

SUMMER OUTLOOK 2024-25:

Navigating a volatile and unpredictable climate



KEY INSIGHTS

The 2024-25 Australian summer is shaping up to be hotter, wetter and more chaotic.

- Heatwaves and extreme heat with little reprieve overnight are on the cards for many Australians. The Bureau is expecting above average maximum temperatures for large parts of Australia, and above average minimum temperatures across almost all of Australia. There is an increased chance of unusually high maximum temperatures across Tasmania, western WA, parts of south-eastern South Australia and western Victoria.
- We could see intense rainfall and possible flooding in parts of eastern and north-western Australia. December is being forecast to be particularly wet, with unusually high rainfall tipped for parts of Queensland's coast, Cape York Peninsula, southern New South Wales, eastern parts of Victoria, Tasmania and South Australia, northern Western Australia and parts of the interior.
- Last summer highlighted the complex interaction of different climate drivers against the backdrop of a rapidly overheating planet. Our weather is now more extreme and erratic, because of pollution from the burning of coal, oil and gas, and we need to be prepared for anything.

Climate pollution from coal, oil and gas has overheated our planet, and changed the rulebook. History may no longer be the best guide for what's next.

- By digging up and burning coal, oil and gas, humans are overheating our planet and have tipped our Earth System out of balance. Last year was the hottest year on record, and it is almost certain that 2024 will eclipse it.
- Everything we experience today is an ocean-atmosphere system made hotter, wetter and more energetic by burning fossil fuels. So when storms or tropical cyclones develop they have the potential to become more destructive.
- Fire weather is being supercharged by higher temperatures, stronger winds and shifts in rainfall that make vegetation drier and fire seasons longer and more destructive. This also shrinks windows when it is safe or possible to do hazard reduction burning.
- Extreme rainfall and flooding is now possible in any year, even if climate drivers like El Niño load the dice towards drier conditions.
- Ocean surface temperatures broke records in the first half of 2024. Marine heatwaves are occurring more often, and lasting longer, which threatens fragile ecosystems like the Great Barrier Reef and Ningaloo.

We are now at higher risk of compounding events - multiple extreme events that occur at the same time, or in rapid succession, in different parts of the country.

- As the frequency of different types of unnatural disasters increases, so too does the likelihood of multiple events coinciding. For example, immediately following the Black Summer bushfires in New South Wales, people impacted by fires faced multiple flood emergencies over the following two years, seriously impacting community recovery.
- Compounding events place enormous strain on our communities, emergency responders, economy and nature.
- Extreme weather conditions to be prepared for this summer include heatwaves, powerful tropical cyclones, heavy rainfall and flooding. Dry periods and forecast hotter-than-average days and nights also raise concern for summer fires in the south west and far west of Victoria as well as parts of the northeast and Mornington Peninsula, parts of South Australia's lower coastal southeast region and lower Eyre Peninsula, Western Australia's southeastern coastline and central west, as well as central western and southern New South Wales.

This new era of climate-fuelled unnatural disasters is endangering all Australians, and making disaster and emergency management much more difficult and expensive.

- While long-range forecasters are usually very good at predicting average conditions over a given period, it is much harder to predict when and where short duration weather events - such as very intense downpours or thunderstorms - are going to strike.
- Australians are already experiencing climate whiplash, as they ricochet from one unnatural disaster to the next, with little time to prepare or recover.
- The further and faster we cut climate pollution this decade, the better the prospects for all Australians.
- Governments also need to focus on disaster preparation, response and recovery in the near-term, so emergency services, communities and households are all better equipped for and protected from escalating climate risks. This must include further investment in climate and weather information services to make sure we get the most accurate and up-to-date information possible.

INTRODUCTION

Climate pollution is making our weather more volatile and unpredictable. Summer is no longer a season of fun. It can also be a season of dread.

This Climate Council briefing paper summarises key findings of the Bureau of Meteorology's summer 2024-25 long-range forecast and the National Council for Fire and Emergency Services' (AFAC) Seasonal Bushfire Outlook Summer 2024. It describes record-breaking global temperatures and the influence of climate pollution on extreme weather events. The briefing then unpacks how our weather is becoming more volatile and unpredictable in a supercharged climate.

Extreme weather conditions to be prepared for this summer include heatwaves, powerful tropical cyclones, heavy rainfall and flooding (BoM 2024a, BoM 2024b). Dry periods and forecast hotter than average days and nights raise concerns for summer fires in parts of southern Australia (AFAC 2024).

Over summer, Australia could experience compound events - multiple extreme events at any one time – concurrently or in rapid succession – in different parts of the country (King 2024). For example, some families made homeless during the 2019-2020 Black Summer bushfires were hit by floods when the fires were extinguished by record downpours.

In a hotter, wetter and more energetic atmosphere, our climate has become more volatile. History is no longer a reliable guide for what to expect next. Climate drivers – recurring phenomena such as El Niño/La Niña, the Southern Annular Mode, and the Indian Ocean Dipole – may be interacting in complex new ways making predictions more difficult. Rising ocean temperatures are affecting rainfall patterns. Extreme events are becoming more intense, more common, and less predictable. We are poorly prepared for these changes, and still doing far too little to tackle the root cause of climate pollution: the relentless extraction and use of coal, oil and gas.

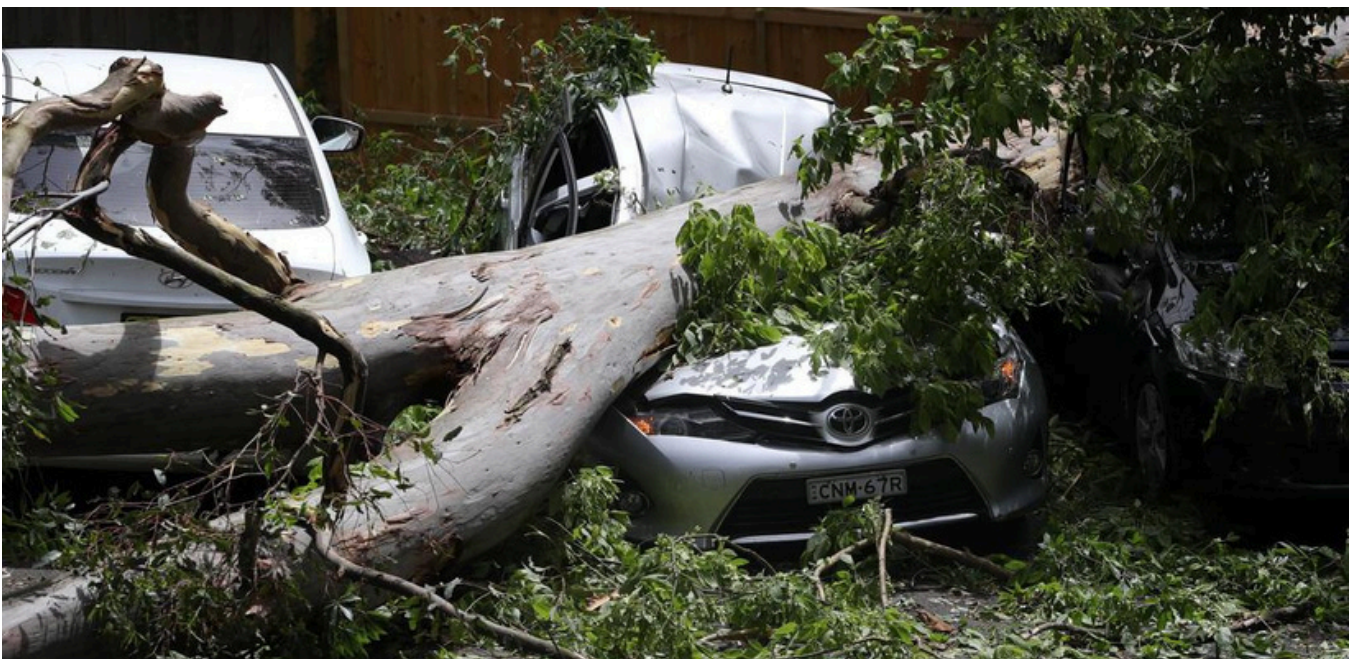


Image 1: Tree crushes car during Sydney storm, December 2024.

Box 1: Important lessons from the 2023-24 summer

- Conditions have become more difficult to predict. The 2023-24 summer highlighted the complex interaction of different natural climate drivers against the background of a rapidly warming planet.
- Everything we experience today takes place in an ocean-atmosphere system made hotter, wetter and more energetic. Our weather is more extreme and erratic. When storms develop they have the potential to become more destructive. Fire weather has been supercharged by higher temperatures, stronger winds and shifts in rainfall making vegetation drier and fire seasons longer and more destructive.
- Extreme rainfall and flooding is possible in any year, even if the climate drivers including El Niño have loaded the dice towards drier conditions. Communities need to be in a constant state of readiness.
- While recent rains have lowered immediate bushfire risk in some parts of the country, there are no grounds for complacency and it is only a matter of time before we see a return to very dangerous fire conditions. Years of rain have weighted the scales toward more extreme fires, as prolific growth provides more fire fuel, and erratic weather conditions reduce opportunities for hazard reduction burning.
- It is critical that every Australian stay up-to-date with the latest weather warnings.

Source: Adapted from Climate Council 2023



Image 2: Cyclone Jasper, supercharged by climate pollution, leaves destruction in its wake. The community of Holloways Beach in Far North Queensland was among the worst hit by flooding, with more than 150 people needing urgent help.

SUMMER 2024-25 FORECAST

This summer is likely to be hot, with a wet start to the season for large parts of the country, a chance of intense tropical cyclones developing up north, and fire hot spots in parts of southern Australia.

Near record warm global ocean temperatures are making our weather volatile and unpredictable.

Summer is to be respected and we need to be vigilant for the sudden onset of unnatural disasters.

The Bureau of Meteorology's long-range forecast for December 2024 to February 2025 (BoM 2024a) outlines the following likely summer conditions:

- Above average rainfall is likely for most of Australia, particularly during December.
- An increased chance of unusually high rainfall for parts of eastern and north-western Australia.
- Warmer than average days are likely across large parts of the country.
- Warmer than average nights are very likely across almost all of Australia with unusually high overnight temperatures for much of northern, eastern and western Australia.



Image 3: Townsville flood, 2019.

TEMPERATURE

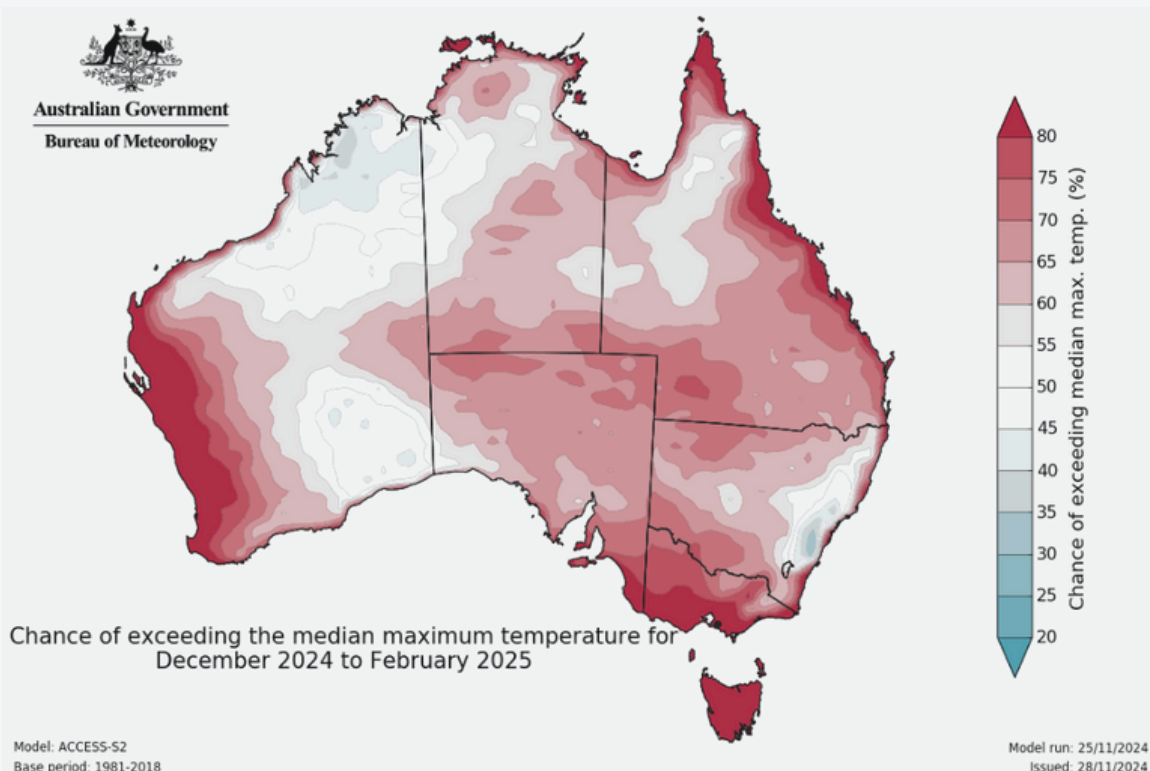
Heatwaves and extreme heat with little overnight cool weather reprieve are on the cards. The Bureau's summer outlook shows that much of the country is likely to experience warmer than average days, and unusually high overnight temperatures for much of northern, eastern and western Australia (BoM 2024a). Specifically:

- Above average maximum temperatures are likely to very likely (60% to greater than 80% chance) for large parts of Australia, while above average minimum temperatures are very likely across almost all of Australia.
- Maximum temperatures are likely to be within the typical range for the season for large parts of central and eastern NSW, eastern parts of WA, south-west SA, the central NT, and southern Cape York Peninsula in Queensland.
- There is an increased chance (up to 3.5 times the normal chance) of unusually high maximum temperatures across Tasmania and western WA and parts of south-eastern SA and western Victoria.

- There is an increased chance of unusually high minimum temperatures¹ across Australia, particularly in the north and large areas in the east and west of the continent (where the likelihood is more than four times the normal chance).
- For December alone, maximum temperatures are likely to very likely (60% to greater than 80% chance) to be below average for eastern WA, most of the NT and parts of inland Qld, and likely to very likely (60% to greater than 80% chance) to be above average for western WA and parts of south-east Australia. Elsewhere, maximum temperatures are likely to be in the typical range for the season.
- There is an increased chance of unusually low maximum temperature for the Pilbara and Kimberley districts in WA in December (up to 3.5 times the normal chance).

Source: Bureau of Meteorology 2024a

Figure 1: Chance of above average temperature across most of Australia this summer.



¹ Unusually high maximum and minimum temperatures are those in the warmest 20% of December to February days and nights, respectively, between 1981 and 2018.

² Unusually low maximum temperatures are those in the coolest 20% of December day temperatures between 1981 and 2018.

RAINFALL

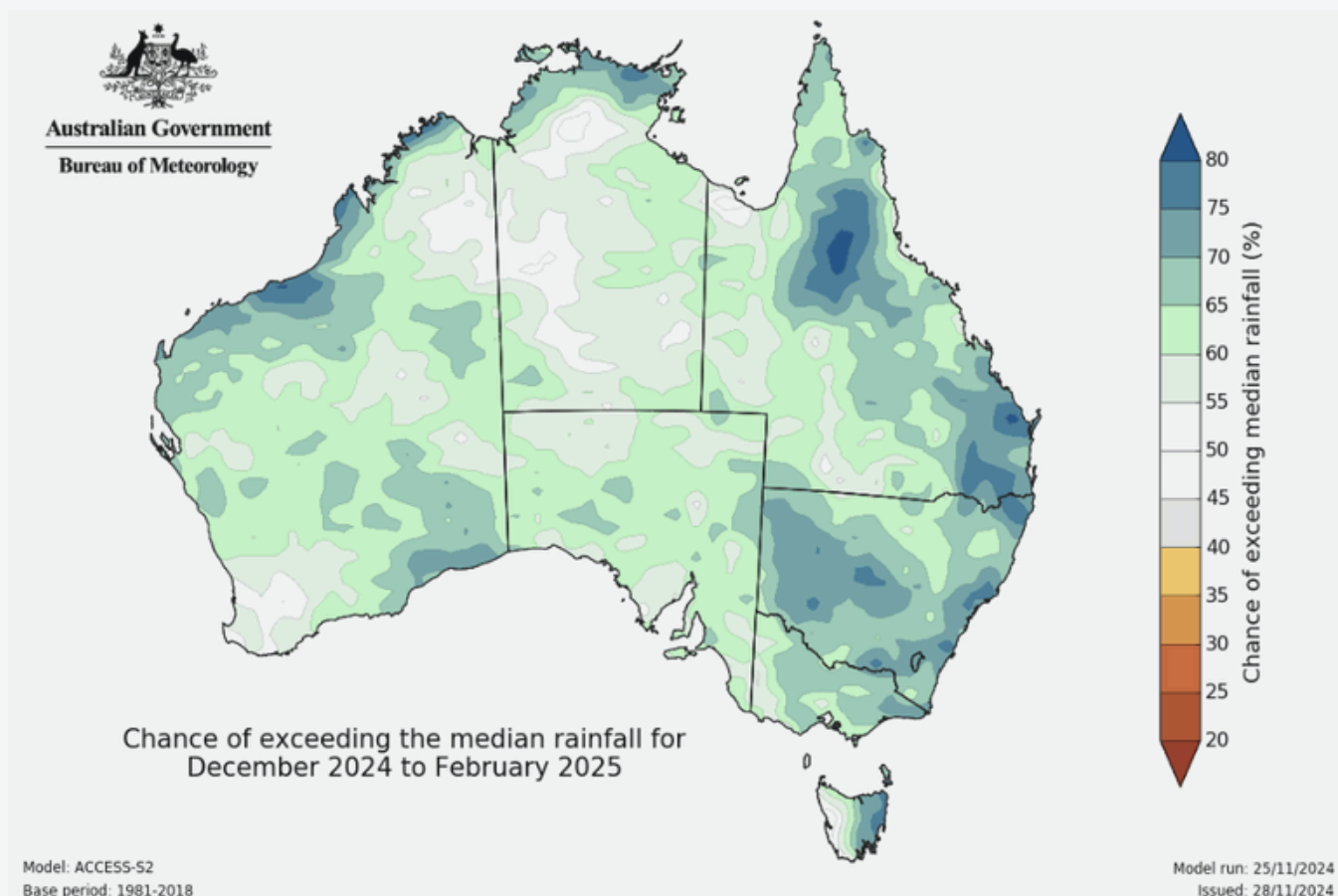
We could see intense rainfall and possibly even flooding in parts of eastern and north-western Australia. The Bureau forecasts above average rainfall is likely for most of Australia, particularly during December, and an increased chance of unusually high rainfall for parts of eastern and north-western Australia (BoM 2024a). Specifically:

- Rainfall is likely (60 to 80% chance) to be above average for much of eastern Australia – including eastern Tasmania, and much of Queensland, NSW and Victoria – and large parts of South Australia, Western Australia and northern NT.

- There is an increased chance of unusually high rainfall³ for parts of Queensland's coastal regions and Cape York Peninsula, southern NSW, eastern parts of Victoria, Tasmania and SA, northern WA and parts of the interior.
- The highest chance of above average rainfall for the season is forecast for December, with almost all of Australia likely to experience above average rainfall.
- The chance of above average rainfall generally decreases as the summer progresses. January rainfall is likely to be within the typical range for the month across most of Australia.

Source: Bureau of Meteorology 2024a.

Figure 2: Chance of above average rainfall (Dec 2024 to February 2025)



³ Unusually high rainfall is defined as the highest 20% of December to February rainfall observations from 1981 to 2018.

BUSHFIRES

Bushfires are always a risk in southern parts of Australia during summer. This summer, the Australasian Fire and Emergency Services Authorities Council has warned of an increased risk of fire for large areas of the country.

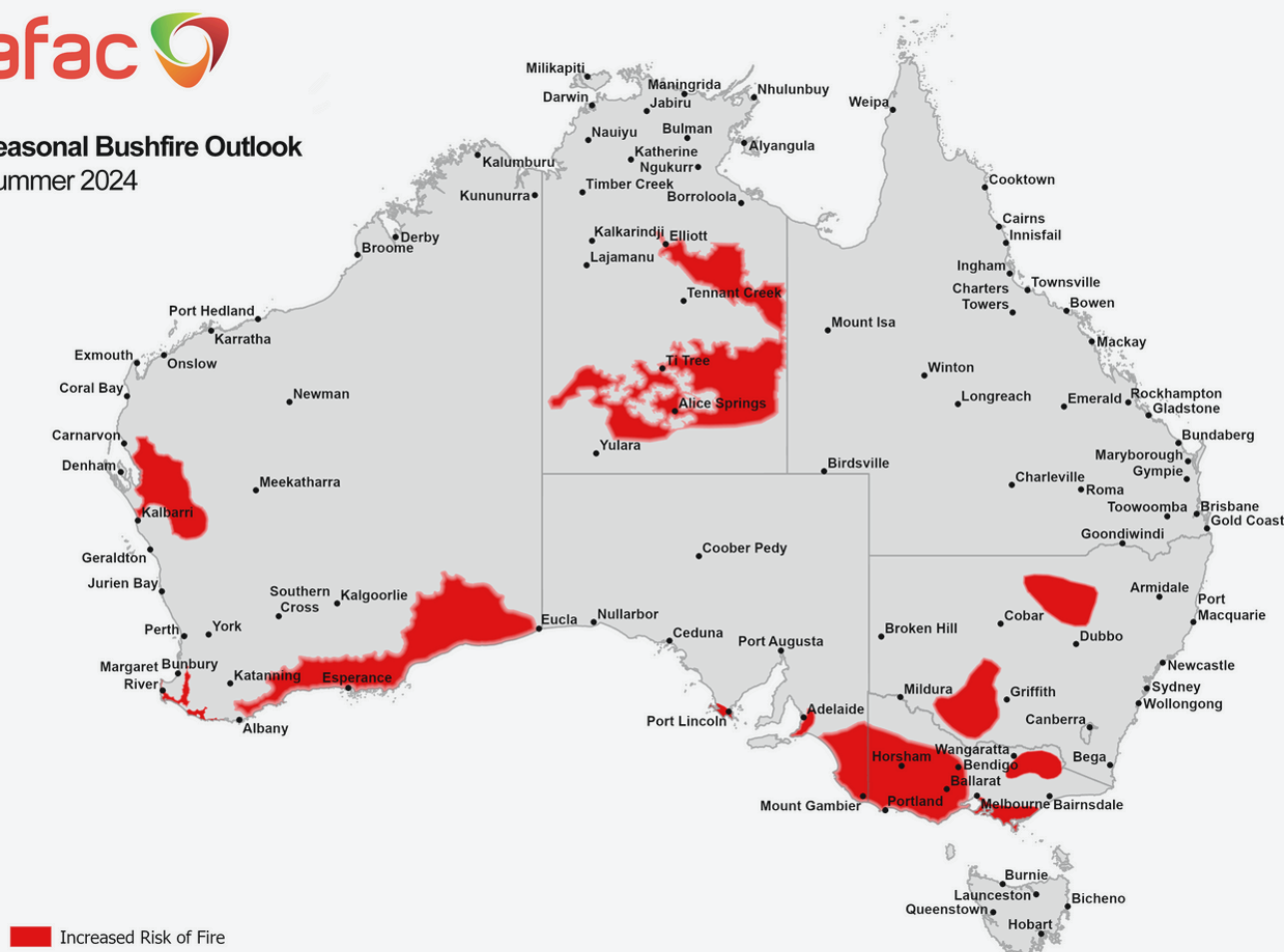
In southwest areas – specifically, Western Australia's southeastern coastline and central west, and parts of South Australia's lower coastal southeast region and lower Eyre Peninsula – there is an increased risk of fire.

Further east, large areas of the southwest and far west of Victoria, parts of the northeast and the Mornington Peninsula in southwest Gippsland, have an increased risk of fire. Moving north, central northern and central southern New South Wales are also predicted to see above normal fire potential this summer (AFAC 2024). Most of these areas have high levels of grassland fuels following previous rains. Even if it rains, grass can dry out rapidly and burn intensely after just a few days of heatwave conditions.

Figure 3: Seasonal Bushfire Outlook Summer 2024



Seasonal Bushfire Outlook Summer 2024



TROPICAL CYCLONES

Since 1982, there has been a decrease in the number of tropical cyclones observed for Australia. With continued warming due to the burning of coal, oil and gas, it is expected that the decline in cyclones will continue, but those that do occur are likely to be more intense (CSIRO and Bureau of Meteorology 2024).

COMPOUND EVENTS

Over summer, Australia could experience compound weather and climate events - multiple extreme events at any one time – concurrently or in rapid succession – in different parts of the country (King 2024). As the frequency of unnatural disasters increases, so too does the likelihood of multiple events coinciding. Such events - known as compound risk or compound events - place enormous strain on our communities, emergency services, our economy and the natural environment.

“As the frequency of major events like bushfires, droughts and floods increases, so too does the likelihood of multiple events coinciding. This leads to the impacts of those events compounding on each other...The consequences of these impacts cascade through our communities, affecting our highly interconnected economic activities, technological services and natural environments – the systems we rely on.” Dawkins 2022

With the possibility of powerful tropical cyclones forming because of the warmer than average ocean temperatures forecast for the Australian region in the coming months, Australian summer 2024-25 could be a prelude to the future (BoM 2024b).

Disaster resilience, or the ability to bounce back after taking a hit, degrades when communities are hit by a succession of unnatural disasters. Communities lose capacity to get back on their feet, local governments run out of money (for example, to fix damaged roads) and the ability of other levels of government to assist in response and recovery efforts reduces as their capabilities are stretched over wide areas for long periods. Many communities devastated by the Black Summer bushfires had to endure three years of record rains and floods immediately after the record fires.

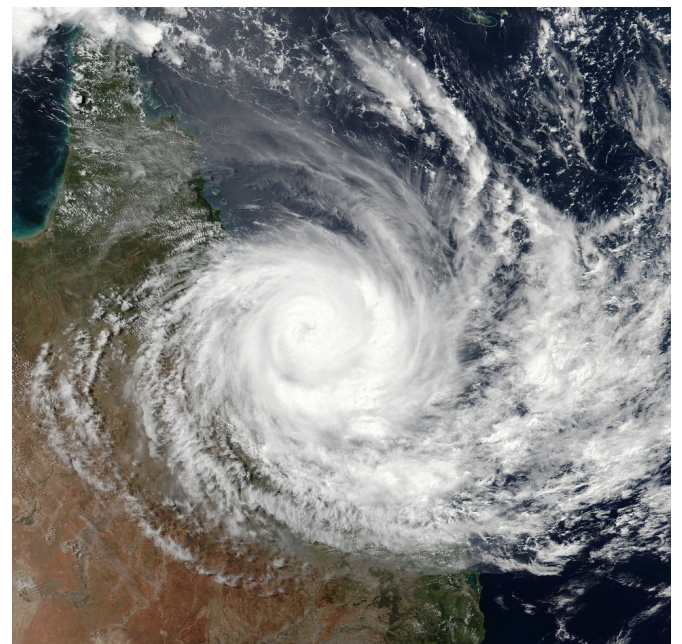


Image 4: Tropical Cyclone Debbie making landfall over the north Qld coast.

RECORD LEVELS OF CLIMATE POLLUTION AND GLOBAL WARMING

Digging up and burning coal, oil and gas has profoundly altered the Earth's carbon cycle, by drawing huge quantities of carbon out of long-term underground storage, burning it and pumping pollution into our atmosphere. This has tipped our Earth System out of balance and blanketed the planet in pollution that traps heat.

It is virtually certain that 2024 will be the hottest year ever recorded (WMO 2024). October 2024 was 1.65°C above pre-industrial level, marking the 15th month in a 16-month period with average temperatures above the 1.5°C threshold set by the Paris Agreement (Copernicus 2024). Looking slightly further back into our recent history, the past 10 years have already been the hottest 10 years ever recorded.

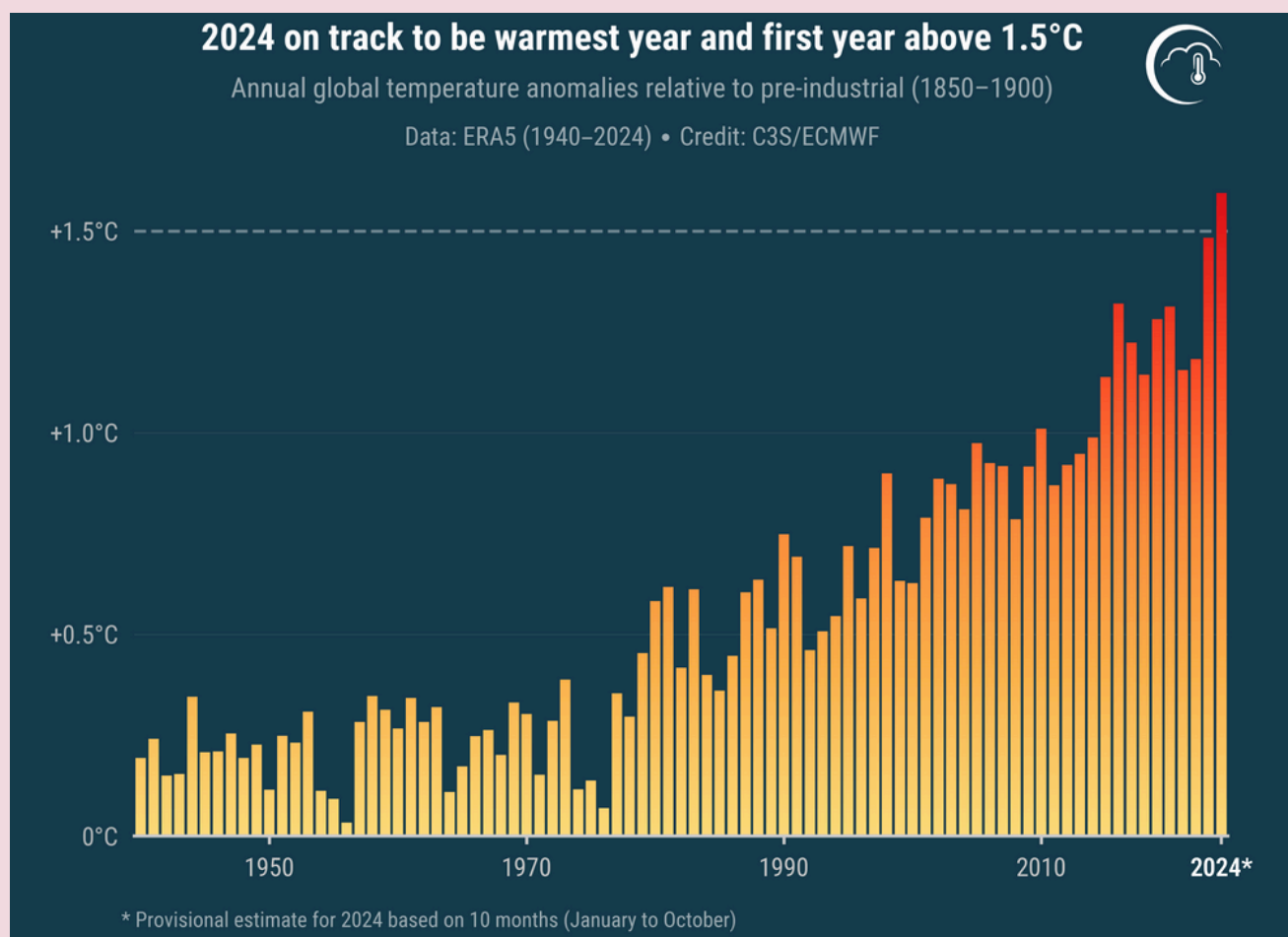


Figure 4: 2024 is on track to be the hottest year on record and the first year above 1.5°C.

Source: Annual global surface air temperature anomalies (°C) relative to 1850–1900 from 1940 to 2024. The estimate for 2024 is provisional and based on data from January to October. Data from ERA5. Credit: Copernicus Climate Change Service /ECMWF 2024.

The reasons for the recent spike in surface air temperature in 2023-24 has been the subject of much debate in scientific circles. The temperature spike is most likely a result of a combination of factors, such as a “catching up” after being constrained by the recent triple La Niña and compounded by warming caused by climate pollution. But it is still not clear how these, or other factors combined explain why 2023-2024 was so hot. What is clear is that it would not be possible to explain the unprecedented heat without considering the largest contributor, the highest atmospheric carbon dioxide concentrations observed in the historical record (Pitman et al. 2024).

Carbon dioxide levels from fossil fuels are set to reach record breaking levels in 2024 (GCP 2024). It is therefore no surprise that 2024 is set to be the hottest year on record.

Climate pollution is rapidly transforming our oceans, as they absorb mind-boggling amounts of excess heat from human-induced global warming (Climate Council 2023).

The ocean has absorbed 93 percent of the excess heat trapped by greenhouse gas emissions and the rate of ocean warming has more than doubled since the mid-1990s (IPCC 2019). In 2023, the ocean absorbed around 3.1 million TWh of heat, equal to approximately 18 times the world’s total energy consumption (WMO 2024). Last year’s marine heatwaves shocked scientists, as waters warmed to previously unthinkable levels. And it appears this was not an anomaly: in the first half of 2024, ocean surface heat levels soared above the heights they reached the previous year (see Figure 5).

The global temperature has risen faster over the last twenty years than anything we have seen, and probably faster than at any point in the Earth’s recorded history. Around the planet, we are dealing with more dangerous, unpredictable and frequent extreme weather events like bushfires, flooding rains, heatwaves and powerful storms (Climate Council 2023).

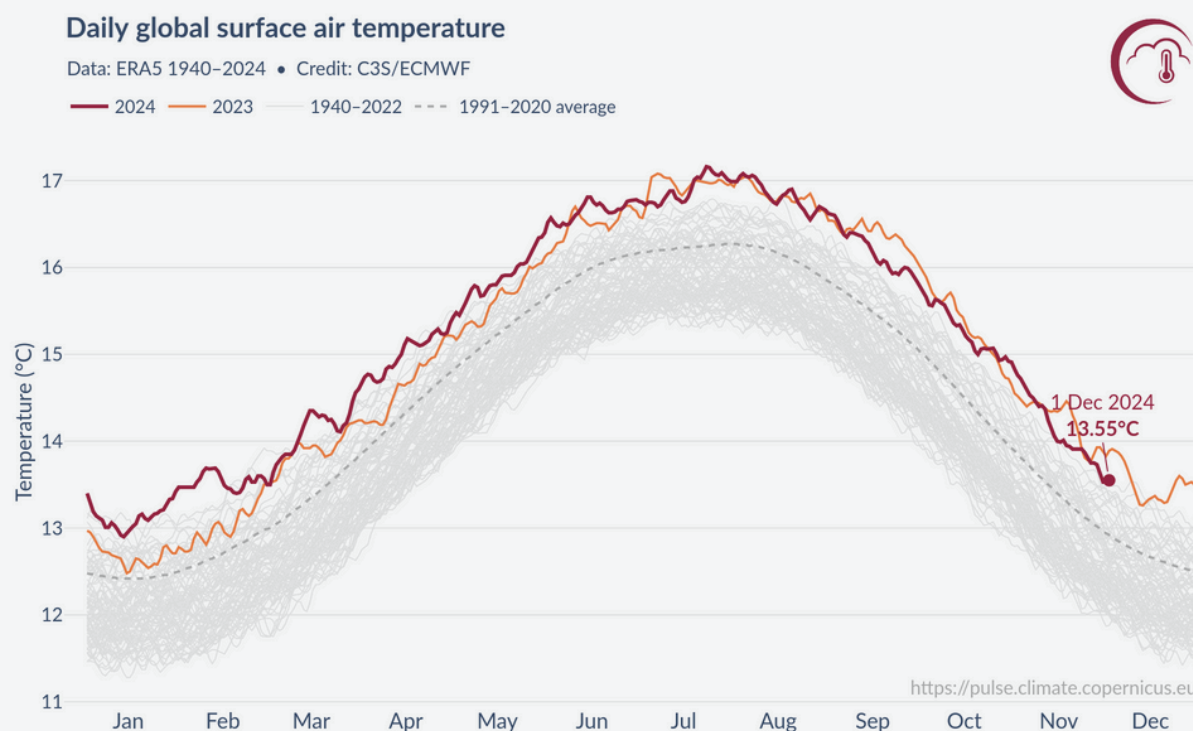


Figure 5: Ocean surface temperatures broke records in the first half of 2024

Box 2: How do we know if we've exceeded the Paris climate target?

The Paris Agreement itself does not specify how many years should make up the period for measuring temperature changes. However, it is informed by the work of the World Meteorological Organization and Intergovernmental Panel on Climate Change, which use periods of 20 or 30 years. This means that, if the world breaches 1.5°C on an individual day, month or year, it does not mean the 1.5°C threshold has been breached because it must be assessed over a longer period of time. But these breaches, such as a record hot 2024, are warning signs that we are getting very close to breaching the long-term limit.

It is highly likely we will break the 1.5°C temperature threshold. The question is, for how long and at what cost?

Climate pollution and rising global temperature goes hand-in-hand, meaning that all future pollution will add to rising global temperatures and worsening unnatural disasters.

Every tonne of carbon kept in the ground matters. Every fraction of a degree matters. We must accelerate the reduction in climate pollution this decade to give future generations a fighting chance.



Image 5: Paris climate target appears on the Eiffel Tower

"It is no longer realistically possible to limit warming to 1.5°C – the remaining carbon budget for that will be exhausted in just a few years. Stabilising the climate at well below 2°C of global warming will require dramatic year-on-year cuts in emissions that allow net zero emissions to be achieved within an increasingly small remaining carbon budget." Pitman et al. 2024

CLIMATE POLLUTION AND UNNATURAL DISASTERS

Climate pollution from the burning of coal, oil and gas is fuelling increasingly severe unnatural disasters.

HEATWAVES

Climate change is already increasing the intensity, duration and frequency of heatwaves in Australia (Reddy et al. 2021).

Heatwaves are often referred to as the 'silent killer' - killing more Australians since 1890 than bushfires, cyclones, earthquakes, floods, and severe storms combined (Coates et al. 2014). Nearly 500 heat-related deaths were reported to a coroner between 2001-2018 (Coates et al. 2023). The true number of heat-related deaths is likely much higher.

Everyone is at risk during a severe heatwave, but particularly people working outside, competing in sport, the elderly, children and people with pre-existing illnesses. Heatwaves also kill wildlife, livestock and pets who can't escape the high temperatures. During the November 2018 heatwave in Far North Queensland, 23,000 spectacled flying foxes (one-third of the local population) dropped dead out of the trees.



Image 6: Heat exhausted couple

RAINFALL

A warmer atmosphere holds more moisture, and more energy to fuel storms. For each 1°C rise in global average temperature, the atmosphere can hold approximately 7 percent more moisture (Trenberth 2011). A warmer atmosphere also means there is more energy to fuel storms that generate heavy rainfall. These factors increase the likelihood of extreme downpours.

Rainfall events in Australia are becoming more intense and frequent. In recent decades, the intensity of short duration (hourly) extreme rainfall events has increased by around 10 percent in some regions, with larger increases observed in the north of Australia (CSIRO and BoM 2024). One study found that extreme and potentially dangerous rapid rain bursts (sub-hourly heavy rainfall) over Greater Sydney have intensified by at least 40 percent over the past two decades (1997 to 2018) (Ayat et al. 2022).

TROPICAL CYCLONES

Christmas Day will mark 50 years since Cyclone Tracy hit Darwin, killing 71 people, injuring 650, and destroying 5,000 homes. Tracy impacted all power, water, sanitation and communications, and over 80 per cent of all commercial and industrial buildings were destroyed or left seriously damaged (AIDR 2024).

The climate has changed drastically since then. Today, cyclones form in a climate that is warmer, wetter, and more energetic than before.

They can be more destructive as they can have stronger wind speeds, dump more rainfall, and retain their strength for longer upon reaching land (Bhati et al. 2019). They can also intensify more quickly and move more slowly – in other words, cyclones may linger longer over a given area (Kossin 2018). In a warmer climate, the total number of cyclones is likely to decrease slightly but the cyclones that do form will likely be more severe (BoM and CSIRO 2024).



Image 7: Byron Bay storm surge, 2020

BUSHFIRES

Climate change is making hot days hotter, and heatwaves longer and more frequent. This has implications for bushfire weather, with fire seasons starting earlier and lasting longer.

As risks to people, property and nature increase and fire seasons lengthen, it is becoming more dangerous to fight fires in Australia. Lengthening fire seasons are already reducing opportunities for fuel reduction burning. This means it is harder to prepare for worsening conditions and to mitigate fires before they start.

The costs of fighting fires are increasing. Australia relies on resource sharing arrangements between countries, as well as states and territories within Australia. As fire seasons overlap and fires become more destructive, governments will be increasingly constrained in their ability to share resources and the costs of tackling fires will increase.

During the Black Summer bushfires in 2019 - 2020, every state and territory experienced fires simultaneously, reducing the ability of fire services to share firefighting equipment, firefighters and aircraft. As our longer fire seasons overlap with those of other countries facing the same trend, particularly the USA and Canada, access to the small international pool of large firefighting aircraft becomes more difficult and contested.

Bushfires cause serious health impacts, including direct loss of life, physical injuries and mental health issues. Large populations are at risk from health impacts of bushfire smoke, which contains respiratory irritants and cancer-causing substances. A study in California found people with long-term (three-year rolling average) exposure to wildfire pollution have an 18 percent higher risk of developing dementia (Elser et al. 2024).



Image 8: Fire burning near Mineral Sizer Court, Narangba in 2023

MARINE HEATWAVES

Global ocean warming is driving an increase in the incidence and severity of marine heatwaves. Similar to land-based heatwaves, a marine heatwave is a prolonged period of unusually warm water in a particular location. Marine heatwaves can be more prolonged than those on land, sometimes lasting many months. Around the world, the incidence of marine heatwaves has doubled since the early 1980s, and they have become longer-lasting, more intense, and more extensive (IPCC 2019).

Australia's Great Barrier Reef has been affected by five mass bleaching events in recent summers – 2016, 2017, 2020, 2022 and 2024 (Hughes 2024).

The bleaching event in 2022 was the first to take place during a La Niña event, which usually brings a reprieve due to greater cloud cover.

Marine heatwaves have already caused mass deaths of key species along 45 percent of Australia's coastline. Australia's giant kelp forests have declined more than 90 percent due to ocean warming (Climate Council 2019). Marine heatwaves also increase the risk of diseases to local fisheries industries, job losses, and loss of tourism revenue.



Image 9: Mass bleaching driven by climate pollution from the burning of coal, oil and gas has had devastating impacts on the globally significant Great Barrier Reef.

UNPREDICTABILITY IN A CHANGING CLIMATE

History may no longer be the best guide for what to expect in the future.

By changing the climate, we are changing the conditions under which all weather forms. Furthermore, while long-range forecasters are usually very good at predicting average conditions over a given period, it is much harder (and perhaps impossible) when looking weeks or months ahead to predict when and where short duration weather events - such as very intense downpours from thunderstorms - are going to strike. Accurately predicting extreme weather is only possible much closer to when the event is about to happen, and even then it can be difficult to accurately forecast extremes.

This new era of climate-fuelled unnatural disasters carries severe consequences for disaster and emergency management in Australia – yet another compelling reason for Australia to accelerate efforts to slash climate pollution further and faster.

This starts with addressing climate pollution at the source, by halting all new and expanded fossil fuel projects. Everything we do now matters, in particular because past government failure to act quicker and more decisively means a considerable increase in climate impacts is locked in from climate pollution that has already been released.

Australians are already experiencing climate whiplash as they ricochet from one unnatural disaster to the next, and so our governments also need to focus on disaster preparation, response and recovery in the near-term – ensuring emergency services have the resources they need and that more Australian households are protected from future climate risks. Further investment in climate and weather information services is vital to ensure we get the most accurate and up-to-date information possible.



Image 10: A young girl from Junee, NSW Australia using a playground impacted by smoke from nearby fires on 5th of January 2020.

ACCELERATING OUR CLEAN ENERGY TRANSFORMATION

After years of climate denial and delay, Australia is finally on the right path by scaling up renewables, storage and clean industries so we can phase out polluting coal, oil and gas.

Governments at all levels have the opportunity to build on this progress and momentum to ensure millions more Australians enjoy the benefits of a cleaner, safer future.

The further and faster we can cut climate pollution during this critical decade, the better the prospects for our kids. Australia can seize the decade by building a clean economy that creates better health outcomes and good, long-term job opportunities for every Australian child alive today, as well as every generation to come.



Image 11: Kids running to wind turbines

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IMAGE CREDITS

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