Australian Meteorological Association Inc

Monana

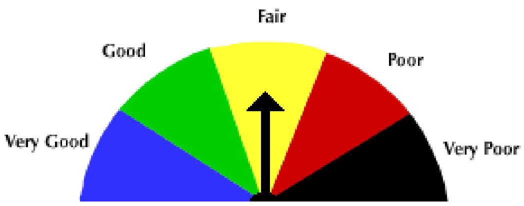
THE OFFICIAL PUBLICATION OF THE AUSTRALIAN METEOROLOGICAL ASSOCIATION INC
February 2021

From The President's Pen

Although 2020 was a tumultuous time and the risks will still remain until the roll-out of the COVID-19 vaccines brings the risks down to a more "normal" level, the AMetA Committee has decided to restart physical meetings (subject to the prevailing government advice in the lead-up to the meetings).

There is, of course, a level of risk until the vaccines reduce the population risk level, but the current official advice and general flow of life in the community suggests that if the mandatory COVID-19 restrictions are adhered to, the risk will be acceptable for people who do not have individual medical advice to the contrary. If you are considering coming to a meeting but are concerned about your health, I suggest that you get medical advice before attending.

Whew! Now that the caveats are out of the way, it is time to look at the first member's meeting which will be on the 19th February 2021—meeting details elsewhere in the magazine. The first thing to note is that currently the Bureau Of Meteorology (BOM) meeting room is no longer available to us because of the risks the pandemic poses to the essential services the BOM provides. I do not believe that the AMetA will be allowed back into that meeting room in the foreseeable future as I think the Federal Government will leave the pandemic restrictions in place for years to come. We lose three things by not being able to use the BOM Meeting room: (1) A free meeting room; (2) an easily accessible Central Business District (CBD) location; and (3) a reduction in the personal relationships between the AMetA and the BOM. The Committee is pondering how to mitigate these losses, but asking visitors for a donation is on the cards. If you know where to get a cheap (preferably free) meeting room, please let us know. If you don't know of one, please ask around.



The February Meeting will include the deferred 2020 Annual General Meeting (AGM), but it should be a rather quick part of the meeting as no elections are required until later in the year with the 2021 AGM. Once that part of the meeting is out of the way, there will be a presentation from the Environmental Protection Authority (EPA) about air quality measurement. Although not a traditional meteorological measurement, the bush fires over the last few years have shown that reductions in air quality can have a significant impact of the population. Air quality is also affected by industrial and other activities such as road traffic. Although the BOM is not responsible for air quality measurements, it includes information about smoke haze on forecasts when this is expected to be significant. After all, whether the air is safe to breathe must be one of the most important aspects of the atmosphere. For people interested in Personal Weather Stations, the EPA will be providing information about cheap air quality sensors that can be used by citizens to monitor things like the size of particles in the atmosphere. The March 2020 edition of Monana magazine carried an article on measuring atmospheric particles that caused record pollution in Sydney as a result of the bushfires.

The 2021 year is shaping up to be a good year for presentations (subject to pandemic and meteorological events impacting on potential presenters). Following the presentation about air quality, it is hoped that the program will include presentations on hydrology and understanding rainfall events. Following on from the previous presentations on local fire events, it is hoped that there will be a presentation on the country wide state of meteorology in relation to the fire seasons.

On a less happy note, it was disappointing that the only person (apart from the usual Committee Members) that submitted an article for the magazine WAS A NON-MEMBER! As a result, no one was awarded one of the prizes that were on offer over the previous year.

Keep Happy, Keep Safe.

Mark Little

email: president@ameta.org.au **mobile:** 0434 602 091

Please Note: Several images used in this magazine are from external sources and many are acknowledged via a hyperlink to the source of the image. Click the image to visit its source. *The AMetA does not have control over the content of linked sites, or the changes that may be made. It is your responsibility to make your own decisions about visiting those sites and determining if that information is suitable for your purposes.*

❆ *ATTENTION ALL SCRIBES AND PHOTOGRAPHERS* ❆

Members are encouraged to submit weather related articles and photos to monana@ameta.org.au for publication in *Monana.*

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.

Another useful website is https://www.theweatherclub.org.uk/index.php/ *(Please note a little patience may be required when accessing this website as it can take some time to open)*

Christmas on the Mighty Murray **By Mark Little**

This Christmas, my wife, Alexa, and I decided to spend time on the river, as it was not expected that the weather would be excessively hot. So, along with the dog, Marduk, we went to our houseboat. When we arrived, the boat looked like it was still decked out for Halloween—it was covered in cobwebs, complete with desiccated insects.

The plague of spiders had caused havoc with the on-board weather station, with the wind speed and direction not functioning, nor was the air quality sensor. The cobwebs were preventing the wind vane from swinging, and the anemometer cups from spinning. Less obviously, the cobwebs were preventing the little fan in the air quality monitor from sucking in an air sample, so the sensor was reading a very low number of particles in the air. A closer inspection of the sensor head revealed that the hole into the tipping spoon in the rain gauge was blocked by a dead insect and a spider's egg sack. The radiation shield around the temperature/humidity sensor was encased with spider's web and its assortment of dead insects.

NO WONDER THE WEATHER STATION WASN'T WORKING PROPERLY!

Well, although I like having a weather station, the weather on the river can have greater consequences that it would normally have at home, so instead of stripping, cleaning and re-assembling the station, we cast off. Because we were travelling downstream, we have to pass through Lock 1 just after passing under the Blanchetown Bridge that can be seen in the background of the photo above. With a stronger than usual current flow from behind and a following Northerly wind, the houseboat can be more difficult to steer at the low speeds required when entering the lock—something that would cause some grief and a loss of some railing paint coming back though the lock on the way home.

After a few hours, and just a bit of engine trouble, we arrived at our intended mooring location near the Stockwell Pump Station upstream of Swan Reach and settled in. After all the mooring lines were set, it was time to clean up the weather station by removing the cobwebs and other detritus.

That got the weather station working again, but there was another problem that needed investigating that was unrelated to the cobwebs.

The air quality monitor sensor (see photo to the left) had been stopping as the weather warmed up. At first, I had thought that the heat was affecting batteries, because I would bring it inside, change the batteries and it would work. However, checking the batteries with a tester ultimately showed that the batteries were okay, and not being adversely affected by the heat. It had to be the sensor itself that was the problem. Luckily, I brought the air quality sensor from home, so I could do some comparisons. Both units failed when left in the midday sun, but continued to work when used under cover. By swapping the in-sun and under-cover units, it became obvious that it was not a fault in a single unit, but a systematic fault in both units.

While the cause of the problem had been identified, the cause of the problem still needs to be addressed. Another location will need to be found, where the solar panel gets enough sunlight to charge the batteries, but not enough that the unit overheats.

Now it was time to take a relaxing paddle down Yatcko Creek that goes from our mooring spot. Unlike the river, it is very difficult to get powered boats down the creek because of fallen trees and shallow areas. Apart from the many birds and native water rats (Rakali) that can be seen along the creeks and lagoons, there are reminders of older days with things like an abandoned stock ferry, back from the days when the ferry was winched across the creek by hand. The old ferry can be seen in front of the kayak on the right-hand side of the creek. The other photo shows a closer image of the old hand driven winch.

While on the river, Beth (our Vice-President and long-time member) told me that she would be travelling up to Morgan and back on the Proud Mary. Alexa and I are familiar with the main commercial passenger river-boats such as the Murray Princess and the Proud Mary, so we knew that the Proud Mary would be passing our mooring location. While relaxing on the back deck, watching the ski boats and other river traffic passing by, I saw the Proud Mary come around the bend from the reach up from Swan Reach. Unfortunately, there was a ski-boat in the channel, and I think that it

was following ski-boat protocol of sitting still and letting moving boats past. However, the Proud Mary needed to remain in the channel, so it gave a blast of the horn to get the ski-boat to move. For those with exceptional eyesight, Beth can be seen on the middle deck. For those with normal vision, here is a photo taken much closer to our mooring.

After Beth had passed coming back from Morgan, we moved to Swan Reach and moored at the pub. Two jet-skis crashed into each other throwing both riders into the water and bits from at least one jet-ski flying, but that is a story for another time.

After having lunch at the pub with our neighbours, we moved back up the river to near where we were before. The next time that the Proud Mary came, the Skipper gave us a blast of their horn in recognition.

When we started back towards Blanchetown, we experienced a weather condition that we had never experienced on the river before. As the houseboat came around the bend, I noticed a swirling pattern on the water—a “willy-willy”. Just before the houseboat hit the willy-willy, it started picking up substantial amounts of water from the river, such that the column of water was visible. As the front of the houseboat hit, the wind caused the houseboat to nearly come to a standstill as the column was hitting us head on. Not only did the wind slow the houseboat — impressive as the boat weighs quite a few tonnes — it also threw water into the houseboat where Alexa was sitting. Not enough to drench her, but enough for her to be startled.

As indicated earlier in the article, having a following wind can be dangerous when coming into things like a lock. We had hoped to come upstream into Lock 1 when the strong following southerly wind had abated. Unfortunately, the wind came up as we entered the lock and blew the stern off-course and before I could correct fully, we bounced off the lock wall a couple of times before we were tied to the lock wall. Luckily, the damage was limited to about 10~15cm of paint being scrapped off the port (left) front corner of the deck railing. Nothing in comparison to the boat that burned on the other side of the river to our mooring on the day we came home.

Our Variable and Changing Climate; Update 2020.

By Beth Walton

Commencing the year with extreme heat events, inland dust storms and widespread bushfires, Australia experienced its 4th-warmest year on record in 2020, with the annual national mean temperature 1.15 °C above average.

Heatwaves also affected large parts of southeastern and eastern Australia in November when Adelaide recorded its highest November mean maximum temperature of 28.8C (cf a long term mean of 24.5°C in the discontinuous record (1888-1978; 2016-2020)) at West Terrace. Despite these hot events, after more than a decade of warmer than average temperatures, Greater Adelaide experienced its coolest year since 2003.

In terms of rainfall, the year commenced with much of Australia affected by an extended drought but in February and March, floods affected eastern Australia particularly in Queensland. However, while southern Murray–Darling Basin water storages saw significant increases during 2020, in Northern NSW and southwestern Queensland water storage levels remained low. For more detail on the 2020 Australian climate summary go to www.bom.gov.au .

The most significant natural climate driver affecting Australia during 2020 was **La Niña**. The Pacific Ocean began cooling over autumn, with early indicators of a developing La Niña emerging from around June. The event matured over winter and was declared in September. It reached its peak at moderate strength by the end of the year. Globally, La Nina years generally show up as cooler years while El Nino years produce above average temperatures.

So, what happened globally? From the assessment of global annual temperature anomalies undertaken by the World Meteorological Organization (WMO), using 5 reputable global data-sets (from the USA (2), the European Union, UK and Japan) 2020 proved to be one of the 3 warmest years on record, sharing this position with 2016 and 2019. The differences in average global temperatures among these years are indistinguishably small. The average global temperature[1] in 2020 was about 14.9°C, (1.2± 0.1) °C above the pre-industrial (1850-1900) level.

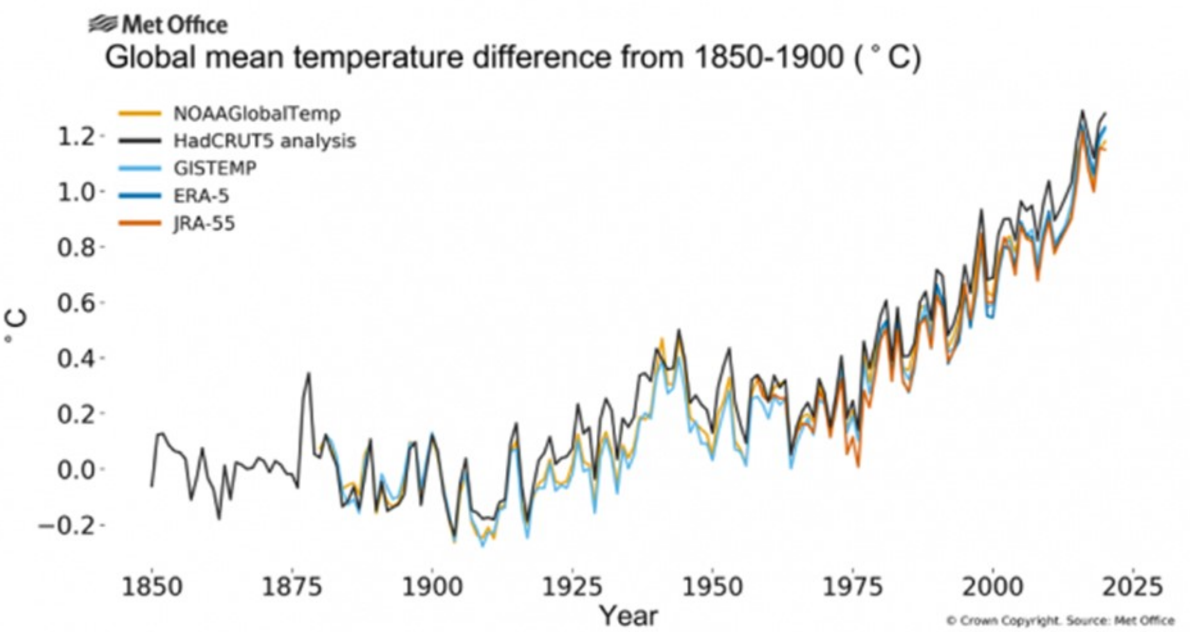


Figure1. Yearly global temperature anomalies as derived from 5 global datasets.

In his recent press release, the President of WMO, Prof. Taalas, commented "It is

1. Average temperature T_{ave} (as opposed to maximum T_{max} or minimum T_{min} temperature) can be calculated by $T_{ave} = (T_{max} + T_{min})/2$.

remarkable that [global] temperatures in 2020 were virtually on a par with 2016, when we saw one of the strongest El Niño warming events on record. This is a clear indication that the global signal from human-induced climate change is now as powerful as the force of nature,”

“The temperature ranking of individual years represent only a snapshot of a much longer -term trend. Since the 1980s each decade has been warmer than the previous one. Heat -trapping gases in the atmosphere remain at record levels and the long lifetime of carbon dioxide, the most important gas, commits the planet to future warming’. Fig1 (previous page) shows the year to year variation from the 50 year (1850-1900) mean global temperature as calculated from each of the 5 datasets used by WMO. For more information on the 2020 Global climate summary go to www.wmo.ch.

Global warming is also evident in Sea Surface Temperature (SST) analyses. This is perhaps more disturbing than the warming observed in atmospheric temperatures.

Water has the highest specific heat of any natural substance. In fact, very roughly speaking, its specific heat is more than 4 times as much as air. In other words, to raise the temperature of 1kg of water by 1°C requires more than 4 times the amount of heat energy to heat an equivalent amount (1 kg) of air. This means water is slow to heat and equally - slow to cool. The chart in Fig 2 shows the above average SST surrounding Australia in 2020. A lot of the heat energy that has been absorbed by greenhouse gases in the atmosphere is now being stored in the ocean. It will take a long, long time for this warming to be reversed.

The annual 2020 SST anomaly for the Australian region was the equal-fourth-highest on record; 0.59 °C above the 1961–1990 average based on data from the NOAA Extended Reconstructed Sea Surface Temperature dataset (ERSST ver 5). SSTs around Australia have warmed by around one degree since 1910, similar to the increase in temperature observed over land. Above average annual SSTs have been observed for the Australian region for every year since 1995, and have been persistently high for the past decade.

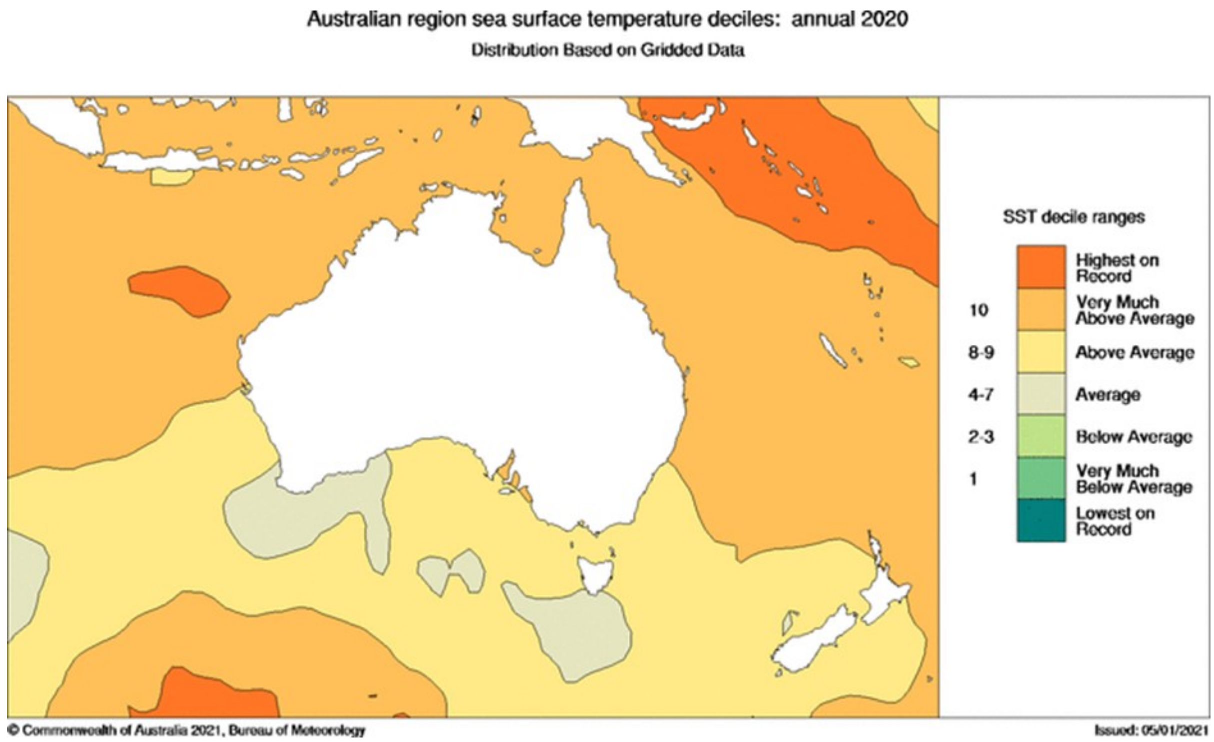


Figure2. Annual Sea Surface Temperature Deciles in year 2020 for the ocean surrounding Australia.

The Air Speed Indicator: It's Benefits and Problems

by Bruce Davis

On 1 June 2009 Air France Flight 447, an Airbus A330 en-route from Rio de Janeiro to Paris, crashed into the Atlantic Ocean killing all 228 passengers and crew. The cause of the accident was eventually attributed to human factors, but the incident that triggered the events was an ***AirSpeed Indicator*** problem.

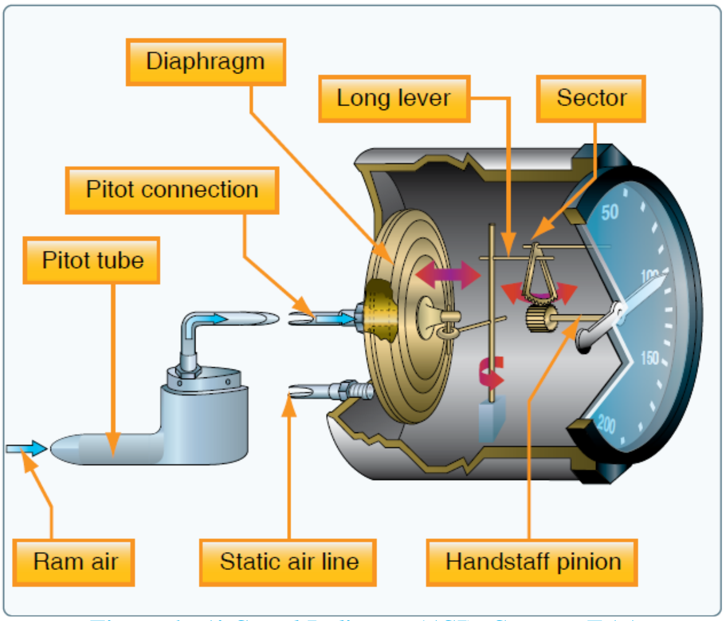


Figure 1: AirSpeed Indicator (ASI) Source: FAA

In earlier issues of Monana I discussed the pressure altimeter - a flight instrument essential for aircraft operation that relies on the properties of the atmosphere. In this issue I wish to discuss its sister instrument the ***AirSpeed Indicator (ASI).*** Also a vital and mandatory instrument for aircraft operation – from the most sophisticated airliner down to the simplest trainer. The method of display may be electronic or analogue and the sensor may be aneroid capsule or solid state but the principal is the same.

As can be seen from figures 1 and 2 the ASI has many similarities with the altimeter. The basic ***ASI*** as indicated in figure 1 consists of an aneroid capsule inside an instrument casing. As with the altimeter, static pressure feeds into the instrument casing. However, air taken from the pitot probe is fed into the aneroid capsule (see figure 1). The pitot probe is usually located under a wing (light aeroplane) or on the nose (heavy aeroplane). Air flowing into the pitot probe is brought to a complete halt inside the pressure chamber resulting in an increase of pressure. An analogy is putting your hand out of the window of a fast moving car and

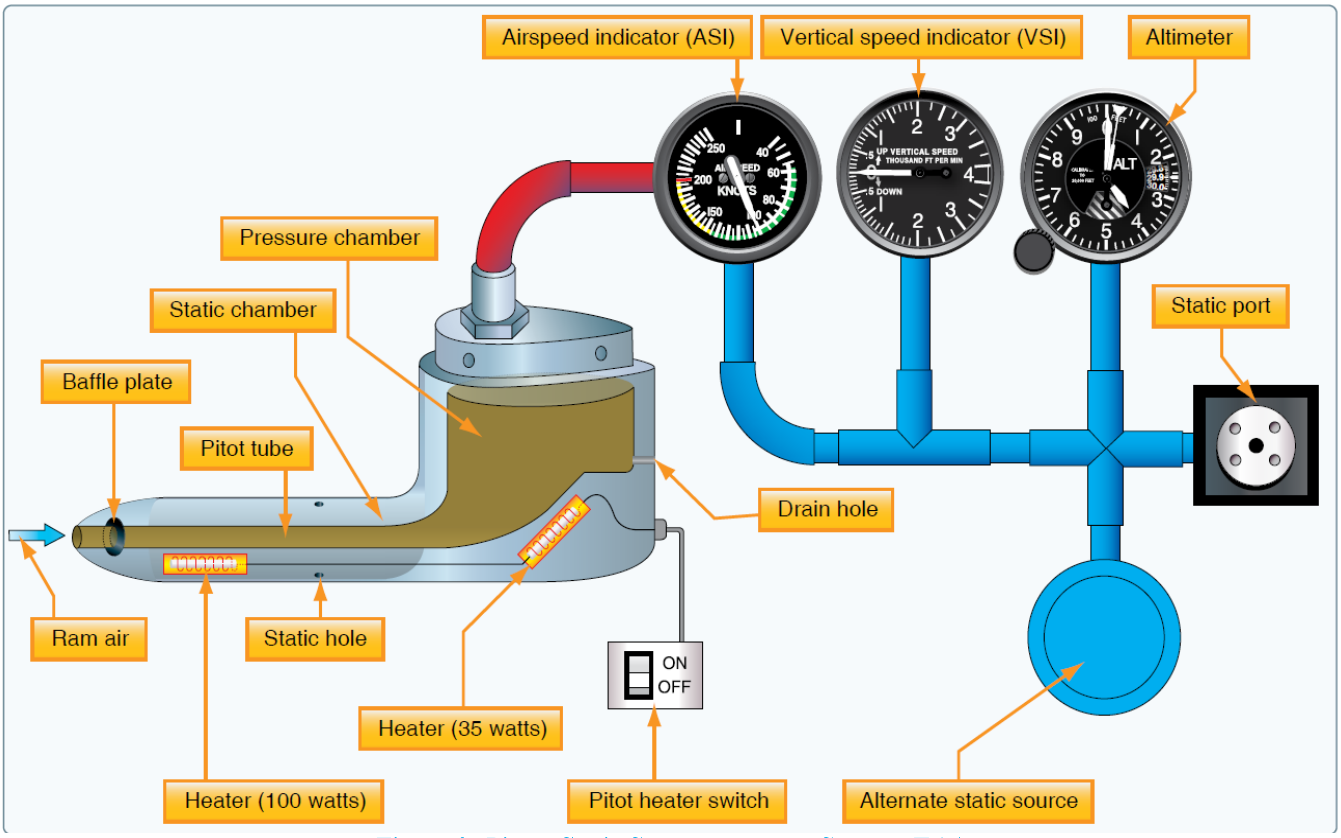


Figure 2: Pitot - Static System Source: FAA

feeling the pressure of the moving air on your hand. This ***pitot*** or ***total pressure*** has 2 components - ***static pressure*** and ***dynamic pressure***. Dynamic pressure is the pressure exerted in bringing moving air to a halt (or by the aircraft moving through the stationary air). Hence, as aeroplane air speed increases this increased pressure will cause the aneroid capsule to expand. Opposing this aneroid capsule expansion is the static pressure inside the instrument casing. Thus the ***ASI*** effectively subtracts static pressure from total pressure to give dynamic pressure. This dynamic pressure is transmitted to the instrument dial as speed - called the ***Indicated Air Speed (IAS).*** Instrument dials of light and heavy aircraft are given in figures 3 and 4.

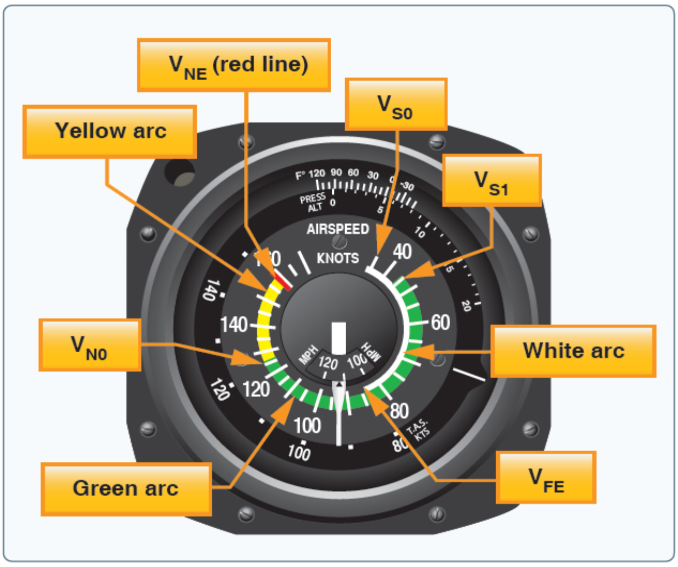


Figure 3: Single Engine AirSpeed Indicator (FAA)

Dynamic pressure can be calculated using the equation $\frac{1}{2}\rho v^2$, where ρ (rho) is the air density and v is the true speed of the aeroplane through the air (the ***True AirSpeed or TAS***). Hence, the actual (true) speed of the aircraft through the air is just one input into the ***IAS*** which implies that the instrument is prone to certain errors.

Like the altimeter, the first errors that affect the ***ASI*** are position and instrument errors. ***IAS*** corrected for these is known as ***Calibrated AirSpeed (CAS).*** As with the altimeter, in normal flight in most modern aeroplanes these 2 are usually small enough to be ignored. However, as with the altimeter, in some conditions of flight they need to be considered.

Figure 4: Jet Electronic AirSpeed Indicator Source: FAA
Note the use of a strip to show trends as well as the digital output.
For more explanation please click on link provided

As mentioned above, dynamic pressure depends upon air density. This implies that the ***IAS*** will only equal the ***TAS*** under certain atmospheric conditions. As might be expected, the ***ASI*** is calibrated so that this occurs at Mean Sea Level in ISA. Given that air density decreases with altitude it can be seen that if an aircraft climbs from MSL at a constant ***IAS***, then the ***TAS*** will be increasing with height (very roughly 2% per thousand feet). In normal circumstances at low altitudes the difference between ***TAS*** and ***IAS*** is insignificant. However, as altitude increases this density error will start to increase and for navigation purposes the ***TAS*** needs to be known. The conversion from ***IAS*** to ***TAS*** is traditionally achieved using the circular slide rule side of a Navigation Computer (see fig 5). The navigation computer is not, as may be first thought, electronic, but a mechanical device, one side of which is a circular slide rule with the other side allowing wind triangle calculations. Although these calculations are now readily carried out by electronic devices aviation authorities still require pilot licence examination candidates to use a navigation computer for safety and redundancy purposes.

For navigation purposes it is the speed across the ground (***GroundSpeed or GS***) that matters. For example with a ***TAS*** of 100 knots and a 20 knot tailwind, the ***GS*** will be 120 knots. To convert from ***TAS*** to ***GS*** the wind triangle side of the navigation computer is used. (see fig 6)

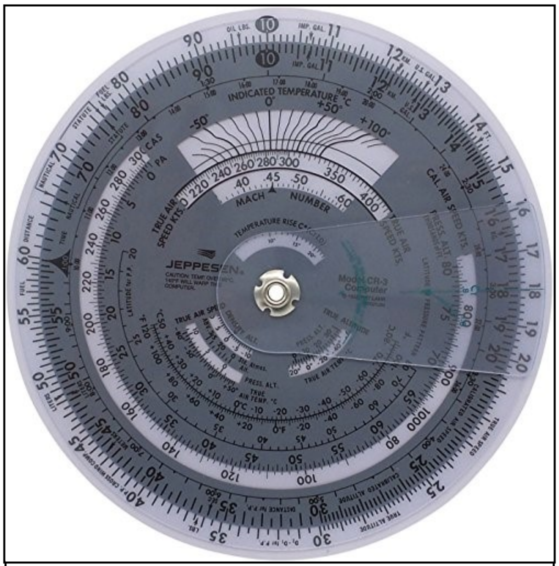


Figure 5: Circular Slide Rule

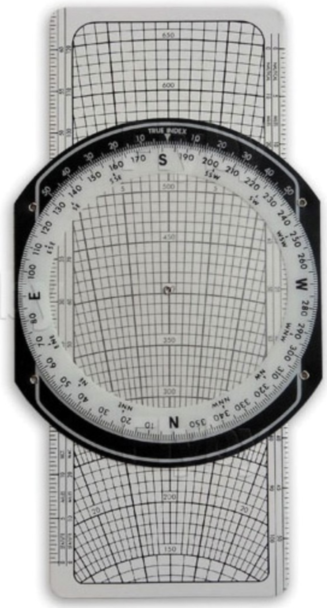


Figure 6: Two types of Wind Triangle Computers

This use of the ***ASI*** has often raised the ire of students. Why, they say, do we need to worry about ***IAS*** when it is ***TAS*** and ***GS*** that matter and instruments are readily available to indicate these? The answer is that although the ***TAS*** and ***GS*** matter for navigation, to the aeroplane it is the ***IAS*** that is all important. The forces “felt” by the airframe are related to dynamic pressure and therefore the ***IAS***. Hence the markings and colour coding on the ***ASI*** (see figs 3 and 4).

Another important function of the ***ASI*** is to help avoid an aerodynamic stall. Such a stall occurs when the angle of attack of a wing (the angle between the wing and the direction of travel) becomes so large that airflow separates from the wing upper surface. This results in a dramatic decrease in lift, increase in drag and control problems. Although stalling is purely a function of angle of attack, it can be shown that, for a given weight, the stalling angle of attack will occur at a particular airspeed for each flight manoeuvre. Hence the term “stalling speed”. On the ***ASI*** (fig. 3), the stalling speed in power off straight and level flight at maximum take-off weight is given with flaps up and flaps down. Of course, an angle of attack indicator would be more useful but they have been expensive and only recently become common in civilian aviation and even they can cause problems (e.g. the recent accidents involving the Boeing B737 Max). This shows that the ***ASI*** is still a very useful instrument.

A problem with the above discussion is that it assumes air is incompressible — something that we know is not the case. It assumes that pitot pressure results solely from the combination of the atmospheric static pressure and dynamic pressure. If we think about it, there must also be a pressure due to air being compressed inside the pressure chamber and this will also affect the ***IAS***.

At low speeds and low altitudes (up to about 200 kts and 10000 ft) compressibility can be ignored. However, at high altitudes and speeds (especially as the speed of sound is approached) it needs to be considered. This brings in a new term, ***Equivalent AirSpeed (EAS). EAS*** is the ***IAS*** corrected for compressibility and is used to calculate ***TAS***. For example, at 30000 ft and 300 KTS CAS, ***EAS*** will be 95% of 300 kt, or 285 kt.

At high speeds and/or high altitudes the measurement of speed is also expressed in terms of ***“Mach Number”*** - the ratio of the aircraft ***TAS*** to the local speed of sound. An aircraft traveling at the speed of sound is traveling at Mach 1.0.

If the airflow over the wing exceeds Mach 1.0, a shock wave will form at that point (see fig 7). Unless the aircraft is designed to fly at supersonic speeds, this wave acts as a

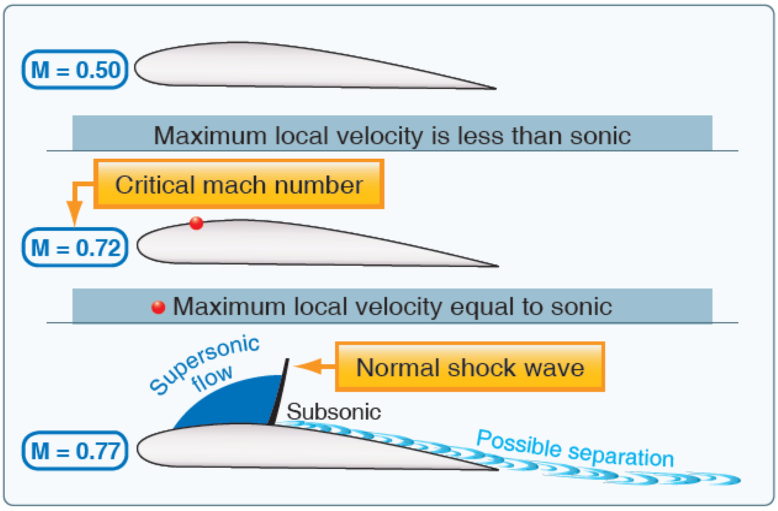


Figure 7: Wing Transonic Airflow Source FAA

barrier to the oncoming air and prevents it flowing over the wing surface. When this occurs on the upper surface (where airflow speed will normally be faster than the aircraft's ***TAS***) the effect is much the same as for an aerodynamic stall and is called a ***shock or high speed stall***. Hence, it is possible for the aeroplane to become uncontrollable even though the ***TAS*** is less than Mach 1. Therefore a ***Maximum Operating Mach Number (*M_{MO}*)*** is specified.

This introduces a further complication. As seen above, the aerodynamic (low speed) stalling ***IAS*** is the same at all altitudes (in fact it is ***EAS*** that stays constant, ***IAS*** will increase slightly due to compressibility) which means that the stalling ***TAS*** will increase with height. However, in the troposphere, the local speed of sound normally deceases with height. Hence the ***TAS*** representing M_{MO} will also decrease with height (up to the tropopause). This results in a point where the Aerodynamic Stalling Speed becomes equal to M_{MO} (see figs 8 & 9). At this point the pilot is presented with a dilemma. If the aeroplane slows down an aerodynamic stall is possible, if it speeds up a high speed stall may occur. Recovery from either may be impossible. This point is colloquially known as "Coffin Corner".

Now let us return to other possible problems. In Fig. 2 there is a pitot heater to prevent or remove ice blocking the pitot probe. Unfortunately this may not always work.

Consider Air France Flight 447, where we began. At the time of the accident the aeroplane was flying in thunderstorm cloud in the ***Inter Tropical Convergence Zone***. Although the pitot heat systems had been activated they were unable to stop partial icing over of all 3 pitot probes (each connected to a separate pitot-static system). This resulted in 3 different ***IAS*** readings. Because of these ***IAS*** discrepancies the aeroplane computers disconnected the autopilot, resulting in the

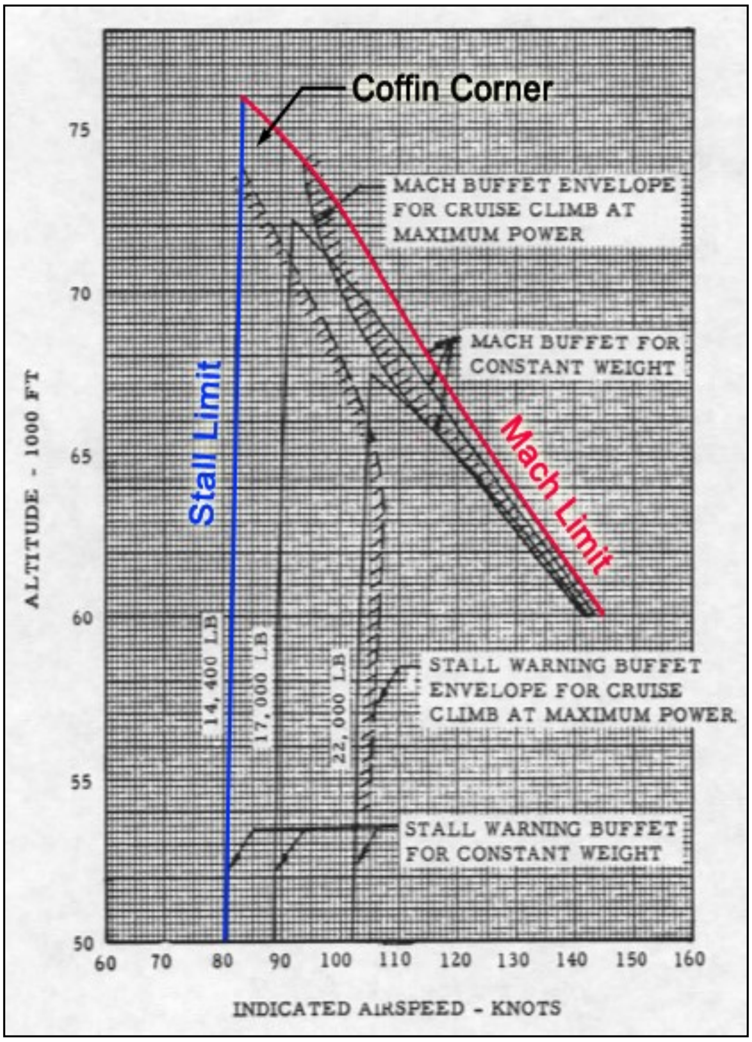


Figure 8: IAS Stall & Mach Buffet Boundaries (Lockheed U2 spy-plane) Source: Wikipedia

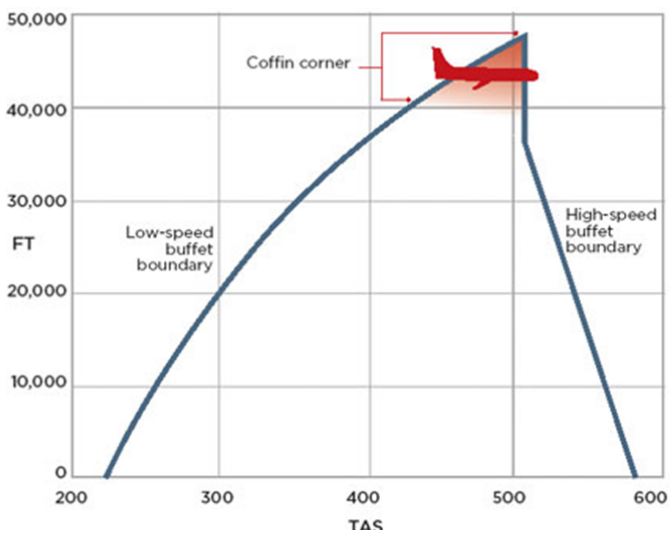


Figure 9: TAS Stall & Mach Buffet Boundaries AOPA

aeroplane having to be hand flown. The pilots may have been unaware that disconnecting the autopilot also disconnected Airbus's stall prevention system, meaning that a stall was now a possiblity. During the flight's final few moments the pilot flying raised the aeroplane's nose and tried to climb. During this time the stall warning sounded continually. Investigators speculated that the pilot flying may have confused buffeting from the stall with that experienced from over speeding and raised the aeroplane's nose in an attempt to reduce speed, although the exact reason is unknown. Many believe that the aeroplane ended up in coffin corner. It is still unexplained as to why the stall warning was ignored and why cross checking with other instruments was not carried out. The result was an aerodynamic stall and fatal crash.

Also of relevance is Northwest Airlines Flight 6231 which crashed soon after departing New York on a ferry flight without passengers to Buffalo on 1st October 1974. All 3 crew members were killed. The cause of the accident was found to be pitot probe icing. However, in this case, unlike Air France, the crew had not activated the pitot heat prior to take-off in icing conditions. Once the pitot probes were blocked by ice the ***ASI*** started to act like an altimeter with ***IAS*** increasing with height. As the aircraft climbed through FL160, the ***IAS*** began to increase. In an attempt to try and reduce ***IAS*** the crew kept raising the aeroplane's nose which increased the climb rate and so further increased the ***IAS***. Eventually the stickshaker stall warning activated but it was either too late or ignored and an aerodynamic stall followed. Again it is unexplained why the crew did not check the airspeed indications with other instruments.

So, even with sophisticated equipment and training, problems with the airspeed indicator, that vital instrument, still cause unnecessary deaths.

The accident report on Air France flight 447 may be found at:

https://www.bea.aero/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf

The accident report on Northwest airlines flight 6231 may be found at:

https://www.ntsb.gov/investigations/AccidentReports/Reports/AAR7513.pdf

A summary of the problems of the Boeing 737 Max may be found at: https://theconversation.com/boeing-737-max-why-was-it-grounded-what-has-been-fixed-and-is-it-enough-150688

The popular series of articles by Dianne Davis on the impact of weather in history has had to be temporarily suspended following a medical incident. Dianne is hopeful that the series will be continued in future editions once her shoulder has healed.

Greater Adelaide in October 2020: wettest since 2016

Rainfall in October was higher than average across Adelaide and the Hills, making it the wettest October since 2016. Both daytime and night-time temperatures were generally close to or warmer than the long-term average, but after several very warm years, days were the coolest since 2016.

For more information plus a summary of October'sstatistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202010.adelaide.shtml

Australian Government
Bureau of Meteorology

Adelaide (West Terrace / Ngayirdapira), South Australia
October 2020 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	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Th	6.8	24.5	1.2			NNW	30	10:22	13.4	72		N	11	1019.3	21.2	37		NNW	19	1016.8
2	Fr	13.4	31.3	0			NNE	48	20:02	24.4	37		NNE	17	1016.6	31.2	23		NNW	20	1013.4
3	Sa	23.9	29.4	0			N	44	16:38	25.7	28		ENE	13	1012.5	27.3	32		NNE	15	1010.0
4	Su	18.4	24.3	0			SSE	37	15:09	20.7	61		NNW	4	1009.9	17.1	73		SSE	19	1008.9
5	Mo	8.1	16.3	22.6			SSE	41	15:09	11.5	73		S	6	1023.0	15.3	57		S	19	1023.2
6	Tu	9.4	16.9	0.4			ESE	37	07:59	10.9	61		SE	19	1024.6	15.1	42		ESE	9	1023.2
7	We	9.0	14.1	3.2			ESE	35	23:20	9.8	76		E	13	1016.9	11.6	91		S	9	1009.8
8	Th	9.3	16.1	16.2			WSW	57	12:50	13.3	68		WSW	28	1011.9	15.1	61		WSW	28	1014.6
9	Fr	11.3	20.4	0.4			W	28	09:16	14.5	59		WSW	13	1021.5	18.9	45		WSW	11	1020.9
10	Sa	12.6	21.2	0			SSW	30	14:17	16.3	59		NNE	13	1020.9	19.6	51		SSW	17	1020.4
11	Su	7.3	24.0	0			WSW	19	13:41	14.6	63		NNE	2	1023.0	22.3	47		WSW	13	1020.3
12	Mo	14.6	28.7	0			NNW	39	11:15	20.7	42		NE	13	1020.3	27.8	25		NW	19	1018.5
13	Tu	13.0	25.4	0			SW	20	15:05	17.6	67		NNW	7	1023.3	24.3	48		SW	9	1022.1
14	We	13.1	32.0	0			NNW	30	11:27	20.9	62		NNW	7	1021.2	30.4	23		NW	15	1017.7
15	Th	20.8	26.8	0			NW	39	12:23	22.0	38		NNE	11	1013.5	23.5	43		SSW	9	1011.8
16	Fr	15.2	20.2	0			NE	35	09:00	16.2	73		ENE	11	1011.8	19.0	79		NNW	13	1011.2
17	Sa	11.9	18.2	2.8			WSW	44	15:20	12.8	76		SSE	9	1015.3	17.4	47		WSW	20	1014.9
18	Su	11.3	17.7	0			SW	39	14:48	12.7	55		S	9	1020.9	16.0	49		WSW	22	1019.7
19	Mo	5.7	18.9	0			WSW	33	13:34	13.1	62		NNW	4	1022.0	17.7	50		SW	19	1018.6
20	Tu	8.5	24.1	0			W	26	11:44	16.0	54		NNE	9	1017.9	22.0	38		WSW	13	1014.7
21	We	11.7	24.9	0			WSW	26	13:53	17.8	58		SSE	6	1015.3	22.6	41		WSW	17	1013.4
22	Th	12.9	26.2	0			ESE	37	20:43	17.7	61		SW	6	1012.3	24.9	42		NE	9	1009.0
23	Fr	17.6	22.6	1.8			E	50	01:25	18.6	68		SE	6	1005.6	20.5	65		SSE	17	1003.3
24	Sa	12.4	17.7	0			SSW	46	13:09	13.2	72		SSW	19	1013.1	14.7	53		S	20	1014.9
25	Su	8.1	16.4	0			ESE	44	08:47	11.7	59		ESE	17	1024.1	14.2	35		SE	19	1022.4
26	Mo	7.9	19.6	0			SE	35	15:33	12.0	61		SE	13	1022.4	16.9	47		SE	15	1019.0
27	Tu	11.4	21.4	0			SW	26	15:44	14.5	73		SSW	2	1020.5	18.0	57		WSW	13	1018.3
28	We	7.7	23.3	0.2			W	24	12:09	15.9	60		N	6	1020.1	20.9	40		WSW	15	1016.8
29	Th	12.9	20.9	0			W	41	15:56	17.5	53		NNE	19	1010.8	18.3	60		WSW	24	1008.8
30	Fr	12.6	18.6	1.2			S	39	10:24	15.1	77		SSW	17	1012.7	16.9	59		S	19	1013.6
31	Sa	13.0	18.2	0			SSE	39	08:41	16.1	57		SSE	17	1018.0	16.2	60		SSE	17	1018.1
Statistics for October 2020																					
	Mean	12.0	21.9							16.0	60			11	1017.5	19.9	49			16	1015.8
	Lowest	5.7	14.1							9.8	28		#	2	1005.6	11.6	23		#	9	1003.3
	Highest	23.9	32.0	22.6			WSW	57		25.7	77		WSW	28	1024.6	31.2	91		WSW	28	1023.2
	Total			50.0																	

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

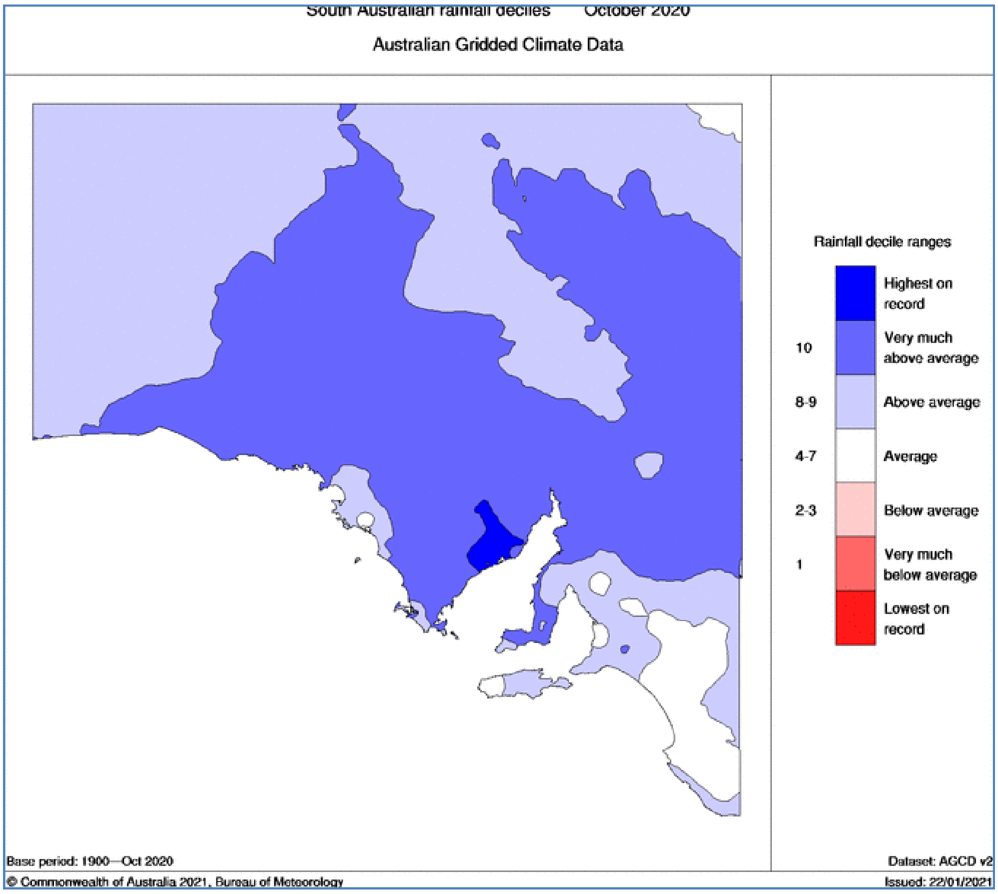
This is the "official" site for Adelaide, having reopened in May 2017. Observations are available from the Kent Town site {station number 023090} up until 31 July 2020.

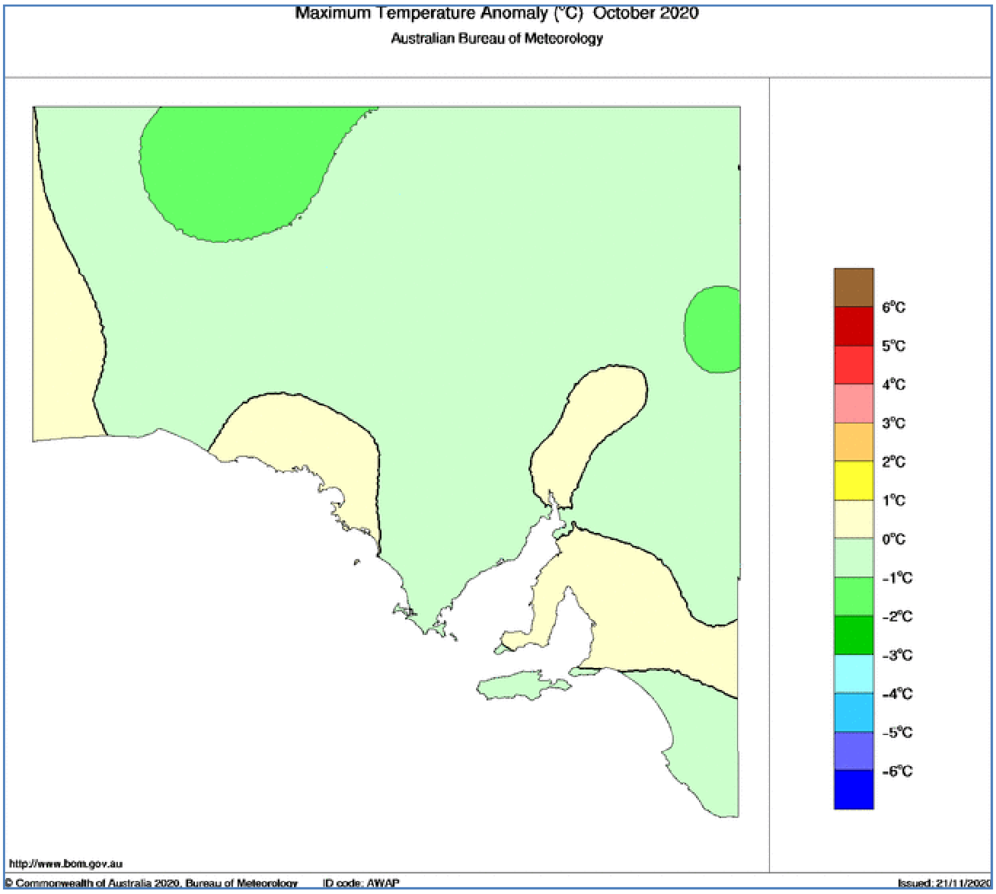
IDCJDW5081.202010 Prepared at 13:02 UTC on 4 Feb 2021

South Australia in October 2020: ninth-wettest on record

Rainfall in October was above to very much above average across most of South Australia, resulting in the state's ninth-wettest October on record and wettest since 2010. Daytime temperatures were generally close to average in the south and cooler than average in the northern Pastoral districts. Several warm nights resulted in above average mean minimum temperatures for most Agricultural districts, but nights were close to average in the state's north and south-east.

For more information plus a summary of October'sstatistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202010.summary.shtml





Greater Adelaide in November 2020: dry and very warm

Rainfall totals in November were less than average across Adelaide and the Hills, with the West Terrace / ngayirdapira site having less than half of its November average rainfall. Both daytime and night-time temperatures were very much warmer than average, with several hot days and warm nights during the month.

For more information plus a summary of November's statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202011.adelaide.shtml

Australian Government
Bureau of Meteorology

Adelaide (West Terrace / Ngayirdapira), South Australia
November 2020 Daily Weather Observations

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

Date	Day	Temps Min	Temps Max	Rain	Evap	Sun	Max wind gust Dirn	Max wind gust Spd	Max wind gust Time	9am Temp	9am RH	9am Cld	9am Dirn	9am Spd	9am MSLP	3pm Temp	3pm RH	3pm Cld	3pm Dirn	3pm Spd	3pm MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Su	7.0	25.9	0			W	30	14:08	15.8	62		NNE	6	1021.0	24.4	37		WSW	17	1019.7
2	Mo	15.6	31.9	0			NNE	39	09:51	24.3	37		NE	15	1021.9	30.1	25		SW	17	1019.3
3	Tu	21.8	35.5	0			NNW	46	10:08	28.6	27		N	19	1016.9	35.3	14		NW	24	1013.6
4	We	13.8	19.3	0.6			SSW	41	17:25	14.8	82		SSW	17	1019.0	17.2	57		SW	20	1019.6
5	Th	7.6	19.2	0.2			SW	41	13:55	13.8	50		SSW	15	1026.5	17.2	43		SSW	11	1025.0
6	Fr	8.8	18.1	0			SW	41	14:36	14.4	51		SSW	7	1025.3	17.6	46		SW	20	1023.6
7	Sa	10.7	23.2	0			SE	31	09:10	15.3	56		SE	13	1027.1	21.7	35		SSE	11	1024.1
8	Su	12.7	28.0	0			ENE	33	03:28	20.0	34		ENE	13	1023.7	26.2	20		ENE	7	1020.1
9	Mo	18.4	33.6	0			WSW	26	12:34	24.3	28		NE	13	1017.7	31.4	12		SSW	9	1013.5
10	Tu	22.5	38.5	0			NNE	54	19:56	31.5	24		NNE	24	1008.7	33.3	28		NNW	24	1005.3
11	We	15.0	25.4	4.8			WNW	50	23:03	18.1	74		N	11	1007.6	24.6	34		WNW	24	1006.4
12	Th	14.8	19.1	0			W	54	23:34	16.0	74		W	19	1008.7	17.6	69		WSW	15	1008.1
13	Fr	12.7	19.8	1.2			WNW	31	12:29	15.2	59		W	17	1009.4	18.7	48		WSW	15	1008.8
14	Sa	11.5	30.1	0			ENE	31	21:36	16.5	56		NNE	11	1010.2	26.2	30		WNW	9	1007.7
15	Su	16.2	38.1	0			WSW	48	16:38	29.3	23		NE	15	1004.0	36.4	10		NNW	17	1000.0
16	Mo	15.1	21.4	0.2			WSW	44	23:52	16.8	60		SW	20	1018.7	19.9	40		SSW	19	1019.7
17	Tu	9.3	25.8	0			NNE	28	10:41	16.6	38		SW	6	1024.2	22.0	32		SSW	13	1021.5
18	We	14.4	33.4	0			NNE	30	08:18	25.8	22		NNE	11	1018.5	32.4	10		WSW	15	1015.0
19	Th	23.5	35.4	0			NNW	48	10:41	29.7	12		NNE	15	1013.3	28.5	36		SW	17	1013.3
20	Fr	12.1	29.7	0			W	30	13:18	18.3	62		NW	6	1019.2	25.9	44		W	19	1017.1
21	Sa	18.0	38.9	0			NNW	31	12:45	24.4	42		NE	9	1015.2	31.2	29		WSW	15	1011.7
22	Su	24.4	30.4	0.2			W	43	11:52	30.4	32		N	13	1010.3	28.0	54		WNW	9	1011.0
23	Mo	15.5	22.9	4.4			WSW	44	15:19	16.8	71		S	13	1017.3	21.4	52		SW	20	1016.0
24	Tu	11.3	23.3	0			SW	30	10:53	16.5	59		WSW	6	1018.1	21.2	52		SW	15	1015.2
25	We	13.9	34.5	0			N	31	11:02	22.7	41		NNW	9	1012.1	33.5	15		NW	15	1008.7
26	Th	15.4	33.0	0			SSE	26	14:59	23.4	47		S	7	1013.3	31.5	29		NNE	11	1011.0
27	Fr	19.4	40.6	0			NNW	46	10:32	32.8	23		NNE	11	1009.2	36.8	19		WSW	13	1007.0
28	Sa	22.4	33.3	0			WSW	50	22:31	26.7	46		WSW	13	1003.5	30.9	27		S	15	1001.4
29	Su	13.8	23.5	2.2			SW	50	00:49	17.6	56		SSE	11	1013.4	20.7	46		SW	22	1013.6
30	Mo	12.0	32.1	0			NNE	41	11:05	20.8	46		NNE	19	1011.5	30.8	17		WNW	20	1005.9
Statistics for November 2020																					
	Mean	15.0	28.8							21.2	46			12	1015.5	26.4	33			15	1013.4
	Lowest	7.0	18.1							13.8	12		#	6	1003.5	17.2	10		ENE	7	1000.0
	Highest	24.4	40.6	4.8			#	54		32.8	82		NNE	24	1027.1	36.8	69		#	24	1025.0
	Total			13.8																	

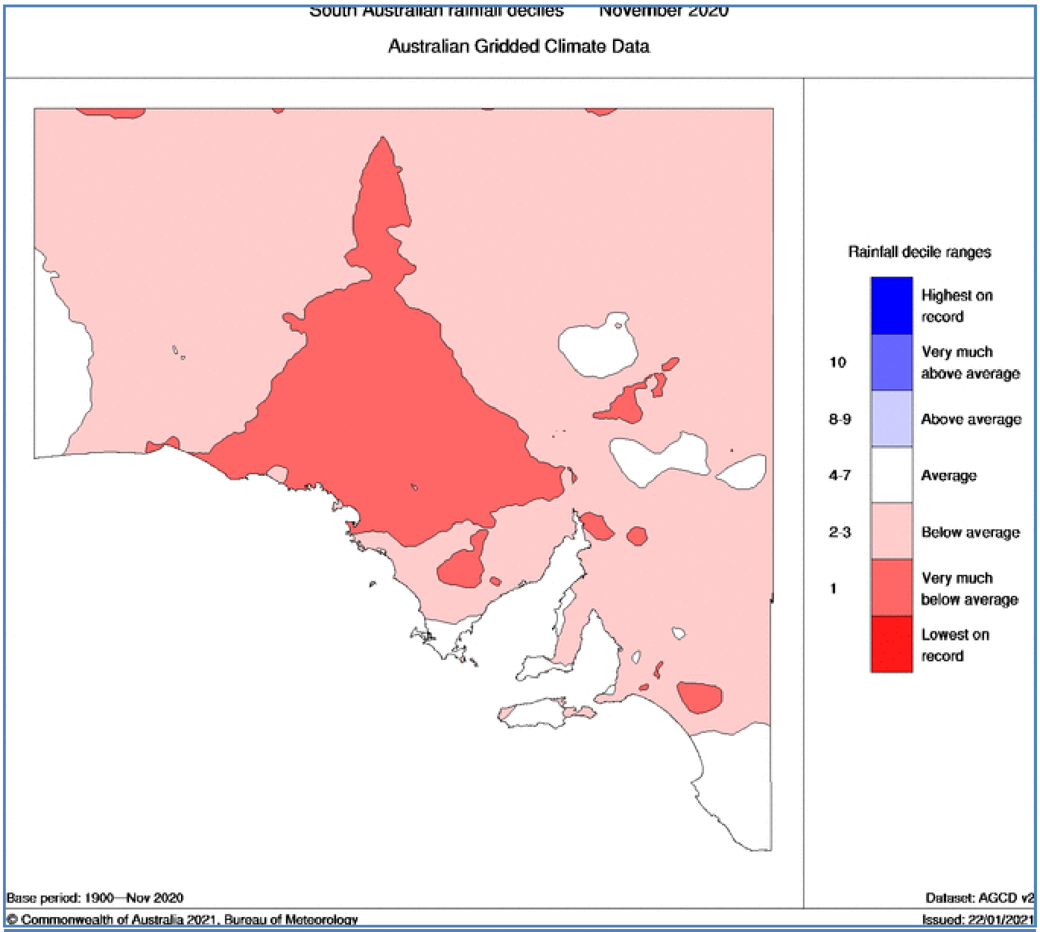
Observations were drawn from Adelaide (West Terrace / Ngayirdapira) {station 023000}
This is the "official" site for Adelaide, having reopened in May 2017. Observations are available from the Kent Town site {station number 023090} up until 31 July 2020.

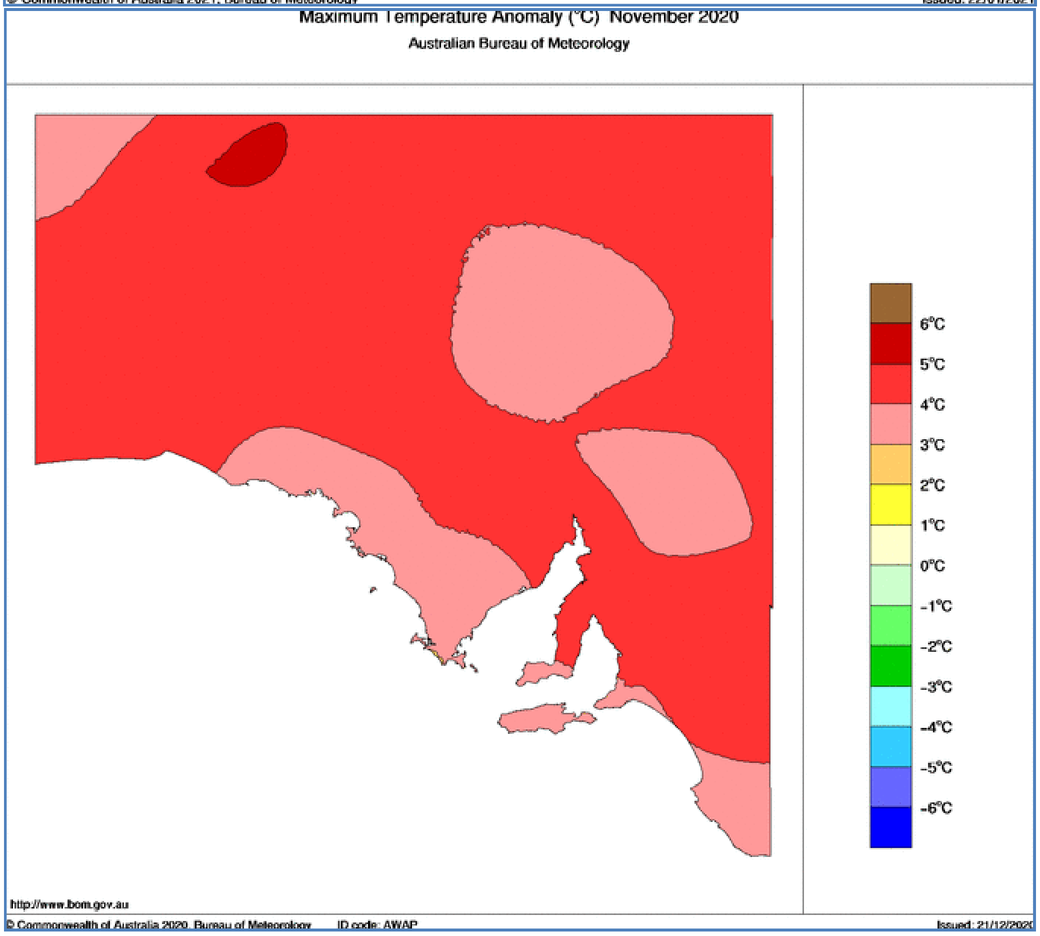
IDCJDW5081.202011 Prepared at 13:02 UTC on 3 Feb 2021

South Australia in November 2020: warmest on record

Rainfall in November was below to very much below average across most of South Australia, making it the state's driest November since 1990. Daytime and night-time temperatures were very much above average for November and the overall mean temperature was the state's highest on record.

For more information plus a summary of Novembers statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202011.summary.shtml





Greater Adelaide in spring 2020: warmer than average

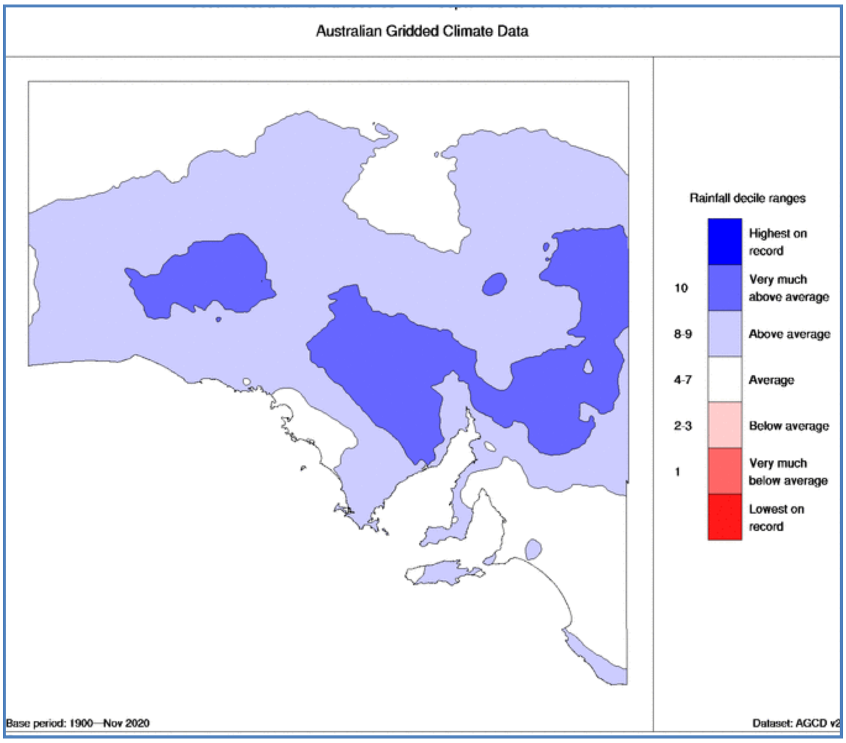
Rainfall in spring was near to or above average across Adelaide and the Hills, despite the season ending with a dry November. Both daytime and night-time temperatures in spring were warmer than average at all sites across Greater Adelaide. Overall, it was Greater Adelaide's warmest spring since 2017.

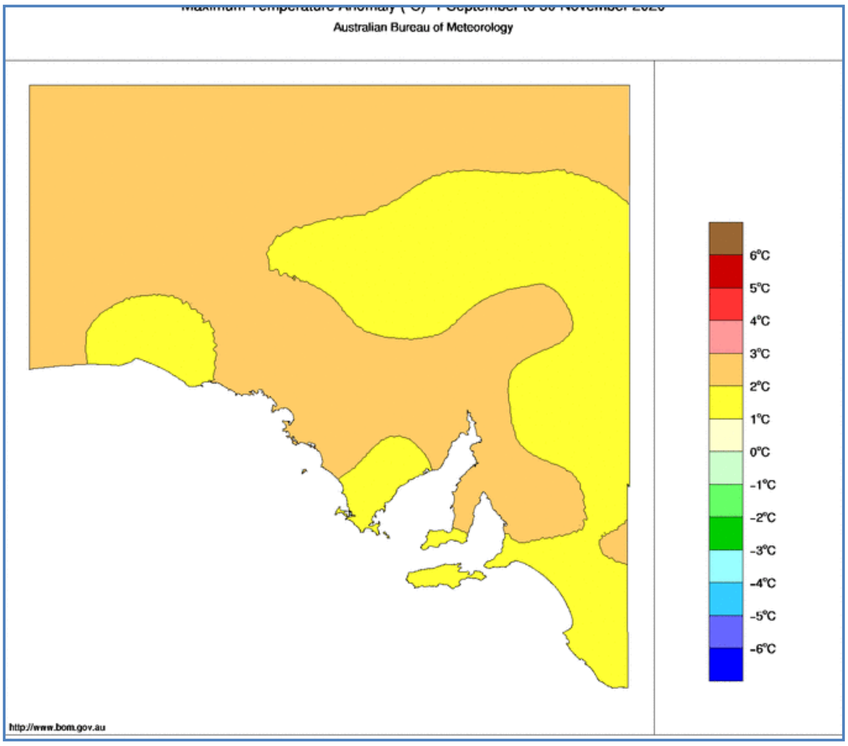
For more information plus a summary of Spring's statistics please see:
http://www.bom.gov.au/climate/current/season/sa/archive/202011.adelaide.shtml

South Australia in spring 2020: third-warmest on record

Rainfall for spring was above average over large areas of central and northern South Australia. Both September and October were wetter than average months for the state, but the season ended with a much drier than average November. Both daytime and night-time temperatures were warmer than average for spring, with temperatures in September and November very much above average. The mean temperature for spring was the third-warmest on record for South Australia as a whole.

For more information plus a summary of Spring's statistics please see:
http://www.bom.gov.au/climate/current/season/sa/archive/202011.summary.shtml





Greater Adelaide in December 2020: drier and cooler than average

December was drier than average at most sites across Adelaide and the Hills. Both daytime and night-time temperatures were generally cool to mild, with most sites having an overall cooler than average month.

For more information plus a summary of December's statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202012.adelaide.shtml

Adelaide (West Terrace / Ngayirdapira), South Australia
December 2020 Daily Weather Observations

Australian Government
Bureau of Meteorology

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

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						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	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Tu	16.9	20.7	4.8			SW	57	13:10	17.8	71		W	20	1011.6	19.2	47		SW	30	1016.2
2	We	12.9	22.1	0			WSW	37	13:53	16.2	47		SSE	11	1025.4	19.4	44		SW	22	1023.8
3	Th	9.9	28.8	0			WSW	31	17:14	19.2	37		NNW	6	1021.1	26.9	15		NW	9	1018.3
4	Fr	11.4	34.1	0			NE	39	22:49	20.9	31		N	6	1017.4	33.2	12		NNE	9	1010.9
5	Sa	20.9	24.1	0			W	63	14:53	24.1	58		NW	22	1001.4	22.7	46		WNW	30	1002.2
6	Su	13.3	21.3	0.6			WNW	54	09:38	16.5	55		W	26	1009.6	20.1	39		W	31	1008.9
7	Mo	12.0	18.0	5.2			SW	56	11:50	15.3	55		SW	24	1012.4	15.8	56		SSW	30	1014.6
8	Tu	12.2	19.8	2.4			WSW	35	16:02	15.1	50		SSW	11	1022.6	18.2	48		WSW	17	1020.9
9	We	9.6	27.5	0			SW	30	11:27	18.7	49		ENE	6	1020.2	24.7	32		WSW	15	1018.1
10	Th	12.8	25.7	0			SSE	37	13:44	17.4	58		SE	15	1023.5	24.7	33		SE	15	1021.9
11	Fr	11.6	29.9	0			SE	39	00:04	17.1	32		WNW	6	1025.1	27.7	12		ENE	17	1020.6
12	Sa	17.1	35.5	0			E	44	02:47	26.5	26		ENE	19	1017.1	34.9	20		NE	20	1012.9
13	Su	25.3	30.9	0			NNE	48	08:55	28.5	24		NNE	19	1012.8	25.6	42		N	17	1012.3
14	Mo	25.2	37.3	0			N	44	09:22	29.8	32		NE	17	1010.2	35.5	22		NNW	15	1008.4
15	Tu	20.3	30.4	0			SSE	35	16:38	26.4	51		N	6	1012.3	29.3	35		SE	17	1011.5
16	We	16.8	27.2	0			SW	37	16:05	20.8	59		SSE	7	1013.0	25.0	52		SW	20	1008.7
17	Th	15.7	21.1	0			SW	43	12:54	18.1	58		SSW	13	1011.3	18.5	52		SSW	20	1011.3
18	Fr	11.7	20.9	0			SW	39	16:18	15.7	44		S	15	1017.7	20.1	41		SW	20	1016.5
19	Sa	10.7	24.6	0			WSW	33	15:54	18.3	46		ENE	7	1019.1	21.6	47		SW	19	1016.6
20	Su	11.5	29.7	0			SW	26	16:47	20.0	36		NE	9	1014.8	26.9	26		WSW	13	1010.8
21	Mo	16.3	21.3	1.0			SW	41	16:47	17.3	73		S	13	1008.3	20.0	52		SW	19	1008.4
22	Tu	11.2	21.6	4.8			WSW	46	15:07	17.0	68		SSW	19	1014.4	20.5	51		WSW	22	1015.4
23	We	12.1	22.2	0			SW	39	15:36	16.8	63			Calm	1021.9	20.8	46		WSW	20	1019.8
24	Th	10.9	26.7	0			SW	37	13:03	18.2	60		N	7	1021.2	25.0	36		SSE	13	1018.5
25	Fr	13.6	29.6	0			WSW	28	14:27	19.4	41		ENE	17	1018.9	28.7	25		SW	15	1015.5
26	Sa	13.7	35.5	0			W	28	14:46	23.1	33		N	4	1013.9	33.1	13		NNW	11	1009.7
27	Su	23.1	26.0	0			SW	59	12:05	25.1	39		SW	19	1005.8	19.6	63		S	22	1008.5
28	Mo	9.2	20.9	0			WSW	44	15:30	15.1	47		SSW	11	1016.8	19.7	32		SW	24	1015.4
29	Tu	10.1	22.8	0			SW	41	15:11	17.2	52		SSW	11	1019.6	20.4	54		SW	20	1017.7
30	We	12.9	29.3	0			SSE	35	19:08	19.3	61		WNW	7	1019.2	27.5	38		WSW	17	1016.0
31	Th	15.3	29.3	0			ESE	35	20:36	20.9	46		ENE	7	1018.6	28.9	26		ESE	13	1015.9
Statistics for December 2020																					
	Mean	14.4	26.3							19.7	48			12	1016.0	24.3	37			18	1014.4
	Lowest	9.2	18.0							15.1	24			Calm	1001.4	15.8	12		#	9	1002.2
	Highest	25.3	37.3	5.2			W	63		29.8	73		W	26	1025.4	35.5	63		W	31	1023.8
	Total			18.8																	

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

This is the "official" site for Adelaide, having reopened in May 2017. Observations are available from the Kent Town site {station number 023090} up until 31 July 2020.

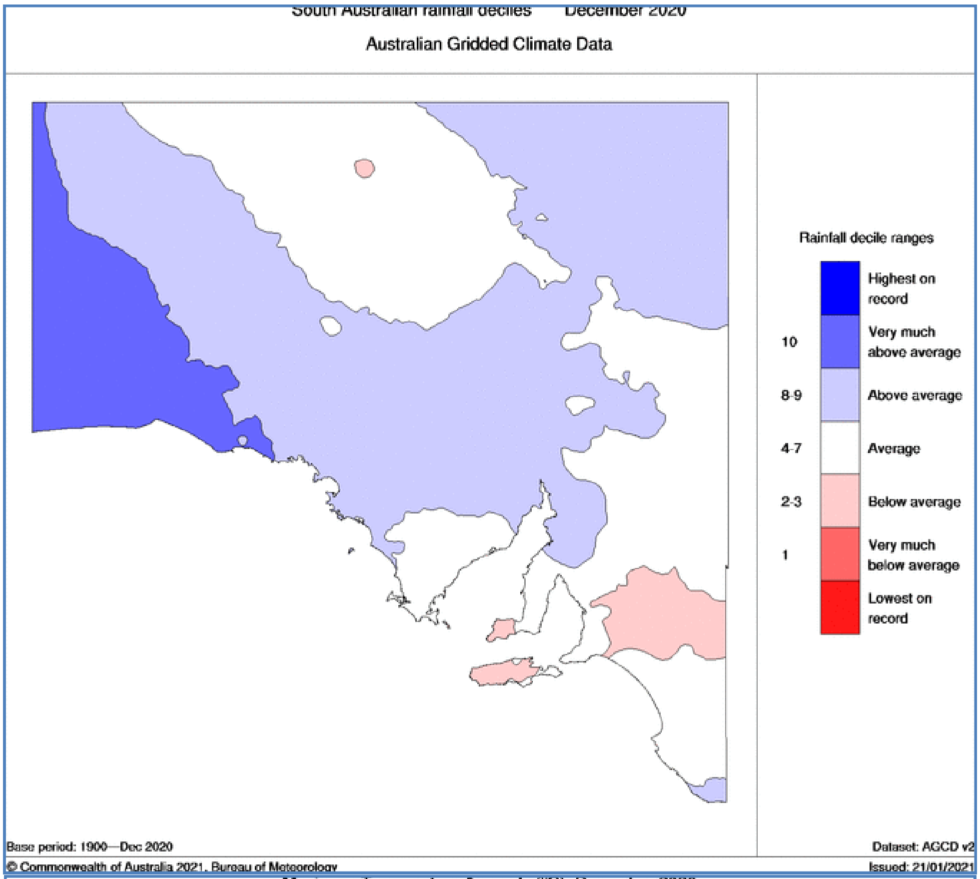
IDCJDW5081.202012 Prepared at 16:02 UTC on 2 Feb 2021

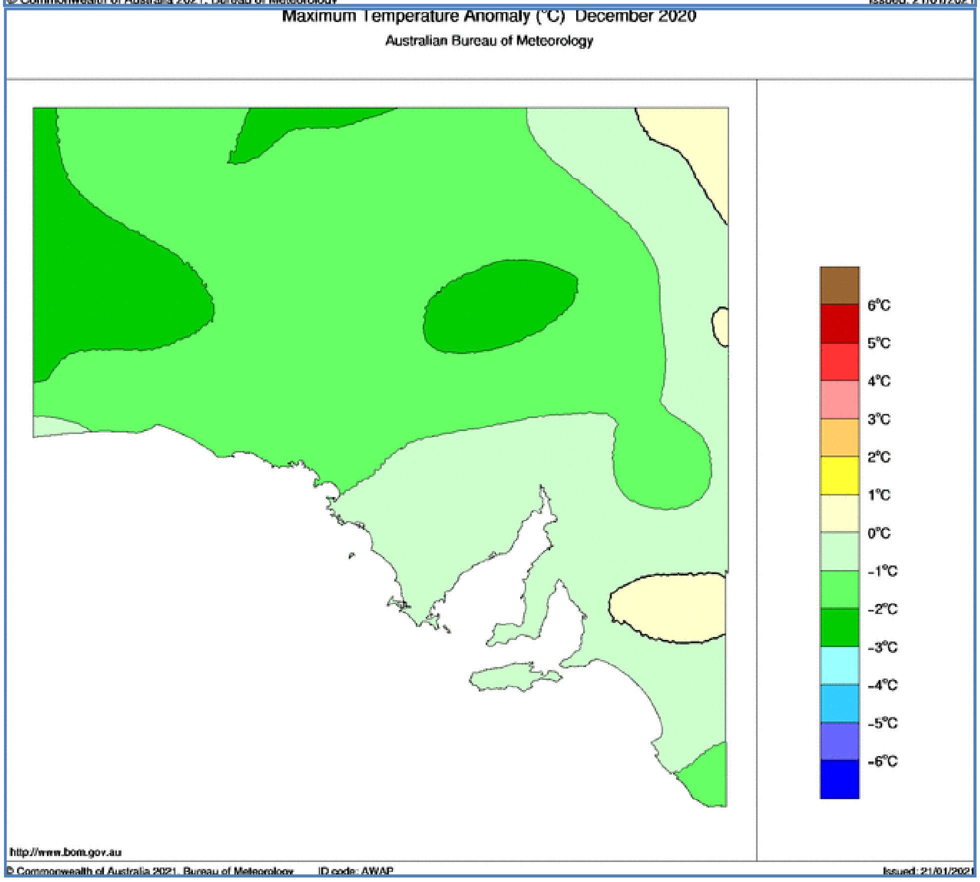
Users of this product are deemed to have read the information and accepted the conditions described in the notes at
http://www.bom.gov.au/climate/dwo/IDCJDW0000.pdf

South Australia in December 2020: cool & wet in the west, dry in parts of the east

Rainfall in December was above to very much above average over much of the state's west and parts of the north, but it was drier than average in some central and eastern Agricultural districts. Daytime temperatures for December were below to very much below average across much of western and northern South Australia. Night-time temperatures were generally close to average across most of the state, but nights were generally cooler than average in Agricultural districts and warmer than average in the north-east. Overall, it was South Australia's coolest December since 2010.

For more information plus a summary of December's statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202012.summary.shtml





Greater Adelaide in 2020: near average rainfall and temperatures

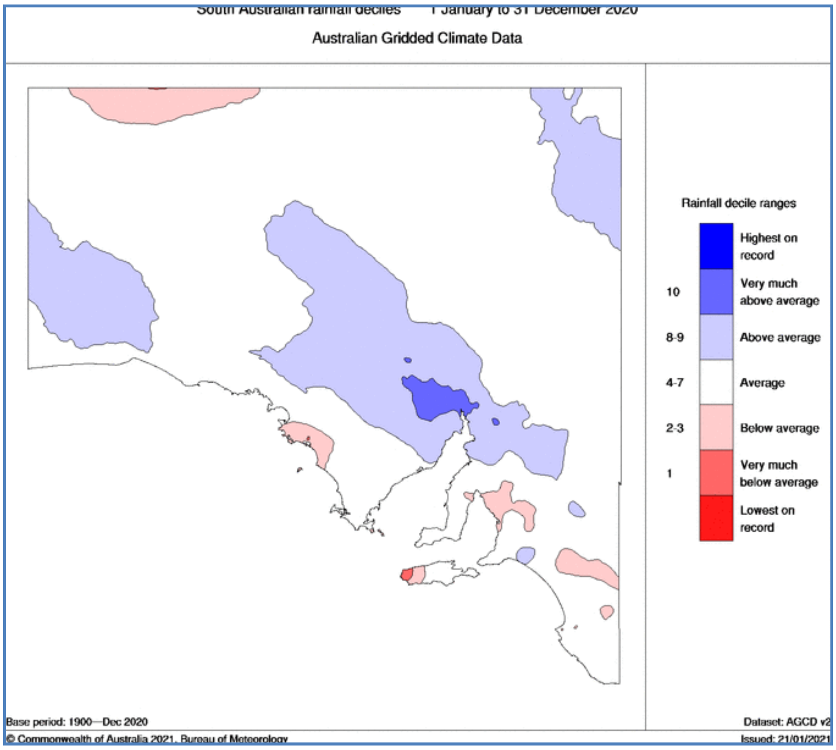
Rainfall in 2020 was close to average or above average at sites across Adelaide and the Hills. Both daytime and night-time temperatures for 2020 were within 1 °C of average at most sites across Adelaide and the Hills.

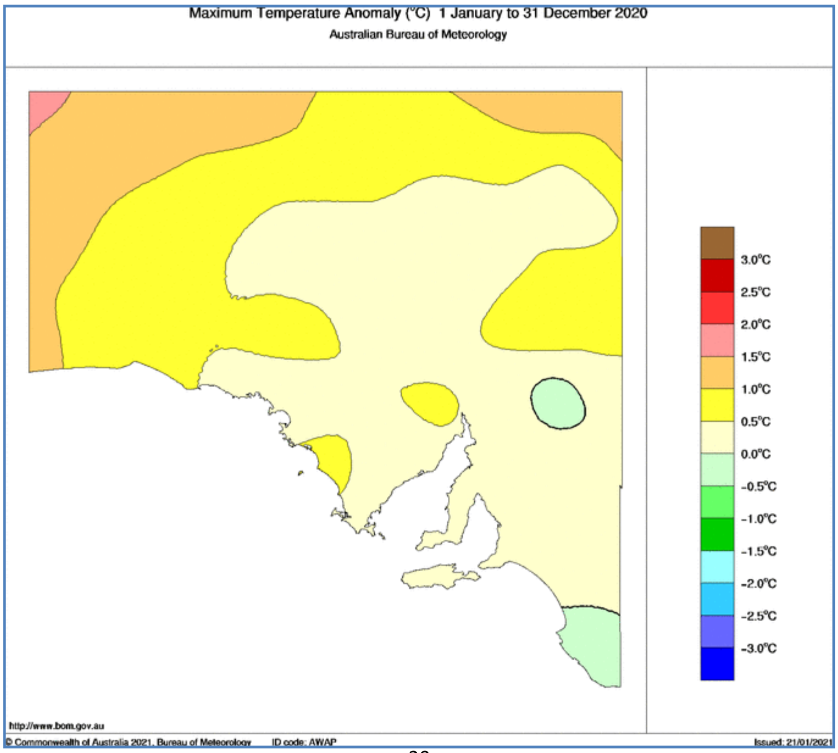
For more information plus a summary of 2020's statistics please see:
http://www.bom.gov.au/climate/current/annual/sa/archive/2020.adelaide.shtml

South Australia in 2020: near average rainfall overall, warm in the west

Rainfall in 2020 was close to average across large areas of South Australia, but it was a drier than average year for some Agricultural districts, including parts of the South East and Eyre Peninsula. Both daytime and night-time temperatures were warmer than average throughout western parts of South Australia in 2020, but nights were cooler than average in parts of the state's south and east.

For more information plus a summary of 2020's statistics please see:
http://www.bom.gov.au/climate/current/annual/sa/archive/2020.summary.shtml





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

NEXT MEETING

6.00 PM TUESDAY 16February 2021

St Saviour's Anglican Church, 596 Port Rush Road, Glen Osmond.

As numbers are limited, tickets are required for this event.

For tickets please book at:

Monitoring Our Air Quality Tickets, Tue, Feb 16, 2021 at 6:00 PM | Eventbrite

Please note that the BOM still has restrictions on non-essential personnel using their facilities, so an alternate venue is being used. All covid requirements for this venue will be complied with.

There is a fee for the rental of the hall, and while the meeting is free, a donation at the door to help with the hire of the hall will be appreciated.

Presentation : Air Quality - an Expert's Analysis

Speaker: Dr Pushan Shah, Environment Protection Authority S.A.

There is increasing evidence that even low levels of air pollution can have adverse effects on our health. With climate change, our hotter, drier summers affect both the dust and pollen counts, while last year's giant bush fires and the recent fire in the Adelaide Hills brought smoke to the metropolitan region.

Dr Shah, a Certified Air Quality Professional, is the Principal Air Quality Scientist, Environment Protection Authority - South Australia, and President of the Clean Air Society of Australia and New Zealand (CASANZ) , SA/NT Branch. As the EPA's Principal Scientist, he is responsible for mapping and improving our understanding of air pollution and its impacts on our South Australian communities. He also delivers authoritative advice to government and private industry on how to avoid adverse impacts from industrial developments. Central to his work is monitoring our air quality and he will explain what elements the EPA monitors and how this is done.

Dr Shah will also cover how individuals can contribute to air quality monitoring using technology at home. This meeting will also be the deferred AGM from 2020.

MEMBERSHIP FEES WAIVED FOR YEAR 2020 - 2021

For further information about AMETA & meeting details please contact:

Secretary:	*Darren Ray*
Phone:	0427872983
Email	secretary@ameta.org.au

For newsletter contributions, comments or suggestions please contact:

Monana	monana@ameta.org.au