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THE OFFICIAL PUBLICATION OF THE AUSTRALIAN
METEOROLOGICAL ASSOCIATION INC
October 2019

OUR CLIMATE: TRENDS AND DRIVERS

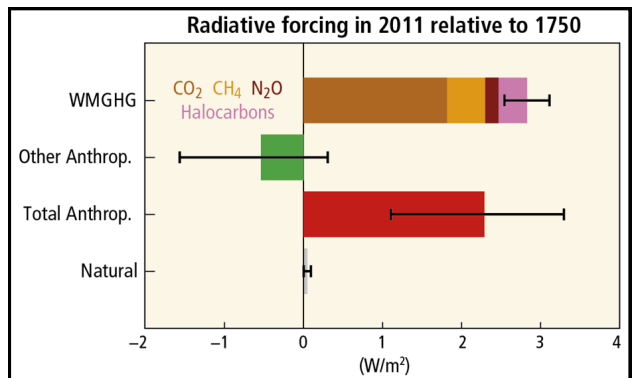
Our August meeting was a National Science Week Event in conjunction with AMOS on the topic of **Our Climate: Trends and Drivers**. It was chaired by John Nairn, State Manager for the Bureau of Meteorology, and speakers included Beth Walton, AMETA president, Darren Ray, Senior Climatologist at Bureau of Meteorology and AMETA Secretary, and Jochen Kaempf, Associate Professor of Oceanography at Flinders University. More than 50 people attended the event and had plenty of questions to ask.

There were 6 major points that the speakers wanted to get across:

- Climate is a complex system with many drivers - global warming will not be uniform over space or time.
- Most climate drivers are cyclical, contributing to natural climate variability on many time scales.
- Increasing concentrations of atmospheric greenhouse gases since the early 1800's is the major contributor to recent global warming (much larger than solar forcing). Unlike cyclical variations, this enhanced greenhouse warming is an ongoing persistent long term trend.
- The oceans and Antarctica are integral parts of our climate system.
- The IPCC assessments and reports are the best sources to confirm validity of media (and other) statements.
- We can all make a difference! Career possibilities abound!

Darren commenced by describing the primary natural drivers.

The graphic on the right compares anthropogenic radiative forcing (i.e. global warming caused by human activities) with solar forcing and is sourced from CSIRO and BOM, 2015, Technical Report: **Climate Change in Australia**. (* WMGHG denotes Well Mixed Green House Gases).



Jochen Kaempf provided a broader geophysical explanation of some of the recent climate change conundrums, including the extreme heatwaves in Europe, the global warming 'hiatus' in the first decade of the 21st century and why numerical models

can provide useful climate change projections even though the *skill* of numerical weather models to forecast beyond 7 days is not great.

Beth provided a quick glimpse into the role and purview of the Intergovernmental Panel on Climate Change – as reported below.

Climate Science Communication The Intergovernmental Panel on Climate Change

Discussions like those that we had at our ScienceWeek 2019 event ***Our Climate: Trends and Drivers*** make me realise people who are less familiar with the science must often wonder ‘What faith should I put in ***this*** or ***that*** claim that I have recently heard about global warming? Does the science support it - or - is it just another ‘theory’, another misconstrued ‘media grab’? Or, how can ***this*** be consistent with ***that*** when they seem to be opposed?

This is a dilemma that decision makers all around the globe have had – ever since clear evidence emerged that atmospheric concentrations of carbon dioxide were increasing, AND that the ***persistent upward trend*** of these concentrations could be related to ***increasing emissions*** from ***increasing fossil fuel use***.

Scientists had long known that atmospheric carbon dioxide (CO₂) absorbs and re-emits infra-red energy radiated by the Earth. In other words CO₂ acts like water vapour - as a greenhouse gas - trapping heat and warming our atmosphere. However, when increasing carbon dioxide concentrations were first detected - back in the late 1960’s /early 1970’s there was ***no observable global warming signal***. (Increasing atmospheric CO₂ concentrations were being observed at an atmospheric monitoring station set up during the International Geophysical Year (IGY) in Mauna Loa, Hawaii in 1958. The IGY was the first global collaborative experiment among geophysical scientists. In 1978 Australia set up a southern hemisphere atmospheric monitoring station at Cape Grim on the pristine northwest corner of Tasmania.)

SO, why - in those early years - should responsible governments and other world leaders listen to the outcry from a few scientists claiming ‘global warming was about to occur’? If it was to happen what would be the consequences? Would they be serious?

More important to governments, energy related companies and other industry leaders - if they decided to reduce emissions - what cost to their economy or their bottom line? It could be enormous! Could it be justified with no immediate evidence that our world was warming? Even if warming was to occur, was that necessarily a problem?

Most global economies, even now, rely on cheap fossil fuel energy. What other options were there to generate electricity? And at what cost? (Australia not only generated around ~90% of its energy from fossil fuel in the 1980’s – it was (and is) also the largest exporter of coal in the world AND coal still vies with iron ore as our top export earner)

Decision makers need to be sure they are spending their dollars wisely. Where could ***unbiased, up-to-date and authoritative scientific information*** about the state of the climate and likely impacts be accessed?

Recognising this was a problem that was not going to go away, in 1988 the World Meteorological Organization and the United Nations Environment Programme established a new United Nations body:

The Intergovernmental Panel on Climate Change.

Its purpose is to make available non-prescriptive, policy-relevant information to

governments and other decision makers about the latest understanding of climate change. This is done through three Working Groups (WG):

- Working Group I: provides assessments of the latest information about the **physical science of climate change**
- Working Group II: assesses the **Impacts, Adaptation Options and Vulnerability** of humans and the environment to changes in climate identified by WG I
- Working Group III: provides information on **Climate Change Mitigation** – both reducing emissions and removing greenhouse gases from the atmosphere.

195 countries are members of the IPCC. It does not undertake its own research but relies on relevant peer-reviewed research from universities and other research centres around the world to produce its regular assessments, special reports and technical reports. These reports are used as primary documents to inform negotiations, such as the Paris Agreement in 2015, under the United Nations Framework Convention on Climate Change (FCCC). (It should be noted the FCCC and IPCC have different definitions of climate change. The FCCC considers climate change in relation to anthropogenic influences (resulting from or produced by human activities) – primarily changes in atmospheric greenhouse gases. The IPCC assesses scientific understanding of both natural and anthropogenic climate change. This is important so that observed changes can be attributed to either natural or anthropogenic causes.)

The assessments and reports undergo rigorous review with over 1000 scientists involved in the larger reports ensuring a comprehensive and reliable resource (Table 1, see below) for researchers, policymakers and other decision makers around the world tussling with the challenge of climate change.

Table 1 contains excerpts from successive IPCC assessments describing the likelihood of current anthropogenic global warming. These are very considered statements, with confidence levels or probabilities included. Other statements in the reports describe the rate and magnitude of future warming.

In 2013-14, IPCC produced its latest comprehensive assessments - the **5th Assessment Reports (AR5)** from its 3 working groups and an accompanying Synthesis Report. The most recent Special Reports include

- **Global Warming of 1.5°C.** (October 2018)
- **Climate Change and Land.** (July 2019)
- **The Oceans and Cryosphere in a Changing Climate** (September 2019)

Technical Reports such as **Guidelines for National Greenhouse Gas Inventories** are also made available through the IPCC process.

The **IPCC 6th Assessment Reports and Synthesis Report (AR6)** will be released during 2021 and 2022 to feed into the next FCCC negotiations. 720 Experts from 90 Countries are currently assessing the most recent developments in the understanding of climate science, the impacts, adaptation and vulnerability to projected future changes in climate and the mitigation options available to reduce global warming and its impacts.

Australians have always made a significant contribution to these reports – especially those of WG 1 and WG 11. More than 20 Australians are involved in the AR6 Assessments and many more experts will submit review comments on the reports before they are finalised.

If you want more information on the latest global understanding of climate change – or you are an expert in a relevant field and would like to become involved in the IPCC process - check out: www.ipcc.ch

Beth Walton Climatologist

TABLE 1.

Report	Assessment of Human induced climate change
1 st – TAR 1990	<i>‘the unequivocal detection of an enhanced greenhouse effect from observations is not likely for a decade or more’</i>
2 nd – SAR 1995	<i>‘The balance of evidence suggests a discernible human influence on global climate’</i>
3 rd – TAR 2001	<i>‘ There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities’</i>
4 th – AR4 2007	<i>‘Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. Most of the observed increase in global average temperatures since the mid 20th century is very likely [90% probability] due to the observed increase in anthropogenic GHG concentrations’</i>
5 th – AR5 2014 (most recent)	<i>‘Anthropogenic GHG emissions have increased since the pre-industrial era This has led to atmospheric concentrations of CO₂, CH₄ and N₂O that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely [95% probability] to have been the dominant cause of the observed warming since the mid-20th century.’</i>

Greater Adelaide in August 2019: cool with near-average rainfall

Rainfall totals in August were near-average to below average for Adelaide and the Hills. Both daytime and night-time temperatures were cooler than average, with cold fronts crossing the city on a regular basis during the month.

Average to below average rainfall

- Rainfall totals in August were average to below average across the region.
- The city had three fewer raindays than average for August
- On the 8th, storms brought severe winds and localised flooding to the Adelaide Hills, with downed power lines causing blackouts and the State Emergency Service responding to more than 340 calls for help, mainly relating to flooding and

downed trees

- McLaren Vale (Pirramimma Winery) had its highest August daily rainfall on record on the 8th and the highest daily rainfall total for the month was 58.0 mm at Piccadilly (Woodhouse) on the 9th
- On the 18th, a cold front brought hail to Adelaide and light snow falls to the Mount Lofty Ranges
- Rainfall totals for the month ranged from 63% of average at Adelaide Airport to 105% of average at Rosedale

Cooler than average days and nights

- Daytime temperatures for August were cooler than average throughout.
- Averaged across the Greater Adelaide region, the mean maximum temperature for the month was 14.2 °C, the lowest for the region in August since 2015.
- The warmest day of the month was on the 31st, with most sites on the Plains exceeding 20 °C in warm northerly winds ahead of a cold front
- Mean maximum temperatures ranged from 1.2 °C below average at Kuitpo Forest Reserve to 0.2 °C below average at Mount Lofty
- Night-time temperatures were near-average or cooler than average throughout.
- The Greater Adelaide region had its lowest mean minimum temperature for August since 2014
- Mean minimum temperatures ranged from 1.7 °C below average at Rosedale to equalling the long-term average at Mount Barker.

Adelaide (West Terrace / ngayirdapira)

- Total rainfall was 42.0 mm, which is 68% of the long-term average of 61.6 mm.
- The mean daily maximum temperature was 15.4 °C, which is 0.7 °C below the long-term average of 16.1 °C. The warmest day was 22.1 °C on the 31st, and the coolest day was on the 12th when the temperature reached 12.1 °C.
- The mean daily minimum temperature was 7.7 °C, which is 0.3 °C below the long-term average of 8.0 °C. The coldest morning was 2.5 °C on the 13th, and the warmest morning was on the 16th when the minimum temperature was 12.6 °C.

Extremes in August 2019

Hottest day	22.6 °C at Adelaide (Kent Town) on the 31st
Warmest days on average	15.9 °C at Parafield Airport
Coollest days on average	9.8 °C at Mount Lofty
Coldest day	4.9 °C at Mount Lofty on the 18th
Coldest night -	1.0 °C at Rosedale on the 12th and 29th
Coollest nights on average	3.9 °C at Rosedale (Turretfield Research Centre)
Warmest nights on average	8.2 °C at Noarlunga
Warmest night	13.1 °C at Adelaide Airport on the 16th
Warmest on average overall	11.6 °C at Adelaide (West Terrace / ngayirdapira)
Coollest on average overall	7.1 °C at Mount Lofty
Wettest overall	126.8 mm at Ashton
Driest overall	30.4 mm at Regency Park
Wettest day	58.0 mm at Piccadilly (Woodhouse) on the 9th
Strongest wind gust	117 km/h at Mount Crawford AWS on the 8 th

For more information plus a summary of August's statistics please see:

<http://www.bom.gov.au/climate/current/month/sa/archive/201908.adelaide.shtml>

Adelaide (West Terrace / Ngayirdapira), South Australia August 2019 Daily Weather Observations

The official site for Adelaide, having reopened in May 2017.



Date	Day	Temps		Rain	Evap	Sun	Max wind gust			8am					3pm							
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP	
		°C	°C	mm	mm	hours	km/h	km/h	local	°C	%	eighths	Dirn	km/h	hPa	°C	%	eighths	Dirn	km/h	hPa	
1	Th	9.4	14.5	0			SSW	22	12:18	11.3	71		SSW	9	1035.4	12.3	84		SW	11	1034.4	
2	Fr	5.7	13.9	0.2			SW	20	17:11	11.4	85		SW	2	1036.3	12.7	78		WSW	6	1034.2	
3	Sa	8.0	13.9	0			W	17	13:27	11.2	79		NNE	4	1035.7	12.9	71		WSW	11	1032.9	
4	Su	7.1	16.1	0			NNW	26	11:07	8.9	79		NNW	7	1031.3	15.5	47		N	15	1026.5	
5	Mo	8.7	19.7	0			NNE	28	10:19	12.0	48		NE	13	1024.3	18.9	31		NNW	19	1020.6	
6	Tu	11.5	19.3	0			NW	48	13:11	13.6	38		N	17	1016.4	17.6	35		NW	19	1012.4	
7	We	6.7	14.1	1.4			SW	33	16:16	10.6	93		E	6	1011.0	12.2	93		SW	11	1005.4	
8	Th	8.8	12.7	9.0			WNW	76	14:54	10.6	76		NW	19	1007.7	11.5	91		W	28	1001.6	
9	Fr	7.9	12.6	10.8			WSW	72	00:14	10.5	55		SW	22	1011.3	10.0	77		W	26	1010.3	
10	Sa	5.8	12.7	3.2			SW	48	23:57	9.0	82		S	7	1018.0	11.9	63		WSW	26	1017.5	
11	Su	9.0	13.1	3.6			SW	48	00:10	10.4	77		S	20	1018.8	10.7	67		S	17	1020.9	
12	Mo	3.9	12.1	0.2			SW	22	12:09	7.6	88		NNW	4	1023.1	11.1	72		WSW	11	1027.2	
13	Tu	2.5	14.2	0.2			N	19	12:27	8.7	74		NNE	6	1030.2	13.1	56		NNW	6	1026.7	
14	We	7.3	17.2	0			NW	41	13:53	11.4	51		NNE	13	1025.6	16.6	39		NNW	20	1021.6	
15	Th	11.4	20.2	0			NNE	41	13:26	14.8	35		NE	15	1021.1	19.3	31		N	20	1015.7	
16	Fr	12.6	15.4	0			SW	37	11:57	13.3	86		WNW	13	1017.5	13.2	82		SSW	15	1019.3	
17	Sa	6.8	18.6	0			N	35	09:41	11.5	64		NE	15	1018.9	17.9	56		NNE	17	1012.5	
18	Su	10.1	12.3	2.0			W	69	10:07	11.2	68		W	20	1011.2	7.8	82		W	20	1013.6	
19	Mo	7.1	13.5	10.4			SW	37	00:28	10.5	64		SW	17	1027.2	12.1	62		SW	17	1029.1	
20	Tu	9.6	14.6	0.4			W	33	11:10	12.6	85		WNW	15	1032.1	13.9	76		WNW	19	1030.6	
21	We	11.6	15.9	0.4			SW	39	22:41	13.0	91		WSW	13	1029.9	15.3	80		SW	17	1028.2	
22	Th	10.8	14.2	0			SW	28	03:14	13.1	78		WSW	13	1029.7	13.3	67		SW	13	1028.5	
23	Fr	7.1	18.7	0			NNW	39	13:05	11.9	64		NNE	17	1025.2	18.0	46		NW	22	1020.1	
24	Sa	11.7	16.1	0			N	35	01:42	13.0	56		N	13	1016.8	13.5	70		SW	20	1017.6	
25	Su	4.2	13.7	0			WSW	28	11:57	10.0	70		SSE	6	1026.1	13.3	59		WSW	13	1024.8	
26	Mo	3.3	14.0	0			W	26	12:33	9.3	72		NNW	6	1029.2	13.3	57		SW	11	1026.5	
27	Tu	4.6	15.5	0			SW	20	15:01	10.8	73		NNW	7	1029.1	14.5	56		WSW	13	1026.1	
28	We	7.4	14.6	0			WNW	37	11:06	9.9	90		NNE	9	1026.7	13.9	78		SW	19	1024.3	
29	Th	2.6	15.3	0.2			ENE	22	09:54	9.5	59		WNW	6	1032.0	14.4	43		WSW	7	1028.2	
30	Fr	4.5	18.1	0			NNE	31	13:57	11.5	53		NNE	13	1026.7	17.7	35		NNE	17	1021.4	
31	Sa	11.4	22.1	0			N	48	10:57	16.0	36		N	17	1020.9	20.8	30		NW	20	1015.1	
Statistics for August 2019		Mean	7.7	15.4						11.3	69				11	1024.2	14.2	61			16	1021.7
		Lowest	2.5	12.1						7.6	35		SW	2	1007.7	7.8	30		#	6	1001.6	
		Highest	12.6	22.1	10.8		WNW	76		16.0	93		SW	22	1036.3	20.8	93		W	28	1034.4	
		Total			42.0																	

Observations were drawn from Adelaide (West Terrace / Ngayirdapira) (station 023000)

This is now the "official" site for Adelaide, having reopened in May 2017. Observations are also available from the Kent Town site (station number 023090).

ICDCJDW5081.201908 Prepared at 13:02 UTC on 21 Sep 2019

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South Australia in August 2019: driest August for more than a decade

Rainfall in August was below average across most of South Australia, making it the driest August since 2007 for the State. Daytime temperatures were generally close to average in most areas of South Australia, while night-time temperatures were cooler than average in the east. Overall, it was South Australia's coolest August since 2010.

Driest August since 2007

- Rainfall in August was 66% below average for South Australia as a whole, the State's driest August since 2007
- Rainfall for the month was below average across most of South Australia
- Only small areas in the far west and parts of the Murraylands and Upper South East districts recorded near-average rainfall for the month
- Totals were less than 60% of average for August across most of the State
- Little or no rain fell in the northern Pastoral districts
- The State's wettest days were the 8th and 9th during the passage of several cold fronts across the south, with more than 40 mm recorded at multiple sites in the Mount Lofty Ranges
- The storms on the 8th brought severe winds and localised flooding to the Adelaide Hills, with power blackouts affecting thousands of properties across SA.
- The highest rainfall totals for the month were in the Adelaide Hills, with 126.8 mm at Ashton the wettest location
- On the 8th, McLaren Vale had its highest August daily rainfall on record

Coolest August since 2010

- Daytime temperatures were generally close to average for August, but nights were cooler than average in the east, resulting in South Australia's overall coolest August for mean temperature since 2010
- Daytime temperatures were cooler than average in the South East and areas of the Northeast Pastoral district, but close to or warmer than average elsewhere
- The mean maximum temperature for South Australia was 0.37 °C above average, but it was the lowest for August since 2010 due to eight consecutive years of much warmer than average Augusts
- Mean minimum temperatures were below average across most of eastern South Australia, including large areas of very much below average minima in some central Agricultural districts and the Northeast Pastoral district
- The mean minimum temperature for South Australia was 1.08 °C below average, the lowest for August since 2014
- On the 7th, Kingscote Aero equalled its coldest August day on record of 10.8 °C, although the old Kingscote site recorded a maximum temperature of just 9.5 °C on 11 August 1960
- Padthaway South had its lowest August temperature on record, -2.1°C, on the 29th, although the old Padthaway site recorded a low of -3.7 °C on 3 August 1997
- Marree Aero had its lowest August mean daily minimum temperature on record and Streaky Bay and Andamooka had their lowest August mean daily minimum temperature for at least 20 years

Extremes in August 2019

Hottest day	30.7 °C at Oodnadatta Airport on the 17th
Warmest days on average	22.1 °C at Oodnadatta Airport

Coollest days on average	9.8 °C at Mount Lofty
Coldest day	4.9 °C at Mount Lofty on the 18th
Coldest night	-4.7 °C at Gluepot Reserve (Gluepot) on the 30th
Coollest nights on average	1.5 °C at Yongala
Warmest nights on average	10.8 °C at Neptune Island
Warmest night	13.5 °C at Neptune Island on the 6th
	13.5 °C at Ceduna AMO on the 24th
Warmest on average overall	14.1 °C at Oodnadatta Airport
Coollest on average overall	7.1 °C at Mount Lofty
Wettest overall	126.8 mm at Ashton
Driest overall	0 mm at several locations
Wettest day	58.0 mm at Piccadilly (Woodhouse) on the 9th
Strongest wind gust	122 km/h at Neptune Island on the 8 th

Some notable statistics for August were:

Record highest August daily rainfall

	New record (mm)	Old record	Years Held
McLaren Vale	31.0 on the 8th	28.8 on the 3rd in 2018	26

Record lowest August daily maximum temperature

	New (°C)	Old	Years Held	Average
Kingscote	10.8 on the 7th	= 10.8 on the 10th in 2003	26	16.0

Record lowest August temperature

	New (°C)	Old	Years Held	Average
Padthaway Sth	-2.1 on the 29th	-2.0 on the 19th in 2003	20	5.9

Record lowest August mean daily minimum temperature

	New record (°C)	Old record	Years Held	August Average
Marree	3.7	4.9 in 2012	21	6.6

Lowest August mean daily minimum temperature for at least 20 years

	Observed (°C)	Most recent lower	August Average
Streaky Bay	7.1	6.9 in 1967*	8.8
Andamooka	5.8	5.5 in 1994	7.3

* note: there are gaps in the historical record at this site, so it is possible a lower value has gone unreported

Many other records were also set in August. For more information plus a summary of statistics please see:

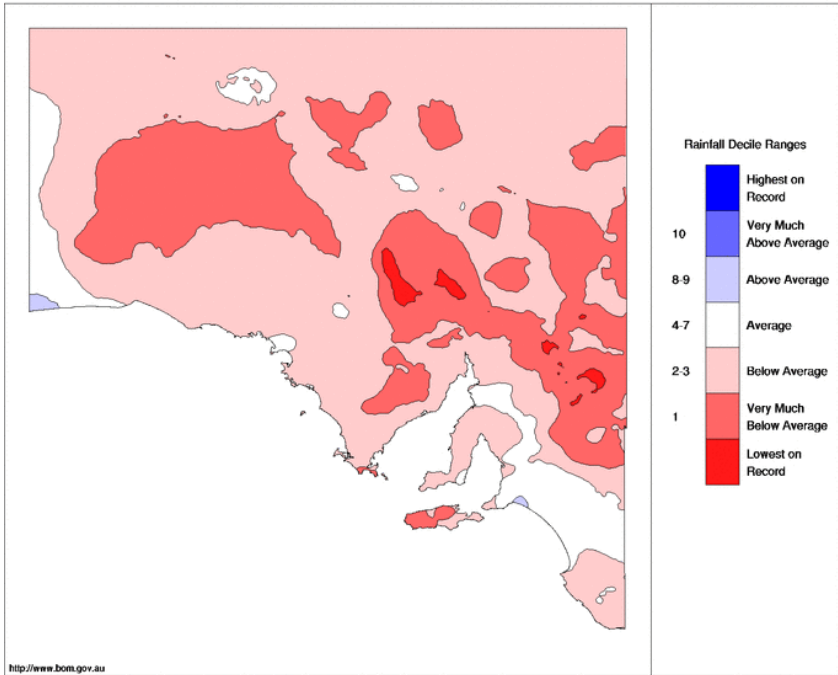
<http://www.bom.gov.au/climate/current/month/sa/archive/201908.summary.shtml>

All the detail you could possibly want and more is available on the BoM website.

Visit <http://www.bom.gov.au/climate> and wander through the various archived climate reports and summaries which are available in text and graphical forms.

South Australian Rainfall Deciles August 2019

Distribution Based on Gridded Data
Australian Bureau of Meteorology

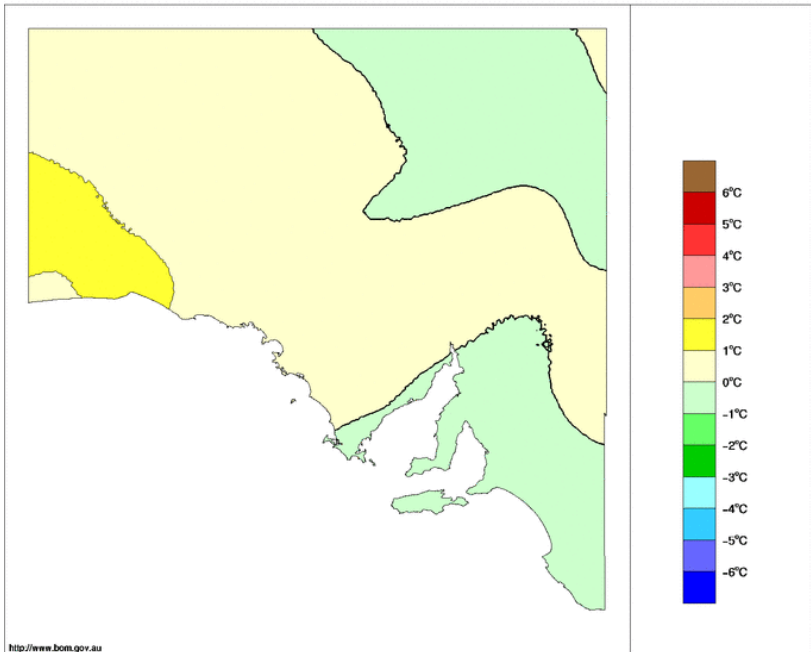


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Issued: 27/09/2019

Maximum Temperature Anomaly (°C) August 2019

Australian Bureau of Meteorology



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Issued: 21/09/2019

Greater Adelaide in winter 2019: rainfall and temperatures close to average

Rainfall in winter was close to average or below average at sites around Adelaide and the Hills. Both daytime and night-time temperatures for winter were generally close to average after a warmer than average July but cooler than average August.

Rainfall average to below average

- Winter rainfall was close to average across Adelaide and the Hills
- June was wetter than average, July was drier than average, August had near-average rainfall
- Multiple cold fronts during winter brought severe winds, rain, and hail at times, plus snow falls to the Mount Lofty Ranges
- Rainfall totals for winter ranged from 77% of average at Kent Town to 94% of average at Mount Barker and Mount Crawford
- Year-to-date rainfall (January to August) was below average
- On 12 June, Belair had its highest winter daily rainfall on record

Near-average temperatures

- Daytime temperatures for winter were generally close to average, but above average in the Hills
- Temperatures across the city were warmer than average in July, but cooler than average in August
- For the Greater Adelaide region, it was the overall coolest winter since 2015
- Mean maximum temperatures ranged from 0.2 °C cooler than average at Mount Crawford to 0.8 °C warmer than average at Mount Lofty
- Night-time temperatures for winter were generally near or warmer than average.
- Mean minimum temperatures ranged from 0.7 °C cooler than average at Rosedale to 1.1 °C warmer than average at Mount Barker
- The first eight months of the year have been warmer than average for both daytime and night-time temperatures

Adelaide (West Terrace / ngayirdapira)

- Total rainfall was 165.2 mm, which is 83% of the long-term average of 199.0 mm
- The mean daily maximum temperature was 15.9 °C, which is 0.3 °C above the long-term average of 15.6 °C. The warmest day was 22.2 °C on 11 Jun, and the coolest day was on 24 Jun when the temperature reached 11.7 °C
- The mean daily minimum temperature was 8.4 °C, which is 0.4 °C above the long-term average of 8.0 °C. The coldest morning was 1.8 °C on 23 Jun, and the warmest morning was on 28 Jun when the minimum temperature was 16.0 °C

Extremes in winter 2019

Hottest day	22.6 °C at Adelaide (Kent Town) on 31 Aug
Warmest days on average	16.2 °C at Parafield Airport
Coollest days on average	10.1 °C at Mount Lofty
Coldest day	4.9 °C at Mount Lofty on 18 Aug
Coldest night	-1.8 °C at Parafield Airport on 24 Jun
Coollest nights on average	5.1 °C at Rosedale (Turretfield Research Centre)
Warmest nights on average	8.9 °C at Noarlunga
Warmest night	16.1 °C at Adelaide (Kent Town) on 28 Jun

Warmest on average overall	12.1 °C at Adelaide (West Terrace / ngayirdapira)
	12.1 °C at Noarlunga
Coolest on average overall	7.7 °C at Mount Lofty
Wettest overall	399.6 mm at Aldgate
Driest overall	117.8 mm at Gawler
Wettest day	67.4 mm at Piccadilly on 12 Jun
Strongest wind gust	117 km/h at Mount Crawford AWS on 8 Aug

Some notable statistics for Winter were:

Record highest winter daily rainfall

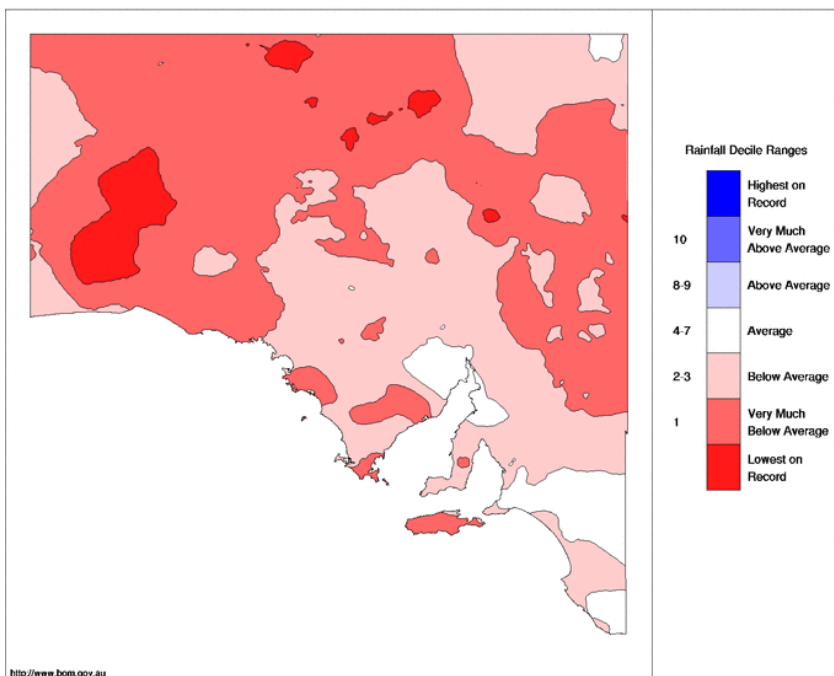
	New record (mm)	Old record	Years Held
Belair	51.0 on 12 Jun	50.8 on 5 Jul 2016	21

For more information plus a summary of Winter's statistics please see:

<http://www.bom.gov.au/climate/current/season/sa/archive/201908.adelaide.shtml>

South Australian Rainfall Deciles 1 June to 31 August 2019

Distribution Based on Gridded Data
Australian Bureau of Meteorology



South Australia in winter 2019: driest winter for more than a decade

Rainfall in winter was below to very much below average across most of the State, making it South Australia's tenth-driest winter on record and driest since 2007. Daytime temperatures were warmer than average for the northern two thirds of the State, but nights were cooler than average in many central and northern areas.

Driest winter since 2007

- Rainfall in winter was 56% below average, making it South Australia's tenth-driest winter on record and driest since 2007
- Rainfall was very much below average across large areas of the State
- All winter months of June, July, and August were drier than average
- Winter rainfall was near-average in some central and southeastern Agricultural districts
- The very dry winter has significantly expanded the areas experiencing serious and severe rainfall deficiency from the first five months of the year and they now cover most of the State except the far northeast and the southeast for the January to August period
- A very dry first eight months of the year, with rainfall very much below average in most areas
- Second-driest year-to-date (January to August) on record; the driest since 1929
- On 12 June, numerous sites had their highest winter daily rainfall on record
- Several sites had either their lowest total winter rainfall on record or their lowest total winter rainfall for at least 20 years

Warm days and cool nights across the north

- Daytime temperatures for winter were warmer than average across the northern two thirds of South Australia
- The mean maximum temperature for South Australia as a whole was 1.06 °C above average
- Night-time temperatures were cooler than average in the Northeast and some areas of the central and western districts, but average to warmer than average in the South East Agricultural districts
- The mean minimum temperature for South Australia as a whole was 0.45 °C below average, the lowest for winter since 2012
- A very warm first eight months of the year, with most of the State very much warmer than average
- South Australia's mean temperature for January to August was 1.14 °C above average; the fourth-highest on record
- Several sites had their lowest winter temperature on record
- On 29 June, Coonawarra had its warmest winter night on record

Extremes in winter 2019

Hottest day	31.6 °C at Oodnadatta Airport on 11 Jun
Warmest days on average	21.4 °C at Oodnadatta Airport
Coollest days on average	10.1 °C at Mount Lofty
Coldest day	4.9 °C at Mount Lofty on 18 Aug
Coldest night	-7.1 °C at Yunta Airstrip on 24 Jun
Coollest nights on average	2.9 °C at Yongala

Warmest nights on average	11.7 °C at Neptune Island
Warmest night	16.1 °C at Adelaide (Kent Town) on 28 Jun
Warmest on average overall	13.6 °C at Moomba Airport
Coollest on average overall	7.7 °C at Mount Lofty
Wettest overall	399.6 mm at Aldgate
Driest overall	0 mm at Moomba Airport
Wettest day	67.4 mm at Piccadilly on 12 Jun
Strongest wind gust	122 km/h at Neptune Island on 8 Aug

Some notable statistics for Winter were:

Record highest winter daily minimum temperature

	New record (°C)	Old record	Years Held	Winter Average
Coonawarra	14.7 on 29 Jun	14.5 on 4 Jun 1988	34	5.3

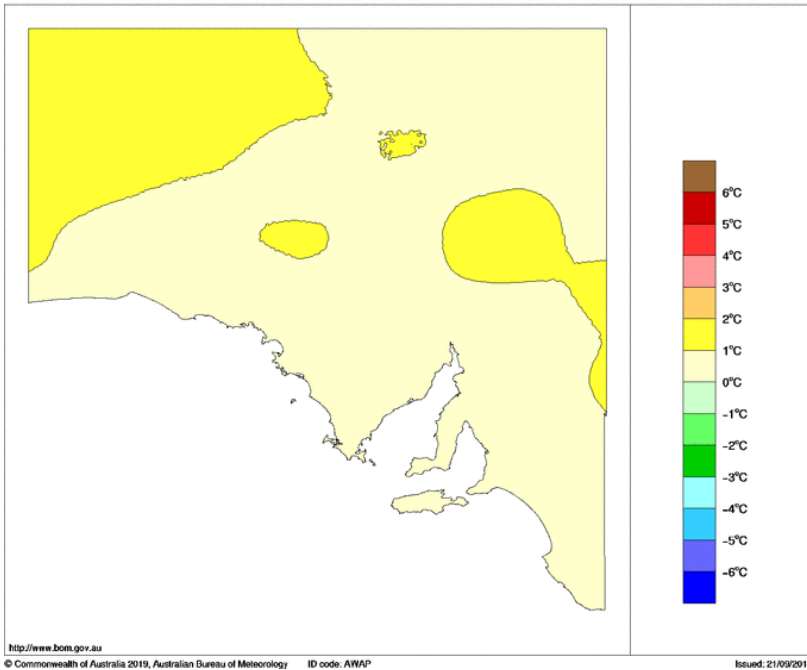
Record lowest winter temperature				
	New record (°C)	Old record	Duration	Average
Coonawarra	-3.8 on 22 Jun	-3.6 on 3 Aug 1997	34	5.3
Edithburgh	-0.5 on 24 Jun	0.0 on 20 Jul 2015	29	7.9
Stenhouse Bay	2.5 on 24 Jun	2.9 on 1 Aug 2012	24	9.5
Gluepot	-6.7 on 24 Jun	-6.5 on 7 Jul 2012	21	4.0
Padthaway South	-4.0 on 23 Jun	-3.2 on 16 Jun 2007	20	5.6

Record highest winter daily rainfall			
	New record (mm)	Old record	Years Held
Brinkworth	46.0 on 12 Jun	45.4 on 1 Jul 1986	121
Mundoora	56.0 on 12 Jun	45.8 on 6 Jun 1994	56
Balaklava	47.4 on 12 Jun	37.6 on 6 Jun 1994	51
Nurom	41.6 on 12 Jun	38.4 on 6 Jun 1994	51
Port Germein	60.0 on 12 Jun	29.2 on 22 Jun 2012	24
Snowtown	41.6 on 12 Jun	37.0 on 23 Jun 2013	22
Clare	44.6 on 12 Jun	37.6 on 5 Jul 2016	26
Belair	51.0 on 12 Jun	50.8 on 5 Jul 2016	21

Record lowest winter total rainfall				
	New record (mm)	Old record	Years Held	Winter Average
Mount Ive	28.0	29.0 in 1885	46	73.7
Morgan	39.8	40.8 in 1997	25	69.1
Marree	0.8	1.4 in 2007	21	22.1

Many other records were also set in Winter. For more information plus a summary of statistics please see:

<http://www.bom.gov.au/climate/current/season/sa/archive/201908.summary.shtml>



Greater Adelaide in September 2019: warm days, cool nights

Rainfall in September was close to average or below average across Adelaide and the Hills. Daytime temperatures were warmer than average, but night-time temperatures were generally cooler than average.

A little drier than average

- Rainfall was near average to below average for September in Adelaide & Hills
- Rainfall totals ranged from 58% of average at Mount Lofty to 90% of average at Kuitpo Forest Reserve
- The wettest day was on the 21st, with some sites in the Hills southeast of the city having more than 20 mm
- Adelaide (West Terrace / ngayirdapira) had 12 rain days for the month, one fewer than the September average
- On the morning of the 3rd, thick fog delayed plane flights at Adelaide Airport

Warm days, cool nights

- There were several very warm days during September, with maximum temperatures above 25 °C at most sites on the 14th, 15th, and 19th
- On the 19th, maximum temperatures were more than 10 °C above average across most of Greater Adelaide
- The warm weather on the 19th was accompanied by strong northerly winds ahead of an approaching cold front, raising the fire weather risk around Adelaide and other

areas of South Australia

- Mean maximum temperatures ranged from 0.1 °C above average at Noarlunga and Kuitpo Forest Reserve to 2.0 °C above average at Mount Lofty
- There were a number of cold nights during the month, with temperatures dropping below zero at Parafield Airport and Rosedale on the 17th
- On the 17th, Noarlunga and Parafield Airport had their lowest September temperature on record
- Mean minimum temperatures ranged from 1.6 °C below average at Parafield Airport to 0.1 °C above average at Mount Lofty

Adelaide (West Terrace / ngayirdapira)

- Total rainfall was 44.4 mm, which is 87% of the long-term average of 50.8 mm
- The mean daily maximum temperature was 19.1 °C, which is 0.7 °C above the long-term average of 18.4 °C. The warmest day was 28.9 °C on the 19th, and the coolest day was on the 6th when the temperature reached 14.6 °C
- The mean daily minimum temperature was 9.0 °C, which is 0.2 °C below the long-term average of 9.2 °C. The coldest morning was 3.4 °C on the 10th, and the warmest morning was on the 15th when the minimum temperature was 17.0 °C

Extremes in September 2019

Hottest day	30.3 °C at Parafield Airport on the 19th
Warmest days on average	20.0 °C at Parafield Airport
Coolest days on average	14.2 °C at Mount Lofty
Coldest day	7.2 °C at Mount Lofty on the 6th
Coldest night	-0.6 °C at Rosedale on the 17th
Coolest nights on average	5.8 °C at Mount Barker
Warmest nights on average	9.1 °C at Noarlunga
Warmest night	17.5 °C at Adelaide (Kent Town) on the 15th
Warmest on average overall	14.1 °C at Adelaide (Kent Town)
Coolest on average overall	10.2 °C at Mount Lofty
Wettest overall	81.2 mm at Ashton
Driest overall	26.0 mm at Red Creek (Burwood)
Wettest day	27.4 mm at Belair (St Johns) on the 21st
Strongest wind gust	87 km/h at Kuitpo Forest Reserve and Mount Crawford AWS on the 6 th

Some notable statistics for September were:

Record lowest September temperature

	New record (°C)	Old record	Years Held	Average
Parafield Airport	-0.2 on the 17th	0.0 on the 1st in 1987	63	8.2
Noarlunga	3.5 on the 17th	4.0 on the 29th in 2003	20	10.3

For more information plus a summary of September's statistics please see:
<http://www.bom.gov.au/climate/current/month/sa/archive/201909.adelaide.shtml>

Adelaide (West Terrace / Ngayirdapira), South Australia September 2019 Daily Weather Observations

The official site for Adelaide, having reopened in May 2017.



Date	Day	Temps		Rain	Evap	Sun	Max wind gust				9am				3pm						
		Min °C	Max °C				mm	mm	hours	Dirn	Spd km/h	Time local	Temp °C	RH %	Cid eighths	Dirn	Spd km/h	MSLP hPa	RH %	Cid eighths	Dirn
1	Su	10.7	17.6	5.0			WSW	35	11:47	14.8	77	WNW	19	1019.4	15.9	56	SW	17	1020.4		
2	Mo	5.3	23.9	0			NE	37	08:08	17.5	43	NNE	20	1016.7	21.8	31	N	9	1014.0		
3	Tu	7.1	18.5	0			WNW	22	13:18	10.9	98	NE	7	1018.1	17.8	59	WNW	9	1016.2		
4	We	9.7	18.2	2.2			NE	24	10:31	11.7	90			1017.7	16.7	72	ENE	2	1014.0		
5	Th	11.1	17.7	2.8			WNW	37	14:26	14.8	80	WNW	11	1013.8	16.1	55	W	20	1011.7		
6	Fr	9.4	14.6	2.8			SW	74	12:11	12.1	72	SW	30	1010.0	13.6	65	SW	28	1014.7		
7	Sa	8.7	14.8	3.0			W	44	14:59	11.2	75	WSW	15	1021.9	13.7	63	WSW	28	1021.4		
8	Su	9.9	15.9	3.2			SSW	48	18:41	13.0	78	W	17	1022.7	15.0	74	WSW	22	1022.6		
9	Mo	6.0	14.9	2.4			SW	30	12:58	12.3	58	S	11	1029.9	14.0	54	SW	19	1028.9		
10	Tu	3.4	17.9	0			WSW	20	14:45	12.1	60	NE	9	1030.6	15.6	54	WSW	13	1027.8		
11	We	8.6	24.0	0			N	39	23:35	17.0	40	NE	9	1029.1	23.2	24	NNW	17	1024.5		
12	Th	15.2	19.4	0			NNE	33	00:11	17.6	56	WNW	11	1027.1	18.4	67	SW	13	1026.9		
13	Fr	7.0	17.4	0			W	26	14:33	12.1	94	S	2	1024.6	15.8	72	WSW	13	1026.9		
14	Sa	8.2	26.8	0			NNE	20	10:17	17.2	65	NNW	9	1026.4	25.8	38	W	7	1022.6		
15	Su	17.0	27.9	0			NNW	31	13:43	22.4	35	NNE	13	1020.2	26.8	24	NW	13	1015.4		
16	Mo	10.2	15.5	1.2			SSE	41	12:01	11.7	76	SSE	7	1023.3	14.0	42	SSE	17	1024.0		
17	Tu	4.5	16.0	0			ENE	26	09:13	10.9	45	ENE	11	1029.5	14.6	43	SW	15	1026.3		
18	We	8.0	21.7	0			ENE	37	20:47	14.9	31	NNE	15	1025.5	21.0	23	NNE	15	1020.4		
19	Th	14.9	28.9	0			NNE	56	12:40	20.4	21	NE	22	1011.8	28.7	14	NNE	24	1006.5		
20	Fr	14.7	19.6	0			WSW	36	02:10	17.9	57	ESE	9	1013.3	16.6	69	SW	7	1012.4		
21	Sa	9.3	15.4	14.8			WSW	44	09:19	11.6	73	SW	20	1016.4	13.5	56	SW	20	1019.4		
22	Su	7.7	15.7	3.6			W	44	17:36	9.5	89	NNE	7	1025.3	15.1	55	WNW	20	1023.4		
23	Mo	9.0	15.6	3.2			WSW	33	13:41	13.4	62	SW	13	1030.3	15.1	52	SW	13	1029.6		
24	Tu	6.2	16.0	0.2			WSW	24	12:53	12.5	73	N	9	1032.5	15.1	55	SW	15	1029.8		
25	We	5.0	19.7	0			WSW	24	12:32	14.0	58	NE	6	1030.8	18.4	51	WSW	13	1025.8		
26	Th	9.3	24.7	0			WNW	28	12:02	19.6	36	NNE	11	1024.2	24.3	22	WNW	7	1020.2		
27	Fr	12.7	18.9	0			WSW	41	12:32	16.4	58	WSW	11	1019.5	18.5	56	SW	19	1019.7		
28	Sa	4.9	16.3	0			WSW	26	12:04	12.8	46	E	13	1023.4	14.2	45	SSW	13	1021.7		
29	Su	5.7	18.4	0			SW	36	14:10	13.8	56	WSW	6	1025.4	16.6	52	WSW	17	1023.5		
30	Mo	9.2	21.5	0			E	30	20:15	15.2	56	E	15	1028.1	20.1	45	WSW	13	1025.1		
Statistics for September 2019																					
Mean		9.0	19.1							14.4	61		11	1022.9	17.9	49		15	1021.0		
Lowest		3.4	14.6							9.5	21		Caltn	1010.0	13.5	14		ENE	2	1006.5	
Highest		17.0	28.9	14.8			SW	74		22.4	98	SW	30	1032.5	28.7	74		#	28	1029.8	
Total				44.4																	

Observations were drawn from Adelaide (West Terrace / Ngayirdapira) (station 023000).
 This is now the "official" site for Adelaide, having reopened in May 2017. Observations are also available from the Kent Town site (station number 023090).
 ID:DJW5081_201909 Prepared at 13:02 UTC on 1 Oct 2019
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South Australia in September 2019: drier than average, warm days, cool nights

Rainfall in September was below average in many areas of South Australia, with only parts of the Eyre Peninsula, around Tarcoola and in the far northeast having a wetter than average month. Daytime temperatures were warmer than average across most of South Australia, but night-time temperatures were cooler than average in the east.

Drier than average

- Rainfall in September was 51% below average for South Australia, continuing a run of ten consecutive months of below average rainfall for South Australia as a whole
- Rainfall was above average over much of the Eyre Peninsula, around Tarcoola and in the far northeast, but was near average to below average elsewhere.
- The highest monthly totals were in central and eastern Agricultural districts, particularly on the Eyre Peninsula, in the Adelaide Hills, and Lower South East .
- A trough and cold front that crossed the State early on the 20th brought 10 to 30 mm of rain to the Eyre Peninsula and gave a few sites their highest September daily rainfall on record
- It has been South Australia's driest first nine months of the year on record, with rainfall since the start of the year below average across almost all of South Australia and large areas very much drier than average

Warm days, with cool nights in the east

- Daytime temperatures were above average across most of South Australia, with only the South East districts having close to average maximum temperatures.
- The mean maximum temperature was 2.87 °C above average for South Australia, the equal sixth-highest on record for September and highest since 2013
- On the 19th, strong northerly winds ahead of a cold front accompanied warmer than average temperatures across the State, with some power outages from wind damage and an elevated fire weather risk
- On the 20th, Renmark Aero had its warmest September night on record
- Following the passage of the cold front on the 20th, Tarcoola had its coldest September day on record
- Night-time temperatures were below average across most of eastern South Australia, including an area of very much cooler than average nights in the Lower South East
- Most western areas of the State had warmer than average nights
- The mean minimum temperature was 0.15 °C above average for South Australia
- A number of sites had their lowest September temperature on record
- A few sites had their lowest September mean daily minimum temperature on record or their lowest September mean daily minimum temperature for at least 20 years
- Naracoorte Aerodrome equalled its lowest September mean temperature on record and Mount Gambier Aero had its lowest September mean temperature since 1992
- South Australia's mean maximum temperature for January to September was the second-highest on record, while mean minimum temperatures have also been warmer than average

Extremes in September 2019

Hottest day	38.1 °C at Nullarbor on the 14th
Warmest days on average	28.9 °C at Oodnadatta Airport

Coolest days on average	14.2 °C at Mount Lofty
Coldest day	7.2 °C at Mount Lofty on the 6th
Coldest night	-4.0 °C at Gluepot Reserve (Gluepot) on the 18th
Coolest nights on average	3.7 °C at Keith (Munkora)
Warmest nights on average	11.4 °C at Neptune Island
Warmest night	21.8 °C at Arkaroola on the 20th
Warmest on average overall	19.9 °C at Oodnadatta Airport
Coolest on average overall	10.2 °C at Mount Lofty
Wettest overall	81.8 mm at Lock
Driest overall	0 mm at Moomba Airport and Oodnadatta Airport
Wettest day	36.0 mm at Yeelanna on the 20th
Strongest wind gust	104 km/h at Cape Willoughby on the 19 th

Some notable statistics for September were:

Record lowest September daily maximum temperature

	New record (°C)	Old record	Years Held	Average
Tarcoola	13.0 on the 20th	14.6 on the 29th in 2003	22	25.4

Record highest September daily minimum temperature

	New record (°C)	Old record	Years Held	Average
Renmark	19.6 on the 20th	19.0 on the 30th in 2001	25	6.6

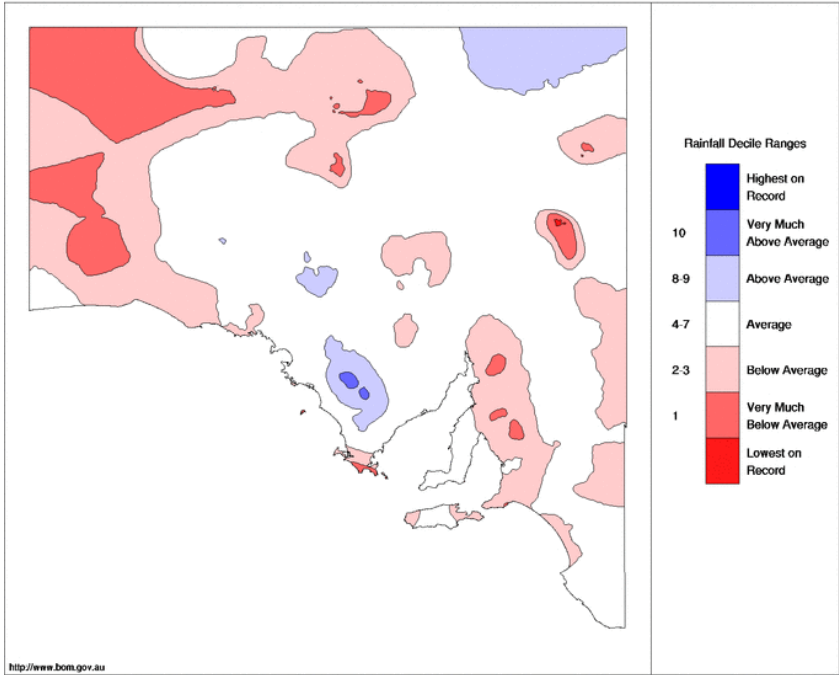
Record highest September daily rainfall			
	New record (mm)	Old record	Years Held
Yeelanna	36.0 on the 20th	31.8 on the 6th in 1912	105
Minnipa	29.4 on the 20th	23.2 on the 3rd in 2010	24
Wudinna	31.8 on the 20th	24.4 on the 3rd in 2010	21

Record lowest September temperature				
	New record (°C)	Old record	Duration	Avg
Ceduna	-1.8 on the 8th	-1.2 on the 1st in 2007	79 yrs	7.8
Parafield	-0.2 on the 17th	0.0 on the 1st in 1987	63yr s	8.2
Kingscote	-2.2 on the 18th	-2.0 on the 5th in 2007	26 yrs	6.4
Strathalbyn	-0.2 on the 18th	0.2 on the 25th in 2018	24 yrs	7.6
Tarcoola	-0.1 on the 7th	0.3 on the 16th in 2018	22 yrs	8.9
Yunta	-3.2 on the 18th	-2.5 on the 5th in 2007	22 yrs	6.5
Gluepot	-4.0 on the 18th	-3.2 on the 4th in 2018	21 yrs	6.6
Noarlunga	3.5 on the 17th	4.0 on the 29th in 2003	20 yrs	10.3
Padthaway Sth	-1.7 on the 17th	-1.0 on the 29th in 2018	20 yrs	7.1

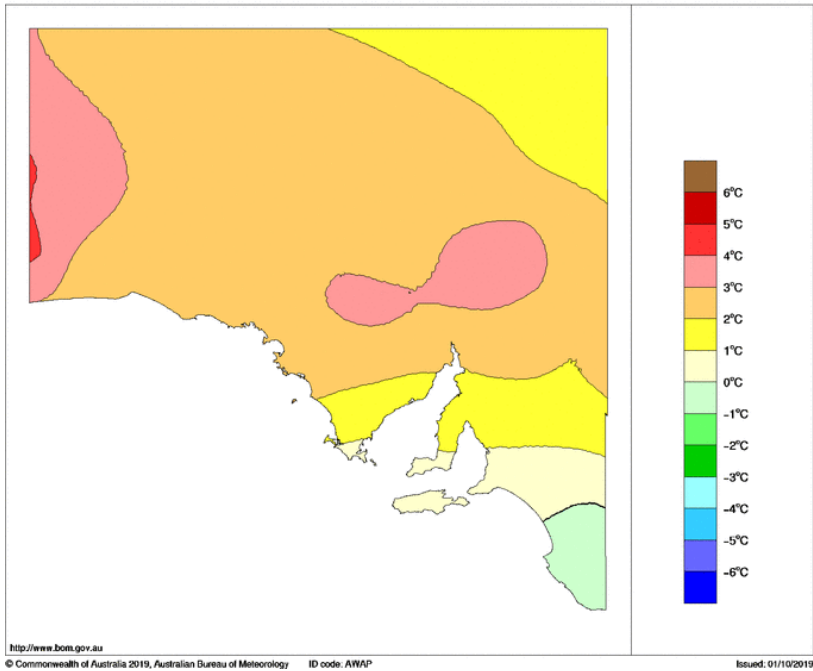
Many other records were also set in September. For more information plus a summary of statistics please see:

<http://www.bom.gov.au/climate/current/month/sa/archive/201909.summary.shtml>

Distribution Based on Gridded Data
 Australian Bureau of Meteorology



Maximum Temperature Anomaly (°C) September 2019
 Australian Bureau of Meteorology





Australian Meteorological Association Inc (AMetA)
www.ameta.org.au

NEXT MEETING

6.00 PM TUESDAY 15 October 2019

Bureau of Meteorology offices, Level 4, Optus Building, NW corner of South Terrace & King William Street, Adelaide

Please also note that the October meeting is the 2019 AGM

This is an important meeting as Several Committee positions (including President and Treasurer) will not be contested by the current incumbents, so there will be significant changes

If you are interested in nominating for a position on the Committee, please email the Secretary darren.ray@bom.gov.au

General committee member positions will be open as well as President and Treasurer

Presentation : Meteorology and aviation

Martin Crowe and Beth Walton (both ex-Bureau of Meteorology forecasters)

There is a lot going on behind the scenes to keep you safe when you hop on an airplane flight. This talk will look at some of the meteorological understanding used by pilots and traffic control to ensure safe flights.

Convenient free street parking is usually available nearby (e.g. South Tce.)

We look forward to seeing you.

For further information contact:

Secretary:	Darren Ray
Phone:	8366 2664
Fax:	8366 2693

Inquiries or suggestions, please contact the Secretary on the phone number listed above.