CLIMATE COUNCIL

OFF THE CHARTS: 2014 WAS THE WORLD'S HOTTEST YEAR ON RECORD

The Climate Council is an independent, crowd-funded organisation providing quality information on climate change to the Australian public.

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Authorship:
Will Steffen

Published by the Climate Council of Australia Limited

ISBN: 978-0-9942453-3-5 (print)
978-0-9942453-2-8 (web)

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Professor Will Steffen
Climate Councillor

What to do in a heatwave

Dr. Liz Hanna, *Health Expert*

IN AN EMERGENCY, CALL TRIPLE ZERO (106 FOR PEOPLE WITH A HEARING OR SPEECH IMPAIRMENT)

- Take care of yourself – everyone is at risk
- Stay cool
- Stay hydrated
- Stay informed – Listen to your local ABC Radio Station
- Keep in touch with family, friends and neighbours

STAY COOL

- Minimise exertion
- Keep out of the sun. Minimise heat exposure for yourself and others
- Limit trips outside and reschedule work meetings and tasks wherever possible
- Spend time in cooled, well air-conditioned places. If you do not have air-conditioning at home spend time in places that do, such as public libraries, cinemas etc.
- Keep your building cool. Close blinds during the day, and open to cool in the evening
- Wear cool, comfortable clothes
- Spray misted water onto body and clothes
- Spend time lying on and under a wet sheet. Indoor fans can be helpful
- Otherwise, avoid using a fan where the indoor temperature is higher than 37°C
- Remind the elderly of these cooling strategies, and assist them to achieve optimal cooling
- Check with your local council to hear their heatwave response plan

STAY HYDRATED

- Drink plenty of fluids, chilled if possible
- Drink enough to urinate at least 3 times a day, and urine should be very pale in colour. If yellow, or darker, keep drinking. Avoid tea, coffee and alcohol.

FOOD

- Ensure that food is refrigerated properly and immediately
- Dispose of spoilt food

TRANSPORT/INFRASTRUCTURE

- Stay informed and up-to-date about planned blackouts
- Have a backup plan in case electricity or transport (road/rail) infrastructure fails

WILDLIFE

- Leave out shallow containers of water for birds, possums and other animals. Place small stones in the bottom of the container. Ensure that the water is left in a shady, protected environment (out of view from birds of prey and high enough to be safe from cats).
- If you find injured or heat-stressed wildlife, bring them into cooler environments and lightly mist them with water
- If you are concerned about an animal, call a wildlife rescue centre near you

PETS

- If dogs or cats appear heat stressed, panting or restless, bath in cool water; call your vet if you are concerned
- Bring your pets indoors when it's very hot, or ensure they have outdoor shelter
- Leave out two bowls of cool drinking water (in case one is knocked over)
- Never leave your pets alone in the car

Key Findings

1. 2014 was the hottest year on record globally

- The global average temperature for 2014 was 0.69°C above the 20th century average, eclipsing the previous records set in 2010 and 2005. Climate change is a major factor in driving these record temperatures.
- The record global warmth of 2014 is part of a long-term trend: the Earth is getting hotter. All of the world's top 10 warmest years have occurred since 1998.
- 2014 is the 38th consecutive year with above average global temperature.
- Across the world record breaking weather and extreme heat events increase heat stress on people, animals and plants, and well as pressure on infrastructure and agriculture.

2. The emission of greenhouse gases is driving record global heat

- This continuing, long-term warming trend has been driven by the emissions of greenhouse gases from human activities, primarily from the burning of fossil fuels.

Climate change is a major factor in extreme heat in Australia

- Hot days are happening more often while heatwaves are becoming hotter, longer and more frequent. This is worsening bushfire danger weather.
- 2014 was Australia's 3rd hottest year.
- An increase in heatwaves and bushfires affects the health of Australians, as well as damaging infrastructure, agriculture and the environment.

3. This is the critical decade

- We are now halfway through the critical decade for action on climate change. To slow and then halt the warming trend, we must cut carbon emissions rapidly and deeply. 2015 is the pivotal year to join global efforts in the lead up to the international climate negotiations in Paris to stabilise the world's climate and reduce the risk of more extreme weather events.

2014 was the hottest year on record

In 2014, the world experienced its warmest year ever since global records began in 1880 (NASA 2015; NOAA 2015). The global average temperature for 2014 was 0.69°C above the 20th century average, beating the previous record set in 2010 and 2005 (NOAA 2015).

This record-breaking year was no one-hit wonder. Based on global surface temperatures over land and sea - all of the world's top 10 warmest years have occurred since 1998, culminating in a scorching 2014. Last year was the 38th consecutive year with above average global temperature (NASA 2015; NOAA 2015). The world is poised for even hotter conditions ahead as the amount of carbon dioxide in the atmosphere continues to increase (IPCC 2014a).

2014 is the 38th consecutive year with above average global temperature

This continuing, long-term warming trend has been driven by the emissions of greenhouse gases from human activities, primarily the burning of fossil fuels. The annual average concentration of carbon dioxide is nearing 400 parts per million (ppm) (NOAA 2014a), vastly higher than the pre-industrial concentration of 280 ppm. Record-high greenhouse gas emissions and the consequent rise in their atmospheric concentrations are creating a much more uncertain and inhospitable future for us all (IPCC 2014a; WMO 2014). Particularly unusual and alarming about the record heat of 2014 were the high temperatures over vast areas of the ocean surface (WMO 2014). Higher ocean temperatures cause the ocean to expand, which contributes to sea level rise as well as damaging species and ecosystems (IPCC 2014b).

In addition to record global heat, 2014 was Australia's third hottest year on record, with annual national mean temperatures 0.91°C above average (BoM 2015). Australia has been getting hotter now for decades (CSIRO & BoM 2014) and seven of the 10 warmest years on record have occurred since 2002 (BoM 2015). Increasing temperatures mean that hot weather and heatwaves are increasing, directly damaging our health as well as ecosystems, agriculture and infrastructure (Climate Council 2014). Rising temperatures are increasing the occurrence of extreme fire danger weather, particularly in Australia's southeast, where many people and much property and infrastructure are at risk from bushfires (Climate Council 2013).

Rising temperatures are increasing extreme fire danger weather, particularly in Australia's southeast

Ocean Heat

Around 93% of the excess energy trapped in the atmosphere by greenhouse gases from fossil fuels and other human activities ends up in the oceans (Rhein et al 2013). This massive store of additional heat was the primary driver for the record-breaking global surface temperature in 2014 - the Pacific, the polar and subtropical north Atlantic, parts of the south Atlantic, and the Indian Ocean all recorded their warmest sea surface temperatures (SST) ever. Globally averaged SST was 0.45°C above the 1961-90 average (WMO 2014).

Land Heat

Record breaking heat was also experienced over the land surface.

Western North America, Europe, eastern Eurasia, much of Africa, large areas of South America and southern and western Australia were especially warm in 2014 (WMO 2014).

Australia had little respite from the previous record-breaking 2013, with yet more temperature records broken in the spring, summer and autumn of 2014.

Australian Heat Records

Climate change is making Australia hotter. Hot days are happening more often while heatwaves are becoming hotter, longer and more frequent. More Australians die every year from extreme heat than from any other type of natural disaster (PwC 2011). Extreme heat can damage infrastructure such as electricity distribution and transport systems (Climate Council 2014), while hot, dry conditions have a major influence on bushfires. The increasing strength and frequency of extreme heat in turn increases the risk of extreme bushfire conditions (Climate Council 2013).

Eight of Australia's hottest summers on record have occurred in the past 15 years

Angry Summer

Continuing hot on the heels of the 'Angry Summer' of 2012/2013, Australians again endured record-breaking extreme events in the 2013/2014 summer. Eight of Australia's hottest summers on record have occurred in the past 15 years (BoM 2014a). Notable records in 2014 included:

- Victoria experienced its hottest four days on record from 14–17 January, and Melbourne set a record for four consecutive days at 41°C and above (14–17 January) and two nights in a row at 27°C or above (15–16 January) (BoM 2014c).
- Adelaide sweltered through a record-breaking five consecutive days of 42°C and above (BoM 2014c).
- During the summer of 2013/2014, Canberra recorded 20 days of at least 35°C (BoM 2014d).

Abnormal Autumn

The exceptional heat continued into the autumn of 2014.

- The average temperature across Australia for April 2014 was 1.11°C above the long-term average. Continuation of abnormally warm temperatures into late May delayed the onset of winter conditions across southern Australia (BoM 2014e).
- A remarkable, prolonged warm spell occurred over the period 8-26 May, with daytime temperatures 4 to 6 °C above normal over much of south-central Australia, extending from South Australia and northwest Victoria into Queensland and the Northern Territory (BoM 2014e).
- Sydney (25 days), Adelaide (16 days) and Melbourne (13 days) all set records for the most consecutive days in May of 20°C or above (BoM 2014e).
- The 24-month period ending with April 2014 was the hottest two-year period on record, with an average temperature 1.16°C above the long-term average, easily eclipsing the previous 24-month record set in the 2002-2004 period (BoM 2014e).

Scorching Spring

Nine of the 10 warmest springs have occurred in just the last 13 years, with spring 2014 the hottest on record in Australia (BoM 2014f).

- National maximum and average temperatures broke records set last spring, with national average temperatures 1.67°C above average (BoM 2014g).
- The warmth continued through much of November with two significant heatwaves resulting in record-high daily maximum and minimum temperatures for many locations across Australia (BoM 2014g).
- Queensland state-wide maximum, minimum and average November temperatures were the highest for over 100 years with over 40 percent of Queensland experiencing the highest November maximum temperature on record (BoM 2014g).
- The earliest above-45 °C day ever recorded in Australia occurred on 9 October when Bidyadanga in Western Australia experienced a record high of 45.2 °C (BoM 2014g).

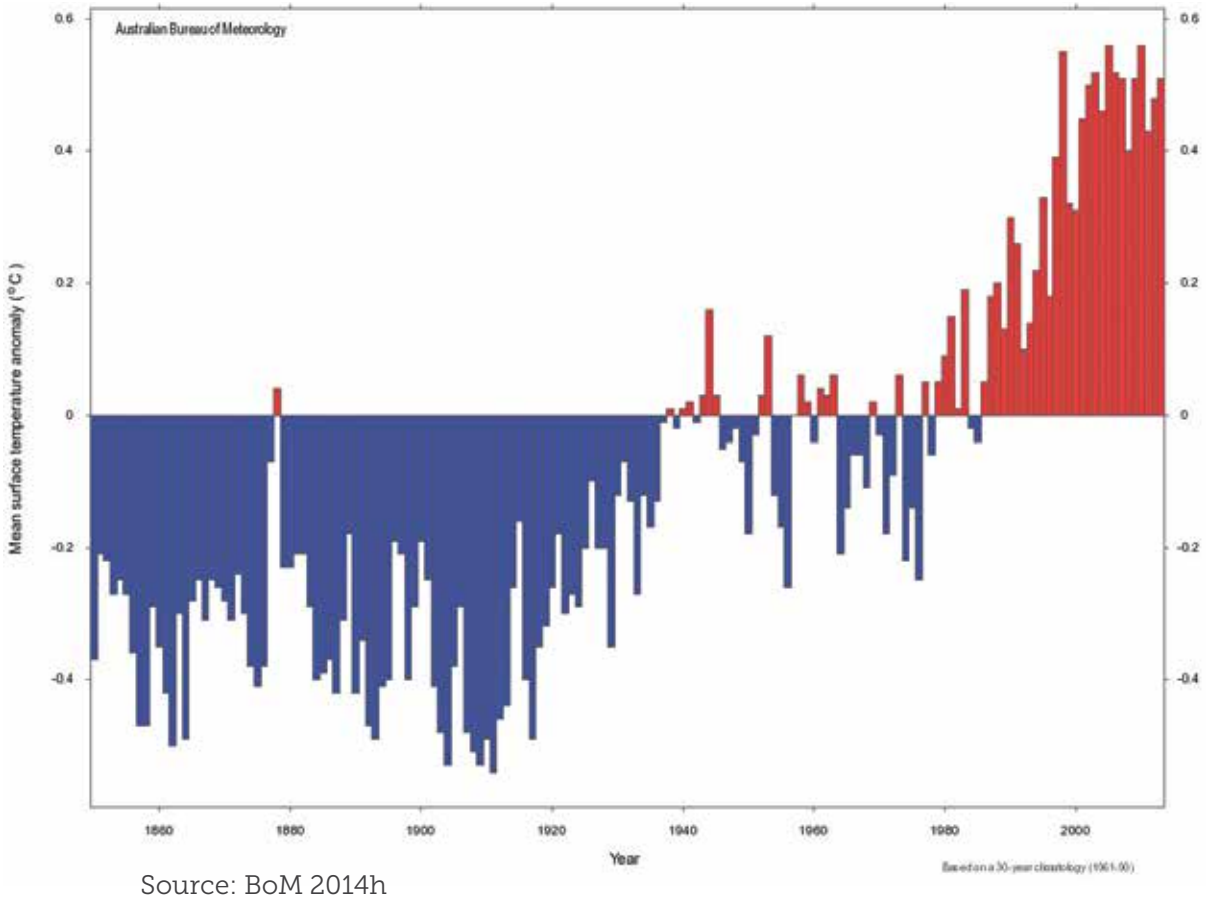
Global Heat Records in 2014

For decades now the Earth has been getting hotter (Figure 1). 1985 was the last year that the world experienced below-average global average temperature (BoM 2014g). Since then every one of the last 29 years has been above average. The 10 warmest years on record have all happened since 1998 (NASA 2015; NOAA 2015). The global warming trend has persisted into 2014 as we've continued to see heat records broken around the world (Figure 2; Annex 1).

In Australia, nine of the 10 warmest springs have occurred in just the last 13 years, with spring 2014 the hottest on record

1985 was the last year that the world experienced below-average global temperature

Figure 1: Annual mean temperature anomaly - Global (1850-2013)



Source: BoM 2014h

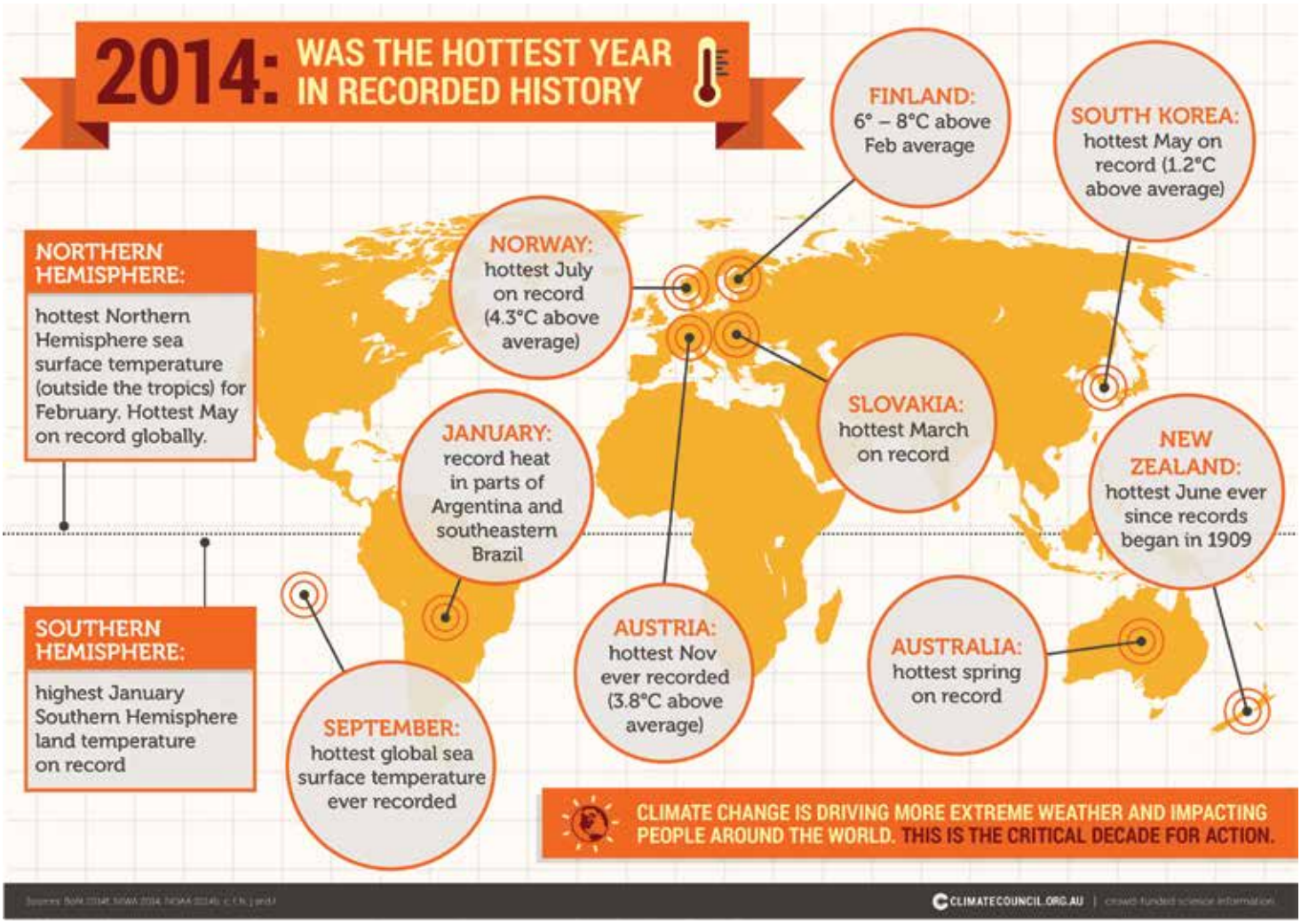


Figure 2: Major Heat Records in 2014

ANNEX 1: GLOBAL HEAT RECORDS IN 2014

JANUARY

- Parts of southeastern Brazil and central and southern Africa experienced record warmth with temperature departures between 0.5°C to 1.5°C above the 1981–2010 average (NOAA 2014b).
- The highest January Southern Hemisphere land temperature on record at 1.13°C above the 20th century average (NOAA 2014b).
- In Argentina, persistence of extremely high temperatures across central and northern parts of the country resulted in several locations setting new maximum, minimum, and mean temperature records for the month of January (NOAA 2014b).

FEBRUARY

- February marked the 29th consecutive February and 348th consecutive month with a global temperature above the 20th century average (NOAA 2014c).
- In the Nordic region, many areas of Finland observed February temperatures 6°–8°C above average, with some regions in the north more than 9°C above average (NOAA 2014c).
- The average Northern Hemisphere ocean surface temperature outside the tropics (20°N–90°N) was record warm for February (NOAA 2014c).

MARCH

- Central Asia was particularly warm for March, with departures from average surpassing +5°C in parts of northern Siberia (NOAA 2014d).
- Slovakia experienced its warmest March on record (NOAA 2014d).
- Record warmth was observed in parts of the northeastern and equatorial Pacific, the eastern North and South Atlantic, and central Indian Oceans (NOAA 2014d).

APRIL

- The combined average temperature over global land and ocean surfaces for April 2014 tied with 2010 as the highest on record for the month, at 0.77°C above the 20th century average (NOAA 2014e).
- In the Northern Hemisphere, the combined temperature over land and ocean surfaces tied with 2012 for record April warmth (NOAA 2014e).

MAY

- The combined average temperature over global land and ocean surfaces for May 2014 was the record highest for this month, at 0.74°C above the 20th century average of 14.8°C (NOAA 2014f).
- Four of the five warmest Mays on record have occurred in the past five years: 2010 (second warmest), 2012 (third warmest), 2013 (fifth warmest), and 2014 (warmest); currently, 1998 has the fourth warmest May on record (NOAA 2014f).
- Across the oceans, the global monthly-averaged sea surface temperature was 0.59°C higher than the 20th century average, marking the highest May temperature on record (NOAA 2014f).
- South Korea reported its highest average May temperature on record, at 1.2°C above the 1981–2010 average (NOAA 2014f).

JUNE

- The combined average temperature over global land and ocean surfaces for June 2014 was the highest on record for the month, at 0.72°C above the 20th century average of 15.5°C (NOAA 2014g).
- The June global sea surface temperature was 0.64°C above the 20th century average of 16.4°C, the highest for June on record (NOAA 2014g).
- Nine of the ten warmest Junes on record have occurred during the 21st century, including each of the past five years (NOAA 2014g).
- June 2014 marked the second consecutive month with record high global temperatures. With the exception of February (21st warmest), every month to date in 2014 has ranked among the four warmest for its respective month (NOAA 2014g).
- New Zealand observed its warmest June since national records began in 1909. The warmth was notable for both its intensity and coverage (NIWA 2014).

JULY

- For the ocean, the July global sea surface temperature was 0.59°C above the 20th century average of 16.4°C, tying with 2009 as the warmest July on record (NOAA 2014h).
- The July temperature for Norway was 4.3°C above the 1961–1990 average, the record highest for July since national records began in 1900 (NOAA 2014h).

AUGUST

- The combined average temperature over global land and ocean surfaces for August 2014 was record high for the month, at 0.75°C above the 20th century average of 15.6°C, breaking the previous record set in 1998 (NOAA 2014i).
- The global land surface temperature was 0.99°C above the 20th century average of 13.8°C, the second highest on record for August, behind 1998 (NOAA 2014i).
- For the ocean, the August global sea surface temperature was 0.65°C above the 20th century average of 16.4°C (NOAA 2014i).

SEPTEMBER

- The combined average temperature over global land and ocean surfaces for September 2014 was the highest on record for September, at 0.72°C above the 20th century average of 15.0°C (NOAA 2014j).
- For the ocean, the September global sea surface temperature was 0.66°C above the 20th century average of 16.2°C, the highest on record for September and also the highest on record for any month (NOAA 2014j).
- The combined global land and ocean average surface temperature for the January–September period (year-to-date) was 0.68°C above the 20th century average of 14.1°C, tying with 1998 as the warmest such period on record (NOAA 2014j).

OCTOBER

- The combined average temperature over global land and ocean surfaces for October 2014 was the highest on record for October, at 0.74°C above the 20th century average of 14.0°C (NOAA 2014k).
- For the ocean, the October global sea surface temperature was 0.62°C above the 20th century average of 15.9°C and the highest for October on record (NOAA 2014k).
- October was the sixth month in a row (beginning in May 2014) that the global sea surface temperature broke its monthly temperature record (NOAA 2014k).

NOVEMBER

- The combined global land and ocean average surface temperature for the September–November period was 0.70°C above the 20th century average of 14.0°C, the warmest such period on record (NOAA 2014l).
- Austria had its warmest November since national records began 248-years ago, with a temperature 3.8°C above the 1981–2010 average (NOAA 2014l).
- The average November temperature for the global oceans was record high for the month, at 0.59°C above the 20th century average (NOAA 2014l).

DECEMBER

- The December 2014 average combined global land and sea surface temperature was the highest since records began in 1880, at 0.77°C above the 20th century average of 12.2°C (NOAA 2014m).
- The average combined global land and ocean surface temperature for January–December 2014 was the highest on record among all years in the 135-year period of record, at 0.69°C above the 20th century average (NOAA 2014m).

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