

THE ANGRIEST SUMMER

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Key Findings

1

The Angry Summer of 2018/19 was characterised by prolonged, continental-wide heatwaves and record hot days, bushfires throughout Australia, and heavy rainfall and flooding in northern Queensland.

Noteworthy records from this summer include:

- > In just 90 days, more than 206 records were broken around Australia.
- > Hottest summer on record for the Australian continent.
- > January was the hottest on record for New South Wales, Victoria, Queensland, Northern Territory, the Australian Capital Territory and Tasmania.
- Port Augusta in South Australia reached a recordbreaking temperature of 49.5°C on January 24 (the highest temperature in the summer).
- Townsville experienced 10-day accumulated rainfall totals of 1,257 mm, breaking the previous 10-day record by more than 330 mm.

2

Serious bushfires raged across the continent through the summer.

- > Every state experienced serious bushfires with properties lost in Queensland, New South Wales, Victoria and Tasmania.
- New South Wales experienced serious fires through autumn and winter, the Queensland fire season lasted much longer than normal and the Tasmanian fire season started early.
- Pristine rainforest in Queensland and Tasmania, previously not prone to bushfires, suffered devastating damage.



3

The Angry Summer was driven by greenhouse gas pollution from the burning of fossil fuels, like coal, oil and gas, and land clearing.

- > The record-breaking heat in Australia over the 2018/19 Summer is part of a long-term warming trend from the burning of fossil fuels and land clearing.
- For many years scientists have warned that climate change is driving worsening extreme weather. The Angry Summer is another example of the consequences of climate change today.
- Protecting Australians from worsening extreme weather requires phasing out fossil fuels and accelerating the transition to renewables and storage technologies.

4

The window to effectively tackle climate change is rapidly closing but many of the solutions we need are already at hand.

- Tackling climate change effectively requires credible national policy to drive down greenhouse gas pollution from fossil fuels across all sectors: electricity, transport and industry, as well as credible policies to address emissions from agriculture and land use.
- Solutions include accelerating the uptake of renewable energy and storage, investing in energy efficiency, and switching away from direct fuel combustion to electrification powered by renewables in transport, industry and buildings.
- > The Federal Government has no credible climate policy in place with greenhouse gas pollution increasing over the past four years.

Introduction

The Australian summer of 2018/19 marked the return of the Angry Summer with record-breaking heat and other destructive extreme weather events. The summer was characterised by prolonged, continental-scale heatwaves, hot days, drought conditions in eastern Australia and bushfires throughout Australia, particularly in Queensland and Tasmania and parts of Western Australia, Victoria and New South Wales. Bushfire seasons started much earlier, lasted longer, and burned in areas that would not be expected to burn, despite there not being an El Niño event. Heavy rainfall and flooding inundated northern Queensland in late January and early February.

We describe this summer as angry due to it being the hottest on record by a large margin (2.14°C above the 1961-1990 baseline) with more than 206 extreme weather records broken (Figure 2). This summer follows previous Angry Summers in 2012/13, 2013/14 and 2016/17 with Australians yet again enduring worsening extreme weather events driven by climate change. The climate is changing quickly, leading to temperature records being broken in close succession. Over recent decades there has been a strong upswing in summer temperatures in Australia, with above average temperatures recorded for most summers since the late 1970s (compared to a 1961-1990 baseline).

Bushfire seasons started much earlier and lasted longer. The past four years have been the four hottest years on record for global surface temperature - 2018 was the fourth hottest, following 2017 (the third hottest), 2015 (the second hottest) and 2016 (the hottest) (NOAA 2019). 2018 was the warmest on record in the oceans, surpassing the previous record set in 2017 (Chen et al. 2019). The hot global average temperatures in 2018, 2017, 2016 and 2015 are part of a long-term upswing in global average temperature that began most clearly in the mid-20th century and has continued since

then. A rapidly warming world is the result of increasing greenhouse gas pollution from the burning of fossil fuels and other human activities such as land clearing. Globally, the 20 hottest years on record have been in the past 22 years and in Australia, nine of the 10 hottest years on record have occurred since 2005. 2018 is the 42nd consecutive year (since 1977) with an above-average global temperature. No one aged under 40 has lived in a year with global average temperatures at or below the global 20th century average.



AUSTRALIAN SUMMER MEAN TEMPERATURE

Figure 1: Summer temperatures have been rising steeply in Australia over recent decades. Source: BoM (2019a).

In Australia the average air temperature for 2018 was 1.14°C above the 1961-1990 average, making 2018 the third hottest year on record. The mean maximum temperature was the second hottest on record (1.55°C above average). It is important to note that the Australian average surface temperature refers to land only, while the global surface temperature refers to a combination of land surface and sea surface temperatures (CSIRO and BoM 2018). Climate change is influencing all extreme weather events as they are occurring in a more energetic climate system (Trenberth 2012). Australia is one of the most vulnerable developed countries in the world to the impacts of climate change. In 2018, Australia experienced extreme heat across many parts of the country, severe bushfires affected parts of South Australia, New South Wales, Queensland, Victoria and Western Australia, intense rainfall triggered flooding in northern Queensland, Hobart and southwest Western Australia, and drought conditions persisted across southern Australia.

Over the 2018/2019 Angry Summer climate change cranked up the intensity of extreme weather with numerous weather-related records broken across Australia (Figure 2).

Climate change is cranking up the intensity of extreme weather.

2018/19 ANGRY " SUMMER

IN JUST 90 DAYS, OVER 206 RECORDS BROKEN, INCLUDING:

- Record-highest summer temperature: 87 locations
- Record-lowest summer total rainfall: 96 locations
- Record highest summer total rainfall: 15 locations
- > Record number of days 35°C or above: 2 locations
- National or state/territory hottest on record: 5 states/territories and (1) Australia.

NORTHERN TERRITORY

WESTERN AUSTRALIA

Hottest summer on record (1.73°C above

Marble Bar: 45°C or

during the summer.

higher on 32 days

average).

Hottest summer on record (2.67°C above average).
Rabbit Flat: 34 consecutive days of 40°C or above.

QUEENSLAND

Cloncurry: 43 consecutive days of 40°C or above (State record).

 Townsville received more than annual average rainfall in 10 days (1,257 mm).

NEW SOUTH WALES

Hottest summer on record (3.41°C above average).

Bourke: 21 consecutive days above 40°C (State record).

CANBERRA

- > Hottest summer on record.
- 35°C or above on 24 days, five times the summer average.

SOUTH AUSTRALIA

- Port Augusta: Hottest temperature this summer - 49.5°C on January 24.
- Adelaide: Hottest temperature for January or any month – 46.6°C on January 24.
- VICTORIA
- Hottest summer on record (2.54°C above average).
- TASMANIA
- Driest January on record.
- > Bushfires burned ~ 200,000 hectares of vegetation.

Note: For all statistics, the average is calculated over the period between 1961 and 1990. Records are for seasonal or monthly mean temperature unless otherwise specified.

Figure 2: Climate change is increasing the frequency and/or severity of extreme weather in Australia. During the 2018/19 Angry Summer over 206 extreme weather records were broken.

Summer 2018/19 in Detail

Climate change is now making many types of extreme weather worse, especially heatwaves.

Climate change is making heatwaves worse and the 2018/19 Summer heatwaves were unprecedented.

HEATWAVES

During the 2018/2019 Summer exceptional heatwaves occurred, which were notable for their continental-wide scale as well as for breaking records for duration and individual daily extremes.

A heatwave in Australia is described as a period of at least three days where the combined effects of high temperatures and excess heat are unusual within the local climate (Nairn and Fawcett 2013). The widespread heatwave conditions occurred throughout most of December and January, but peaked in late December and in mid-January. The latter heatwave was the most significant heatwave on record at the national scale. The extent and duration of the heatwaves led to a number of extremely hot days for nationally averaged daily temperatures, including six of the ten hottest days for mean maximum temperature, eight of the ten hottest days for mean minimum temperature (including the six hottest) and eight of the ten hottest days for mean temperature (including the hottest three).

In South Australia, the heatwaves affected stone fruit growers, with stone fruit cooking on the trees (ABC 2019). In New South Wales, roads started to melt and commuters experienced delays as train tracks threatened to buckle (SMH 2019). Extreme heat also caused mass deaths of flying foxes, with one third of the locally endemic spectacled flying fox population perishing in Cairns during the November heatwaves on the tropical Queensland coast, and thousands of flying foxes perishing in Adelaide during the January heatwaves (Independent 2019).



Figure 3: Highest three-day heatwave category reached in different areas between January 11 - 26. Large areas of Western Australia, South Australia, New South Wales and Victoria were affected by either severe or locally extreme heatwaves during this period (BoM 2019b).

Climate change is making hot days and heatwaves more frequent and more severe (Perkins and Alexander 2013; Climate Council 2014). Australia's climate has warmed by about 1.1°C from 1910, with most warming occurring since 1950 (CSIRO and BoM 2019). As a result, the number of record hot days has doubled since 1960 (CSIRO and BoM 2012). Over the period 1971–2008, both the duration and frequency of heatwaves has increased, and the hottest days during heatwaves have become even hotter (Perkins and Alexander 2013). These trends have

continued since 2008. Australian capital cities, where the majority of Australians live, have experienced increasing severity and intensity of extreme weather. The risk of experiencing severe heatwaves in summer, in terms of their frequency and intensity, has increased two- and threefold, respectively, due to climate change (Perkins et al. 2014).

RECORD-BREAKING HEAT

It was the warmest January on record for Australia in terms of mean, maximum, and minimum temperatures. The national mean temperature was 2.91°C above average. The mean maximum temperature was 3.37°C above average and the mean minimum temperature was 2.45°C above average. January was also the hottest month on record for every state and territory except South Australia and Western Australia. New South Wales broke its previous hottest month record by more than 2°C (BoM 2019c). For nationally averaged mean maximum temperature, Australia had its hottest December day on record. Numerous locations, including Adelaide, reported their highest daily maximum temperature on record. A new record was set in New South Wales for the highest minimum temperature ever observed in Australia, and state/territory records were also set for South Australia, Queensland and the Northern Territory. See the Bureau of Meteorology's summer report (BoM 2019e) for site specific records broken, including state and territory summaries, and Figure 2 for examples of extreme weather records broken over the 2018/19 Angry Summer.

BUSHFIRES

Bushfires affected nearly all of Australia. Fire seasons started early in New South Wales, Tasmania and Victoria, with many fires started by "dry" lightning storms. New South Wales experienced major fires on the South Coast and in the Hunter in August (during winter), then major fires on the Northern Slopes in February. In New South Wales fire fighters were battling blazes all year round. Western Australia experienced major fires in May, then again in early 2019. Queensland experienced fires from August to November with Catastrophic fire weather in sub-tropical areas causing fires to burn intensely in rainforests normally not prone to fire. During January and February uncontrolled fires burned throughout Tasmania in vast areas of the Tasmanian Wilderness World Heritage Area where vegetation is not adapted to fire, because for thousands of years it has been too damp to burn.

Tasmania had its hottest and driest January on record, making vegetation particularly flammable and susceptible to ignition by lightning from dry thunderstorms (BoM 2019c). Given that the lightning-caused fires were started in remote areas, they were difficult to control, burning about 194,427 hectares of vegetation and leading to very poor air quality across the state (Wood 2019). A preliminary analysis suggests that around 3.2 percent of the area burned in Tasmania in 2019 was rainforest, which is particularly vulnerable to fire, and about 30 percent was wet eucalypt forest where fires are rare (Wood 2019).

All Australian states experienced severe bushfires during summer.



Figure 4: Fire damage around Eliza Plateau walking track from the Celtic Hill Fire, Southwest Tasmania.

Over recent decades, there has been an increase in very high to extreme fire weather over large parts of Australia and a lengthening of the bushfire season, especially in south eastern Australia (CSIRO and BoM 2018). There has been an increase in incidences of lightning-ignited fires in the Tasmanian Wilderness World Heritage Area over recent decades, possibly linked to changes in rainfall patterns that have led to decreased soil and fuel moisture and increased ignition efficiency (Styger, Marsden-Smedley and Kirkpatrick 2018). In the past, the coincident occurrence of an El Niño and a positive phase of the Indian Ocean Dipole was a key influence behind serious bushfire seasons; however, these influences were absent during the 2018/2019 Summer, suggesting climate change was a major influence.

Over recent decades, large areas of Australia have experienced an increase in extreme fire weather and a lengthening of the fire season.

INTENSE RAINFALL AND FLOODING

An active monsoon trough and a slowmoving low-pressure system over the northern tropics produced extremely heavy rainfall in tropical Queensland from late January 2019 into early February. The rainfall during this event was exceptional. In and around Townsville, the accumulated totals from consecutive days of heavy rainfall were the city's highest on record since records began in 1888. In the seven days to 4 February 2019, the Bureau's site at Townsville Aero recorded 1052.8 mm, and 1257.0 mm in the ten days to 6 February (BoM 2019d). Prior to this event, the Townsville record for a 7-day period was 886.2 mm (January 1998) and for a 10-day period was 925.5 mm (January 1953). Townsville has already in 2019 recorded more than its average annual rainfall of 1128.0 mm (based on all years of data for the site from 1941-2018) (BoM 2019d).

The heavy rainfall overwhelmed the capacity of the Ross River Dam, prompting authorities to open the floodgates of the dam to full capacity on February 4, releasing about 1,900 cubic metres of water per second into the Ross River, and ultimately, into low-lying Townsville suburbs. Three people died and thousands of properties were affected. Final damage assessments conducted by Queensland Fire and Emergency Services have revealed that 2,063 properties experienced floodwater inundation of up to 25 cm, 1,101 properties experienced inundation of up to 1 metre and 135 properties suffered inundation of over 1 metre (Townsville Bulletin 2019). The insured losses from this event amounted to \$887 million as at February 21 (ICA 2019).

Climate change is increasing the probability of heavy rainfall events in most areas across Australia, which in turn increases the risk of severe flooding events.



Figure 5: Flooding in Townsville, 4 February 2019.

Climate change increases the probability of heavy rainfall events in most locations across Australia. As the climate changes, it is becoming more challenging to predict flooding events. Annual exceedance probabilities (which are based on historical data and refer to the probability of a flood event occurring in any year) may no longer be reliable for predicting the probability of future events. The physical relationship between temperature and the water-holding capacity of the atmosphere suggests that total rainfall on heavy rain days will increase by about 7 percent per degree of warming. Although heavy rainfall is highly variable in Australia, observations over recent decades suggest that for short-duration, hourly rainfall, the increase has been more than 7 percent (Guerreiro et al. 2018).

The Window of Opportunity to Act is Rapidly Closing

The extreme weather events of the Angry Summer 2018/19 provide the latest evidence of a long-term trend of worsening extreme weather. In Australia, the frequency and / or intensity of many extreme weather events – heatwaves, bushfire conditions, intense rainfall and floods – have increased over the past several decades, consistent with trends that have been observed globally. Australia is on the frontline of climate change with worsening impacts and growing risks to the vibrancy and resilience of our way of life, our health, the economy and environment. With greenhouse gas pollution rising the past four years (Australian Government 2019), it is clear the Federal Government has no credible policy in place to reduce greenhouse gas pollution.

Any new fossil fuel projects, such as new coal, are fundamentally at odds with effectively tackling climate change. Tackling climate change effectively requires a credible national policy to drive down greenhouse gas pollution across all sectors: electricity, transport, industry, agriculture and land use. The solutions are at our disposal but the window of opportunity is rapidly closing.

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Page 8: Figure 4 'Fire damage around Eliza Plateau walking track from the Celtic Hill Fire, Southwest' by Luke Tscharke/ Climate Council.

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