Australian Government
Bureau of Meteorology

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SPECIAL CLIMATE STATEMENT 38

Australia's wettest two-year period on record; 2010–2011.

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National Climate Centre
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Note: This statement is based on preliminary data available as of 31 January 2012, which may be subject to change as a result of standard quality control procedures.

Introduction

Frequent heavy rain events from spring 2010 to autumn 2011, and again in late 2011, lead to Australia's wettest two-year period on record. Averaged across Australia, total rainfall for 2011 was 705 mm, making it the second-wettest year on record (behind 1974 with 760 mm), and ahead of 2010 (third-wettest) with 703 mm. Back-to-back La Niña events resulted in a two-year rainfall total for 2010–2011 of 1409 mm, surpassing the old record of 1407 mm set during 1973–1974.

The exceptional rainfall was heavily influenced by La Niña conditions. The period from 2010 into early 2011 saw one of the strongest La Niña events in history. While this La Niña event declined through winter 2011, a weaker event re-emerged in spring and persisted into the summer months of 2012. These conditions, coupled with very warm sea surface temperatures to the north of Australia and in the eastern Indian Ocean, contributed to making 2010–2011 Australia's wettest two-year period on record.

La Niña events bring warmer ocean waters and enhanced tropical convection to the Australian region. The strength of the atmospheric circulation is measured by the Southern Oscillation Index (SOI). The 2010–2011 La Niña event was associated with both record SOI values and record sea surface temperatures in regions that are historically linked to increased rainfall across Australia (see http://www.bom.gov.au/announcements/media_releases/climate/change/20110105.shtml).

Spring 2011 saw the redevelopment of a second La Niña event. While the second event was weaker than the first, it occurred in conjunction with sustained warm sea surface temperatures in the Indian Ocean to the west and southwest of the continent. Well above-average rainfall fell in November and December and was sufficient to push the Australian 2011 total to the second-highest value on record, with the state of Western Australia recording its highest annual rainfall on record.

The heavy rainfall in 2010–2011 was remarkable in terms of its spatial extent (Figure 1), and it ended a record sequence of dry years in parts of southern and eastern Australia, especially the southeast of Australia focussed on Victoria.

Ending December 2009, southeast Australia (south of 33°S, east of 135°E inclusive) had the driest 11-year, 10-year, 9-year, 8-year, and 7-year periods on record. This extended dry was characterised by both a decline in autumn and winter rainfall, as well an as absence of very wet years in general. These conditions are described in previous Special Climate Statements (see Special Climate Statement 22, available from http://www.bom.gov.au/climate/current/statements/scs22.pdf). In some contrast, much of northern Australia experienced unusually wet conditions, in the form of increased summer monsoonal rainfall, in the decade leading up to 2010. In this context, the two very wet years extend a remarkable record breaking period of heavy rainfall across this region.

Rainfall in southwestern Australia for 2010 and 2011 stands in strong contrast to the rest of southern Australia. Despite the presence of La Niña, 2010 was the driest year on record for the region (an annual total of 395 mm, with the next-driest 1940 with 439 mm). While hemispheric conditions were arguably more favourable for rainfall in the southwest during 2011, the region received only near-average rainfall; which was not sufficient to offset the extreme dry conditions that have affected this region for some decades.

Small areas of southwest Western Australia inland from Margaret River have seen the driest two-year period on record. For the southwest corner of Western Australia as a whole, the two-year period 2010–2011 was the fourth-driest two-year period on record, with the partially overlapping 2009–2010 period being the driest on record.

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Wettest two-year period on record with rainfall closely following La Niña cycles

The major rain events and associated flooding during the 2010–2011 La Niña cycle are documented in Special Climate Statement 24c (http://www.bom.gov.au/climate/current/statements/scs24c.pdf).

The beginning of 2010 saw the decay of a weak to moderate El Niño event from the previous year. This event was somewhat atypical in that the drier than average conditions over Australia usually associated with an El Niño event persisted until only October 2009 and did not extend into the summer period. Rainfall for the remainder of spring and through to autumn 2010 was above average over much of central and eastern Australia.

By winter 2010, the Bureau of Meteorology stated that a La Niña event was likely to develop in the tropical Pacific. By spring 2010 the event was well established, with a range of indicators showing the likelihood that it would be a strong La Niña.

September 2010 saw Australia's wettest September on record. It was also the wettest September on record for Queensland and the NT, and the third-wettest for SA and WA. It was the third-wettest October on record for Australia and the wettest for the NT. Consequently, spring 2010 was the wettest on record for Australia, Queensland, NSW, and the NT and the second-wettest for SA.

In summer the rainfall records continued, with Australia recording its second-wettest December on record and the wettest December for Queensland. Coinciding with this heavy rainfall, the SOI in December was the highest on record for that month, and the highest monthly value since 1973, also a strong La Niña year. Temperatures in the oceans across the north of the continent were also highest-on-record during the spring and early-summer periods contributing to the heavy rainfall.

The start of 2011 saw heavy rainfall and associated severe flooding continue in Queensland and also in southern parts of Australia. Victoria had its wettest January on record. February was also a wet month across Australia, with Australia recording its second-wettest February on record and SA and WA their wettest and second-wettest, respectively. This resulted in WA, and Australia as a whole, recording its second-wettest summer on record. Victoria recorded its wettest summer and SA its third-wettest. As the La Niña event was declining in the tropical Pacific, March again saw a wet month across much of Australia, with highest-on-record rainfall for the month in Australia, Queensland and the NT.

As the 2010–2011 La Niña event waned, so did the rainfall. In fact, rainfall returned to below average across much of the continent. April and May 2011 recorded below-average rainfall across large areas of Australia, with June especially dry across inland NSW and eastern SA. Winter brought below-normal rainfall across Australia, mainly resulting from dry conditions across southeastern Australia, and continuing a more than decade-long trend of drier than normal late autumn - early winters across this region.

By spring 2011, a weaker La Niña event returned to the tropical Pacific. Rainfall again returned to above average across large parts of Australia, especially northern Australia. Western Australia recorded its third-wettest October and the NT its fourth-wettest November on record.

2010–2011 - an end to the 'Big Dry'?

As wet as it has been, the longer term averages still show much of Australia to have received below-average rainfall. Dry conditions have persisted across both southwestern and southeastern Australia in recent decades. The drought conditions can be characterised in a number of different ways. Perhaps the most statistically significant rainfall changes that have occurred are a 10–20%

reduction in autumn and winter rainfall across the southeast since 1996, and a similar decline in winter rainfall across the southwest since around 1970. The April to November period is the main rainfall and runoff season for both these parts of Australia, with less rainfall falling in summer. Special Climate Statement 9, released in October 2006, reported on an exceptionally dry decade in parts of southern and eastern Australia
(http://www.bom.gov.au/climate/current/statements/scs9a.pdf).

During the period of declining autumn and winter rainfall, there has also been an absence of wet years across the southeast and southwest. This has exacerbated drought conditions in these regions.

The substantial decline in autumn and winter rainfall in recent decades is largely associated with a reduction in rainfall from cold fronts/low pressure systems and an increase in mean surface pressure, associated with an increase in the number of high pressure systems.

The heavy rainfall of 2010 and 2011 effectively brought an end to the sequence of dry years, or episodic drought, across southeastern Australia. 2010–2011 was Australia's wettest two-year period on record (Figure 1), just edging out 1973–1974 (Figure 2), which was also dominated by La Niña events. A number of rainfall stations recorded their record-highest two-year totals in 2010–2011 (Table 1). Perhaps most significantly, the record rainfall provided relief to water storages across eastern and southern Australia, with the notable exception being the southwest, which is continuing to suffer from severe hydrological drought.

It is notable, however, that the bulk of the above-average rainfall of the past two years fell during the northern wet season (typically running from around October to April), with tropical influenced weather systems bringing monsoonal-like rainfall to much of the continent. By contrast, dry conditions persisted during the 2010 and 2011 April to June period (the start of the early winter rainfall period) across southern Australia.

The high 2010 and 2011 rainfall was therefore not associated with winter-time storm systems, and did not represent a return to normal conditions over the southern Australian winter season. In this way, the recent trend of rainfall reductions in autumn and winter was not reversed by the back-to-back La Niña events.

Furthermore, the sustained La Niña conditions failed to meaningfully impact on rainfall across southwestern Western Australia. In Figure 1 the below-average rainfall in the southwest of the country compared to 1973–74 is evident. This area is largely dependent on frontal systems during the winter half of the year, and missed out on a lot of the tropical moisture that much of the rest of the country received. Also, by comparing the two maps, we can see that southeastern Australia also received more rainfall in 1973–74, though the differences are not significant.

In light of the exceptionally wet two-year period (2010–2011) we have updated maps from the Special Climate Statement 22 which previously reported on the extended dry in southern areas. Arguably, and by many measures such as increases in soil moisture, refilling of dams, and frequent flooding etc., the long dry can now be said to be over. This is certainly true of the northern parts of the Murray-Darling Basin where severe drought conditions have given way to flooding.

However, the 15-year and the 10-year rainfall decile maps (Figures 3 and 4) show that over much of southeastern Australia and southwestern Australia large areas of below-average and very-much-below-average rainfall remain, while pockets of record-low 15-year totals are evident along the coast in southwest WA, western Tasmania and parts of Victoria including near the catchments for Melbourne.

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With the longer 15-year period (Figure 3), 56% of Victoria and 74% of Tasmania remains in the lowest rainfall decile. With the shorter 10-year period (Figure 4), large areas of below-average rainfall also remain evident with 40% of Victoria and 39% of Tasmania in the lowest decile. The updated long-term deficiency maps reflect just how extreme and prolonged the dry period was over southern parts of Australia leading into 2010–2011. This continues to be significant for these regions; given that almost all of the excessive rainfall over the past two years fell out of season, and that long term declines in autumn and winter rainfall remain.

An alternative way to consider the impact of the rainfall declines and recent rainfall is to look at the cumulative rainfall anomalies for southeastern Australia (Figure 5). The cumulative rainfall anomalies provide a measure of just how much rainfall the region has 'missed out on' in the past 15 years.

While the systematic accumulation of rainfall deficits was reversed with the heavy spring and summer rainfall of 2010, the total two-year record rainfall makes up for about one third of the total rainfall 'missed out on' since 1996. Additionally, the recovery peaked in autumn 2011, with a return to deficits from that time on. In other words, the accumulated below-normal rainfall during the 'Big Dry' remains substantially greater than the extra spring and summer rainfall that has fallen during the past two years.

Further information

This statement is based on information available as of 31 January 2012. The information in this statement is based on preliminary data, and may change as further data are obtained and quality assurance is undertaken.

For general enquiries on this statement

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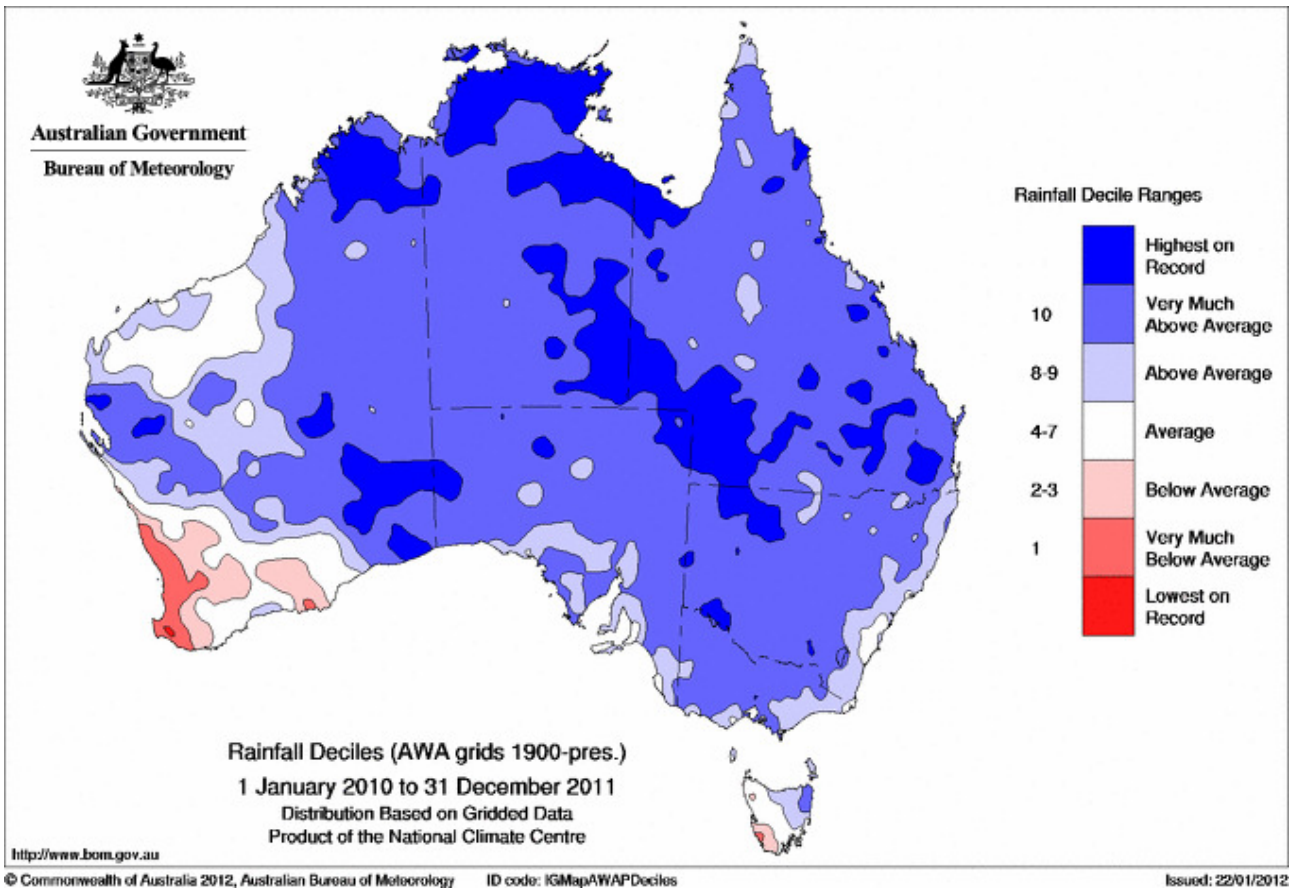

Figure 1: Australian rainfall deciles for the two years, January 2010 to December 2011.

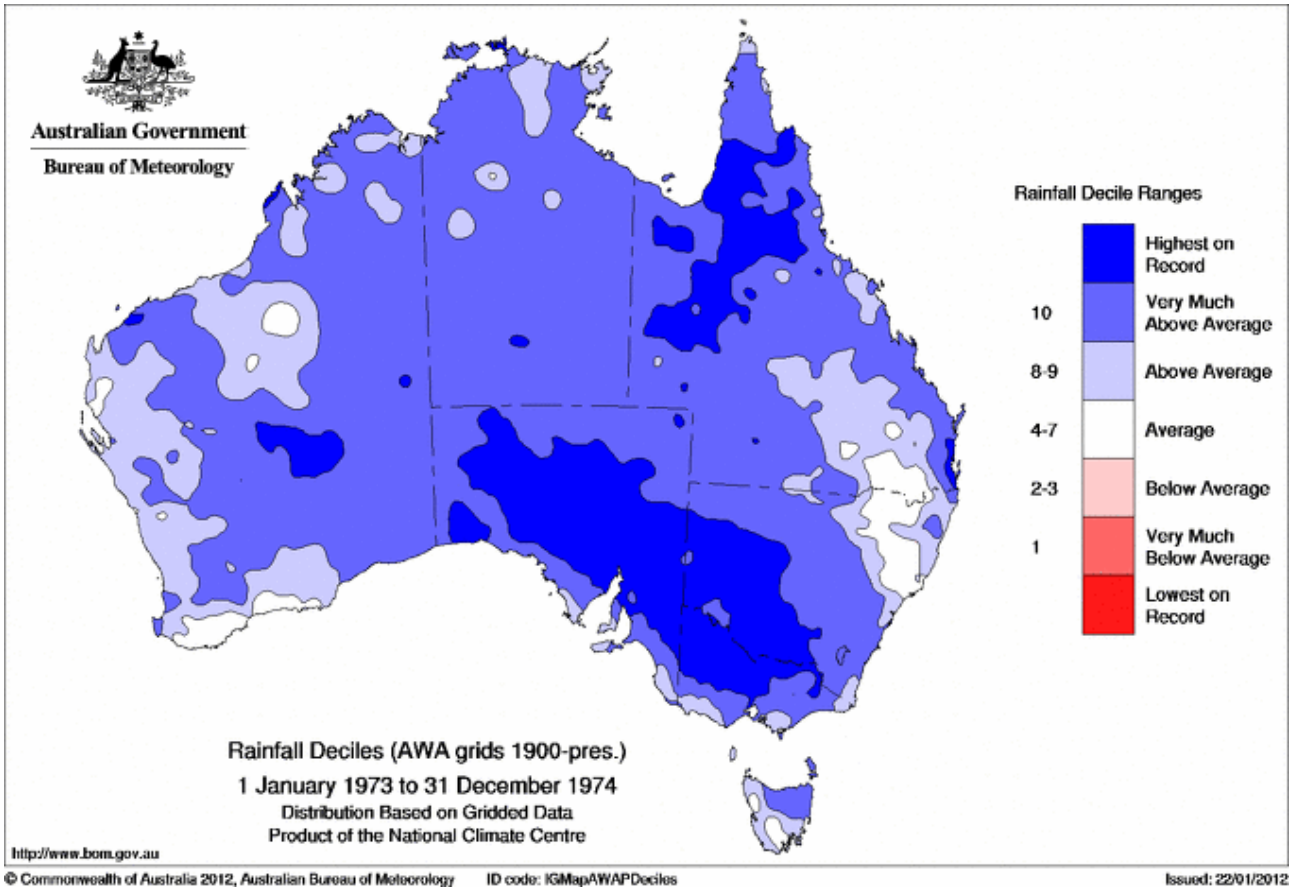

Figure 2: Australian rainfall deciles for the two years, January 1973 to December 1974.

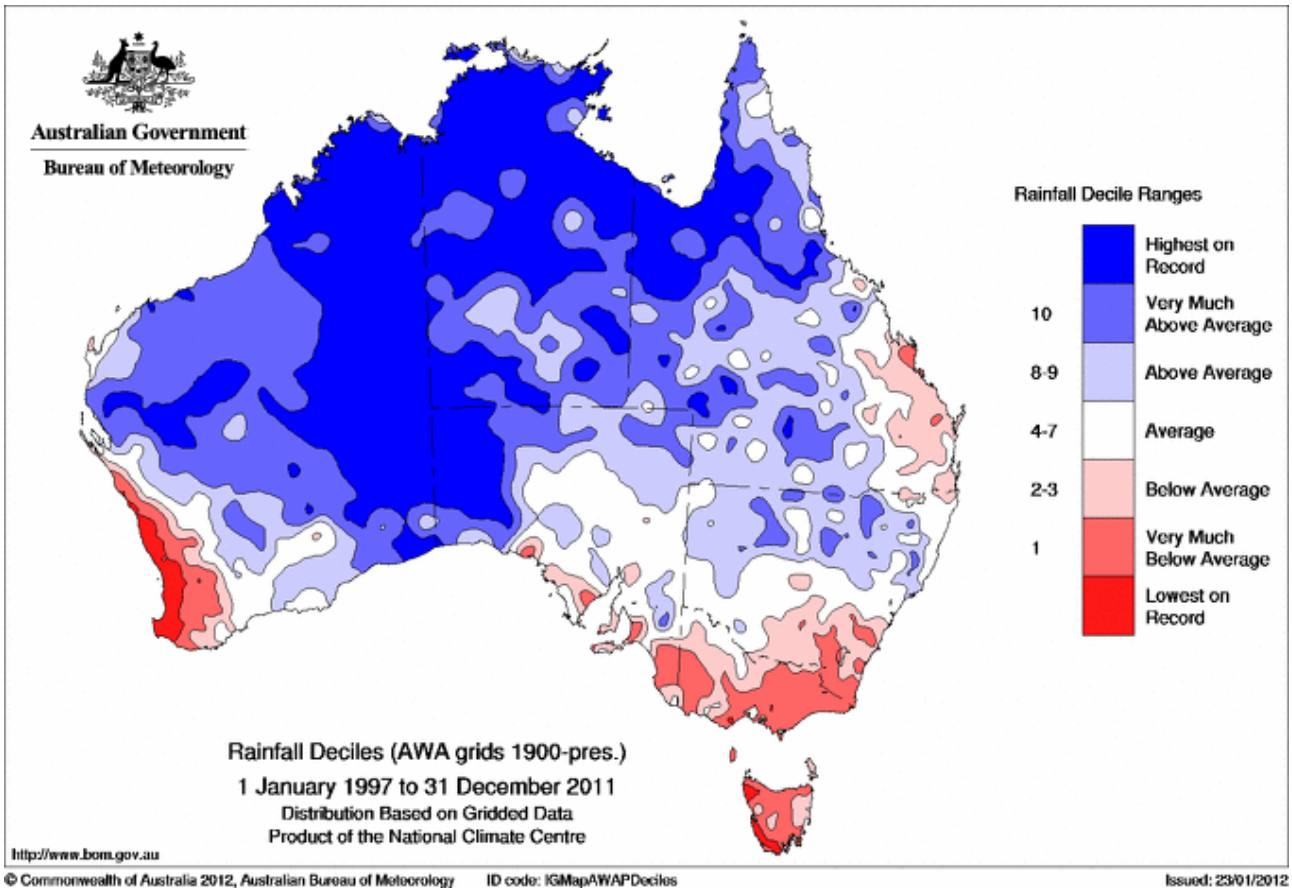

Figure 3: Australian rainfall deciles for the 15 years, January 1997 to December 2011.

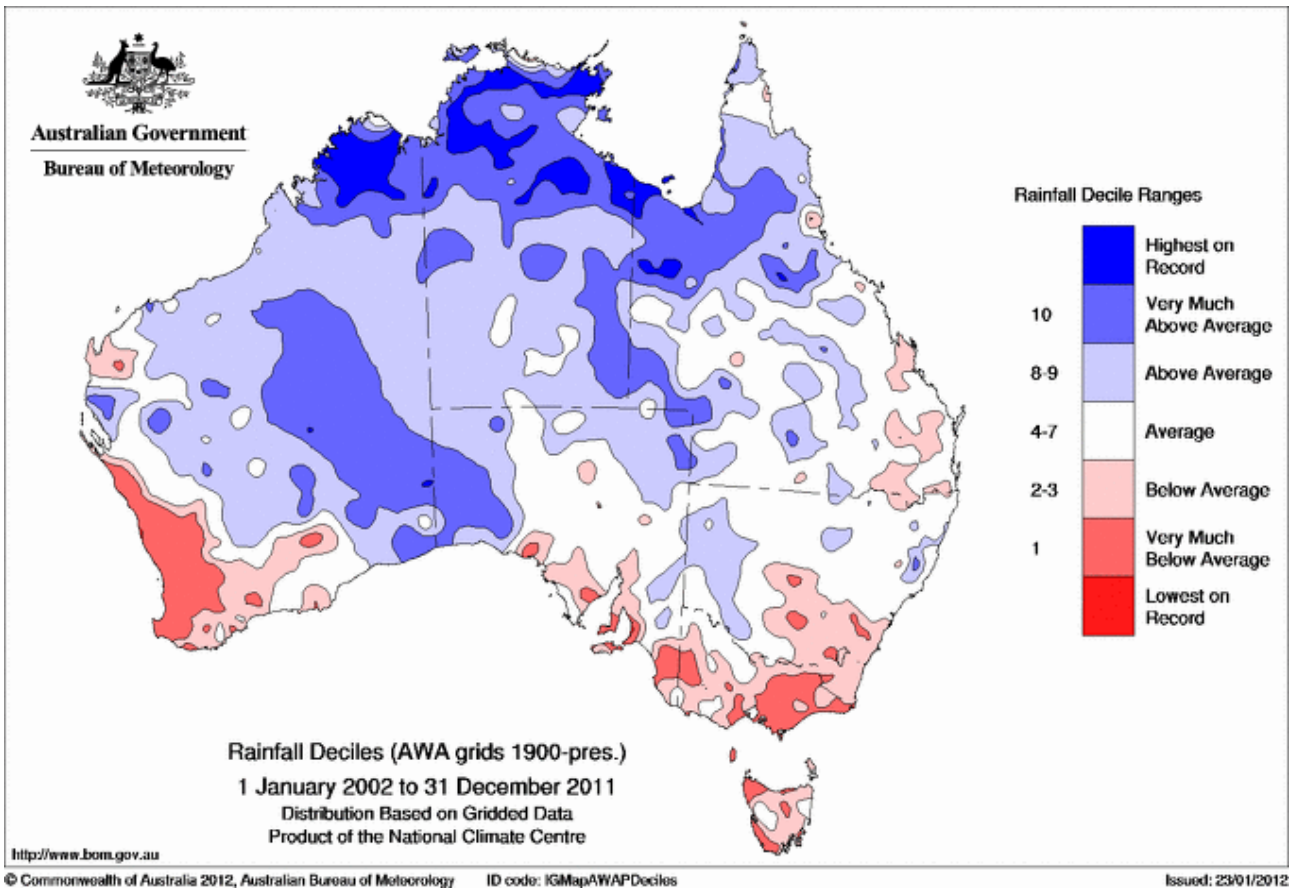

Figure 4: Australian rainfall deciles for the 10 years, January 2002 to December 2011.

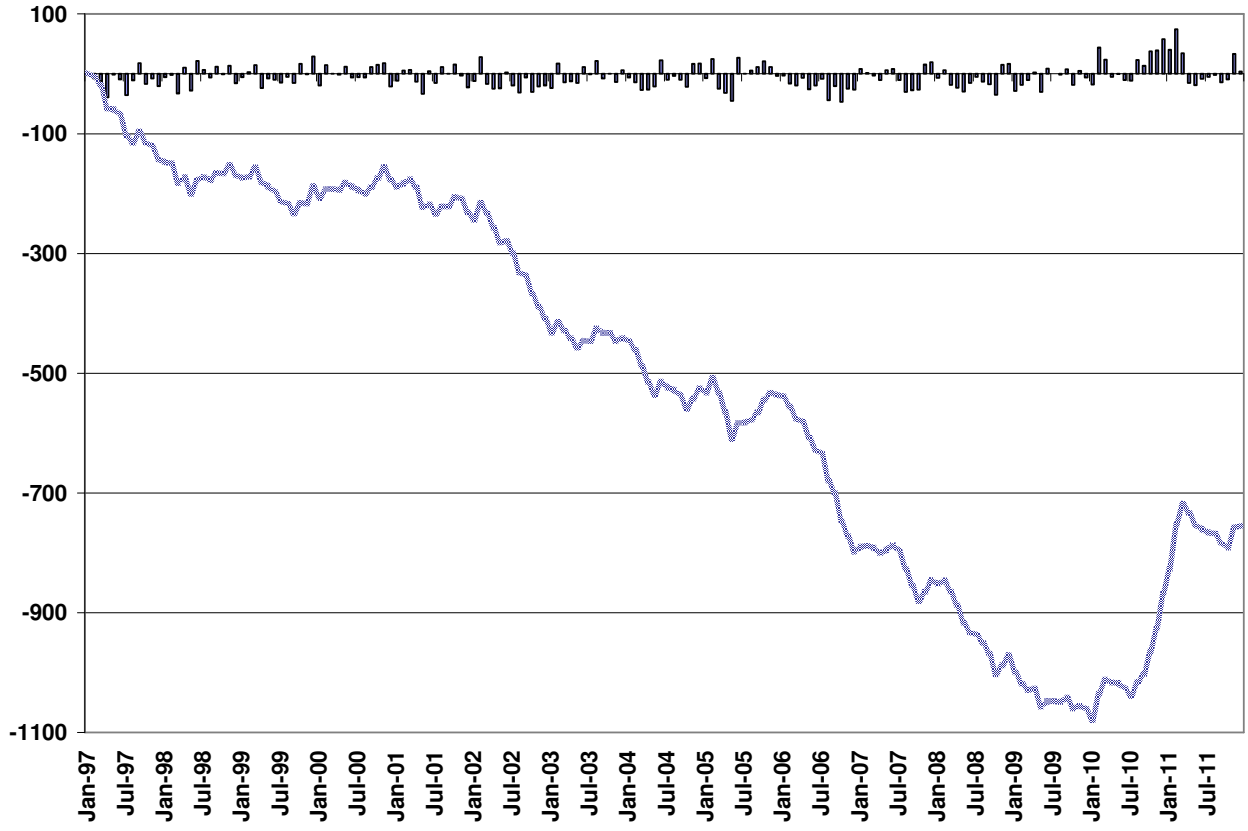

Figure 5: Cumulative rainfall anomalies for southeastern Australia starting from January 1997 to December 2011 in mm. Individual monthly anomalies are shown in the columns.

Station number	Name	Rainfall (mm)	Average (mm)	Years of record
2009	GIBB RIVER	3145	1537.01	73
2032	WARMUN	2709	1448.96	98
3027	FOSSIL DOWNS	1757.8	1067.12	93
11003	EUCLA	855.7	562.19	81
14621	NUTWOOD DOWNS	2709.7	1462	69
14815	WATERLOO	2402	1320.91	84
15594	ARLTUNGA	1591.9	616.49	54
24517	MANNUM	935.2	591.47	109
25006	KAROONDA	1031.2	683.22	93
25017	SANDALWOOD	946	651.04	92
29039	MORNINGTON ISLAND	4362.8	2466.11	77
31053	RAVENSHOE	3573.2	2454.66	69
32043	UPPER STONE EXELBY	5346.4	3192.9	66
32091	ELPHINSTONE POCKET NO1	5697.6	3663.16	55
33059	PLANE CREEK SUGAR MILL	5895.3	3459.19	98
33119	MACKAY M.O	4868	3178.08	51
35007	BAUHINIA DOWNS STORE	2241.6	1344.21	99
35021	COMET	1885	1153.73	106
35049	GILLESPIE	1933.7	1028.04	107
35063	SOMERBY	2186.4	1251.66	78
35069	TAMBO	1914	1051	111
35070	TAROOM	2185.9	1329.82	111
35081	WOLEEBEE NEVASA	2076.8	1225.43	89
35090	REWAN STATION	2740.5	1610.61	52
38000	BEDOURIE	1326.9	395.72	53
39000	ABERCORN	2232	1359.14	60
39004	BARALABA	2145.2	1430.28	84
39073	MUNDUBBERA	2324.2	1402.28	99
39204	COLODAN	2041.4	1230.14	51
40071	LANARK	2004	1327.38	67
40082	UNIVERSITY OF QUEENSLAND GATTON	2176	1547.58	111
40120	LOWOOD DON ST	2480.4	1578.24	101
40135	MOOGERAH DAM	2688.3	1898.62	82
40158	NANANGO	2388.8	1547.32	111
40198	TAROME	2656.8	1910.7	93
40247	LINDFIELD	3294.4	2152.35	88
40428	BRIAN PASTURES	2192.2	1407.78	55
41050	JANDOWAE	2087.4	1337.2	107
41069	MILLMERRAN	1908.5	1327.29	108
41082	PITTSWORTH	2222	1385.88	111
41083	PRATTEN	1918.1	1348.67	104
41306	TOSARI	1987	1257.41	52
41404	ELLANGOWAN	2027	1398.76	58
42009	DRILLHAM	1888.9	1214.33	71

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42010	DULACCA TRUCK STOP	1867.9	1200.11	103
42022	MEANDARRA	1918.2	1166.31	64
43038	WALLUMBILLA	1980.3	1174.42	101
43052	WARKON	1684	1090.68	95
43060	HAVELOCK	1886.4	1106.37	55
44025	COWLEY STATION	1396	751.71	103
44038	GLENORIE	1751.9	970.27	79
44045	KENILWORTH	1647.6	912.51	79
44137	ROSEHILL	1534.1	977.71	54
47040	WENTWORTH (WAMBERRA STATION)	1076.8	505.84	63
47045	WENTWORTH (WILLOW POINT)	1024	518.89	77
49063	IVANHOE (KILFERA)	1077.5	542.43	62
55136	WOOLBROOK (DANGLEMAH ROAD)	1975.6	1557.68	52
56023	OLD KOREELAH (MCPHERSON)	2470.4	1745.78	98
72150	WAGGA WAGGA	1737.6	1146.16	69
74053	HENTY	2097.5	1185.64	110
75032	HILLSTON AIRPORT	1296.6	730.23	111
75042	MAUDE	1333.6	640.63	108
76031	MILDURA	1249.4	579.07	64
79075	RUPANYUP	1281.4	845.55	100
80002	BOORT	1424	798.16	92
81085	DUNOLLY	1563	979.01	107
86117	TOOROURRONG	2117.4	1601.51	111
88051	REDESDALE	1825.4	1183.18	84
88067	YEA	1904.8	1263.66	107
89005	BEAUFORT	1936	1372.64	100
92011	GLADSTONE	2292.8	1693.23	70

Table 1. Selected two-year highest total rainfall records which have occurred from January 2010 to December 2011 at locations with 50 or more years of data.

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