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Special Climate Statement 51 – an exceptional autumn hot spell in northern and central Australia

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Cover image: Ranges between Winton and Boulia, Queensland, Bureau of Meteorology, July 2007.

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1 Introduction

An exceptional hot spell for the time of year affected large parts of northern and central Australia during March 2015. Initially, the heat was significant but relatively localised, mostly confined to the Top End and Gulf Country in the Northern Territory and adjacent areas of far northwest Queensland. From mid-March onwards, the heat extended over a much larger area. It peaked on 19 and 20 March when records were set over large parts of the Northern Territory and Queensland, as well as outback South Australia and northern New South Wales.

Many records were set during this hot spell. The Northern Territory and Queensland had their hottest March days on record in area-averaged terms, whilst the event also included the highest temperature ever observed in Australia in the second half of March.

March is a somewhat unusual month for extreme heat in the northern tropics. It is in the later part of what is normally the wet season, and temperatures are typically moderated by cloud cover, damp soils and green vegetation. The timing of the event's peak in the second half of the month is particularly noteworthy as, the potential for extreme heat normally declines rapidly through March, in central and southern Australia.

2 Detailed discussion of the hot spell

2.1 Development of the hot spell

The February 2015 Australian mean temperature anomaly of +1.67 °C was the second largest February anomaly on record, only exceeded by the 1983 value of +1.93 °C. It was also only the second time that the Australian average mean temperature for February exceeded 29 °C.

Persistent hot conditions prevailed through much of western Queensland through February and early March. While few significant records were set for individual days, a number were set for extended heat for the time of year, including 28 consecutive days of 40 °C or above at Urandangi (on the Queensland-Northern Territory border), 20 days at Boulia, and 10 days at Longreach – all of which were records for such spells ending in March. (The 28-day spell at Urandangi fell only just short of the Queensland record for any time of year, of 31 consecutive days of 40 °C and above, set at Urandangi and Boulia during the El Niño summer of 1972–73 and equalled at Birdsville in 2012–13).

The extreme heat (temporarily) cleared from most of western Queensland as cooler air penetrated on southeasterly winds in the wake of a trough. The heat retreated to the northern parts of the Northern Territory and the extreme northwest of Queensland. From 5 March onwards, temperatures were consistently at or near record levels for March in the Gulf Country on both sides of the Queensland – Northern Territory border, as well as in parts of the Top End.

After being confined to a relatively small region for more than a week, extreme heat extended southwards from 17 March as northwest airflow developed between an elongated north-south ridge of high pressure off the east coast of Australia and two troughs approaching central Australia from the west. The first trough weakened over central Australia and had little impact on conditions. The most widespread extreme heat occurred on 19 March ahead of a second, stronger trough, with temperatures at or near record levels for the time of year over a large area encompassing much of western Queensland, most of the Northern Territory, the northern and eastern outback of South Australia, and the far north and west of New South Wales, extending as far south as the far northwest of Victoria.

Conditions moderated over southern and western parts of this region on 20 March as the trough crossed, but it remained very hot over most of Queensland and northeast New South Wales. By 21 March, with the trough located over central Queensland¹, the most extreme part of the hot spell had ended, although temperatures remained well above normal in tropical inland Queensland and the northern half of the Northern Territory.

¹ Severe thunderstorms also occurred in association with this trough on 21 March in southern Queensland and northern New South Wales. A detailed discussion of these storms is outside the scope of this statement.

2.2 Persistent heat in the Gulf Country

One of the most notable features of the hot spell was the persistence of the heat in the Gulf Country, on both sides of the Northern Territory – Queensland border. This was especially pronounced at those locations where February rainfall was well below normal and the usual moderating influence of green vegetation on temperatures at this time of year was limited or absent.²

The most notable prolonged heat was at Borroloola. The highest March temperature recorded in 20 years of observations at the airport prior to 2015 was 38.8 °C. This value was exceeded on each of the 18 consecutive days from 5 to 22 March³, with 14 of these 18 days also exceeding the March record (40.0 °C) from an earlier Borroloola site which operated from 1957 to 1978. The highest temperature, 43.3 °C, occurred on 12 March, more than 3 °C in excess of the previous record at either Borroloola site. Centre Island, with 41 years of observations, exceeded its previous March record on six occasions during this period, and records were also set further east at Wollongorang and Burketown (Table 1).

Over the fortnight from 6 to 19 March, maximum temperatures averaged 5 to 7 °C above the normal for the 1961–90 reference period over most of the Gulf Country (Figure 1). This is especially noteworthy because, at this time of year, temperature variability is relatively low and even a single day more than 5 °C above normal is rare.

2.3 Heat extends over large parts of the continent

From 17 March onwards, the heat extended south and east to cover large parts of the continent.

The peak extent of the hot spell was on 19 March. The highest temperature on this day was 46.5 °C at Birdsville—the highest temperature ever recorded in Australia in the second half of March (surpassing 46.0 °C at Roebourne, Western Australia, on 20 March 2013), and was 3.2 °C warmer than anything previously recorded in Queensland in the second half of March. It was also the second-highest March temperature on record in Queensland, after 46.7 °C at Boulia on 2 March 1951. In total, fifteen Queensland stations reached 43 °C on either 19 or 20 March, a temperature which no Queensland station had reached on or after 19 March in any previous year, whilst the

² As an indicator of the local influence of preceding rainfall, McArthur River (48 kilometres southwest of Borroloola), which had received 42 millimetres of rain in the last week of February from storms which largely missed Borroloola, was generally about 1 °C cooler than Borroloola during the 5–20 March period, whereas normally it would be slightly hotter.

³ No daily maximum temperature was registered at Borroloola on 5 March due to an instrument outage during the morning, but temperatures exceeded 38.8 °C during that part of the day when the site was operating.

previous latest date of a 45-degree temperature in Queensland was 8 March (at Birdsville in 1982).

A Northern Territory record for March was set when Jervois reached 44.0 °C on the 19th, breaking the previous record of 43.9 °C set at Finke on 16 March 1968. In South Australia, Moomba's 45.4 °C was also the hottest ever in the State so far into autumn (Table 2), and was more than a week later than the previous latest 45-degree temperature in South Australia (on 11 March 1973 at Marree). The next day, a further State record for the highest temperature ever so late into autumn was set in New South Wales, with 42.9 °C at Mungindi.

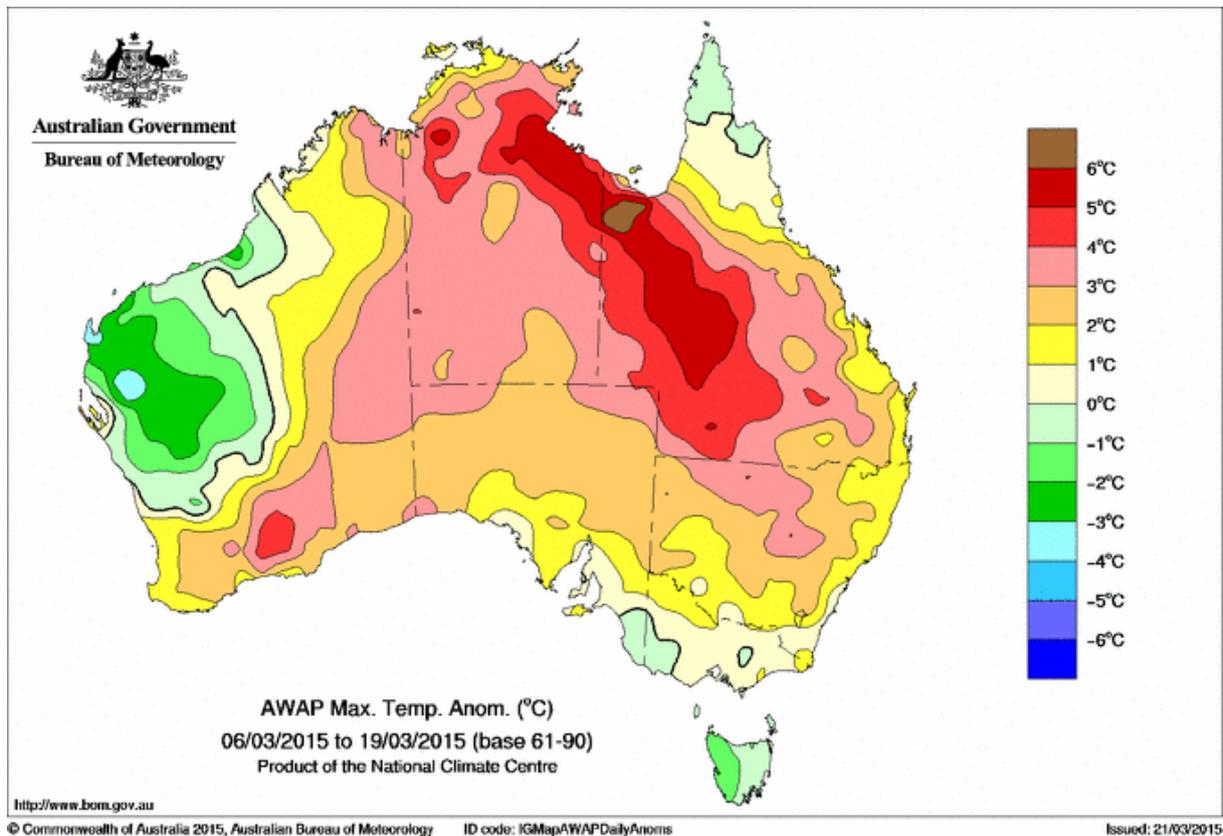


Figure 1. Maximum temperature anomaly for Australia, 6–19 March 2015.

19 March was the hottest March day on record, in area-averaged terms, for both the Northern Territory and Queensland. For the Northern Territory, the area-averaged maximum was 39.99 °C, surpassing the previous record of 39.87 °C set on 3 March 1988, with the values of 39.73 °C on 18 March and 39.63 °C on 17 March ranking third and fourth respectively. For Queensland, the area-averaged maximum on 19 March was 38.73 °C, and on 20 March 38.42 °C, both surpassing the previous record of 38.41 °C set on 1 March 1923.

Numerous site records for March were also set (Table 1). A total of 30 locations with 40 or more years of data had their hottest March day on record between 6 and 20 March (Figure 3). Seven of the 112 ACORN-SAT locations had their hottest March day on record (Table 1), with a further 15 experiencing their highest temperature ever so far into autumn (Table 3). Records were set on numerous days but were most extensive on 19 and 20 March, when March records were analysed across 3.4 and 4.0 per cent of Australia's area respectively (Figure 2).

While overnight minimum temperatures were mostly above normal through the region during the event, they generally did not reach record levels. The limited exceptions mostly occurred on 21 March, where Longreach's overnight minimum of 28.5 °C was 1.4 °C above its previous record, and records were also set at Isisford and Texas (Queensland) and Murwillumbah (New South Wales).

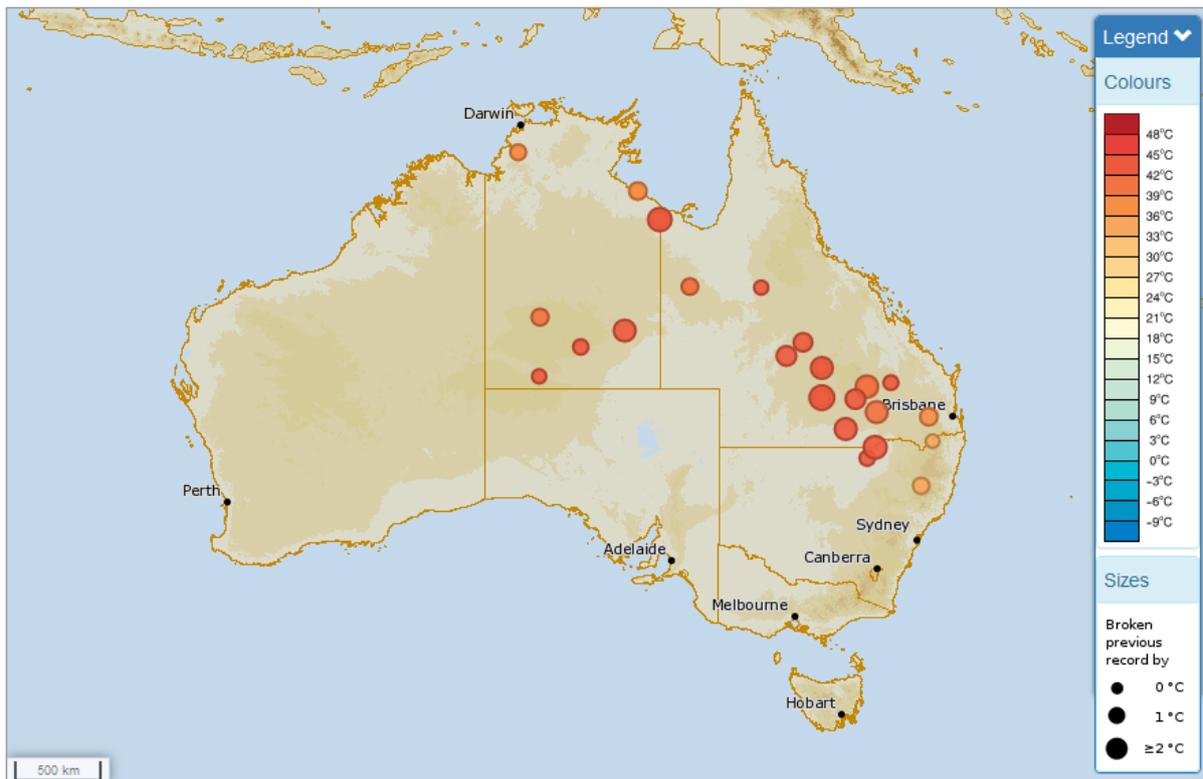


Figure 2. Location of stations where record high maximum temperatures were set in the period from 6 to 20 March 2015. The colour of each circle indicates the temperature reached and the size of the circle the margin by which the previous record was broken.

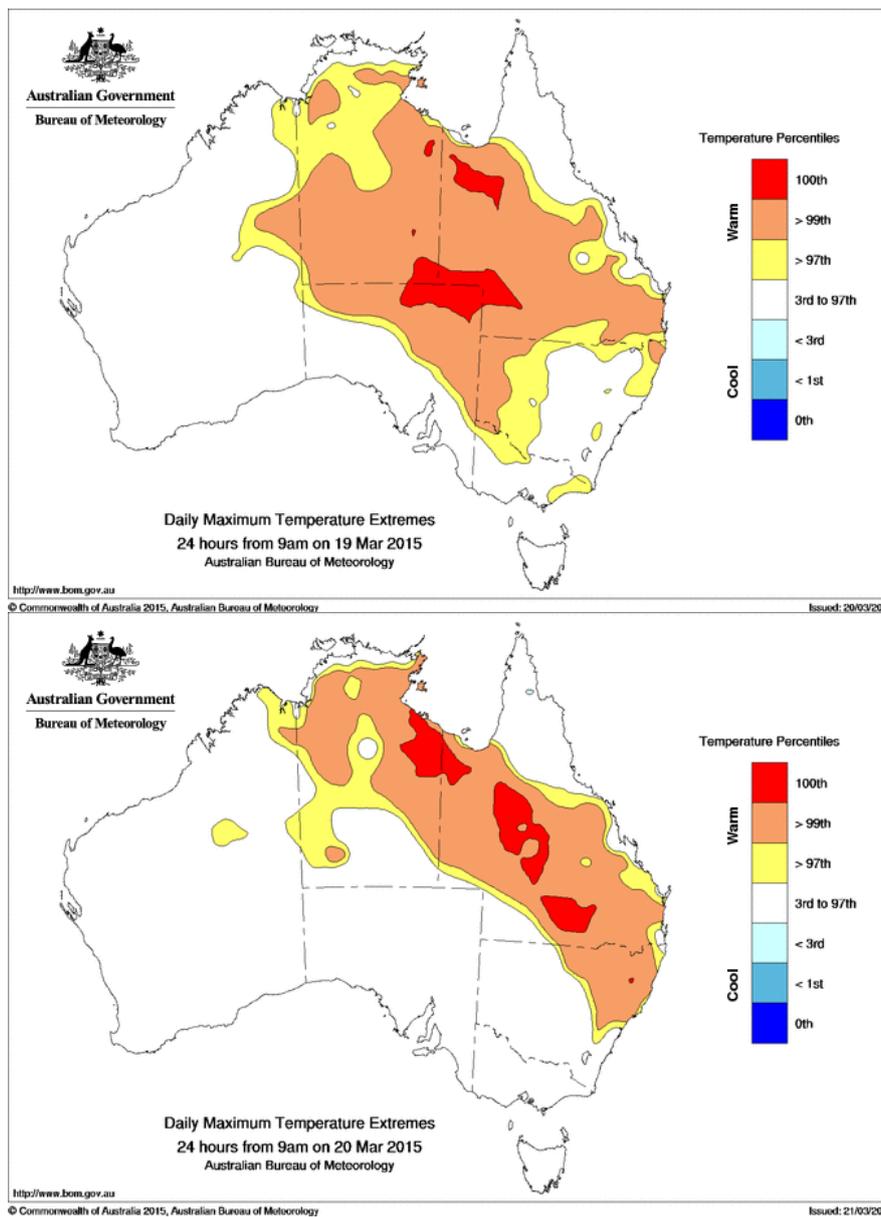


Figure 3. Areas where record high March temperatures occurred on 19 (top) and 20 (bottom) March 2015.

2.4 Monthly extremes resulting from the hot spell

The prolonged hot spell, combined with generally above-average temperatures in early and late March, resulted in numerous records being set for March monthly mean temperatures in Queensland and adjacent parts of the eastern Northern Territory (Figure 4). At some locations, such as Longreach and Mount Isa, monthly mean maximum temperatures for March were up to 1 °C above previous records.

It was the hottest March on record for Queensland as a whole. Mean maximum temperatures for the State were 2.88 °C above the average for the 1961–1990 reference period, surpassing the previous record set in 1915 by 0.21 °C, while mean minimum temperatures were 1.62 °C above average, 0.15 °C above the previous record set in 2007.

Julia Creek's mean maximum for the month was 40.5 °C, Century Mine's 40.2 °C, and Winton Airport's 40.1 °C. These are the first instances of any station in Queensland having a mean maximum temperature of 40 °C or above in March.

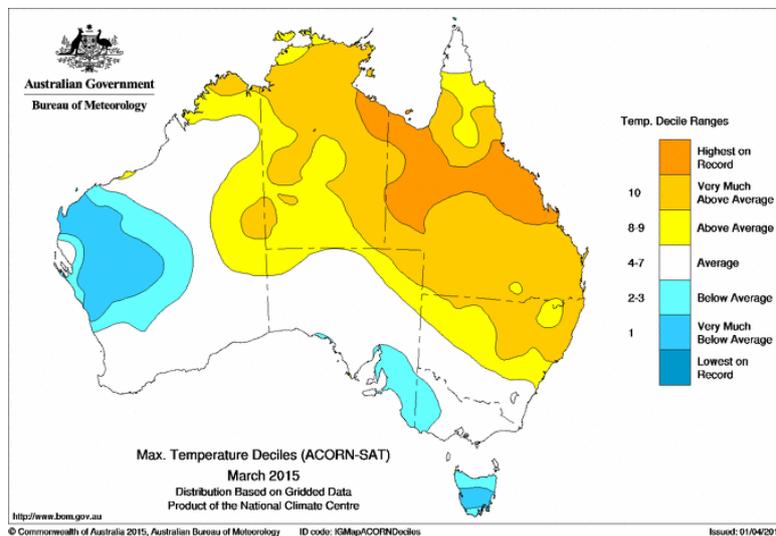


Figure 4. Deciles of mean monthly maximum temperature for March 2015.

2.5 Causes and impacts of the extreme heat

Large parts of western Queensland have been affected by long-term rainfall deficiencies, as detailed in the Bureau of Meteorology's Drought Statement (Figure 5). This was due in part to a dry start to the wet season, adding to the two previously poor successive wet seasons in inland Queensland. An extended break in the 2014–15 northern wet season from early February onwards resulted in already dry deep soils being matched by drier shallow soils, resulting in a reduction in the evaporative cooling at a time when normally the wet is reaching a peak. Likewise, reduced vegetation due to the persistent dry would have resulted in lower transpiration. A lack of monsoonal activity in Australian longitudes during February and March also contributed to the build-up of heat in the northern interior.

The heat is also likely to have exacerbated the impact of the drought, through increased evaporation and further reducing the limited pasture growth which has occurred during the 2014–15 wet season. Most of the drought-affected areas had rainfall well below average for February, and have had little or no rain so far in March, with rains associated with tropical cyclones *Marcia* and *Nathan* passing to the east and north of the region respectively.

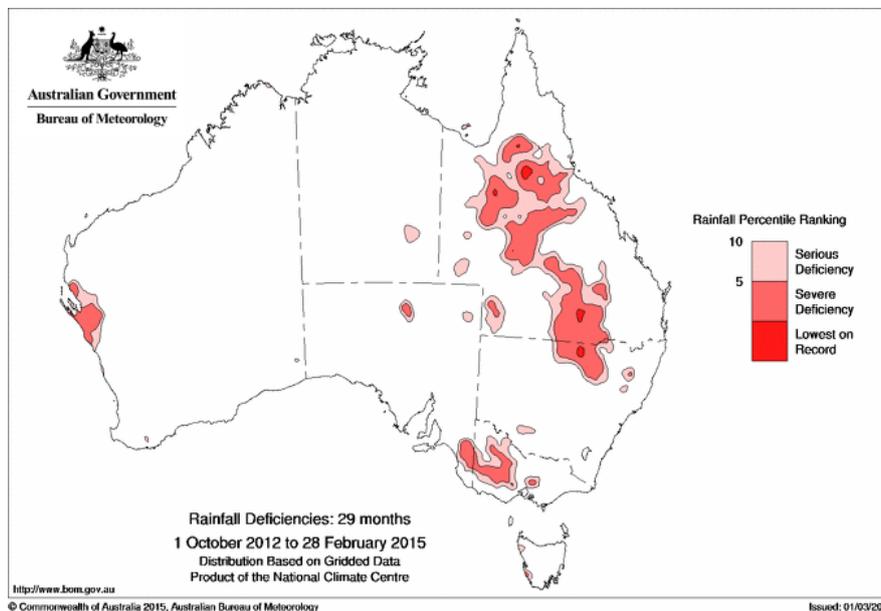


Figure 5. Rainfall deficiencies for the 29 months October 2012 – February 2015.

Table 1. March record high maximum temperatures at locations with 40 or more years of data. ACORN-SAT locations are shown in italics.

Station number	Station name	State	Value (°C)	Date	Previous record
14703	Centre Island	NT	38.8	17 Mar	38.1 (1/3/1980)
15511	Curtin Springs	NT	43.4	19 Mar	43.3 (2/3/2007)
15528	Yuendumu	NT	41.7	18 Mar	41.1 (23/3/1990)
<i>15548/15666</i>	<i>Rabbit Flat</i>	<i>NT</i>	<i>43.3</i>	<i>18 Mar</i>	<i>43.2 (3/3/1988)</i>
15590	Alice Springs	NT	42.5	19 Mar	42.2 (4/3/1951)
15602	Jervois	NT	44.0	19 Mar	42.5 (8/3/2004)
17096/17123	Moomba	SA	45.4	19 Mar	45.2 (3/3/2009)
<i>29004/29077</i>	<i>Burketown</i>	<i>QLD</i>	<i>42.7</i>	<i>11 Mar</i>	<i>42.1 (1/3/1988)</i>
29025/29058	Julia Creek	QLD	43.0	20 Mar	42.1 (10/3/2004)
29127	Mount Isa	QLD	41.4	20 Mar	40.9 (1/3/1985)
30024/30022	Hughenden	QLD	40.6	6 Mar	40.4 (8/3/2004)
<i>30045</i>	<i>Richmond</i>	<i>QLD</i>	<i>42.4</i>	<i>20 Mar</i>	<i>42.3 (1/3/1923)</i>
35069	Tambo	QLD	42.0	20 Mar	40.5 (2/3/1985)
35070	Taroom	QLD	42.2	20 Mar	42.0 (12/3/2007)
<i>36007</i>	<i>Barcaldine</i>	<i>QLD</i>	<i>42.2</i>	<i>20 Mar</i>	<i>41.3 (3/3/1985)</i>
36026	Isisford	QLD	44.6	20 Mar	43.5 (4/3/1985)
36143/36034	Blackall	QLD	42.6	20 Mar	41.8 (4/3/1985)
37043/37058	Urandangi	QLD	44.9	20 Mar	43.8 (4/3/1985)
<i>38002/38026</i>	<i>Birdsville</i>	<i>QLD</i>	<i>46.5</i>	<i>20 Mar</i>	<i>45.0 (8/3/1982)</i>
41095	Stanthorpe	QLD	34.2 (=)	20 Mar	34.2 (17/3/1998)
41359	Oakey	QLD	38.7	20 Mar	38.0 (12/3/2007)
43015	Injune	QLD	41.7	20 Mar	40.1 (12/3/2007)
43020	Mitchell	QLD	42.1	20 Mar	41.0 (3/3/2009)
43030/43091	Roma	QLD	42.9	20 Mar	41.1 (3/3/1958)
43035	Surat	QLD	41.9	20 Mar	40.4 (15/3/1998)
44010	Bollon	QLD	43.2	20 Mar	41.7 (2/3/1985)
<i>44021</i>	<i>Charleville</i>	<i>QLD</i>	<i>43.3</i>	<i>20 Mar</i>	<i>40.7 (2/3/2009)</i>

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48031	Collarenebri	NSW	42.1	20 Mar	41.8 (14/3/1998)
52026	Mungindi	NSW	42.9	20 Mar	41.2 (1/3/2011)
55136	Woolbrook	NSW	34.5	20 Mar	34.0 (18/3/2002)

Table 2. National and State records for the highest temperature so far into autumn.

Region	Value (°C)	Location	Date	Previous highest on or after this date	Previous latest date of such a temperature
Australia	46.5	Birdsville	19 Mar	46.0 (20/3/2013, Roebourne (WA))	9 March (Emu Creek, WA, 1973)
Northern Territory	44.0	Jervois	19 Mar	43.0 (25/3/1990, Wave Hill)	27 February (Rabbit Flat, 1998)
Queensland	46.5	Birdsville	19 Mar	42.9 (27/3/2013, Birdsville)	2 March (Bouliia, 1951)
South Australia	45.4	Moomba	19 Mar	43.7 (27/3/1943, Oodnadatta)	7 March (Tarcoola, 1986)
New South Wales	42.9	Mungindi	20 Mar	42.5 (21/3/1986, Ivanhoe)	19 March (Tibooburra, 2002)

Table 3. ACORN-SAT locations which set records for highest temperature so far into autumn (in addition to stations with monthly records shown in table 1). Stations shown in italics also set or equalled records for the latest date on which 40 °C was reached at that station.

Station number	Station name	State	Value (°C)	Date	Previous highest on or after this date
15135	Tennant Creek	NT	40.6	20 Mar	40.3 (22/3/2013)
17031/17126	Marree	SA	43.4	19 Mar	42.8 (21/3/1980)
17043	Oodnadatta	SA	44.7	19 Mar	43.7 (27/3/1943)
36031	Longreach	QLD	43.1	20 Mar	40.8 (24/3/2001)
37010	Camooweal	QLD	42.3	20 Mar	40.7 (21/3/2013)
38003	Boulia	QLD	44.4	20 Mar	42.2 (25/3/1942)
<i>42023/42112</i>	<i>Miles</i>	<i>QLD</i>	<i>41.3</i>	<i>20 Mar</i>	<i>38.4 (29/3/1998)</i>
<i>43034/43109</i>	<i>St. George</i>	<i>QLD</i>	<i>42.0</i>	<i>20 Mar</i>	<i>39.4 (24/3/1933)</i>
45017/45025	Thargomindah	QLD	43.5	19 Mar	41.8 (19/3/2002)
46037/46126	Tibooburra	NSW	42.5	19 Mar	41.2 (21/3/1980)
52026/52088	Walgett	NSW	42.6	20 Mar	40.0 (24/3/1933)
<i>53027/53048</i> <i>/53115</i>	<i>Moree</i>	<i>NSW</i>	<i>41.3</i>	<i>20 Mar</i>	<i>40.3 (20/3/2002)</i>
55024	Gunnedah Research	NSW	39.5	20 Mar	39.3 (21/3/2002)
61078	Williamtown	NSW	37.7	20 Mar	37.0 (5/4/1986)
63005	Bathurst Ag	NSW	34.0 (=)	20 Mar	34.0 (22/3/1980)

Notes

Values in this statement are current at 1 April 2015, and subject to the Bureau's quality control processes.

The dataset from which area averages are drawn (ACORN-SAT) commences in 1910, while that which mapped spatial analyses are drawn from commences in 1911. Station data prior to national introduction of standardised instrument shelters in 1910 are used only if they are known to have been measured using standard equipment comparable with current standards. This matter is discussed further at <http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Early-data>.

Further information is available from <http://www.bom.gov.au/climate/>.