



Australian Government
Bureau of Meteorology

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SPECIAL CLIMATE STATEMENT 17

The exceptional January-February 2009 heatwave in south-eastern Australia

First Issued 4th February 2009

Updated 12th February 2009

National Climate Centre

Cite: National Climate Centre, 2009. The exceptional January-February 2009 heatwave in south-eastern Australia, Bureau of Meteorology, Special Climate Statement 17.

Note: This statement only covers the climatological aspects of the January-February 2009 heatwave. It is anticipated that a separate report on the fire weather aspects of the event will be produced at a later date.

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Introduction

An exceptional heatwave affected south-eastern Australia during late January and early February 2009. The most extreme conditions occurred in northern and eastern Tasmania, most of Victoria and adjacent border areas of New South Wales, and southern South Australia, with many records set both for high day and night time temperatures as well as for the duration of extreme heat.

There were two major episodes of exceptional high temperatures, from 28-31 January and 6-8 February, with slightly lower but still very high temperatures persisting in many inland areas through the period in between.

Widespread very hot conditions began to develop in the southeast from 27 January onwards. The presence of a slow-moving high pressure system in the Tasman Sea, combined with an intense tropical low off the northwest coast of Western Australia and an active monsoon trough, provided the ideal conditions for hot air of tropical origin to be directed over the southern parts of the continent. The initial acute phase of the heatwave extended from 28 to 30 January, with many individual-day records set on those days. A weak change brought some relief to southern coastal areas from 31 January onwards, but inland areas, as well as much of South Australia, remained very hot until 5 February. Extreme heat then returned throughout most of the region (except Tasmania), peaking on 7 February when record high temperatures were set across most of Victoria, before the Tasman Sea high finally moved away on the 8th.¹

Highest temperatures reached during the heatwave

Selected individual record high temperatures set during the heatwave are shown in Table 1.

The first stage of the heatwave – 27-31 January

In the first stage of the heatwave, the most exceptional heat, compared with historic experience, occurred in northern and eastern Tasmania. The previous state record of 40.8°C, set at Hobart on 4 January 1976, was broken on 29 January when it reached 41.5°C at Flinders Island Airport. This record only lasted one day, as Scamander, on the east coast, reached 42.2°C on the 30th. Four other sites broke the previous Tasmanian record that day, St. Helens (41.8), Ross (41.6), Cressy (41.4) and Fingal (41.3). Fingal also reached 40.6°C on the 29th, only the second time that a Tasmanian site has reached 40°C on two successive days².

Nearly half of Tasmania had its hottest day on record on 30 January (Figure 1), with many records broken by large margins, particularly in the north. Launceston Airport (39.9) broke its previous record (37.3) by 2.6 degrees.³ This is the second-largest margin by which a record high maximum has been broken at any of the 103 locations in the long-term high-quality Australian temperature data set⁴. Launceston Airport also reached 37.2°C on the 29th and 37.5°C on the 31st, meaning that three of the four warmest days on record at the site now come from the 2009 heatwave. (Whilst the Launceston Airport site was not open in January 1939, data from Launceston city indicate the temperatures in that year were well below 2009 levels).

¹ The very slow-moving pattern is also likely to have contributed to the persistent heavy rain and flooding in tropical Queensland. This will be discussed in a separate statement at a later time.

² The previous occasion was at Hobart on 29-30 December 1897.

³ Two sites are currently operating in parallel at Launceston Airport, on opposite sides of the airport 1.4 km apart. All data quoted in this statement are from the old site (91104), which is scheduled to close later in 2009. The new site (91311), which opened in 2004, reached 40.4°C on 30 January 2009.

⁴ Tewantin (Queensland) reached 44.2°C on 26 January 1940 and has not exceeded 41.1°C on any other day.

The January-February 2009 event has now been responsible for seven of the eight highest temperatures on record in Tasmania; a total of eight sites reached 40°C, a mark which had only been reached on 16 previous occasions in the state's recorded history. Another unusual feature of the event was that the highest temperatures occurred in the state's northern half, whereas most extreme high temperatures in Tasmania (including all 16 previous observations of 40°C or above) have been in the southeast around Hobart, or on the east coast from Swansea southwards.

In southern South Australia, and much of central, southern and western Victoria, maximum temperatures widely reached their highest levels since at least 1939. Melbourne and Adelaide both narrowly missed all-time records during this initial heatwave period. Melbourne's 45.1°C on 30 January was the second-highest on record behind 45.6°C on 13 January 1939, while Adelaide's 45.7°C on the 28th ranks third behind two 1939 readings of 46.1°C and 45.9°C. At a few mainland locations, including Geelong (45.3°C on the 29th) and Wilsons Promontory (41.4°C on the 30th) even the 1939 marks were surpassed, while post-1939 stations where all-time records were set or equalled included Nuriootpa, Mount Barker, Cape Borda, Keith and Mount Gambier (SA), Omeo and Mangalore (Victoria), and Tumbarumba (NSW).

South Australia's highest temperature during this part of the event was 48.2°C at Kyancutta on 28 January, while Victoria's peak was 45.8°C at Avalon Airport on 29 January and Charlton on 31 January. Another notable reading was 48.0°C at Pallamana, near Murray Bridge, on the 28th. These values fell short of state records (which are 50.7°C and 47.2°C for SA and Victoria, respectively).

Overnight minimum temperatures were also very high in many places during this part of the event. Adelaide experienced its warmest night on record when the temperature only fell to 33.9°C in the early hours of 29 January, and other site records included those at Ceduna and Murray Bridge (Table 1). In Victoria, Melbourne Airport's minimum of 30.5°C on the 29th was only 0.4°C short of the Victorian record, set at Mildura in 1999 and Kerang in 2001, while Melton Mowbray's 24.0°C on the 30th was the fourth-highest January minimum on record for Tasmania. The extremely high day and night temperatures combined for a record high daily mean temperature at Melbourne (35.4°C on 30 January), which, along with the previous day (35.0), were the first time Melbourne's daily mean temperature has exceeded 35°C.

On the morning of 29 January, an exceptional event also occurred in the northern suburbs of Adelaide around 3 a.m. when strong north-westerly winds mixed hot air aloft to the surface. At RAAF Edinburgh, the temperature rose to 41.7°C at 3.04 a.m. Such an event appears to be without known precedent in southern Australia.

The second acute stage of the heatwave – 6-8 February

After a slight drop in temperatures during the first few days of February, extreme heat returned to the southeast on 6 February. Temperatures rose sharply in South Australia and western Victoria on the 6th, but it was the 7th which saw the most exceptional heat of the whole event.

On 7 February (Figure 2), the focus of the most extreme heat, which was accompanied by high winds and very low humidity, was in Victoria. An all-time state record was set at Hopetoun, in the state's north-west, when the temperature reached 48.8°C, exceeding the old record of 47.2°C, set at Mildura in January 1939⁵ by a considerable margin. Eight other sites, in the Mallee, Wimmera and in the area immediately west of Melbourne, also exceeded the old record, including Walpeup (48.1°C), Avalon Airport (47.9°C), Horsham (47.6°C), Longerenong (47.6°C) and Laverton

⁵ A report of 48.3°C from Boort in January 1939 is known, but these data have not been digitised and have not been able to be verified at this time.

(47.5°C). The Hopetoun temperature is also believed to be the highest ever recorded in the world so far south. A total of 14 sites exceeded the previous Victorian February record of 46.7°C.⁶

Many all-time site records were also set in Victoria on 7 February, including Melbourne (154 years of record), where the temperature reached 46.4°C, far exceeding its previous all-time record of 45.6°C set on Black Friday (13 January) 1939. It was also a full 3.2°C above the previous February record, set in 1983. Three of Melbourne's five hottest days have now occurred during this event. Geelong (47.4) and Wilsons Promontory (42.0) were among long-term sites which broke all-time records which had been set only the previous week. In total, of the 35 currently open sites in Victoria with 30 years or more of data which reported on 7 February, 24 set all-time records, five set February records, and only six failed to set records at all.⁷ Record high temperatures for February were set over 87% of Victoria.

The extreme heat on the 7th also affected eastern South Australia and the southern fringe of New South Wales. In South Australia, Renmark (48.2°C) set a February record for South Australia; this was also the highest temperature ever recorded in South Australia outside the pastoral districts or the Eyre Peninsula. Port Augusta (48.1°C) and Whyalla (48.0°C) also exceeded the previous South Australian record. No state records were set in New South Wales, where the highest temperature was 46.8°C at Menindee, but all-time records were set at a few locations in the state's south, with Wagga Wagga Airport (45.2°C) exceeding 45°C for the first time. This part of the heatwave did not penetrate south to impact on Tasmania, as occurred during the first acute stage.

The heatwave largely ended on 8 February, as a cool change crossed the south-east, although temperatures remained very high (albeit mostly slightly lower than the previous day) in New South Wales and the far north-east of Victoria.

As the most extreme heat in this part of the event only lasted for one or two days, very high overnight temperatures were not as much of a feature of this period as they were in the previous week, but there were still some high overnight minima recorded, including 33.7°C at Roxby Downs on the 7th, the second-highest on record for February in South Australia.

The duration of the heatwave

In addition to its peak intensity, the 2009 heatwave was also notable for its duration. The 1939 heatwave was similarly prolonged in many inland areas, but sea-breezes and weak changes brought temporary relief to coastal areas, a feature which was absent in 2009 during the heatwave's first week. (In 1939, Melbourne had three days above 43°C between 8 and 13 January, but there were interspersed with days in the 20s and low 30s, and there was no night in the period warmer than 18°C). At Adelaide and Melbourne, the event most directly comparable with the 2009 heatwave was that of January 1908, which had lower peak temperatures but set records in both locations for consecutive days above 40°C. Over the five days 27-31 January 2009, maximum temperatures were 12-15°C above normal over much of Victoria and southern South Australia (Figure 3).

Table 2 shows a range of records set during the event for consecutive days above threshold, both by day and night. Both Adelaide and Melbourne set records for the most consecutive days above 43°C. Adelaide's temperatures were at this level on each of the four days 27-30 January, and Melbourne's for three days from 28-30 January, breaking the previous records of two at both locations. Adelaide also equalled its 1908 record with six consecutive days above 40°C, while Melbourne's three

⁶ This record was set in February 2004. The pre-2004 record was 45.6°C, which was surpassed at 33 Victorian sites on 7 February 2009.

⁷ These six sites were Cape Otway, Heywood and Casterton (southwestern sites which were reached by a cool change by early afternoon), Rutherglen and Dartmouth Dam (in the far northeast), and Gabo Island (in far east Gippsland).

consecutive days above 40°C was the first time this had occurred since 1959, and the seventh time in history. Adelaide ultimately had nine consecutive days above 35°C; after never having experienced more than eight consecutive days above 35°C before March 2008, it has now happened twice within twelve months.

In most inland areas the number of consecutive days above 40°C has not (yet) reached the levels set in 1939, but there were a number of exceptions. At Mildura, where maximum temperatures remained above 40°C throughout the heatwave, 12 consecutive days above 40°C occurred, the longest such sequence ever recorded at a Victorian station, while Broken Hill's 12-day sequence was also a record. Nhill's six consecutive days above that level set a new record, while Bendigo and Rutherglen both experienced five consecutive days above 40°C, setting a record at the former and equalling it at the latter. Nuriootpa (SA) and Sale (Victoria) also set records for the most consecutive days above 40°C. Records have also been set for consecutive days above more extreme thresholds at numerous inland locations, including Kerang, Deniliquin, Snowtown and Nhill, whilst in southern New South Wales, Deniliquin and Wagga Wagga both set records for consecutive days above 37.8°C (100°F). A notable record for prolonged heat was also set at Launceston Airport, where there were three consecutive days above 37°C in a location which had never previously experienced consecutive days above 35°C.

The prolonged nature of the heatwave, and in coastal areas the replacement of a very hot and dry air mass with a warm, humid one, has also led to many records being set or approached for consecutive days with minimum temperatures above thresholds. Melbourne (six consecutive nights above 20°C) equalled its record set during the 1908 heatwave, while Adelaide (six consecutive nights above 25°C) fell just short. At Mildura a record was set with seven consecutive nights above 24°C, while an indication of the depth of the warm air was that Cabramurra in the Snowy Mountains (elevation 1482 m) remained above 19°C for four days, having never done so for more than two days previously. (Cabramurra also equalled its all-time record high with 32.0°C on 30 January, while further south Mount Baw Baw (1561 m) reached 30°C for the first time on record with 30.9°C on the same day, before surpassing it with 31.5°C on 7 February). Further inland, Woomera experienced a record 11 consecutive nights above 25°C.

The dry conditions before and during the heatwave

The heatwave, as would be expected, was accompanied by very dry conditions, with only isolated thunderstorms occurring during the period. Conditions were also very dry in the weeks leading up to the event, especially in Victoria and South Australia.

Melbourne had no measurable rain from 4 January to 7 February, the equal second-longest dry spell on record for the city (35 days). This approaches the record of 40 days set in 1954-55. Melbourne (0.8 mm) had its second-driest January on record, and with only 2.2 mm to 12 February has now experienced its driest start to a year on record. A number of locations around Melbourne (including Preston and Toorourrong Reservoir, near Whittlesea), as well as Ballarat, set new January records for rainfall. Many stations in Victoria north and west of Melbourne, and in South Australia and southern New South Wales, had no rain in January, including Port Pirie, Clare, Adelaide Airport, Renmark and Keith (SA), Swan Hill, Nhill, Stawell, Bendigo, Yarrawonga, Heathcote and Maryborough (Victoria) and Deniliquin (NSW). Most of these locations have experienced at least one rainless January previously.

These dry conditions have further reinforced very long-term rainfall deficits in much of south-eastern Australia, particularly Victoria (see Special Climate Statement 16). The most acute long-term deficits, relative to previous records, have been in the area immediately north-east and east of Melbourne.

Contacts for further information

The following climate meteorologists may be contacted for further information about this event:

National: David Jones (03-9669 4085), Andrew Watkins (03-9669 4360), Blair Trewin (03-9669 4623),

State-specific: Darren Ray (SA) (08-8366 2664), Ian Barnes-Keoghan (Tasmania) (03-6221 2043), Perry Wiles (NSW) (02-9296 1525), Agata Imielska (NSW) (02-9296 1539), Harvey Stern (Victoria) (03-9669 4956).

Notes

Temperature observations in Australia under standard conditions comparable with present-day instruments began around 1910. Pre-1910 temperature data are only used in this statement if it is known that the instruments used at that site at the time were comparable with current standards.

Some 1939 records quoted in Tables 1 and 2 are drawn from recently digitised data which are yet to be fully incorporated in the Bureau's climate database and are not yet included in Bureau web pages.

Where two or more station numbers are quoted in Tables 1 and 2, data from two or more sites have been merged. The station number currently in operation is quoted first.

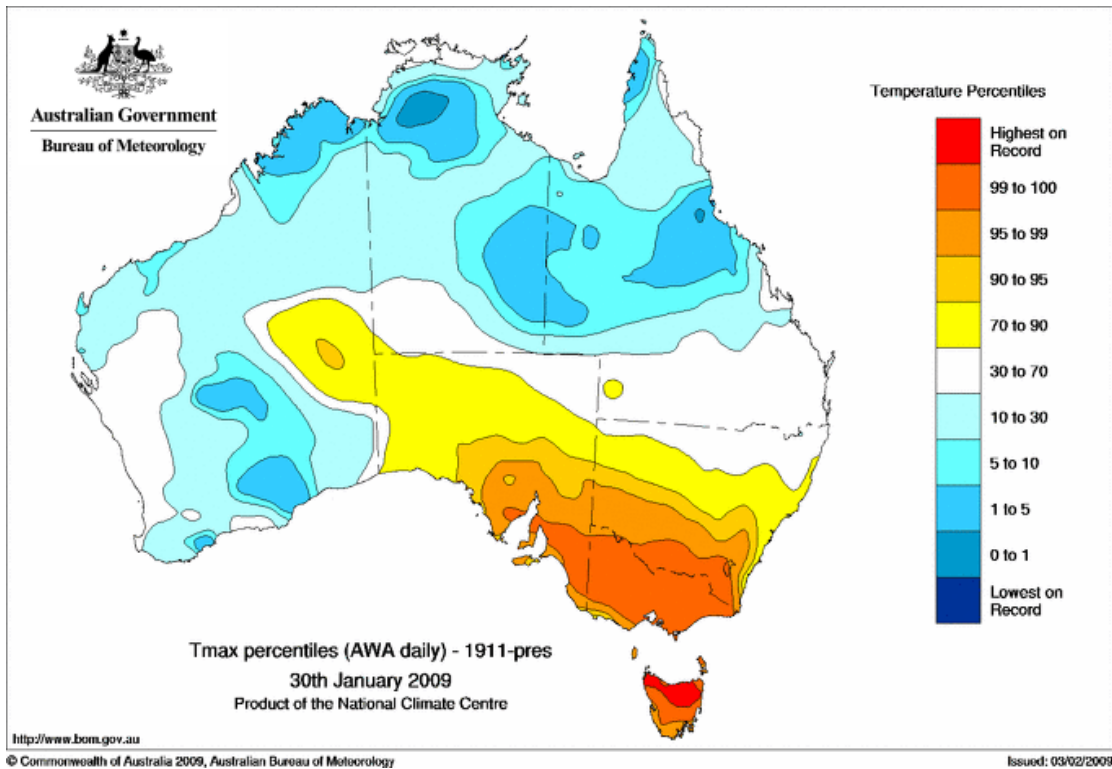


Figure 1. Australian temperature deciles for 30 January 2009, showing the large area in Tasmania which experienced its hottest day on record

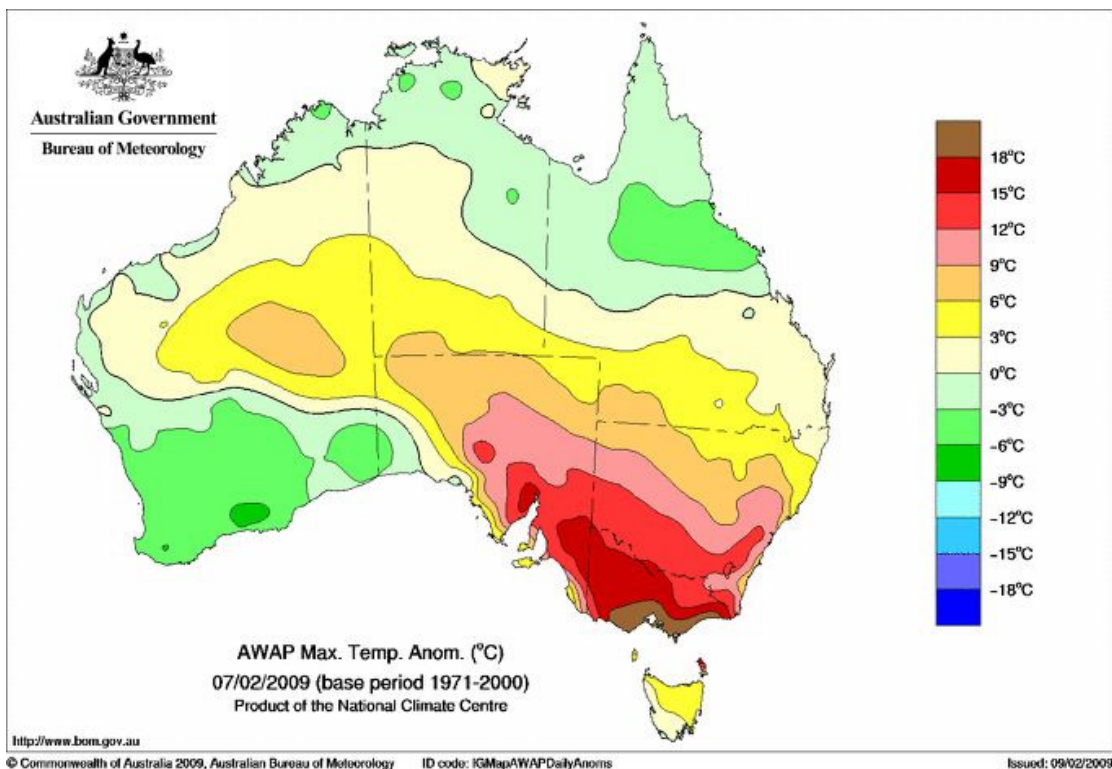


Figure 2. Maximum temperature anomalies (differences from the 1971-2000 average) for 7 February 2009

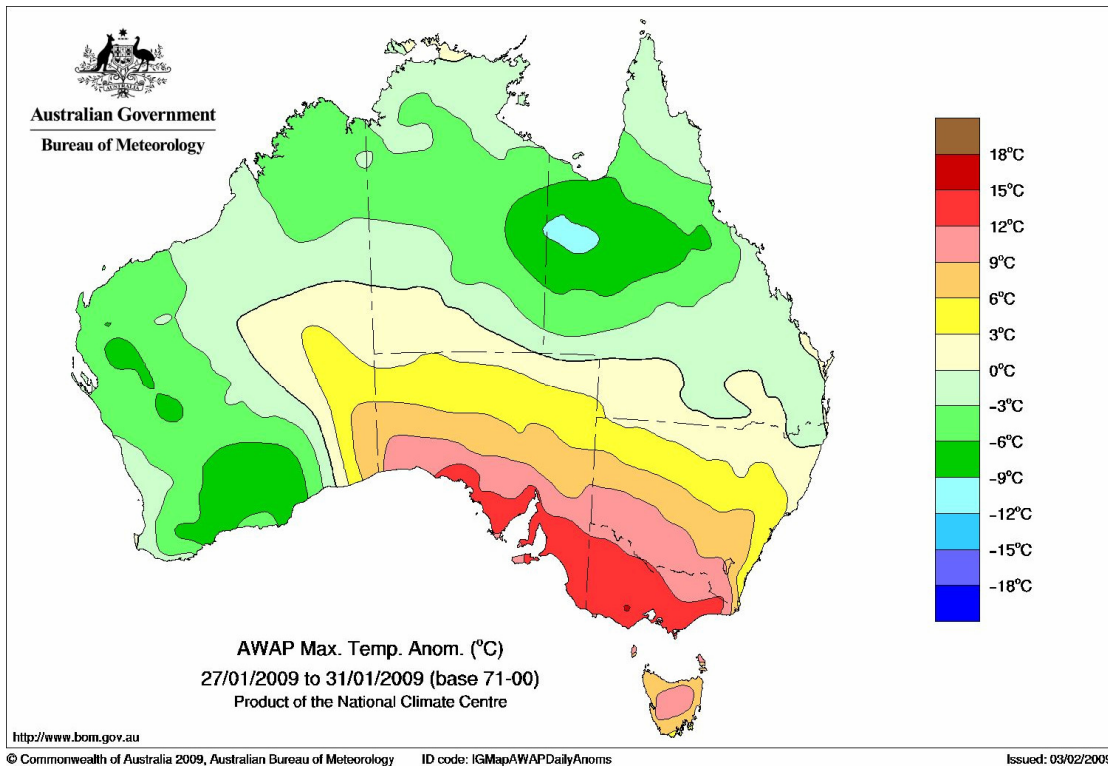


Figure 3. Maximum temperature anomalies (differences from the 1971-2000 average) for the period 27-31 January 2009

Station number	Location	Value	Date	Previous record	Date	Years of data
Maximum temperature						
<u>South Australia</u>						
19062	Yongala	44.0*	7/2	43.4	25/1/2003	53
22823/22801	Cape Borda	40.0	28/1	39.0	23/1/1982	48
23373/23321	Nuriootpa	44.1 (=)	28/1	44.1	25/1/2003	53
23733	Mount Barker	44.5	28/1	43.0	23/1/1982	53
24511	Eudunda	43.9*	7/2	43.5	31/1/1968, 14/2/2004	44
24518	Meningie	45.1	28/1	43.6	14/2/2004	42
24521	Murray Bridge	46.6	28/1	46.4	14/2/2004	42
25507	Keith	45.5	28/1	45.4	25/1/2003	47
26021/26020	Mount Gambier	43.6 (=)	28 and 29/1	43.6	16/2/1983	100
<u>New South Wales</u>						
63039	Katoomba	37.6	8/2	36.6	21/2/2004	47
70080	Taralga	39.8	8/2	38.8	30/1/2003	53
71032	Thredbo (Top Stn)	27.8	30/1	27.0	6/2/1985	32
72023	Hume Reservoir	44.9	7/2	43.7	1/2/1968	45
72043	Tumbarumba	40.2*	1 and 7/2	39.4	31/1/1968 1/2/1968	43
72091	Cabramurra	32.0 (=)	30/1	32.0	23/1/2003, 18/1/2003	47
72150	Wagga Wagga	45.2	7/2	44.8	23/1/2001	67
<u>Victoria</u>						
76047	Ouyen	46.8	7/2	46.7	14/2/2004	53
76064	Walpeup	48.1	7/2	46.6	31/1/1968	45
77094/77042	Swan Hill	46.9	7/2	46.7	10/1/1939	101
78031	Nhill	47.1	7/2	45.9	13/1/1939	102
78077	Warracknabeal	46.8	7/2	46.0	24/1/1982	40
79023	Horsham	47.6	7/2	45.7	31/1/1968	53
79028	Longerenong	47.6	7/2	46.4	31/1/1968	45
80015	Echuca	46.8	7/2	45.3	3/1/1990	53
80023	Kerang	46.9	7/2	46.1	10/1/1939	102
80091	Kyabram	46.6	7/2	44.7	24/1/1982	45
81123/81003	Bendigo	45.4	7/2	44.3	10/1/1939	101
81049	Tatura	44.8*	7/2	43.3	24/1/1982	44
82042	Strathbogie	42.0	7/2	41.5	24/1/1982	36
83025	Omeo	40.2	30/1	40.0	31/1/1968, 1/2/1968	53
85096	Wilson's Promontory	42.0*	7/2	41.1	18/1/1959	101
86038	Essendon	47.3	7/2	45.8	31/1/1968	40
86071	Melbourne	46.4	7/2	45.6	13/1/1939	154
86077	Moorabbin	46.7*	7/2	44.3	25/1/2003	38
86104	Scoresby	46.1*	7/2	42.8	25/1/2003	42
86127	Wonthaggi	45.0*	7/2	43.0	24/1/1982	41
86282	Melbourne Airport	46.8	7/2	44.6	25/1/2003	39
87031	Laverton	47.5	7/2	45.0	25/1/2003	66
87163/87117 /87025	Geelong	47.4*	7/2	44.8	25/1/2003	102
88023	Lake Eildon	45.4*	7/2	42.3	24/1/1982	39
88109	Mangalore	46.1*	31/1	44.4	24/1/1982	50
88110	Castlemaine	43.9	7/2	43.7	31/1/1968	43
89002	Ballarat	44.1	7/2	42.5	13/1/1939	102
89085	Ararat	44.7	7/2	42.9	25/1/2003	40
90186/90172 /90082	Warrnambool	44.8	7/2	44.4	13/1/1939, 17/1/1959	102
<u>Tasmania</u>						
91009	Burnie	33.8	31/1	32.8	20/1/1982	44
91104	Launceston Airport	39.9	30/1	37.3	28/1/1943	70
91292/91092	Smithton	36.6	30/1	34.6	7/2/1983	47
99005	Flinders Island AP	41.5	29/1	38.8	25/1/2003	46

Minimum temperature						
	<u>South Australia</u>					
18012	Ceduna	32.7	29/1	32.6	27/1/1967	70
18040	Kimba	31.5	29/1	30.6	22/1/2006	41
23090/23000	Adelaide	33.9	29/1	33.5	24/1/1982	123
24521	Murray Bridge	29.1	29/1	28.2	24/1/1982	42
	<u>New South Wales</u>					
71041	Thredbo Village	20.2	8/2	20.0	15/2/2004	35
73007	Burrinjuck Dam	26.8	6/2	26.0	7/2/1997	44
	<u>Victoria</u>					
78015/78031	Nhill	28.6	29/1	28.4	3/1/1991	102
86282	Melbourne Airport	30.5	29/1	27.3	1/1/2008	39

Table 1. Selected records for highest daily maximum and minimum temperature set in the period 27 January – 8 February 2009. Stations with data from 1939 have station numbers shown in bold. Where an asterisk is shown, the record breaks one which was set earlier in the 2009 heatwave. Previous records shown are for the period prior to 2009.

Station number	Location	Threshold	No of days	Dates	Previous record	Years of data
Maximum temperature						
	<u>South Australia</u>					
16098/16044	Tarcoola	44	6	2-7/2	5 (13-17/2/2004)	48
18192/18070	Port Lincoln	30	7 (=)	27/1-3/2	7 (several)	100
21046/21133	Snowtown	43	6	27/1-1/2	4 (31/1-3/2/1912)	102
23090/23000	Adelaide	43	4	27-30/1	2 (several)	123
		40	6 (=)	27/1-1/2	6 (14-19/1/1908)	
23373/23321	Nuriootpa	40	5	27-31/1	3 (20-22/1/2006, 30/12/2007- 1/1/2008)	53
26021/26020	Mount Gambier	43	2	28-29/1	1 (several)	101
		39	3 (=)	27-29/1	3 (several)	
	<u>New South Wales</u>					
47007	Broken Hill	40	12	27/1-7/2	10	102
65070/65012	Dubbo	35	18	23/1-9/2	17 (6-22/2/2004)	89
70014	Canberra	39	3	6-8/2	2 (31/1-1/2/1968, 23-24/1/2001)	69
72150/72151	Wagga Wagga	37.8	13	27/1-8/2	10 (5-14/1/1939)	102
74258/74128	Deniliquin	42	5	28/1-1/2	4 (10-13/1/1939)	100
		37.8	14	26/1-8/2	10 (7-16/2/1939)	
	<u>Victoria</u>					
76031	Mildura	40	12	27/1-7/2	9 (6-14/1/1939, 7-15/2/1939)	102
78015/78031	Nhill	40	6	27/1-1/2	4 (several)	102
		44	4	28-31/1	2 (17-18/1/1959, 31/1-1/2/1968)	
80023	Kerang	44	4	28-31/1	2 (24-25/2/1968)	101
81123/81003	Bendigo	40	5	28/1-1/2	3 (17-19/1/1959, 4-6/1/1999)	101
		42	4	28-31/1	2 (14-15/2/2004)	
82039	Rutherglen	40	5 (=)	28/1-1/2	5 (11-15/1/1939)	98
85072	Sale	40	3	28-30/1	2 (17-18/1/1959)	64
86071	Melbourne	43	3	28-30/1	2 (20-21/1/1875)	154
87031	Laverton	43	3	28-30/1	1 (several)	65
89002	Ballarat	40	3 (=)	28-30/1	3 (17-19/1/1959)	102
		39	4	28-31/1	3 (17-19/1/1959)	
	<u>Tasmania</u>					
91104	Launceston Airport	35	3	29-31/1	1 (several)	70
Minimum temperature						
	<u>South Australia</u>					
16001	Woomera	25	11	28/1-7/2	8 (31/1-7/2/1993)	60
26026	Robe	20	4 (=)	28-31/1	4 (16-19/1/1908)	102
	<u>New South Wales</u>					
72161/72091	Cabramurra	19	4	29/1-1/2	2 (23-24/1/2001, 22-23/1/2006)	47
	<u>Victoria</u>					
76031/76077	Mildura	24	7	28/1-3/2	5 (10-14/1/1939, 27-31/1/1943)	103
86071	Melbourne	20	6 (=)	29/1-3/2	6 (16-21/1/1908)	154

Table 2. Selected records for the greatest number of days with temperatures at or above set thresholds. Stations with data from 1939 have station numbers shown in bold.