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Bureau of Meteorology

Special Climate Statement 47 - an intense heatwave in central and eastern Australia

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1 Introduction

A significant heatwave affected much of the central and eastern interior of Australia over the New Year period in late 2013/early 2014. The heatwave was not as extensive or as prolonged as the heatwave of January 2013, and was not associated with destructive fires to the same extent, but was nevertheless highly significant with substantial areas having their hottest day on record.

The first stage of the heatwave developed from 27 December, when very high temperatures occurred on the Nullarbor, including record high temperatures for December at Eucla and Forrest near the Western Australia-South Australia border. Over the next three days the focus of the heat moved to the southern and central interior of Queensland, where a few locations had their hottest day on record on either 29 or 30 December.

There was a slight moderation in conditions over Queensland on 31 December, but by then extremely hot air had redeveloped in the southern interior of Western Australia. This air mass moved east to cover much of the South Australian outback on 1 January.

Over the next three days the hottest air moved slowly eastwards, on the north side of an elongated trough over New South Wales which absorbed the remnant circulation of Tropical Cyclone Christine, which had made landfall on the Pilbara coast on 31 December and moved southeast over the Australian continent. Extreme heat, and moderate to strong northwesterly winds – an unusual wind direction for mid-summer in the region – covered northeast South Australia, southwest Queensland and the far northwest of New South Wales on 2 January.

On 3 January, the focus of the most exceptional heat was in a region straddling the New South Wales-Queensland border, extending from the upper Hunter north and west to cover much of the northern inland of New South Wales east of Bourke, as well as the Maranoa and Warrego regions of southern Queensland. The majority of the records set during the heatwave occurred on this day. The extent and intensity of the heat is highlighted by the fact that Friday 3 January broke by record for Queensland's hottest day on record (in area average terms). The following day, the northwest winds extended to near the coast in southeast Queensland, bringing extreme heat to metropolitan Brisbane and surrounding regions, although coastal temperatures mostly fell short of records.

By the 5th the most significant heat had retreated to the central and northern interior of Queensland, where the heatwave continues largely unabated at the time of writing.

2 Detailed analysis of the heatwave

2.1 General summary of the heatwave

Temperatures well above average affected much of central and eastern Australia over the period (Figure 1). For the week ending 4 January, average maximum temperatures were 8°C or more above normal over parts of southern inland Queensland, and were at least 6°C above normal over most inland regions of that State, as well as parts of northern inland New South Wales. Inland Queensland has been seriously affected by drought over the last 12 months and it is possible that low soil moisture was a contributor to the intensity of the heat.

The highest temperature to occur during the heatwave was 49.3°C at Moomba, in the far northeast of South Australia, on 2 January. (It was marginally hotter, 49.6°C, at the same location in January 2013). 12 locations in northern South Australia, southwest Queensland and northwest New South Wales reached 48°C or above (Table 3). This included a site record 49.1°C at Walgett on 3 January, which was also the highest temperature observed at any New South Wales location since 1939 (when it reached 50.0°C at Wilcannia and 49.7°C at Menindee during the heatwave associated with Black Friday). 45°C was exceeded over most of the central and eastern interior of Australia, as well as over the Nullarbor (Figure 2).

The most significant records broken were on 3 January. It was the hottest day on record for Queensland, in area-averaged terms, for daily maximum, minimum and mean temperature (Table 4), with the statewide mean temperature exceeding the previous record by an extraordinary 0.75°C. The day was the hottest on record over 10.2 per cent of Queensland and 14.6 per cent of New South Wales (Figure 3), a region covering most of the Maranoa and Warrego in Queensland, and the Northwest Slopes and Plains and Northern Tablelands in New South Wales. In total, record high maximum temperatures occurred over 8.8 per cent of Australia from 1 to 4 January, including 16.8 per cent of New South Wales, 16.8 per cent of the Northern Territory, 15.2 per cent of Queensland and 7.9 per cent of South Australia.

2.2 Station-specific records

34 locations with 40 or more years of data, mostly in Queensland and New South Wales had their hottest day on record between 30 December and 4 January (Table 1), with 3 more equalling their records. 15 additional locations set monthly records for either December or January without breaking their all-time records.

Some locations in southern inland Queensland set all-time records on 29 or 30 December which were then broken themselves in early January. As an example, Roma broke its all-time record high temperature on three separate occasions, on 29 and 30 December and then finally on 3 January.

A major feature of the heatwave was the very large margin by which some records were broken, particularly in northern New South Wales. At Narrabri, the 47.8°C

observed on 3 January surpassed the previous record by 3.6°C, the largest such margin at any Australian location with 40 or more years of data¹. Gunnedah Research, with 76 years of observations, broke its previous high temperature record by 2.8°C, the largest margin (between the highest and second-highest temperatures) at any of the 112 locations in the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) data set.

Overnight temperatures were well above normal but were generally less extreme than daytime maximum temperatures. However, a number of station records were still set (Table 2), mostly in southern and central Queensland.

2.3 Prolonged heat in parts of Queensland

The heat was most prolonged in inland Queensland, particularly the central west of the state, which was too far north to experience much moderation in temperatures between the peak phases of the heatwave on 29-30 December and 2-4 January.

Urandangi, in the far west of the State near the Northern Territory border, had five consecutive days of 45°C or above from 30 December to 3 January, well in excess of the previous record of three. Other locations to set records for consecutive days above thresholds (Table 5) included Barcaldine (with ten consecutive days of 40°C or above), Isisford and Hughenden, while Mount Isa equalled a record with five consecutive days of 42°C or above.

With the extended duration of the heat, weekly average temperatures were also very high. Barcaldine (43.2°C) and Charleville (43.4°C) both set records for the highest weekly average maximum temperature, surpassing records set in 1972 (42.8°C) and 2006 (42.6°C) respectively.

¹ Prior to the current event, the largest margin between the highest and second-highest temperatures at an Australian location was 3.1°C at Tewantin, Queensland (highest 44.2°C, second-highest 41.1°C). The Tewantin margin has now been reduced to 2.5°C as it reached 41.7°C there on 4 January 2014.

Location	State	Site numbers	Value (°C)	Date	Previous record
Eucla	WA	11003	47.4	27 Dec	45.6 (4/12/1925, 26/12/1949)
Forrest	WA	11004/11052	46.5	27 Dec	45.6 (26/12/1949)
Southern Cross	WA	12074/12320	45.7	30 Dec	45.2 (30/12/2007)
Brunette Downs	NT	15085	45.6	2 Jan	44.3 (20/1/1985) (Jan) 45.5 (19/2/1983, 2/12/2007) (all)
Coober Pedy	SA	16007/16090	47.4	1 Jan	47.8 (30/12/1972)
Tarcoola	SA	16044/16098	48.9 (=)	1 Jan	48.5 (23/1/1982) (Jan) 48.9 (27/12/1949) (all)
Lockhart River	QLD	28008	38.0	5 Jan	37.7 (6/1/1994)
Hughenden	QLD	30024/30022	43.9	4 Jan	43.6 (5/1/1994)
Clermont	QLD	35019/35124	44.3	31 Dec	43.3 (1/12/1996)
Tambo	QLD	35069	43.3 (=)	30 Dec	43.3 (13/12/1979)
Tambo	QLD	35069	44.5	3 Jan	44.2 (4/1/1973)
Taroom	QLD	35070	44.0 (=)	30 Dec	44.0 (25/12/1972)
Taroom	QLD	35070	45.3	4 Jan	44.0 (6/1/1994)
Barcaldine	QLD	36007	44.9	3, 4 Jan	44.8 (4/1/1973)
Isisford	QLD	36026	46.6	30 Dec	46.0 (27 and 28/12/1972)
Blackall	QLD	36034/36143	45.4	30 Dec	44.6 (24/12/1972, 13/12/1979)
Blackall	QLD	36034/36143	45.7	3 Jan	44.6 (28/1/1990)
Camooweal	QLD	37010	46.0	2 Jan	45.4 (11/1/1971)
Urandangi	QLD	37043/37058	47.2	30 Dec	47.0 (12/12/1979)
Urandangi	QLD	37043/37058	47.3	2 Jan	46.6 (29/1/1990, 14/1/2013) (Jan) 47.0 (12/12/1979) (all)
Windorah	QLD	38024	47.3	29 Dec	47.1 (22/12/1990)
Windorah	QLD	38024	48.0	3 Jan	47.6 (12/1/2013)
Rockhampton	QLD	39083	41.5	30 Dec	41.3 (8/12/1981)
Gympie	QLD	40093	42.4	4 Jan	40.8 (6/1/1994) (Jan) 42.0 (26/12/2001) (all)
Kingaroy	QLD	40112/40922	41.0 (=)	4 Jan	41.0 (6/1/1994)
Goondiwindi	QLD	41038/41521	46.4	3 Jan	45.0 (3/12/1913, 4/1/1942)
Toowoomba	QLD	41103/41529	39.5	4 Jan	39.3 (6/1/1994)
Applethorpe	QLD	41175	37.8	3 Jan	37.0 (19/1/2003)
Injune	QLD	43015	44.1	30 Dec	43.0 (26/12/1972) (Dec) 43.8 (20 and 28/1/1980) (all)
Roma	QLD	43030/43091	45.5	30 Dec	44.0 (7/12/1981)
Roma	QLD	43030/43091	45.8	3 Jan	44.6 (10/1/2013)
St. George	QLD	43034/43109	45.5	29 Dec	45.4 (3/12/1913)
St. George	QLD	43034/43109	47.2	3 Jan	45.4 (29/1/1932) (Jan) 45.6 (17/2/1925) (all)
Surat	QLD	43035	45.7	3 Jan	44.0 (19/1/1980, 7/12/1981)
Charleville	QLD	44021/44022	46.0	29 Dec	45.6 (3/12/1913, 26/12/1938)
Cunnamulla	QLD	44026	47.0 (=)	3 Jan	47.0 (13/1/2013)
Quilpie	QLD	45015	46.2	29 Dec	46.1 (22/12/1990)
Quilpie	QLD	45015	47.1	3 Jan	46.5 (12/1/2013)
Collarenebri	NSW	48031	48.0	3 Jan	47.0 (4/1/1990)

Coonamble	NSW	51010/51161	47.6	3 Jan	46.7 (13/1/2013)
Mungindi	NSW	52020	46.2	29 Dec	45.0 (26/12/1972, 7/12/1981)
Mungindi	NSW	52020	48.2	3 Jan	46.8 (12/1/2013)
Walgett	NSW	52026/52088	49.1	3 Jan	48.5 (13/1/2013)
Moree	NSW	53027/53048/ 53115	47.3	3 Jan	46.1 (29/1/1932)
Narrabri	NSW	53030/54038	47.8	3 Jan	44.2 (13/1/2013)
Barraba	NSW	54003	44.9	3 Jan	41.3 (4/1/1973) (Jan) 41.8 (3/2/2006) (all)
Pindari Dam	NSW	54104	41.5	3 Jan²	40.2 (8/1/1994) (Jan) 41.2 (21/2/2004) (all)
Gunnedah Research	NSW	55024	45.9	3 Jan	42.3 (7/1/1964, 12 and 13/1/2013) (Jan) 43.1 (19/11/1968) (all)
Quirindi	NSW	55049	45.1	3 Jan	42.9 (12/1/2013) (Jan) 43.4 (2/2/2006) (all)
Tamworth	NSW	55054/55325	45.1	3 Jan	42.5 (12/1/2013)
Woolbrook	NSW	55136	37.5	3 Jan	36.5 (12/1/2013 and 4 earlier dates)
Armidale	NSW	56002/56037	36.9	3 Jan	36.3 (31/1/2003) (Jan) 36.5 (19/12/1990) (all)
Glen Innes Ag	NSW	56013	34.5	29 Dec	33.8 (4/12/1979)
Glen Innes Ag	NSW	56013	36.0	3 Jan	34.5 (27/1/1981)
Inverell Research	NSW	56018	38.7	29 Dec	38.5 (7/12/1981)
Inverell Research	NSW	56018	41.1	3 Jan	39.9 (25/1/2003)
Inverell (Raglan St)	NSW	56017/56242	41.9	3 Jan	41.7 (15/1/1939, 8/2/1952)
Tabulam	NSW	57095	38.3	29 Dec	38.2 (13/12/1979)
Murrurundi	NSW	61051	41.2	3 Jan	40.9 (12/1/2013)
Gulgong	NSW	62013	42.3	3 Jan	42.0 (12 and 18/1/2013)
Mudgee	NSW	62021/62101	42.5	3 Jan	42.2 (7/1/1964, 15/2/2004)
Coonabarabran	NSW	64008	44.0	3 Jan	42.6 (4/1/1973)
Dunedoo	NSW	64009	44.2	3 Jan	43.7 (12/1/2013)

Table 1. Records set during the heatwave for highest maximum temperature at locations with 40 or more years of data. Values which set a record for any month are shown in bold. Where a site set both December and January records, these are shown separately.

² Maximum temperature for the 72 hours ending at 9am on 6 January; highest temperature in this period almost certainly occurred on the afternoon of 3 January.

Location	State	Site numbers	Value (°C)	Date	Previous record
Wiluna	WA	13012	31.0	30 Dec	30.5 (19/12/2005)
Brunette Downs	NT	15085	31.5	4 Jan	31.0 (3/1/1994) (Jan) 31.2 (3/12/2007) (all)
Yuendumu	NT	15528	30.4	3 Jan	30.2 (11/1/1987, 14/1/1988)
Horn Island	QLD	27021/27022/ 27058	28.4 (=)	5 Jan	28.4 (22/1/1958)
Weipa	QLD	27042/27045	28.7	5 Jan	28.2 (22/1/1994)
Tambo	QLD	35069	29.5	4 Jan	28.8 (5/1/2006)
Barcardine	QLD	36007	30.5	4 Jan	29.3 (1/1/1977, 13/1/1999) (Jan) 30.4 (2/12/1996) (all)
Monto	QLD	39104/39330	26.8	5 Jan	26.0 (20/1/1980, 17/1/2005)
Applethorpe	QLD	41175	23.0	4 Jan	22.0 (7/1/2004) (Jan) 23.0 (21/2/2004) (all)
Mitchell	QLD	43020	29.7	3 Jan	29.0 (5/1/2006) (Jan) 29.3 (10/12/2009) (all)
Roma	QLD	43030/43091	29.2	3 Jan	28.6 (4/1/2006) (Jan) 28.9 (27/12/1957) (all)
Surat	QLD	43035	29.4	3 Jan	28.7 (30/1/1981) (Jan) 29.4 (6/11/1965, 9/2/2005) (all)
Tabulam	NSW	57095	26.2	4 Jan	26.1 (7/1/1994)

Table 2. Records set during the heatwave for highest minimum temperature at locations with 40 or more years of data. Values which set a record for any month are shown in bold.

Location	State	Site number	Temperature (°C)	Date
Moomba	SA	17123	49.3	2 Jan
Walgett	NSW	52088	49.1	3 Jan
Tarcoola	SA	16098	48.9	1 Jan
Birdsville	QLD	38026	48.7	2 Jan
Lightning Ridge	NSW	48243	48.5	3 Jan
Tibooburra Airport	NSW	46126	48.4	2 Jan
Marree Comparison	SA	17031	48.3	2 Jan
Mungindi	NSW	52020	48.2	3 Jan
Marree Airport	SA	17126	48.1	2 Jan
Oodnadatta	SA	17043	48.0	1 Jan
Windorah	QLD	38024	48.0	3 Jan
Collarenebri	NSW	48031	48.0	3 Jan

Table 3. Sites which reached 48°C or above between 26 December 2013 and 4 January 2014.

Maximum temperature		Mean temperature		Minimum temperature	
Temperature (°C)	Date	Temperature (°C)	Date	Temperature (°C)	Date
41.82	3/1/2014	34.54	3/1/2014	27.26	3/1/2014
41.64	14/11/1915	33.79	27/1/1947	26.82	7/1/2004
41.52	26/1/1940	33.74	26/1/1940	26.81	23/12/1990
41.48	10/1/1932	33.57	26/1/1947	26.77	28/1/1947
41.47	28/1/1990	33.48	12/1/2013	26.71	28/1/1940
41.38	25/1/1940	33.46	13/1/2013	26.58	5/1/2006
41.33	1/12/1996	33.44	28/1/1947	26.53	27/1/1947
41.29	11/1/1932	33.42	28/1/1940	26.35	6/1/2006
41.26	29/12/2013	33.40	10/1/1932	26.31	4/1/2014
41.25	4/12/1913	33.34	6/1/2006	26.29	7/1/1994

Table 4. Hottest area-averaged days on record for Queensland. Values set during the current heatwave are shown in bold.

Location	State	Site numbers	Threshold (°C)	Number of days and dates	Previous record
Tennant Creek	NT	15087/15135	45 (=)	2 (2-3 Jan)	2 (2-3/12/2007)
Mount Isa	QLD	29127	42 (=)	5 (30 Dec – 3 Jan)	5 (2-6/1/1994, 30/1-3/2/2002)
Hughenden	QLD	30024/30022	42	7 (30 Dec – 5 Jan)	4 (6-9/11/1965, 2-5/12/2002)
Tambo	QLD	35069	42 (=)	2 (29-30 Dec, 3-4 Jan)	2 (28-29/1/1990 and 4 other occasions)
Barcaldine	QLD	36007	40	10 (27 Dec – 5 Jan)	8 (23-30/12/1972)
Isisford	QLD	36026	42	10 (27 Dec – 5 Jan)	6 (9-14/1/2013 and 3 other occasions)
Camooweal	QLD	37010	45 (=)	2 (1-2 Jan)	2 (8-9/1/2006 and 3 other occasions)
Urandangi	QLD	37043/37058	45	5 (30 Dec – 3 Jan)	3 (10-12/12/2007)
Injune	QLD	43015	42	2 (29-30 Dec, 3-4 Jan)	2 (15-16/1/1979)

Table 5. Locations which set records for the most consecutive days with maximum temperatures at or above the stated threshold.

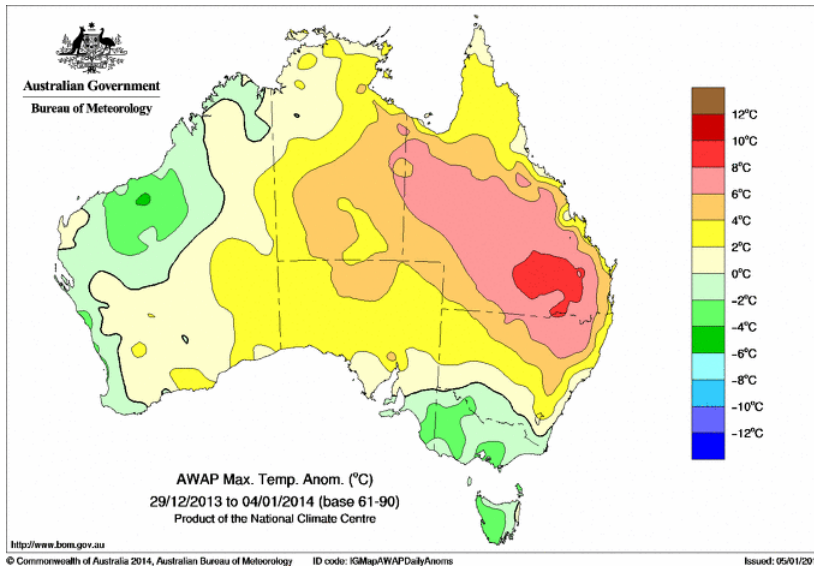


Figure 1. The maximum temperature anomaly for the period 29 December 2013 – 4 January 2014.

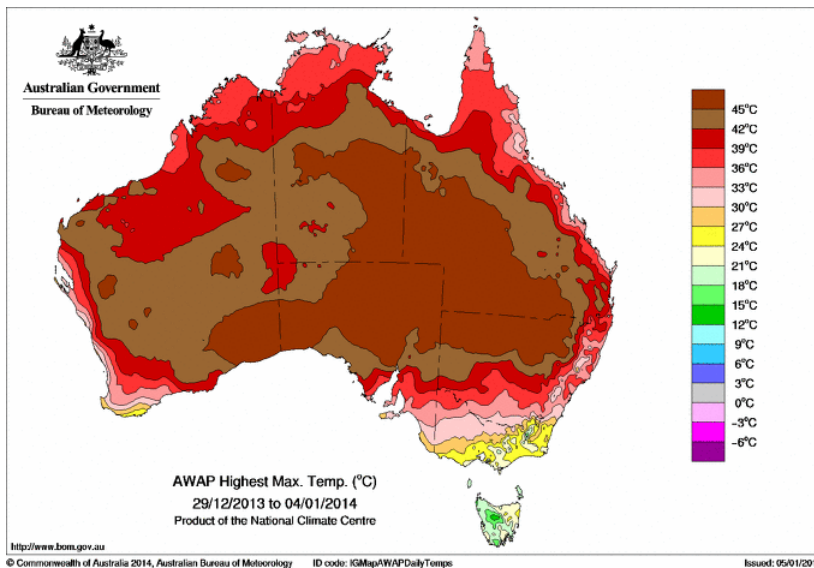


Figure 2. The highest temperature recorded for the period 29 December 2013 – 4 January 2014.

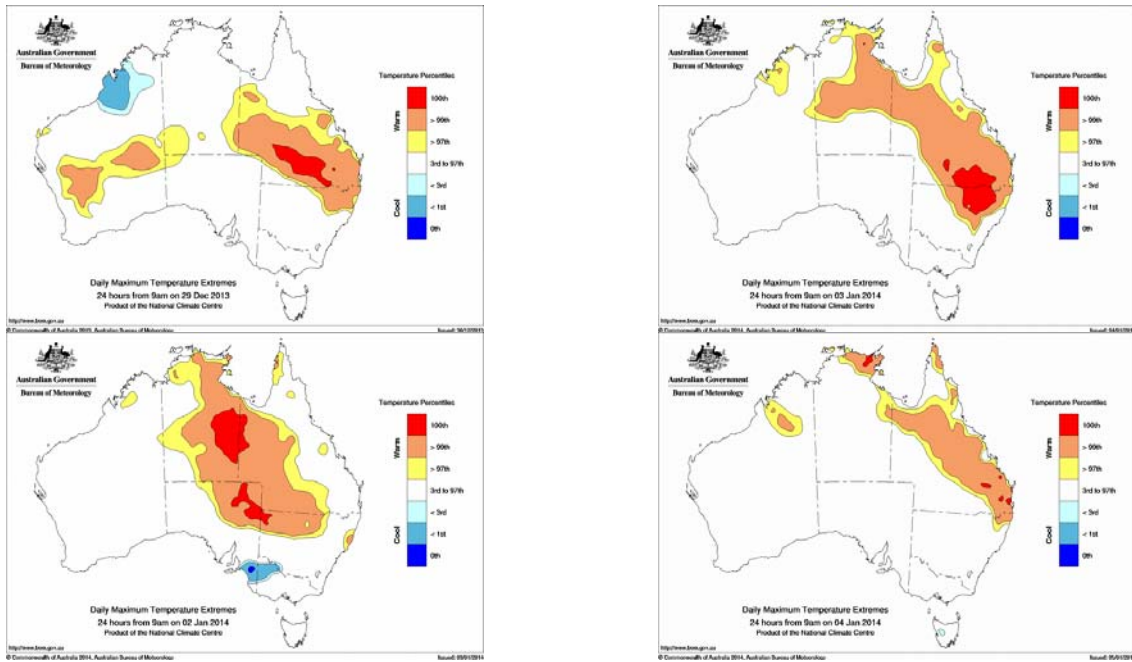


Figure 3. Areas of record high maximum temperatures on selected days of heatwave. Records were set over areas shown in red.

Further information

This statement is based on data available as of 6 January 2014. Some changes may occur as a result of late-arriving data or the Bureau's routine quality control procedures.

Temperature data prior to 1910 are generally not used for the purposes of this Statement due to the lack of standardisation of instrument shelters, making most pre-1910 observations not strictly comparable with more recent data.