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Special Climate Statement 66—an abnormally dry period in eastern Australia

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Cover image: Farmland east of Bourke, 3 August 2018 (Photo: Mark Wilgar).

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Introduction

The past 12 to 24 months has seen the development of notable dry conditions across much of eastern Australia. Following a generally very wet period from May to September 2016, dry conditions developed in many parts of eastern Australia from late 2016. Tropical Cyclone *Debbie* and its aftermath brought very heavy rain to many parts of the east coast in March 2017, but in inland eastern Australia, January to September 2017 was a relatively dry period.

The last quarter of 2017 was relatively wet in Victoria and the eastern inland, and was marked by a major rain event at the start of December, although that event had little effect on the east coast. Much of tropical inland Queensland had heavy rains in March 2018, but these rains were much less significant south of the Tropic of Capricorn.

The most intense dry phase of the recent period began in early 2018. The core of the abnormal dryness was in New South Wales, but other areas were also seriously affected, including southern inland Queensland, and central and east Gippsland in eastern Victoria. As the year continued, despite some winter rains along the southern coastal fringe, significant rainfall deficiencies extended to cover much of Victoria (except for the southwest) and large parts of eastern South Australia. It was also an exceptionally dry period (even by the region's standards) in central Australia. The dry period culminated in September 2018, which was Australia's driest September, and second-driest month, on record. Some areas had useful rains in October 2018, the first month in 2018 in which rainfall averaged over New South Wales was above average, although the heaviest rains occurred in coastal northern New South Wales and the southeast quarter of Queensland, outside the regions worst affected by previous dry conditions.

The dry conditions of the last two years follow shortly after long-term rainfall deficiencies in the period from April 2012 to April 2016, which primarily affected two regions; most of inland Queensland (and adjacent border areas of northern New South Wales), and central and western Victoria. The most significant long-term rainfall deficits have occurred in those areas affected by both the 2012-2016 and 2016-2018 dry periods, most notably southern inland Queensland and northern New South Wales. In these areas, below-average rainfall has prevailed for most of the last 6 ½ years, interrupted only briefly by the wet conditions of mid-2016. Northwestern Queensland, which also suffered badly in 2012-16, has had near- or above-average rainfall since 2016, whilst in central and western Victoria, rainfall in 2017 was near or above average before dry conditions returned in 2018.

1. Rainfall deficiencies

Significant rainfall deficiencies have occurred during the current event on a range of timescales. Long-term deficiencies, covering the period since 2012, have affected parts of the eastern interior, and central and western Victoria. Deficiencies since the start of 2017 affect most of inland New South Wales, extending into parts of southern Queensland, and have also occurred in Gippsland; in these regions, January to September 2017 and January to September 2018 were both much drier than usual, interrupted by a period of average to above-average rainfall from October to December 2017. Over the 15 months from July 2017 to September 2018, significant rainfall deficiencies occurred in all of these areas, but also extended to coastal areas which had had heavy rain in early 2017, particularly in the Hunter, Sydney and Illawarra regions.

For the nine months from January to September 2018, rainfall deficiencies extended to cover almost all of New South Wales, except for coastal areas north of Newcastle and parts of the Australian Alps. They also covered much of southern inland Queensland, most of Victoria away from the southwest, and most of South Australia from Spencer Gulf to the eastern border (except the Lower Southeast district).

1.1. April 2012 to September 2018 (78 months)

Long-term rainfall deficiencies, over the period since early 2012, have primarily covered two regions (Figure 1): a large part of inland Queensland, extending north to parts of the north tropical coast around Townsville and south into northern border areas of New South Wales; and much of central and western Victoria.

Inland Queensland was affected by extensive rainfall deficiencies for the period from April 2012 to April 2016, covering both the northwest and the southern interior. These deficiencies were significantly reduced by heavy (and unseasonable) rains from May to September 2016. From late 2016 onwards, rainfall has remained near or above average in northwest Queensland, bounded to the south approximately by the Tropic of Capricorn, and long-term deficiencies have generally not redeveloped in those areas. However, south of the tropics, dry conditions returned after October 2016 with similar, or in places even greater, intensity to that experienced in the 2012-2016 period, contributing to severe rainfall deficiencies at the multi-year timescale. The worst-affected region has been southern inland Queensland and adjacent northern border areas of New South Wales, where rainfall for the 78-month period has been 20% or more below average.

Whilst a dry period of this duration is unusual, it is not unprecedented. Whilst the ranking of the individual events varies from place to place, over much of the affected region (particularly on the Queensland side of the border), the second half of the 1960s were as dry as recent years have been, whilst an even longer dry period extended from the mid-1920s to the mid-1930s.

The other large region which has had rainfall deficiencies on this timescale has been central and western Victoria. As in Queensland, consistent dry conditions began in April 2012 (following an extremely wet period in 2010-12) and continued into early 2016, before a very wet winter and spring in 2016. Following a year with generally slightly below average rainfall in 2017, extremely dry conditions redeveloped from the start of 2018 (see section 1.4). The combination of several years of dry conditions from 2012-16 with a very dry 2018 has resulted in substantial multi-year rainfall deficits. Over large parts of central and western Victoria, rainfall for the 78 months since April 2012 is only slightly higher than it was during the peak of the Millennium Drought in the 2000s, with the late 1930s and 1940s (particularly north of the Great Dividing Range) providing the only comparable period since 1900.

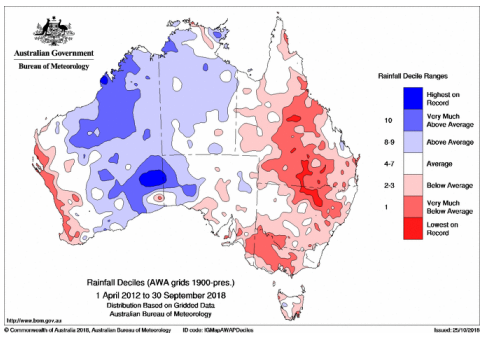

Figure 1. Australian rainfall deciles for the 78 months from April 2012 to September 2018.

1.2. January 2017 to September 2018 (21 months)

Both 2017 and 2018 have seen rainfall which was well below average through much of New South Wales and southern inland Queensland, with only a brief period of near- to above-average rainfall in the last quarter of 2017. Over most of this area, rainfall for the period has been 25% to 50% below the 1961-1990 average. The dry conditions have extended north in Queensland to also cover some inland areas to the north of the Tropic of Capricorn, in areas which were too far west to be affected by Tropical Cyclone *Debbie* in March 2017, and too far south or east for the March 2018 rain event. Locations which have had their driest such period on record are scattered throughout inland New South Wales and southern Queensland (Figure 2), with the largest concentration in the Warrego district of Queensland and around Broken Hill in far western New South Wales, although no rainfall district had its driest 21 months on record (Table 1).

Another area of notable rainfall deficits at this timescale has been central and east Gippsland in Victoria, from the Latrobe Valley east to the New South Wales border. The January to September period was very dry in this region in both 2017 and 2018, with the area missing out on the near-average rains further west in Victoria in 2017; for example, East Sale had its driest January to September on record in 2018, and its second-driest in 2017. Above-average rains in the last quarter of 2017, especially in December, only made a limited impact on these deficiencies. It has been the driest 21 months on record for an area extending from Sale to Orbost.

There are few precedents for such large rainfall deficits covering such a large area of eastern Australia for a period of this length (Table 2). As an indicator of this, the 21-month area-averaged rainfall for January 2017 to September 2018 was the fourth-lowest on record, and the lowest since 1964-65, for New South Wales, and the third-lowest after 1901-02 and 2006-07 for the Murray-Darling Basin. For the Murray-Darling Basin, rainfall over the period was 570.4 mm (32% below the 1961-1990 average), ranking behind the 497.2 mm in 1901-02, whilst for New South Wales, 657.0 mm (31% below average) ranks behind 559.8 mm in 1901-02.

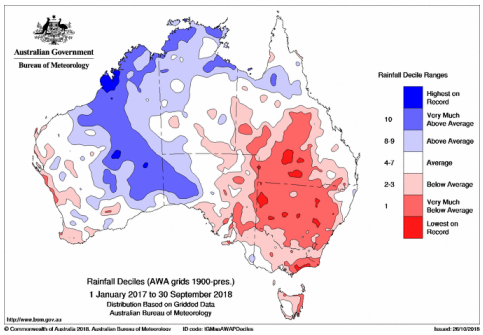

Figure 2. Australian rainfall deciles for the 21 months from January 2017 to September 2018.

1.3. July 2017 to September 2018 (15 months)

The 15-month period starting in July 2017 also saw widespread rainfall deficiencies in eastern Australia (Figure 3). Whilst the core region of deficiencies remained the Murray-Darling Basin, compared with the 21 months starting in January 2017, it was somewhat drier in coastal New South Wales (particularly from the Hunter southward) and in eastern South Australia. Conversely, 15-month deficits have been slightly weaker than 21-month deficits in Victoria, particularly Gippsland. At a regional scale, it was the second-driest 15-month period (starting in July) on record for New South Wales, after 1901-02, whilst for the Murray-Darling Basin it ranked fourth after 1901-02, 1928-29 and 1918-19.

For this period, a particular focus of intense rainfall deficiencies has been an area of coastal New South Wales centred on the Illawarra, extending into the Southern Highlands and parts of metropolitan Sydney, particularly the southern and western suburbs, with sustained dry conditions beginning in July 2017 after a wet March and, in some areas, June. Almost every long-term site in this region had its driest 15 months on record, with totals for the period generally between 50% and 70% below average. Another region where numerous records were set was the upper Hunter and southern North West Slopes and Plains region, including Scone, Murrurundi and Tamworth.

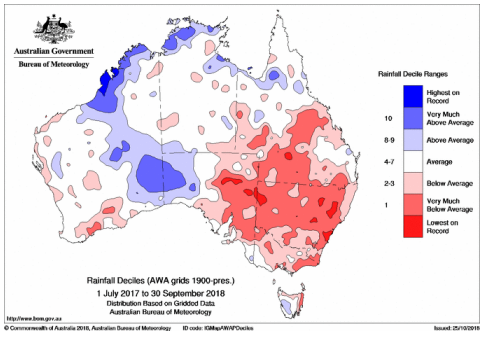

Figure 3. Australian rainfall deciles for the 15 months from July 2017 to September 2018.

1.4. January to September 2018 (9 months)

The most intense phase of the dry period to date has occurred in the first nine months of 2018. Almost all of New South Wales, except for coastal regions north of the Hunter and parts of the Snowy Mountains, has had rainfall in the lowest 10% of all years (Figure 4), with totals 40 to 60% below average over most of the eastern part of the

State, and more than 60% below average in the western half, as well as parts of the central west. The very dry conditions also extended to cover most of Victoria away from the southwest (which had average to above-average rains in winter) and the eastern half of South Australia.

Many parts of western New South Wales had less than 100 millimetres of rain for the period, extending as far east as Condobolin and Griffith. Waterbag, northeast of Broken Hill, had only 17.8 millimetres for the nine months, and a number of other sites in and around Broken Hill had less than 30 millimetres, whilst locations with less than 50 millimetres included Cobar, Wilcannia, Menindee and Pooncarie. The very dry conditions extended to northwest Victoria, with only 59 millimetres for the nine months at Mildura. Rainfall totals which were the lowest on record for the nine months were widespread in all of these regions.

Another region of exceptional dryness for the first nine months of 2018 was the central west of New South Wales. Dubbo, Peak Hill and Forbes had rainfall for the period which was 70 to 75% below average, which was the lowest on record at all three locations.

January to September was the third-driest on record for New South Wales (53% below the 1961-1990 average), after 1902 and 1965, and the second-driest after 1902 for the Murray-Darling Basin (52% below average). Victoria (31% below average) had its eighth-driest January to September on record, and its driest since 2006.

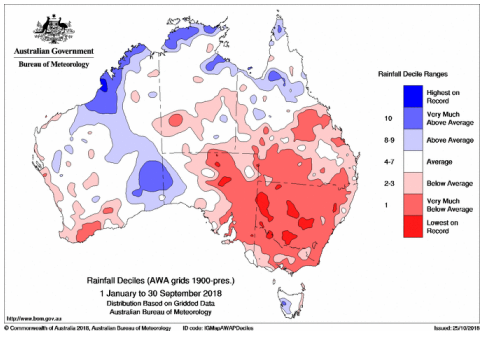

Figure 4. Australian rainfall deciles for the 9 months from January to September 2018.

One distinguishing feature of 2018 has been an almost complete absence of widespread heavy rain events in inland southeastern Australia. One indicator of this is that the wettest day (on an area-averaged basis) of 2018 for the Murray-Darling Basin has been 17 October, with a region-wide average of 6.71 mm; by way of comparison, there were eight days wetter than this in September 2016 alone. The 1961-1990 average number of days above 10 mm is 5.3, and above 5 mm is 23.4, compared with none and 4 respectively in 2018 to date.

1.5. Summary

The recent dry conditions in eastern Australia have few precedents for their combination of extent and duration. Whilst there have been individual years in the last century with rainfall similar to or less than that in 2018, only twice since 1900 have such dry conditions been sustained for a period of nearly two years across the Murray-Darling Basin. The intensity of the rainfall deficiencies in the Basin over the last two years is on a par with the worst seen in any individual two-year period during the Millennium Drought, although dry conditions have not yet been sustained for as long as they were during that event.

Whilst many areas have been affected by significant rainfall deficiencies, areas which have been affected particularly severely include, in New South Wales, parts of the central west, the New England Highway corridor from the Tamworth area south to the upper Hunter, and the Illawarra and Southern Highlands; and in Victoria, central and east Gippsland. At longer timescales, northern inland New South Wales near the Queensland border has also been badly affected.

The recent period has been notably dry at a range of timescales. Indicating the extent of the dry conditions in New South Wales, of the 388 long-term rainfall stations[1] currently operating in the State, 105 have had their driest period on record for at least one of the 9-month, 15-month or 21-month periods ending in September 2018. In total, nationally, 82 long-term stations have had their driest 9-month period on record, 87 their driest 15-month period, and 50 their driest 21-month period (Table 3).

2. Other notable climatic features of 2018

2.1. Temperature and humidity

Temperatures during the summer and early autumn of 2017-18 were well above average (Figure 5). The December-March period was the third-hottest on record for New South Wales for both maximum and mean temperature, although seasonal temperatures fell short of the records set during the previous summer (2016-17). April was also very warm; it was the warmest April on record for Australia[2] as a whole, and for New South Wales and South Australia, whilst in Victoria it ranked second after April 2005.

Through the cool season in 2018, maximum temperatures were well above average through most of eastern Australia, whilst minimum temperatures were mostly relatively close to average. An increased diurnal temperature range is typical of eastern Australia (especially inland areas) during the cool season in drought years, due to reduced cloud cover and soil moisture. In New South Wales, the mean diurnal temperature range for the April to September period was 1.67 degrees above the 1961-1990 average, a value which is typical of severe drought years (Table 4). However, both daytime and nighttime temperatures were 1 to 1.5 °C warmer than those of previous major drought years, except for 2002, which had similar temperatures to 2018. New South Wales is currently on track for its warmest year on record, with mean temperatures 1.43 °C above the 1961-1990 average for the January-September period, which compares with the full-year record of 1.42 °C above average set in 2017.

There were significant late-season frosts in inland southeast Australia[3], with South Australia and Victoria having their lowest September mean minimum temperatures since 1985 and 1994 respectively. These frosts caused significant agricultural losses in parts of northern Victoria and eastern South Australia.

[1] For these purposes, a currently-operating long-term rainfall station is defined as one with at least 50 years of data, and no missing monthly data from January 2017 to September 2018 inclusive.

[2] See Special Climate Statement 65 for further details on the warm April.

[3] Late-season frosts also caused agricultural damage in September in southern Western Australia, but these are outside the scope of this statement.

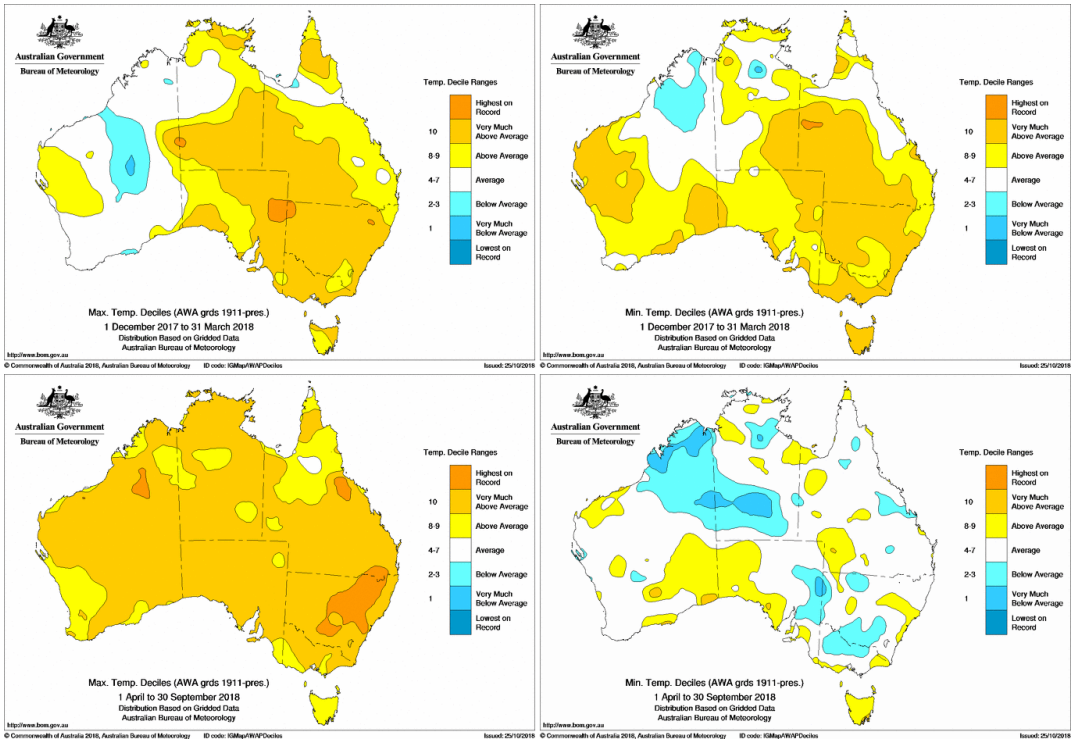

Figure 5. Temperature deciles for maximum (left) and minimum (right) temperature, for the periods from December 2017 to March 2018 (top) and April to September 2018 (bottom).

The level of atmospheric moisture (humidity) has also been well below average. For the period from April to September, the average 3pm water vapour pressure (an indicator of the amount of water vapour in the atmosphere) was the lowest on record for Australia, with a national mean of 8.15 hPa surpassing the previous record of 8.41 hPa set in 1994. Records were also set for this period for New South Wales, Queensland, South Australia and the Northern Territory, with Victoria ranking third behind 1982 and 2006. Vapour pressure was below average almost throughout Australia (Figure 6)[4], with the largest departures from average being in northwestern Australia and the eastern interior on both sides of the New South Wales-Queensland border.

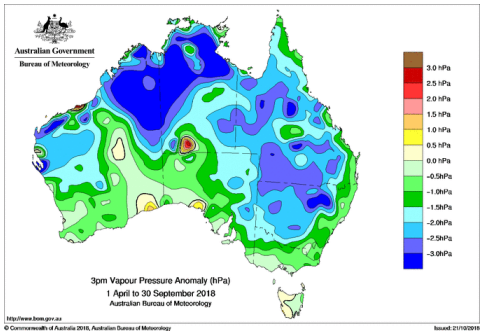

Figure 6. 3pm vapour pressure anomalies for Australia for the period from April to September 2018.

[4] Isolated areas of above-average vapour pressure are believed to reflect instrument problems at a small number of individual stations.

2.2. Soil moisture

Soil moisture in the root zone (surface to 100 centimetres) was well below average through mid-2018 over most of New South Wales (Figure 7), although record low levels were only reached locally, particularly in the northwestern quarter of the State. Soil moisture values for this period in the lowest decile also extended to eastern South Australia, Gippsland and some parts of Queensland, but were generally slightly less extensive in those regions than the corresponding rainfall deficiencies (noting that April to October is the drier period of the year in inland Queensland, and hence soil moisture is relatively low at that time of year even in a normal year). Monthly soil moisture at the end of the driest period, in September, was broadly similar to that through the cool season as a whole.

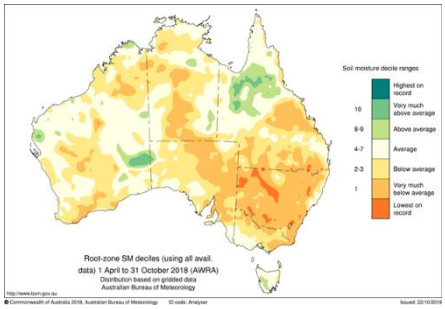

Figure 7. Soil moisture deciles in the root zone (0 to 100 cm) from the AWRA model, for the period April to October 2018.

2.3. Evaporation and wind

Evaporation was well above average in most of Australia during the winter of 2018. Averaged over Australia, pan evaporation for June to August 2018 was the third-highest on record (446.8 mm), just below the record of 452.8 mm set in 1977. South Australia and Queensland both had their highest winter seasonal evaporation on record, with New South Wales ranking second.

Wind speed in winter was above average in most of southern Australia, especially in July and August, with the strongest anomalies over Victoria and Tasmania. However, wind speed was close to average over most of Queensland and the northern half of New South Wales.

2.4. Fire danger

The dry and hot conditions contributed to elevated fire dangers, and in particular an extended fire season, both at the end of the 2017-18 season and the start of the 2018-19 season.

Seasonal deciles for the Forest Fire Danger Index (FFDI) are shown in Figure 8. Autumn values of the FFDI were the highest on record over most of New South Wales west of the ranges, as well as in parts of Victoria. They were also the highest on record in the Sydney region and in the Far South Coast district of New South Wales, both of which experienced major fires abnormally late in the season during autumn 2018.

FFDI values were also well above average in most of eastern Australia in late winter and early spring 2018, and were the highest on record in parts of central and eastern New South Wales. This contributed to a number of unseasonable fires in southeastern New South Wales, including a fire which burned for several weeks north of Bemboka in August and September.

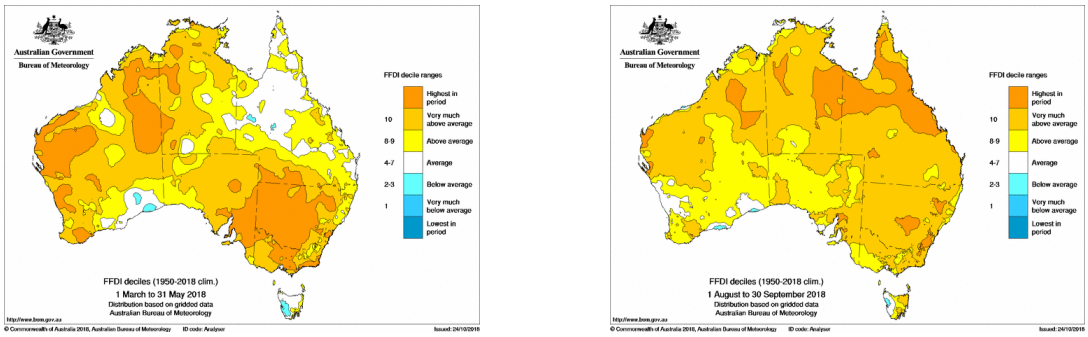

Figure 8. Seasonal forest fire danger index (FFDI) deciles for March to May 2018 (left) and August to September 2018 (right)

3. Broadscale climate drivers influencing the current dry conditions

The most consistent signal from a broadscale climate driver in 2018 has been of cool sea surface temperatures in the eastern tropical Indian Ocean, in the region north of Western Australia and south of the Indonesian islands of Java and Sumatra. These were particularly apparent from mid-2018 onwards. These conditions are broadly consistent with a positive Indian Ocean Dipole mode, which is typically associated with below-average winter and spring rainfall across large areas of the Australian continent, although at the time of writing, it was not yet confirmed whether sea surface temperatures had been anomalous for a sufficiently long period for 2018 to be formally designated as a year with a positive Indian Ocean Dipole.

The El Niño-Southern Oscillation has been in a neutral phase for most of 2018, with sea surface temperatures in the tropical Pacific below average for most of the first half of the year, then above average since mid-year. At the time of writing, the equatorial Pacific is now approaching El Niño conditions (Figure 9), with the Niño 3.4 index at +0.7 °C for the week ending 21 October (sustained values above +0.8 °C are indicative of an El Niño). It is unusual, but would not be unprecedented, for an El Niño to develop during the last quarter of the year.

The two closest analogues in recent decades for the broadscale climate drivers of 2018 are 1994 and 2006. Both of these years had a positive Indian Ocean Dipole, and weak, late-developing El Niño events (which began during the southern hemisphere spring). Both 1994 and 2006 were very dry years in much of eastern Australia, although in 2006 the most severe dry conditions were further south, especially in Victoria and southern New South Wales. In both years, dry conditions were well established before the Pacific reached El Niño thresholds.

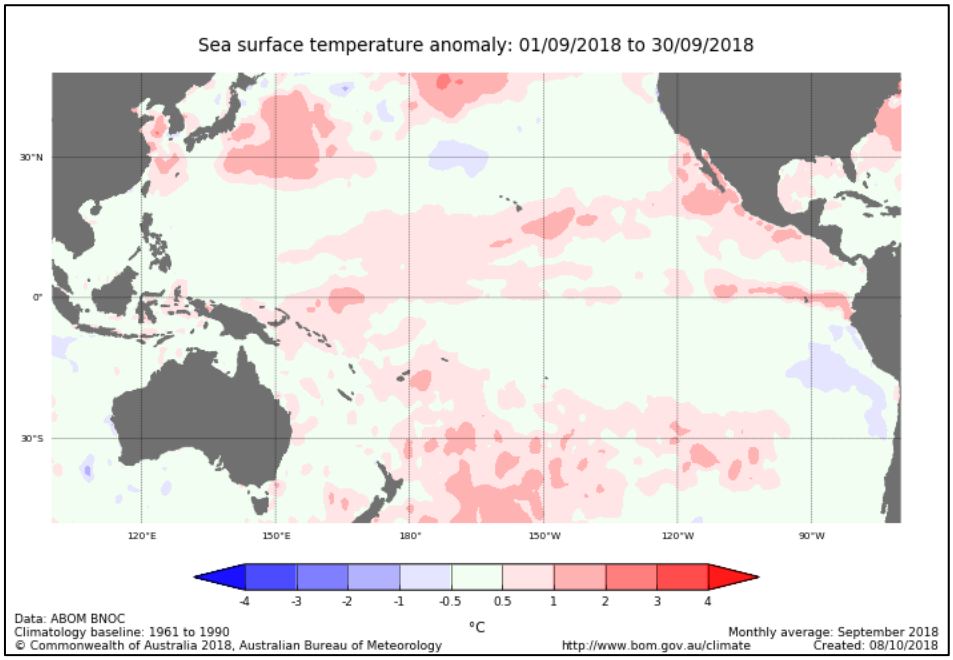

Figure 9. Sea surface temperature anomalies for the Pacific and eastern Indian Ocean, September 2018.

4. How has October 2018 rainfall affected deficiencies?

The most significant rains of the year in eastern Australia south of the tropics have occurred in October. It is the first month in 2018 in which rainfall averaged over New South Wales has been above average, with a provisional statewide average of 48.6 mm (9% above the monthly average) for the month. Whilst many stations report manually at the end of each month and hence do not yet have October data available, a real-time assessment is possible using a more limited network.

The heaviest rains have fallen in the southeast quarter of Queensland, and on and near the coast of New South Wales from the Sydney region northwards. A few places, mostly in inland southeast Queensland, have had their wettest October on record, and most of the coastal region from Newcastle to Bundaberg has had October rainfall in the highest decile (Figure 10).

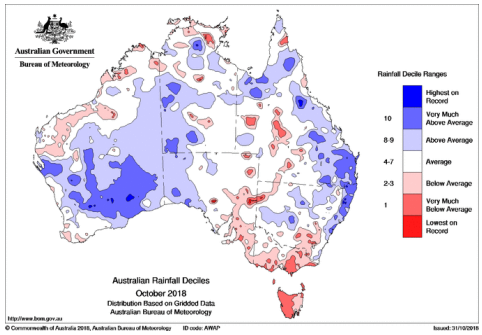

Figure 10. Rainfall deciles for October 2018.

West of the ranges, rainfall in New South Wales and Queensland has generally been close to average, but with wide local variations; much of the rain has fallen in thunderstorms, which can produce very heavy rain in localized areas whilst missing others a short distance away. One example of this has occurred in central New South Wales, where Dubbo has received 90.4 mm for the month (62.8 mm of this on the two days 4-5 October), whilst many other sites within a 100-kilometre radius have only received between 25 and 50 mm (e.g. Peak Hill, with 38.2 mm). Heavy rain associated with thunderstorms also brought significant totals to some parts of far western New South

Wales which had been exceptionally dry in the first nine months of 2018 – Broken Hill Airport, which had had only 24.8 mm of rain for the year to date up until then, received 29 mm in 10 minutes in a storm on the evening of 3 October – but the northwest of the State largely missed out on this rain.

The October rains have had very little effect on the area covered by rainfall deficiencies since the start of 2018, apart from local improvements, mostly around Sydney and in the eastern Darling Downs in Queensland (Figure 11), although the intensity of the deficiencies has reduced. Meanwhile, continued below-average rainfall in Victoria and South Australia has led to an expansion of rainfall deficiencies in those States. The lack of improvement partly reflects the fact that the rainfall deficiencies are large enough in many areas that it will take a sustained period of rainfall over some months to eliminate them, and is partly a result of the heaviest October rains occurring in coastal areas which had missed the worst of the dry conditions earlier in the year. Furthermore, rains at this time of year are too late to be of more than limited value in winter cropping areas.

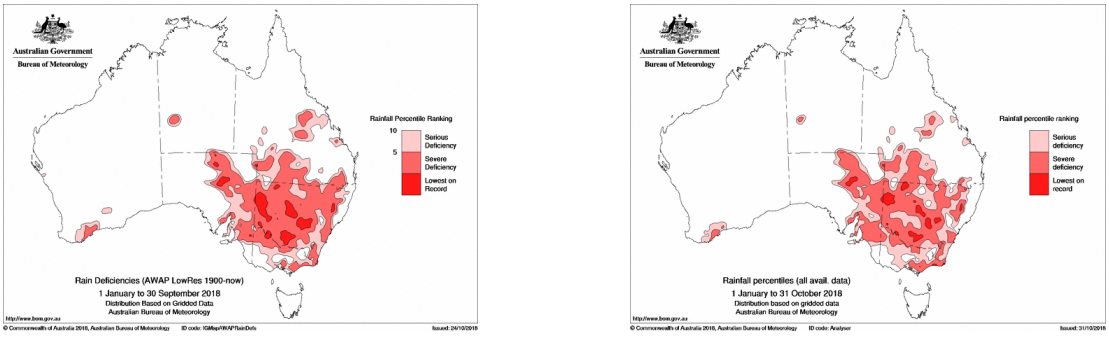

Figure 11. Rainfall deficiencies for the period from January to September 2018 (left) and January to October 2018 (right).

The October rains have led to some improvement in soil moisture in New South Wales, where soil moisture is now above average on the north coast and in some parts of the far south-west, and near average over most of the northern half of the State (Figure 12). There has, however, been continued deterioration in Victoria and Tasmania.

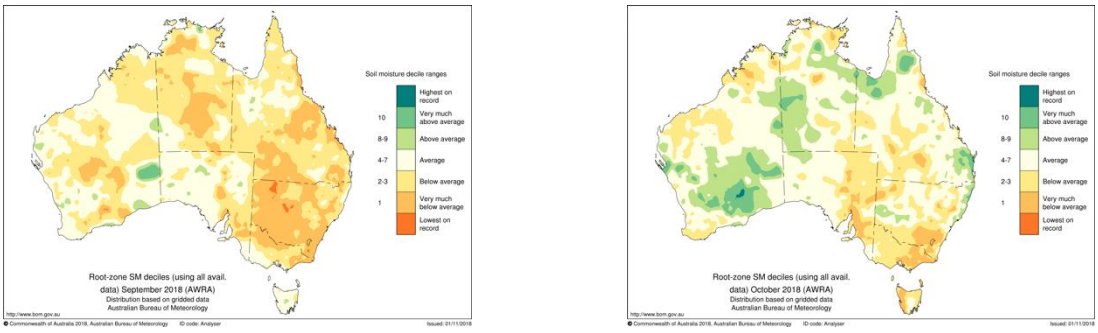

Figure 12. Soil moisture deciles for the root zone (0 to 100 cm) using the AWRA model, for (left) September and (right) October 2018.

It is interesting to note that there have been previous occurrences of heavy coastal rain in October in otherwise very dry years. Two of the wettest Octobers on record in coastal areas of northern New South Wales and southern Queensland were in 1914 and 1972 (Figure 13). These were both severe drought years in southeastern Australia, and October 1914 was also an exceptionally hot month in inland southeastern Australia, setting some records which still stand today. October 1902 was also relatively wet in coastal New South Wales.

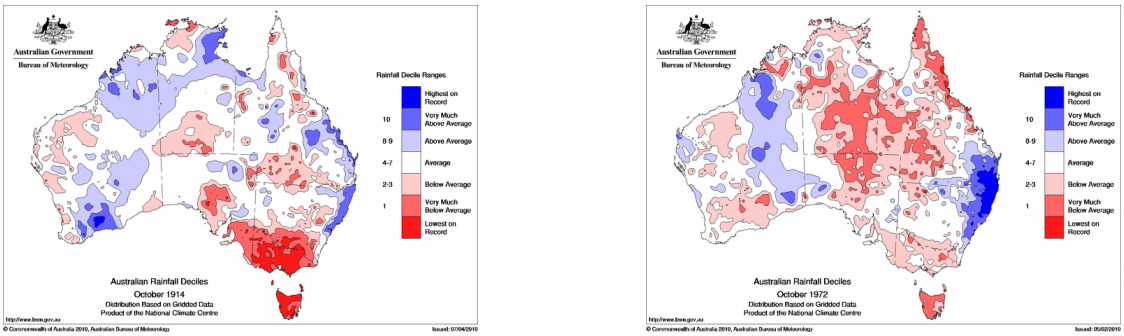

Figure 13. Rainfall deciles for October 1914 (left) and October 1972 (right).

5. The current event in a longer-term context

Whilst the current drought is a particularly severe event, most of the Murray-Darling Basin does not show a clear long-term trend in rainfall (Figure 14). The Murray-Darling Basin previously experienced major multi-year droughts in 1895-1903, 1938-1946 and 2001-2009. The general pattern in inland New South Wales and Queensland has been one of a relatively dry first half of the 20th century, a relatively wet second half of the 20th century (with especially wet decades in the 1950s and the 1970s), then a return since 2001 to rainfall more typical of the 1900-1950 period (except during the extremely wet conditions associated with the 2010-11 and 2011-12 La Niña events). The more limited evidence available suggests that rainfall in the late 19th century was comparable to that of the 1950-2000 wet period.

There are clear downward trends in rainfall since the 1990s in southern parts of eastern Australia, particularly Victoria. These trends are concentrated in the cool season (April to October) with little change during summer. A major influence on this drying has been the strengthening and extension of the subtropical high pressure ridge during winter, shifting many potential rain-bearing weather systems south of the Australian continent.

The drought has taken place against a backdrop of consistently rising temperatures. Warming was slower to develop in the Murray-Darling Basin than it was over most other parts of the country, with little trend in mean temperatures over most of the 20th century, but in recent decades it has seen the most rapid warming in Australia (Figure 14). Since 1970 most of the region has been warming at a rate of between 0.2 and 0.4 °C per decade, compared with a national average of around 0.15 °C per decade. The last five years, all of which have had mean temperatures at least 1 °C above the 1961-1990 average, have all ranked amongst the nine warmest on record for the Basin (with 2017 being the warmest), and nine of the Basin's ten warmest years have occurred since 2005. This warming has placed additional moisture stress on many systems within the region, over and above that associated with variations in rainfall.

Notwithstanding the general warming, trends in winter minimum temperatures have been weak in parts of inland southeastern Australia, with some regions showing stable or increasing frost frequency since the 1980s, especially in northern Victoria and southern inland New South Wales. This has occurred in conjunction with decreasing cool-season rainfall in the region, and strengthening of the subtropical ridge.

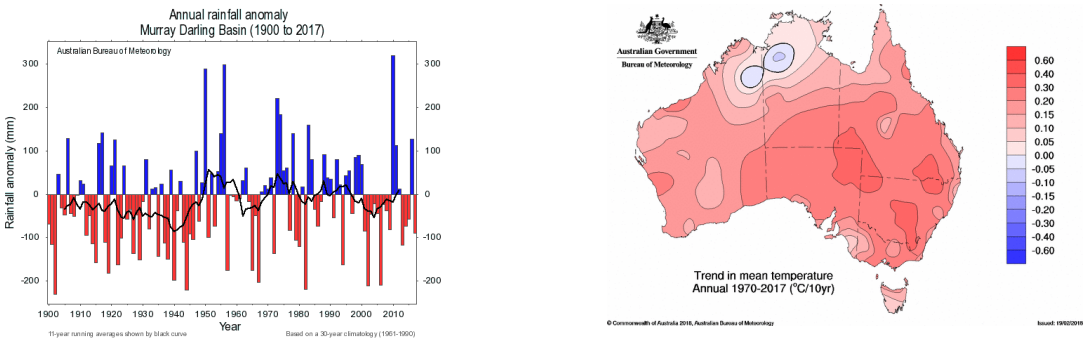

Figure 14. (Left) Mean annual rainfall anomalies (from 1961-1990 average) for the Murray-Darling basin, with an 11-year running mean (black line). (Bottom) Australian mean temperature trends (°C/decade) for the period from 1970 to 2017.

Tables

District number	District name	State	Jan-Sep 2018 (9 months)	Jul 2017 – Sep 2018 (15 months)	Jan 2017 – Sep 2018 (21 months)
17	Far North	SA	−75	−58	−46
19	Upper North	SA	−56	−46	−38
20	Northeast	SA	−68	−44	−39
21	Lower North	SA	−41	−29	−24
23	East Central	SA	−33	−16	−17
24	Murray River	SA	−50	−31	−25
25A	Murray Mallee	SA	−50	−32	−19
25B	Upper Southeast	SA	−30	−12	−8
26	Lower Southeast	SA	−7	+1	+3
34	West Central Coast	QLD	−41	−38	−21
35	Central Highlands	QLD	−29	−21	−20
36	Central Lowlands	QLD	−49	−45	−46
37	Upper Western	QLD	−19	−19	−26
38	Lower Western	QLD	−57	−50	−49
41	East Darling Downs	QLD	−45	−35	−22
42	West Darling Downs	QLD	−32	−20	−18
43	Maranoa	QLD	−36	−24	−24
44	Warrego	QLD	−58	−47	−47
45	Far Southwest	QLD	−75	−59	−61
46	Western (Far Northwest)	NSW	−80	−62	−59
47	Western (Lower Darling)	NSW	−75	−49	−48
48	Western (Upper Darling)	NSW	−70	−50	−49

Table 1: District rainfall averages (% above/below 1961-1990 average) for periods ending in September 2018. Values which are the lowest on record are shown in bold.

District number	District name	State	Jan-Sep 2018 (9 months)	Jul 2017 – Sep 2018 (15 months)	Jan 2017 – Sep 2018 (21 months)
49	Western (Southwest Plains)	NSW	−71	−46	−45
50	Central Western Plains (S)	NSW	**−65**	−43	−39
51	Central Western Plains (N)	NSW	−62	−44	−42
52	Northwest Plains (W)	NSW	−58	−46	−43
53	Northwest Plains (E)	NSW	−55	−42	−35
54	Northwest Slopes (N)	NSW	−51	−40	−23
55	Northwest Slopes (S)	NSW	−57	**−47**	−35
56	Northern Tablelands (W)	NSW	−40	−33	−13
57	Northern Tablelands (E)	NSW	−35	−25	−11
58	Upper North Coast	NSW	−35	−24	−2
59	Lower North Coast	NSW	−34	−27	−15
60	Manning	NSW	−25	−26	−16
61	Hunter	NSW	−42	−43	−33
62	Central Tablelands (N)	NSW	−45	−42	−38
63	Central Tablelands (S)	NSW	−47	−41	−35
64	Central Western Slopes (N)	NSW	−52	−44	−41
65	Central Western Slopes (S)	NSW	**−60**	−43	−38
66	Metropolitan (E)	NSW	**−47**	**−51**	−32
67	Metropolitan (W)	NSW	−55	**−57**	−36
68	Illawarra	NSW	−52	**−53**	−36
69	South Coast	NSW	−46	−38	−32

Table 1 (cont.): District rainfall averages (% above/below 1961-1990 average) for periods ending in September 2018. Values which are the lowest on record are shown in bold.

District number	District name	State	Jan-Sep 2018 (9 months)	Jul 2017 – Sep 2018 (15 months)	Jan 2017 – Sep 2018 (21 months)
70	Southern Tablelands (Goulburn-Monaro)	NSW	−43	−31	−29
71	Southern Tablelands (Snowy Mountains)	NSW	−33	−20	−19
72	Southwest Slopes (S)	NSW	−32	−19	−20
73	Southwest Slopes (N)	NSW	−48	−28	−29
74	Riverina (E)	NSW	−54	−26	−29
75	Riverina (W)	NSW	−67	−36	−35
76	North Mallee	VIC	−58	−33	−24
77	South Mallee	VIC	−50	−28	−19
78	North Wimmera	VIC	−37	−21	−16
79	South Wimmera	VIC	−26	−14	−12
80	Lower North	VIC	−51	−28	−21
81	Upper North	VIC	−45	−27	−23
82	Lower Northeast	VIC	−32	−16	−18
83	Upper Northeast	VIC	−27	−14	−18
84	East Gippsland	VIC	−36	−30	−31
85	West Gippsland	VIC	−31	−20	−24
86	East Central	VIC	−25	−14	−15
87	West Central	VIC	−29	−24	−17
88	North Central	VIC	−28	−18	−18
89	Western Plains	VIC	−21	−13	−9
90	West Coast	VIC	−10	−4	−2

Table 1 (cont.): District rainfall averages (% above/below 1961-1990 average) for periods ending in September 2018. Values which are the lowest on record are shown in bold.

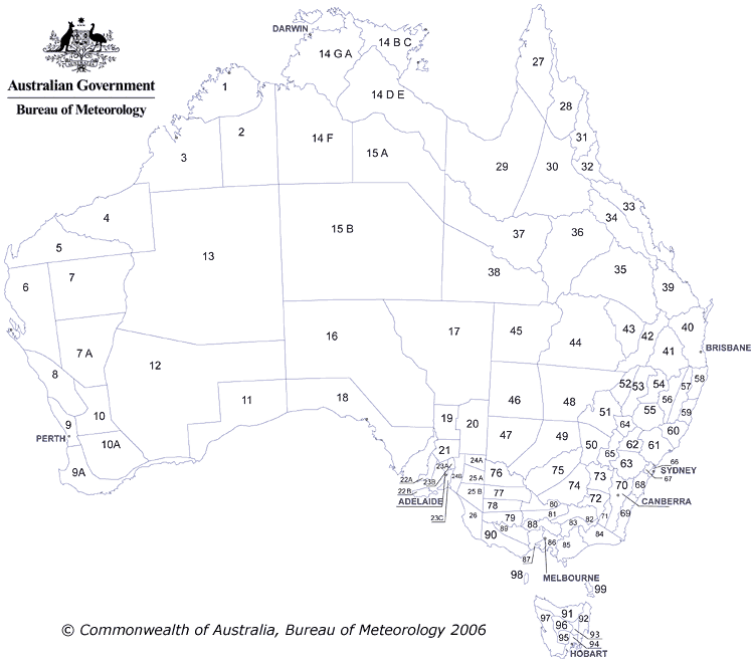

Figure 15. Australian rainfall districts.

Murray-Darling Basin			New South Wales		
9-month	15-month	21-month	9-month	15-month	21-month
125.1 (1902)	316.0 (1901-02)	497.2 (1901-02)	151.1 (1902)	358.1 (1901-02)	619.8 (1901-02)
171.5 (2018)	356.3 (1928-29)	557.4 (2006-07)	190.5 (1965)	**402.7 (2017-18)**	621.4 (1965-66)
177.4 (1965)	369.7 (1918-19)	**570.4 (2017-18)**	**191.3 (2018)**	406.7 (1918-19)	654.6 (2002-03)
204.5 (1927)	**386.5 (2017-18)**	576.9 (1944-45)	204.4 (1940)	424.5 (1964-65)	**657.0 (2017-18)**
205.3 (1944)	388.0 (1926-27)	591.5 (2002-03)	237.9 (1927)	425.0 (1926-27)	658.5 (1940-41)

Table 2: Lowest regional averages on record for 9-, 15- and 21-month periods ending in September. Periods ending in September 2018 are shown in bold.

Station number	Name	State	Value (mm)	Previous record
17043	Oodnadatta	SA	21.8	24.0 (1977)
18022	Cowell	SA	93.8	94.1 (1988)
18116	Cleve Airport	SA	156.2	161.6 (1999)
22020	Wallaroo	SA	150.8	162.0 (1994)
25000	Alawoona	SA	98.5	108.4 (1959)
25006	Karoonda	SA	115.0	122.3 (1959)
25046	Pinnaroo (Kombali)	SA	108.2	123.2 (1982)
46052	Wanaaring (Owen Downs)	NSW	29.4	32.4 (1982)
46117	Broken Hill (Waterbag)	NSW	17.8	40.4 (2002)
47019	Menindee	NSW	37.1	42.1 (1938)
47048	Broken Hill	NSW	24.6	59.8 (2002)
48027	Cobar	NSW	35.0	75.0 (1965)
49045	Euston (Sunnyside)	NSW	52.4	82.8 (1967)
50010	Burcher	NSW	126.8	184.6 (1957)
50014	Condobolin	NSW	93.4	126.5 (2008)
50016	Goonumbla (Coradgery)	NSW	122.6	124.8 (2006)
50031	Peak Hill	NSW	120.6	163.7 (1965)
50036	Trundle	NSW	99.7	122.3 (1902)
50040	Ungarie	NSW	109.8	148.1 (1914)
50045	Yalgogrin North	NSW	132.2	147.3 (1944)
50052	Condobolin Ag Res	NSW	101.0	154.9 (2006)
50108	Wilmatha (Wanganui)	NSW	125.6	177.4 (1982)
50119	Alectown (Vanvilla)	NSW	120.6	194.2 (2006)
50139	Tomingley (Gundongs)	NSW	190.6	195.4 (2006)
51122	Curban (Ercildoune)	NSW	142.4	186.5 (2017)

Table 3: Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 9 months January to September 2018.

Station number	Name	State	Value (mm)	Previous record
54124	Crooble Station	NSW	217.0	236.7 (2002)
54125	Caroda (Roseberry Park)	NSW	256.0	318.3 (1980)
55000	Attunga (Garthowen)	NSW	172.8	188.2 (1965)
55006	Blackville	NSW	174.2	209.2 (1902)
55014	Curlewis	NSW	174.3	186.7 (1925)
55016	Danglemah (Rutherglen)	NSW	219.0	272.7 (1954)
55041	Nundle	NSW	208.8	239.8 (1965)
55136	Woolbrook	NSW	209.4	244.1 (1965)
55164	Weabonga (Stoneleigh)	NSW	238.8	258.0 (1965)
55176	Loomberah (Pendene)	NSW	162.8	205.4 (1965)
56028	Uralla (Salisbury Court)	NSW	253.2	257.4 (1994)
56034	Uralla (Dumaresq St)	NSW	235.8	262.3 (1902)
56094	Dundee (Wattle Dale)	NSW	342.6	357.4 (2002)
57014	Glen Elgin (Glenbrook)	NSW	225.2	282.3 (1915)
61089	Scone Soil Cons	NSW	191.8	200.1 (1965)
61220	Yarramalong (Lewensbrook)	NSW	452.2	463.5 (1991)
63146	Cheetham Flats (Jundas)	NSW	304.6	307.6 (1965)
65012/65070	Dubbo	NSW	118.2	148.5 (1902)
65016/65103	Forbes	NSW	123.2	146.6 (2006)
66058	Sans Souci	NSW	392.0	445.0 (2017)
66124	Parramatta North	NSW	356.5	361.3 (2004)
66137	Bankstown Airport	NSW	306.4	362.2 (1994)
67033/67105	Richmond	NSW	214.8	265.0 (1980)
68003	Berry	NSW	380.5	386.0 (1888)
68036	Kangaroo Valley	NSW	407.0	418.7 (1965)

Table 3 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 9 months January to September 2018.

Station number	Name	State	Value (mm)	Previous record
69015	Eden	NSW	273.4	287.4 (1968)
70161	Cooma (Myalla)	NSW	186.6	226.0 (2004)
73000	Barmedman	NSW	132.0	143.1 (1914)
73054	Wyalong	NSW	151.1	160.4 (2006)
73110	Grenfell (Corowood)	NSW	194.2	198.1 (2006)
73150	Stockinbingal (Sunnydale)	NSW	149.6	171.8 (2006)
74000	Ardlethan	NSW	142.6	149.1 (1967)
74040	Jerilderie (Pooginook)	NSW	84.1	112.3 (1902)
74050	Grong Grong	NSW	133.7	151.3 (1902)
75041	Griffith	NSW	97.4	128.4 (2007)
75079	Yenda	NSW	123.5	133.0 (1967)
75142	Merriwagga (Sylvanham)	NSW	94.8	106.2 (1994)
76031	Mildura	VIC	59.0	99.0 (2004)
76044	Nyah	VIC	85.4	92.6 (1976)
76046	Nyah (Yarraby Tank)	VIC	92.9	95.1 (1944)
76106	Murrayville (Carina)	VIC	124.2	141.2 (2002)
77015	Gama	VIC	95.4	104.0 (1914)
77039	Sea Lake	VIC	82.5	101.7 (1914)
82029	Milawa	VIC	233.1	241.3 (2006)
84045	Lake Tyers	VIC	267.8	284.6 (1986)
84093	Bete Bolong	VIC	308.2	328.6 (2003)
85033	Giffard	VIC	200.0	213.7 (1927)
85072	East Sale	VIC	217.4	232.0 (2017)
85238	Erica (Parkers Corner)	VIC	531.2	572.2 (2008)
86018	Caulfield	VIC	296.7	324.0 (1927)

Table 3 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 9 months January to September 2018.

Station number	Name	State	Value (mm)	Previous record
86035	Eltham	VIC	325.8	351.7 (1923)
86074	Mitcham	VIC	345.8	370.2 (1997)
86077	Moorabbin Airport	VIC	320.0	326.0 (2008)
86088	Oakleigh	VIC	284.4	335.0 (1967)
86111	Springvale	VIC	336.4	388.2 (2008)
86117	Toorourrong Reservoir	VIC	333.8	341.2 (2015)
88060	Kinglake West (Wallaby Creek)	VIC	536.6	540.4 (2015)

Table 3 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 9 months January to September 2018.

Station number	Name	State	Value (mm)	Previous record
19043	Tarcowie	SA	322.0	344.9 (1943-44)
19052	Wirrabara	SA	371.5	403.5 (1928-29)
21016	Crystal Brook	SA	318.6	319.1 (1881-82)
21060	Jamestown	SA	416.6	430.3 (2007-08)
21072	Huddleston (Willow Ponds)	SA	393.8	400 8 (2007-08)
24564	Blanchetown	SA	230.2	234.4 (2007-08)
25006	Karoonda	SA	267.4	270.6 (1966-67)
37052	Mundurin Station	QLD	97.0	111.0 (1963-64)
41017	Chinchilla	QLD	334.9	369.9 (1901-02)
41098	Tannymorel	QLD	469.4	515.1 (1990-91)
41120	Yangan	QLD	453.0	474.0 (1918-19)
41128	Wondalli	QLD	353.8	391.2 (1941-42)
41371	Melva	QLD	524.2	539.0 (2013-14)
41391	Woodspring	QLD	369.9	415.6 (1979-80)
41445	Leslie Dam	QLD	450.7	476.2 (1990-91)
41504	Glen Royal	QLD	363.6	449.3 (1990-91)
44129	Pingine	QLD	153.0	169.0 (1926-27)
47048	Broken Hill	NSW	87.2	166.6 (1982-83)
48027	Cobar	NSW	182.4	211.0 (2006-07)
50052	Condobolin Ag Res	NSW	334.7	342.0 (1979-80)
50119	Alectown (Vanvilla)	NSW	355.6	389.8 (2014-15)
51122	Curban (Ercildoune)	NSW	317.2	426.3 (2001-02)
52016	Gwabegar	NSW	327.0	391.9 (1928-29)
52033	Pilliga (Nirvana)	NSW	255.8	275.2 (1901-02)

Table 4: Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 15 months July 2017 to September 2018.

Station number	Name	State	Value (mm)	Previous record
53002	Baradine	NSW	409.2	452.4 (1964-65)
53034	Wee Waa (Pendennis)	NSW	329.2	361.5 (1926-27)
53073	Kenebri (Ellerslie)	NSW	363.5	427.8 (2013-14)
54125	Caroda (Ellerslie Park)	NSW	551.1	589.9 (1979-80)
55016	Danglemah (Rutherglen)	NSW	498.4	531.4 (1953-54)
55041	Nundle	NSW	537.1	626.4 (1964-65)
55043	Willow Tree (Parraweena)	NSW	423.2	425.9 (1939-40)
55057	Willow Tree (Valais)	NSW	444.6	465.3 (1939-40)
55066	Wallabadah (Woodton)	NSW	491.8	513.8 (1939-40)
55105	Attunga (Tarana)	NSW	496.8	534.1 (1979-80)
55120	Attunga (The Pines)	NSW	412.7	419.4 (1964-65)
55136	Woolbrook	NSW	485.9	614.7 (1964-65)
55157	Winton (Dalblair)	NSW	432.2	484.5 (1964-65)
55164	Weabonga (Stoneleigh)	NSW	525.2	626.0 (1918-19)
55176	Loomberah (Pendene)	NSW	443.8	560.7 (1964-65)
55183	Duri (Ashgrove)	NSW	503.8	510.1 (1964-65)
55244	Willow Tree (Cooinda)	NSW	345.0	486.8 (1964-65)
55255	Quirindi (Spring Vale)	NSW	417.0	453.3 (1965-66)
55054/55325	Tamworth	NSW	422.4	467.8 (1994-95)
56028	Uralla (Salisbury Court)	NSW	534.9	577.6 (1939-40)
56034	Uralla (Dumaresq St)	NSW	448.6	571.4 (2015-16)
56083	Glen Morrison (Branga Plains)	NSW	572.0	629.7 (1965-66)
57014	Glen Elgin (Glenbrook)	NSW	595.4	682.0 (2001-02)
61007	Bunnan (Milhaven)	NSW	332.0	365.2 (1939-40)
61051	Murrurundi	NSW	512.8	538.0 (1939-40)

Table 4 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 15 months July 2017 to September 2018.

Station number	Name	State	Value (mm)	Previous record
61075	Merriwa (Bowglen)	NSW	283.6	362.8 (1939-40)
61089	Scone Soil Cons	NSW	320.8	369.6 (1979-80)
61095	Rouchel Brook (Albano)	NSW	429.4	436.2 (1979-80)
61196	Ellerston (Poitrel)	NSW	483.4	562.8 (1964-65)
61220	Yarramalong (Lewensbrook)	NSW	703.8	721.4 (1979-80)
61327	Pokolbin (Myrtledale)	NSW	554.0	562.6 (1979-80)
63012	Running Stream (Brooklyn)	NSW	555.4	564.3 (1901-02)
63035	Hill End	NSW	601.0	615.3 (1901-02)
63036	Jenolan Caves	NSW	584.5	647.7 (1901-02)
63077	Springwood	NSW	524.6	540.5 (2001-02)
63254	Orange Ag Institute	NSW	696.6	798.9 (1982-83)
64008	Coonabarabran	NSW	410.8	434.6 (1901-02)
64050	Weetaliba (Munna)	NSW	461.8	511.0 (1994-95)
65030	Dubbo (Mentone)	NSW	402.6	456.5 (1901-02)
65016/65103	Forbes	NSW	264.2	348.1 (1913-14)
66013	Concord	NSW	628.6	653.8 (1956-57)
66058	Sans Souci	NSW	549.0	658.0 (2016-17)
66124	Parramatta North	NSW	506.7	607.6 (1979-80)
66137	Bankstown Airport	NSW	433.8	626.0 (2003-04)
66158	Turramurra	NSW	772.7	865.9 (1979-80)
66164	Rookwood	NSW	586.4	587.4 (1946-47)
67002	Castlereagh	NSW	460.7	460.8 (1979-80)
67015	Bringelly	NSW	389.7	417.4 (1964-65)
67021	Richmond (UWS Hawkesbury)	NSW	388.9	420.9 (1939-40)
67033/67105	Richmond	NSW	348.2	403.6 (1979-80)

Table 4 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 15 months July 2017 to September 2018.

Station number	Name	State	Value (mm)	Previous record
68003	Berry	NSW	577.6	746.2 (1941-42)
68036	Kangaroo Valley	NSW	587.7	705.0 (1964-65)
68044	Mittagong	NSW	584.0	587.7 (1979-80)
68045	Moss Vale	NSW	551.1	592.6 (2003-04)
68052	Picton	NSW	363.4	451.6 (1964-65)
68076/68072	Nowra	NSW	588.2	645.7 (1964-65)
68083	Culburra	NSW	743.4	769.6 (1980-81)
68108	Woonona	NSW	706.6	763.6 (1941-42)
68110	Berkeley	NSW	644.6	707.4 (1964-65)
68131	Port Kembla	NSW	604.6	625.1 (1980-81)
70124	Richlands (Bouverie)	NSW	788.8	821.3 (1964-65)
77039	Sea Lake	VIC	243.5	257.6 (1929-30)
88009	Cairn Curran Reservoir	VIC	373.2	398.9 (2014-15)

Table 4 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 15 months July 2017 to September 2018.

Station number	Name	State	Value (mm)	Previous record
20049	Mooleulooloo	SA	175.9	176.8 (2002-03)
21072	Huddleston (Willow Ponds)	SA	539.0	563.8 (1958-59)
21076	Manoora (Cooinda)	SA	559.0	592.8 (1976-77)
23735	Mount Compass	SA	1182.9	1214.3 (1961-62)
37052	Mundurin Station	QLD	188.2	199.8 (1964-65)
41017	Chinchilla	QLD	525.5	550.7 (1922-23)
41391	Woodspring	QLD	666.6	685.0 (1979-80)
41504	Glen Royal	QLD	777.0	779.1 (2000-01)
43080	Karoola Park	QLD	545.4	593.5 (1965-66)
44021	Charleville	QLD	388.6	401.4 (1964-65)
46015	Broken Hill (Langawirra)	NSW	154.6	165.5 (1940-41)
47031	Stephens Creek Reservoir	NSW	154.8	194.0 (1913-14)
47048	Broken Hill	NSW	133.2	213.6 (1982-83)
48027	Cobar	NSW	293.6	328.6 (1964-65)
48031	Collarenebri	NSW	376.4	489.7 (1918-19)
50008	Peak Hill (Bruie Plains)	NSW	499.3	514.3 (1922-23)
51066	Eumungerie	NSW	547.6	623.1 (1965-66)
51122	Curban (Ercildoune)	NSW	485.0	609.6 (2006-07)
52016	Gwabegar	NSW	497.0	562.0 (2006-07)
52023	Pilliga	NSW	453.0	507.9 (1918-19)
52033	Pilliga (Nirvana)	NSW	378.5	406.4 (1918-19)
53044	Wee Waa	NSW	600.7	605.5 (1979-80)
53073	Kenebri (Ellerslie)	NSW	557.7	602.7 (2002-03)
54125	Caroda (Roseberry Park)	NSW	970.3	1037.8 (2002-03)
55057	Willow Tree (Valais)	NSW	737.8	740.6 (1901-02)

Table 5: Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 21 months January 2017 to September 2018.

Station number	Name	State	Value (mm)	Previous record
55244	Willow Tree (Cooinda)	NSW	587.0	668.0 (1994-95)
61075	Merriwa (Bowglen)	NSW	583.1	596.8 (1939-40)
61089	Scone Soil Cons	NSW	552.1	594.6 (1965-66)
61097	Moonan Flat	NSW	697.6	741.5 (1965-66)
61196	Ellerston (Poitrel)	NSW	833.6	864.3 (1965-66)
61327	Pokolbin (Myrtledale)	NSW	1017.0	1039.8 (1979-80)
63012	Running Stream (Brooklyn)	NSW	878.0	972.5 (1918-19)
63035	Hill End	NSW	831.5	875.2 (1982-83)
63254	Orange Ag Institute	NSW	983.6	1003.7 (1982-83)
64010	Elong Elong	NSW	625.4	672.2 (1965-66)
65030	Dubbo (Mentone)	NSW	594.6	636.0 (1918-19)
65034	Wellington	NSW	583.8	667.4 (1922-23)
66058	Sans Souci	NSW	969.0	1146.0 (2016-17)
68003	Berry	NSW	1112.1	1139.9 (1941-42)
84003	Bruthen	VIC	715.3	805.1 (1979-80)
84016	Gabo Island	VIC	1076.8	1106.8 (1972-73)
84025	Nicholson (Yendalock)	VIC	642.6	731.7 (1907-08)
84028	Nowa Nowa	VIC	815.0	870.7 (1979-80)
84045	Lake Tyers	VIC	796.4	877.3 (1979-80)
84093	Bete Bolong	VIC	826.4	949.2 (2003-04)
85033	Giffard	VIC	680.6	692.9 (1943-44)
85072	East Sale	VIC	639.2	691.8 (2009-10)
85238	Erica (Parkers Corner)	VIC	1394.8	1459.2 (2002-03)
86074	Mitcham	VIC	1034.8	1058.9 (2002-03)
88009	Cairn Curran Reservoir	VIC	541.8	587.9 (2014-15)

Table 5 (cont.): Long-term stations (50 years or more of data) which have had their lowest rainfall on record for the 21 months January 2017 to September 2018.

Year	Maximum temperature	Minimum temperature	Mean temperature	Diurnal temperature range
1940	+0.56	−1.01	−0.23	+1.57
1965	+0.61	−0.45	+0.08	+1.06
1982	+0.79	−0.93	−0.07	+1.72
1994	+0.93	−0.95	−0.01	+1.88
2002	+1.93	+0.14	+1.03	+1.79
2006	+0.71	−0.70	+0.01	+1.41
2018	+1.93	+0.26	+1.09	+1.67

Table 6: Temperature anomalies (°C, from 1961-1990 average) for the April to September rainfall in significant drought years in New South Wales.

References and further information

Data used in this statement is current as of 9 a.m. on 31 October 2018 and is subject to the Bureau's routine quality control processes. Maximum temperature observations prior to 1910 have not been used unless it is known that they were measured using standard equipment comparable to post-1910 standards.

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