

OFF THE CHARTS: 2013 WAS AUSTRALIA'S HOTTEST YEAR

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2013 was a remarkable year for hot weather in Australia. Not only did we easily set the record for the hottest year since records began in 1910, we also experienced the hottest summer and warmest spring on record; the hottest January and warmest September on record; and the hottest summer day and warmest winter day on record. No part of Australia was spared the heat. For all states and the Northern Territory, 2013 ranked within the four hottest years they had experienced.

Australia's record hot year is part of a global, longer-term trend. Over the past century, the Earth's climate has warmed and continues to warm. More record hot weather is occurring around the planet. The increasing atmospheric concentrations of greenhouse gases caused by human activities are the primary cause of the warming. Stabilising the climate requires urgent and deep reductions in greenhouse gas emissions, especially those of carbon dioxide that result from burning fossil fuels.

Key Facts

- 1** 2013 was Australia's hottest year on record, easily breaking earlier records set in 2005 and 1998.
- 2** Many temperature records – on monthly and daily timeframes, and in all seasons – were set across the continent.
- 3** The record-breaking year extends the long-term trend in Australia and across the globe of rising air and sea temperatures, loss of ice, and worsening extreme weather as the climate continues to warm.
- 4** Stabilising the climate requires urgent and deep reductions in the emissions of carbon dioxide and other greenhouse gases.

A record-breaking year

It is now official. 2013 was Australia's hottest year since records began in 1910 (BoM 2014).

The area-averaged mean temperature for the continent for 2013 was 1.20°C above the 1961-1990 average. The mean maximum temperature during the year was 1.45°C above average, while the annual mean for minimum temperatures was 0.94°C above average.

The record heat was widespread across the continent (Figure 1). 2013 ranked in the four warmest years on record for all states and the Northern Territory.

The records weren't confined to the temperature over Australia's land surface. Our surrounding seas also experienced an unusually hot year. Records were set for the highest sea surface temperature (SST) in both January and February, and November experienced its second highest average SST on record. For the year through to November (December SST data are not yet available), 2013 is on track to be the third highest for SSTs since 1910, about 0.51°C above the long-term average. Over the past century, SSTs for the seas surrounding Australia have risen by about 1°C, similar to the increase recorded over land.

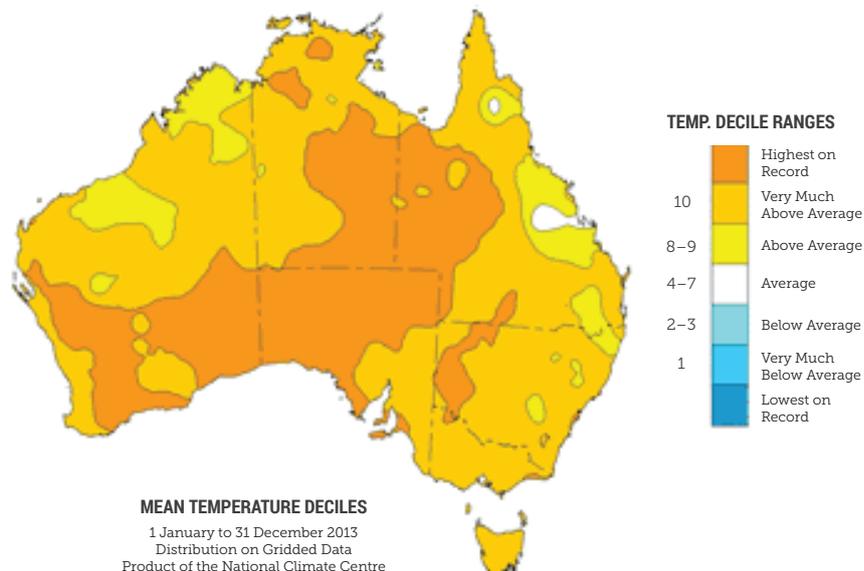


Figure 1: 2013 annual mean temperatures compared to historical temperature records. (Source: Redrawn from BoM 2014)

2013 in detail

The year began with a bang. A massive pool of hot air was established over 70% of the continent at the beginning of January. Australia recorded its hottest ever area-averaged maximum temperature of 40.30°C on 7 January.

Through the period 2 – 8 January, the country experienced seven consecutive days of area-averaged maximum temperature over 39°C. In 102 years of weather records, Australia has experienced only 21 such days, and eight of them occurred in 2013. January 2013 was Australia's hottest January on record.

The sea surface temperatures in the region around Australia were also very high. Records were set for both January and February, with the record for February 0.6°C above the long-term (1961-1990) average and 0.13°C above the previous record.

Warm weather continued past the end of summer, leading to more heat records in autumn, and pushing back the onset of the cooler months. The winter remained mild, and was the third warmest on record.

Record-breaking heat reappeared at the end of August and pushed winter rudely out the door. On 31 August, the average maximum temperature for Australia reached 29.92°C, the warmest winter day

on record. The end of August marked the warmest 12-month period (1 September 2012 – 31 August 2013) on record.

Spring immediately began to look like summer as Australia experienced its hottest September on record, with some remarkable observations. The monthly average temperature was 2.75°C above the 1961-1990 average, smashing the previous September record by 1.1°C. Some of the state records were astounding; South Australia shattered its previous record by 5.39°C and New South Wales by 4.68°C.

Then came October, 1.43°C above the long-term average (BoM 2013a). The October heat was widespread as the entire continent experienced above-average temperatures. Alice Springs airport had its hottest October day on record (42.6°C), Canberra was 2.5°C hotter than the long-term average, and West Kimberley (WA) set a new record, around 4°C above the long-term average. The end of October marked the third month in a row that a record was set for the warmest 12-month period. By the end of November, Australia had experienced its warmest spring on record.

By then, we were well on track to experience our hottest calendar year since records began over 100 years ago. Above-average temperatures continued through the remainder of 2013 to finish off a remarkable year for heat.

Putting 2013 into context

The previous hottest year for Australia was 2005, and 2013 easily beat that record by 0.17°C. Previously, the second hottest year was 1998, which now slips into third place.

The record temperatures of 2013 were not significantly influenced by the ENSO (El Niño-Southern Oscillation) phenomenon, as the climate system was in neither an El Niño or La Niña phase during the year, as measured by the Southern Oscillation Index.

El Niño years are normally warmer than usual, while La Niña years are cooler.

Over the past decade all years except one (2011) have recorded annual mean temperatures above average. Australian land surface temperatures have risen by about 1°C over the past century, with most of the rise occurring since 1950 (Figure 2). This is similar to global observations, where it is clear that the long-term warming trend continues (IPCC 2013).

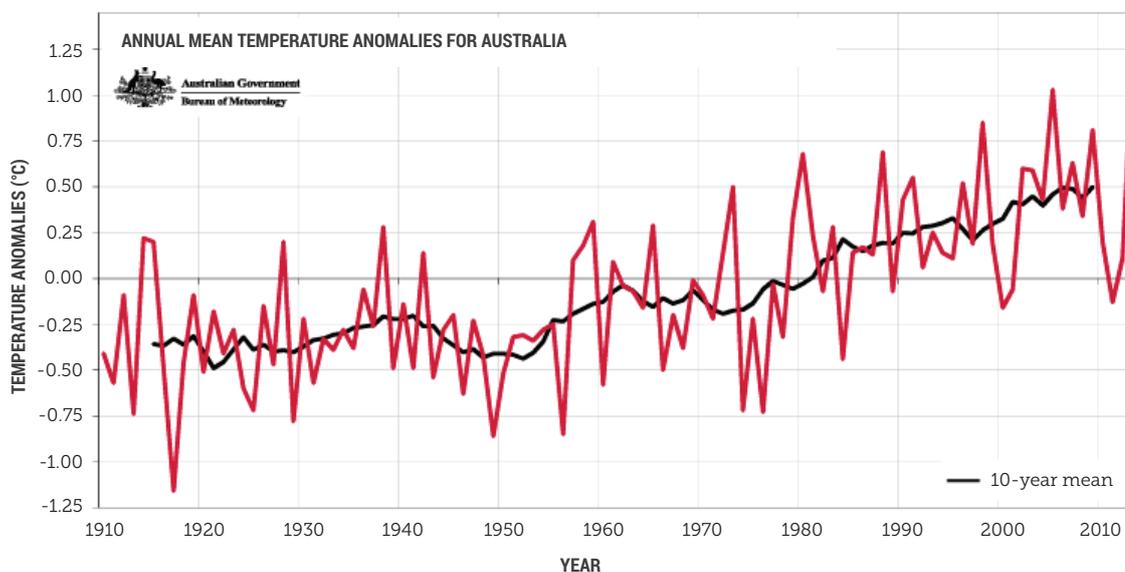


Figure 2: Annual mean temperature anomalies for Australia (compared with the 1961-1990 average). The black line shows the 10-year moving average. (Source: Redrawn from BoM 2014)

Globally, 2013 is on track to be the sixth hottest year since global records began in 1880, according to an assessment by the World Meteorological Organization of three global climate datasets for the January – November 2013 period.

No year since 1985 has experienced a global mean temperature below the 1961-1990 average, and nine of the ten warmest years have occurred in the past 12 years (2002-2013).

The link to climate change

The link between climate change and record hot weather is clear. The rising concentration of carbon dioxide and other greenhouse gases in the atmosphere is trapping more heat. Each of the last three decades has been successively warmer at the Earth's

surface than any preceding decade since 1850 (Figure 3), and the global average surface temperature has increased by 0.85°C over the period 1880-2012. In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years (IPCC 2013).

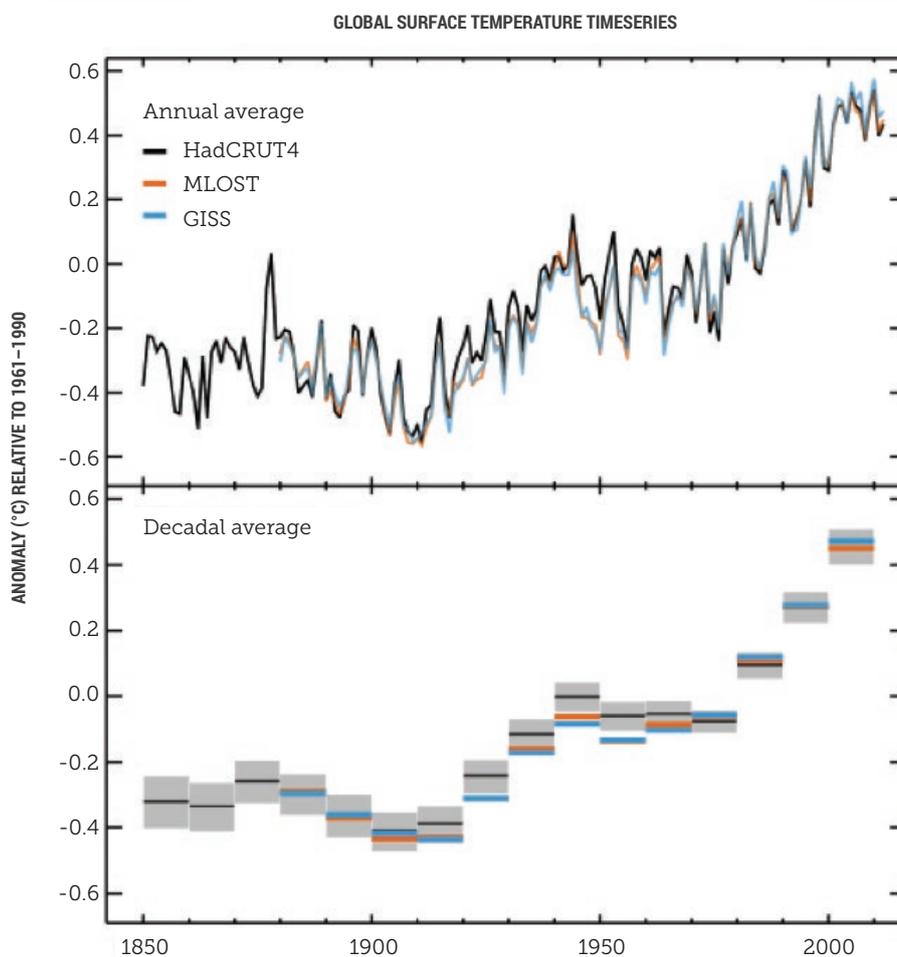


Figure 3: Observed global average combined land and ocean temperature anomalies from three surface data sets (black – HadCRUT4, yellow – MLOST, blue – GISS). Top panel: annual average values, bottom panel: decadal average values including the estimate of uncertainty for HadCRUT4. Anomalies are relative to the mean of 1961-1990. (Source: Redrawn from IPCC 2013)

All weather is now occurring in an atmosphere that contains vastly more heat than it did 50 years ago (Trenberth 2012). This is loading the dice towards more record hot weather, in Australia and around the world.

Observations bear this out. It is very likely that human-driven climate change has contributed to warmer and/or more frequent hot days and nights over most land areas around the world since 1950, and has likely contributed to increases in the frequency and/or duration of heatwaves in many regions, including Australia (IPCC 2012; 2013).

For Australia, the annual number of record hot days has doubled since 1950 (CSIRO and BoM 2012). In fact, in the last decade, the frequency of record hot days has been more than three times greater

than the frequency of record cold days (Trewin and Smalley 2012).

Record hot weather brings many risks. Human health is affected by extreme heat, directly through heat stress and indirectly through the exacerbation of existing medical conditions. Many other species of animals are subject to ill health and death under extreme temperatures. Infrastructure, such as that for electricity distribution and transport, can fail during heatwaves, and agricultural production is reduced during periods of unusually high temperatures.

Although more record hot weather is virtually certain for the next few decades, even higher risks of heat for the second half of the century can be averted by slowing climate change and then stabilising the climate system.

This requires urgent, persistent and deep reductions in greenhouse gas emissions over the coming decades, here in Australia and around the world.

THE HEAT IS ON

2013 AUSTRALIA'S HOTTEST YEAR ON RECORD

JAN **HOTTEST JANUARY ON RECORD** 

JUL **QLD's 3RD WARMEST JULY ON RECORD**  **WARMEST JULY ON RECORD FOR CANBERRA, HOBART, & AROUND MELBOURNE** 

FEB **HOTTEST SUMMER ON RECORD** 
(DEC 2012 – FEB 2013)

AUG **2ND WARMEST WINTER (JUN-AUG) ON RECORD FOR QLD, S.A. & N.S.W.**  **W.A.'s 2ND WARMEST AUGUST ON RECORD** 

MAR **TASMANIA'S HOTTEST MARCH ON RECORD**  **RECORD BREAKING HEATWAVE IN MELBOURNE** 

SEP **AUSTRALIA'S HOTTEST SEPTEMBER ON RECORD**  **NORTHERN TERRITORY'S HOTTEST DRY SEASON ON RECORD** (MAY-SEPT 2013)

APR **HOTTEST NORTHERN WET SEASON ON RECORD** ALICE SPRINGS AND DARWIN (OCT 2012 – APR 2013)  **W.A.'s 3RD HOTTEST APRIL ON RECORD**

OCT **QLD's 2ND HOTTEST OCTOBER ON RECORD**  **W.A.'s 2ND HOTTEST OCTOBER ON RECORD** 

MAY **S.A.'s 3RD HOTTEST AUTUMN ON RECORD** (MAR – MAY) 

NOV **AUSTRALIA'S WARMEST SPRING ON RECORD** 
(SEP – NOV 2013)

JUN **2ND HOTTEST START TO A CALENDAR YEAR (JAN - JUN) ON RECORD**

DEC **AUSTRALIA'S HOTTEST YEAR ON RECORD** 
(JAN – DEC 2013)

THE SCIENTIFIC EVIDENCE IS IRREFUTIBLE

IT'S TIME FOR ACTION ON CLIMATE CHANGE

See page 9 for reference list



Written by Professor Will Steffen.

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