/wmo-confirms-2024-warmest-year-record-about-155degc-above-pre-industrial-level>

² Bureau of Meteorology & CSIRO. (2025). 'State of the Climate 2024'. Bureau of Meteorology Website. Accessed 07 March 2025 from <http://www.bom.gov.au/state-of-the-climate/>

³ Adam, D. (2023). 'What a 190-year-old equation says about rainstorms in a changing climate'. *Earth, Atmospheric and Planetary Sciences*, 120(14). <https://doi.org/10.1073/pnas.2304077120>

⁴ Ramsay, H. (2025). 'Here are seven things to know about tropical cyclones'. CSIRO Website. Accessed 07 March 2025 from <https://www.csiro.au/en/news/All/Articles/2025/March/things-to-know-about-tropical-cyclones>

⁵ Studholme, J. (2021). 'Poleward expansion of tropical cyclone latitudes in warming climates'. *Nature Geoscience*, 15(1), 14-28. <https://doi.org/10.1038/s41561-021-00859-1>

⁶ Bureau of Meteorology & CSIRO. (2025). 'State of the Climate 2024'. Bureau of Meteorology Website. Accessed 07 March 2025 from <http://www.bom.gov.au/state-of-the-climate/>

⁷ Insurance Council of Australia. (2025). 'Historical Normalised Catastrophe list – January 2025'. Insurance Council of Australia Website. Accessed 07 March 2025 from <https://insurancecouncil.com.au/industry-members/data-hub/>

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