Australian Meteorological Association Inc

Monana

THE OFFICIAL PUBLICATION OF THE AUSTRALIAN METEOROLOGICAL ASSOCIATION INC
October 2021

From the President's Pen

by Mark Little

Well, what a year it has been!! We have been lucky in South Australia with comparatively less pandemic related problems than some of the other states, but as Australia-wide restrictions begin to ease, we may have periods where issues increase, rather than decrease. Hopefully, if these events occur, they will be short lived as the "new normal" settles in. How ever it goes, you can rest assured that the AMetA will continue to follow all relevant health procedures to protect our members.

Putting any pandemic glitches aside, what can members look forward to in the 2021-2022 membership year?

Well, the Committee is looking to find the best presenters to keep you informed on the current state of Meteorology in South Australia and around the world. Our aspiration is to be able to put together a list of presenters for the next 12 months. However, this is an aspiration that is not likely to be met any time soon because good presenters are in demand, both professionally and as presenters. It is likely that the best we can do is to outline potential topics and/or presenters, but with the understanding that the farther the meeting is in the future, the more likely it is that it may change.

As has been noted before, the Monana Editor, Bruce, is branching out to undertake new adventures, leaving less time for the arduous duty of hunting up articles and publishing the magazine. Bruce has been a great editor, but there comes a time when the call of other activities must be answered. As a result, Monana will be reduced to a single edition per year—unless someone else wants to take on the role of Editor.

To fill the void created by the reduction in annual magazine issues, a new eBulletin will be sent to members on a semi-regular basis. In fact, a couple of eBulletins have already been sent out. Members are encouraged to provide items for this eBulletin, but unlike the magazine, this can consist of just a sentence of two and perhaps a link where members can find out more information. As long as it is weather-related, it can be about almost anything, even For Sale or Wanted messages.

While the AMetA currently has a positive bank balance, our finances are still teetering on the edge of making a loss. Should it turn out that the AMetA goes back to hiring a hall for our meetings, our financial situation will become tighter. Since the membership fee is probably about right at $20 ($4 per meeting) and we are asking for donations from visitors, it is time for the AMetA to think about how we can get more members.

Now all the pep-talks are out of the way, it is time to talk about the good stuff. The End of Year Function has been booked in the area downstairs at the Benjamin-on-Franklin Hotel on the evening of Tuesday, the 23rd of November. The AMetA has dined at this establishment before and a good time was had by all, so don't forget to let the Secretary (Beth) know if you wish to come. More information including links to the hotel and its menu, as well as the contact email to register your attendance will be provided in a later eBulletin.

Well, that is about it from me for the moment, so you can get on with reading the always interesting articles in this magazine.

Keep Happy, Keep Safe.

Mark Little

President

Transformations at the Bureau of Meteorology

By Beth Walton

Paul Lainio

At the AMetA annual general meeting in August, Paul Lainio, BoM Decision Support Services, provided an extremely interesting overview of major transformations occurring at the Bureau. Through utilising advances in data acquisition, modelling capability and scientific understanding, the Bureau is strengthening meteorological services for all Australians; aiming to contribute to ongoing reduction in lives lost due to natural hazards, and to making an annual contribution of ~$2billion in value towards the nation's social and economic outcomes by 2022.

In 2017 a 6-year program to comprehensively redesign the Information and Communications Technology (ICT) systems commenced. Priority was given to addressing security, stability and resilience. Improved modelling capability – both higher resolution and the ability to model small scale processes such as convection, is enabling many new products to be developed.

The Public Services transformation got underway in 2019 and involves consolidation of basic operational forecasting services to just two centres, Melbourne and Brisbane. These centres will also serve as Environmental Prediction hubs, building expertise in hazard warning (eg bushfires, severe storms, floods, tropical cyclones....) and coordinating operational warning services. A small contingent of state-based forecasting staff will remain in each capital city, capable of surging quickly into operational mode when required and working jointly with the larger centres to provide local warning services. South Australia will be part of an Environmental Prediction Centre for Marine and Antarctic Services (in conjunction with Tasmania).

As a first step in revamping state operations, 2 - 7 day forecasts and beyond (weather and seasonal) for South Australia are already disseminated from one of the National Centres. Shorter term forecasts are to be transferred by 2022. This will free up some state forecasting staff to work with local stakeholders (especially Emergency Services and the media) to gain a better understanding of 'weather triggers' and the way weather impacts decision making. Insight gained will be used to further enhance services.

The ACCESS suite of numerical models underpin both weather and seasonal forecasting services. For weather forecasting the global model ACCESS-G, with

Covid Safe Entry

The Meeting Audience

resolution of 12x12 km in mid latitudes, is run out to 10 days with reruns every 6 hours. In well populated areas (see Fig 1) higher resolution models (ACCESS-C), with grid points at 1.5km, are initialised using forecast output from the global models to provide detailed local forecasts.

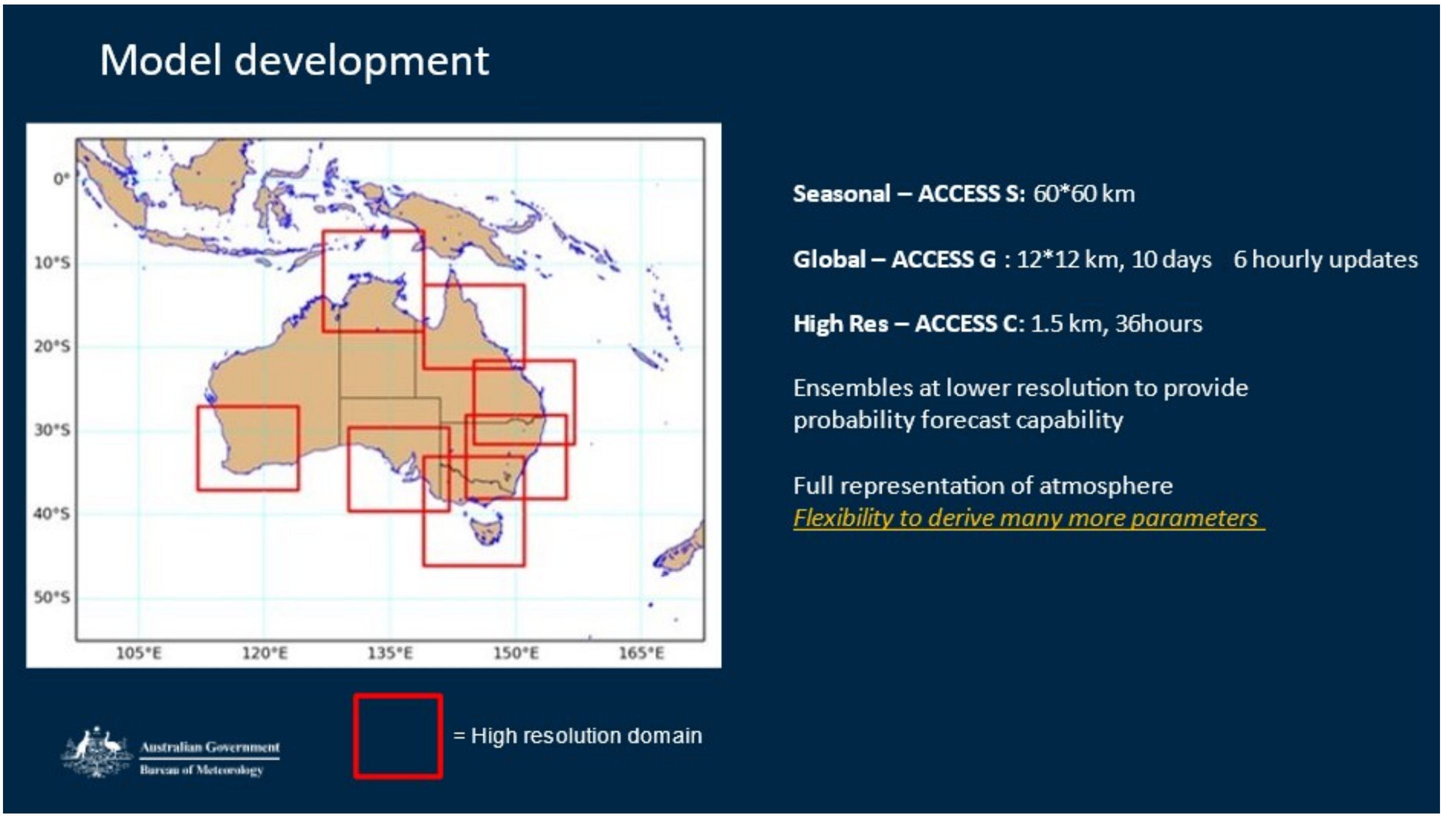

Fig 1 showing the regions covered (outlined in red) by detailed forecasts using high resolution ACCESS-C output.

The increased computing power is also being applied to reanalysis and climate projection projects. Reanalysis of the 29 year period 1990-2018 is providing hourly data at fine spatial resolution (12km over the Australian region and 1.5km over selected cities, including Adelaide), and with 70 atmospheric levels to better investigate past high impact weather events. More than 100 different meteorological parameters can be generated. These reanalyses will improve future forecasts and give a greater understanding of and preparedness for extreme weather.

Another modelling advance for the Bureau is the Rainfields Project. It uses a blend of rain gauge observations and quality controlled rainfall volume data from 66 weather radars across the continent, to enable rainfall accumulations (for periods of 5 mins to 24 hr) to be generated within any radar domain (a radius up to 200km). Combining this information with numerical model output, such as convective activity generated from the fine resolution ACCESS-C model, gives potential to produce Quantitative Precipitation Forecasts across Australia.

The increased computer power also enables repeated runs of the numerical models over the same time period, using slightly different, but still plausible, initial conditions. This is termed ensemble modelling. The suite of possible forecasts generated can then be ranked to determine not only the most likely or most common outcome (ie the mean forecast, or that with a 50% chance of occurring) but also the less likely outcomes (e.g. those with only a 10% probability) but which, if they did occur could produce extremely hazardous conditions. These more extreme forecasts can assist specific users with risk assessments e.g. emergency services can prepare contingency plans in heavy rainfall/ flood situations. The suite of forecast products can also be used in sensitivity analyses - assessing the impact of small variations in input parameters. This type of ensemble modelling can contribute to climate change projections out to 2100.

How does the transformation affect us? Apart from improved forecasting services, watch for a significant revamp of the BoM website later this year. Feedback on the new design and accessibility will be sought from users. There is also an expanding use of communication platforms (Webinars, You Tube, Instagram, Blogs, Facebook, Twitter etc) not only to deliver forecasts and other servicers but also for public interaction and as a means to improve the community's understanding of meteorology.

AMETA AGM REPORTS

The AMETA AGM was held on Tuesday August 24th 2021 at the conclusion of the general meeting.

The following reports were presented:

President's Report 2020-2021

As stated in the latest edition of Monana, there are going to be a few changes on Committee. Although I said in the latest "From The President's Pen" in the Monana that I would not be nominating for President, after discussions with the rest of the Committee, I have decided to re-nominate for President. I was offered a chance to update my article in the Monana, but I'm afraid that I was slack and didn't update the piece about not nominating for President.

So, now that my apology is out there, it is time to review the year that was – well, the year from the last AGM (February this year), and to gaze into the crystal ball for the upcoming year.

This year there will be a significant change to the Committee with Mac and Bruce stepping down. Thanks for all the good work. Many thanks to those who have nominated, but we still need another two General Committee Members to make up the Committee as defined by the Constitution.

The members nominating for the Committee are:

President:	**Mark Little**
Vice-President:	**Warwick Grace**
Secretary:	**Beth Walton**
Treasurer:	**Jon Lethbridge**
Committee Member:	**Dave Brown**
Committee Member:	**Gary Goland**
Committee Member:	**Graham Boyce**

As a reward, nominating members will be eligible for a two-week all expenses paid holiday to …Oops! Just remembered COVID. 😢
It looks like we will need to postpone that until another AGM.. 😊

On a more serious note, the AMetA is in a better financial position than expected because members of Committee have been donating not only their time for the tasks that they do, but in most cases, they have elected to donate the money needed to carry out those tasks. While that was appreciated in a time when the Association was coming to grips with having to pay for things like hall rental, in the end it was unfair to allow those people to fund the enjoyment of other members from their own pockets. I think that it is important members appreciate the dedication of their committee members.

Our long serving Editor for the **Monana** (Bruce) is stepping back from all the work it takes to publish the magazine to enjoy other activities. If members would like to keep getting the **Monana** regularly, they will need to step up to help with the production of the magazine and to make sure that there are articles to include in the magazine.

The Constitution says that only one edition of **Monana** is required per year. If that suits you, then you don't need to do anything. However, if you want at least the current number per year, be sure to let your committee know. However, in that case also be prepared to say how you can help make sure that the **Monana** continues as you would like.

Normally, one of our problems is finding a speaker who is available on the meeting date. Now things are a bit different in that a couple of Probus Clubs are looking to get a speaker from the AMetA to talk at their meetings. It is a bit of a change to be sought out to provide speakers, rather than seeking speakers for our meetings.

AMETA Financial Statement 2020 - 2021

AMetA Society Cheque Account

Opening Balance(30 June 2020):	$3,583.00
Account Interest:	$0.12
Term Deposit Interest:	$21.00
Subscriptions (EFT, Cheque):	$1749.24
Books (EFT)	$38.00
Donations (EFT)	$3.92
Closing Balance (30 June 2021):	**$3,825.28**

Cash Holdings

Cash Holding (30 June 2021):	**$430.10**

AMetA Term Deposit Account

Opening Balance (1-August-2020):	$2,000.00
Closing Balance (30 June 2021):	$2,000.00
Balance (30 June 2021):	**$6,255.38**

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Weather the Words?

by Dianne Davis

Walking through a shopping centre the other day during lunchtime (with required mask firmly in place) I heard, as one does, snippets of conversation of passers-by. And what struck me was that all the discussions were about the weather. This brought home to me once again the pivotal role that weather plays in our lives and in our language.

That morning I had shot out of bed ***like a thunderclap*** because the alarm had failed. It was ***raining cats and dogs*** and as I tried to find appropriate clothing for the **foul** and **harsh** conditions outside, I knew I was ***losing my cool***.

I ran at ***lightning speed*** to the bus stop where, as usual, the others waiting there gave me the ***cold shoulder***. Not a ***bright face*** amongst them – just ones giving me an ***icy reception.***

On the bus I passed a park and saw people ***warming up and cooling down*** their bodies according to where they were in their routine. Mind you most looked ***freezing*** in their skimpy gym clothes, but with their ***faces all steamy*** with sweat. No doubt they thought that all would be as ***right as rain*** when they were fit.

As I neared the office, I knew that there would be ***dark clouds ahead***. I hoped that there would have been ***a thaw in the relations*** between two colleagues and pondered why they were always so ***bleak*** with one another. Their ***arid*** faces and ***burning*** anger were always present. Surely coming to work like that would mean it must always feel ***like a wet week*** with constant ***dark clouds on the horizon***.

On the other hand, the new recruit had such a ***sunny personality*** that they always seemed to be on ***cloud nine*** and was like a ***breath of fresh air*** around the place. In addition, the innovative boss from another branch had moved at ***hurricane*** speed to bring about a new ***dawn.***

The boss entered with the design for our new building, and I was ***completely blown away by it***. Or, as one of the others said they were, ***completely thunderstruck***. It seemed as if from now on, physically at least, we would have reason to ***look on the bright side***. When we were asked for feedback, there were ***floods of comments*** and the ***doldrums seemed to have lifted***. It looked like ***blue skies ahead***.

To celebrate, that evening we all went out for drinks. Unfortunately, many of us ***ended up under the weather!***

The latest Report from the Intergovernmental Panel on Climate Change *by Beth Walton*

In August 2021 the Intergovernmental Panel on Climate Change (IPCC) released '**Climate Change 2021 – The Physical Science Basis'**, the first of 4 component reports of its 6th global assessment (AR6). It provides the most up to date physical understanding of the climate system, observed climate change and possible pathways to limit future climate change. The report is based on comprehensive assessment of peer reviewed literature accepted up to 31 January 2021.

Some Observed Changes in aspects of the Climate System

- Atmospheric Carbon Dioxide Concentration – the highest in 2 million years
  - (Other greenhouse gases are also increasing – e.g. Methane and Nitrous Oxide)
- The ***rate*** of Global Warming – unprecedented in at least the last 2000 years
- ***Global*** Sea Level Rise – the fastest rate in 3000 years
- Arctic Sea Ice (late summer) – the lowest areal extent in 1000 years.
- Glacial Retreat (areal extent) – unprecedented in more than 2000 years

Climate change is widespread, rapid and intensifying

Stabilising the climate will require strong, rapid and sustained reductions in Green House Gas emissions, including reaching net zero CO_2 emissions (the dominant greenhouse gas).

(WWW.IPPC.CH[1] 09 August 2021)

The Report shows that greenhouse gas (GHG) emissions from human activities are responsible for approximately 1.1°C of net global warming since the period 1850-1900 and finds that, averaged over the next 20 years, global warming is expected to reach or exceed 1.5°C (compared to 1850-1900). **Unless there are immediate, rapid and large scale reductions in GHG emissions, limiting warming to close to 1.5°C or even 2.0°C will be beyond reach.**

Projections in the Report show that in the coming decades, climate changes will increase in all regions of the globe. For 1.5°C of global warming, there will be increased heat waves, longer warm seasons and shorter cold seasons. At 2°C global warming, heat extremes would more often reach critical tolerance thresholds for agriculture and health.

But it is not just about temperature:

[1] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.

Other changes which will increase with further warming

- **The water cycle is intensifying**.
- This brings more intense rainfall and associated flooding as well as more intense drought periods
- **Rainfall patterns are affected.**
  - In high latitudes, precipitation is likely to increase but it is likely to decrease over large parts of the subtropics.
- **Sea level will continue to rise throughout the 21st century**.
  - Extreme sea level events in coastal regions that may previously have been a 1 in 100 year event could happen every year by the end of the 21st century.
- **Changes in the ocean, including warming, more frequent heatwaves, ocean acidification, and reduced oxygen levels** have been clearly linked to human influence.

Detailed regional assessments, including information that helps translate physical changes in the climate (e.g.. changes in temperature, rainfall patterns and extremes, wind, etc) into the significance for society and ecosystems are included in the report. This data can inform risk assessment, adaptation and other decision making. Further information can be explored in detail and at an advanced level in a newly developed interactive Atlas at: https://interactive-atlas.ipcc.ch/

The 6th IPCC Assessment Report

IPCC reports provide the most authoritative information on how our climate is changing. There are 195 member countries on the Intergovernmental Panel. This latest Working Group I Report was compiled by 234 authors from 66 countries. An additional 517 authors made contributions and over 14,000 references were cited!.

Two more reports focussing on **'Impacts, Adaptation and Vulnerability'** (from IPCC Working Group II) and **'Mitigation Options'** (from IPCC Working Group III) will be released early in 2022.

The final report of this Assessment, the **AR6 Synthesis Report**, will be released in September 2022.

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)*

WHEN ICE ISN'T NICE

by Bruce Davis

Figure 1: SAAB 340 operated by REX Airlines. Source Wikimedia

The inspiration for this article came after recently watching an episode of the TV program "Air Crash Investigation". The program in question covered the crash of a SAAB 340A turboprop aeroplane in Argentina in 2011 killing all 22 on board (Sol Líneas Aéreas Flight 5428). This aeroplane type is commonly used in Australia by Regional Airlines such as Regional Express on the Adelaide to Whyalla route (see Figure 1)

As with many accidents, multiple factors contributed to the accident with human factors being the final cause. However, the chain of events started with airframe icing.

Many people incorrectly believe that, given Australia's climate, aeroplane icing would not be a problem. That is not correct as a search of the Australian Transport Safety Bureau (ATSB) incident database shows. The most affected aeroplanes are turboprops like the SAAB 340 as they tend to spend more time in icing conditions. Jet engine airliners often climb quickly through the icing layers and cruise above them.

One such icing incident from this database refers to the same type of aeroplane. On 5 November 2008 at about 1838 Eastern Standard Time, the flight crew of a Saab Aircraft AB 340B, (VH-UYI), identified an incipient (approaching or the onset of a) stall while flying a holding pattern in icing conditions. The aircraft's stall warning system did not activate. The pilot in command disconnected the autopilot and recovered the aircraft from the stall. During the recovery, both engines exceeded their maximum continuous operating temperature for an extended period. The Aircraft Operating Manual stated that the Saab 340B stall warning system had an activation level designed for a clean wing only. Subsequently SAAB issued updated operating procedures for flight in icing conditions, designed to prevent ice build-up on the airframe.

This report is interesting in that it suggests that the aeroplane's stall warning would not operate correctly in the icing conditions encountered. Fortunately, the crew recognised the problem and were able to take corrective action – although the process required exceeding the design limitations of the aeroplane.

Ice affects both the powerplant and the airframe. All effects are negative.

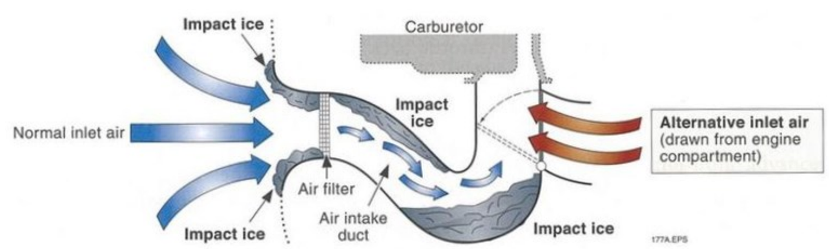


Figure 2: Piston Engine Impact Icing *Source: UniSA*

The engine effects are normally due to the blocking of the air intakes of both piston and jet engines aeroplanes when moisture in the airstream freezes on impact with inlet components. However, the effects often occur at temperatures above freezing and often in clear air. This is because air passing into the engine (in both piston and jet engines) frequently undergoes rapid expansion with subsequent adiabatic cooling (Cooling of a parcel of gas by expansion, with no heat exchange between the parcel and the surrounding air). (See Figures 2, 3 & 4).

In piston engine aeroplanes with a carburettor (such primitive technology still exists in aircraft engines) the cooling process is also aided by latent heat absorbed as fuel evaporates. Hence intake icing can occur at temperatures around 30° C providing the air is sufficiently humid and engine power setting is low. Interestingly, in Australia, such icing is more likely in winter whereas in England it tends to occur more often in summer.

One form of induction icing peculiar to jet aeroplanes occurs during flight through air containing small ice crystals (often invisible). These very small ice crystals melt as they impact on the warm internal engine components enabling adhesion to occur. A thin film of super cooled liquid (water still in liquid form at temperatures below 0°C) may then form over parts of the engine, enabling the further build-up of ice crystals. The sheer volume of these partially melted crystals cools these surfaces below freezing, causing ice accumulation in the engine core. This reduces the internal temperature of the engine leading to various engine malfunctions.

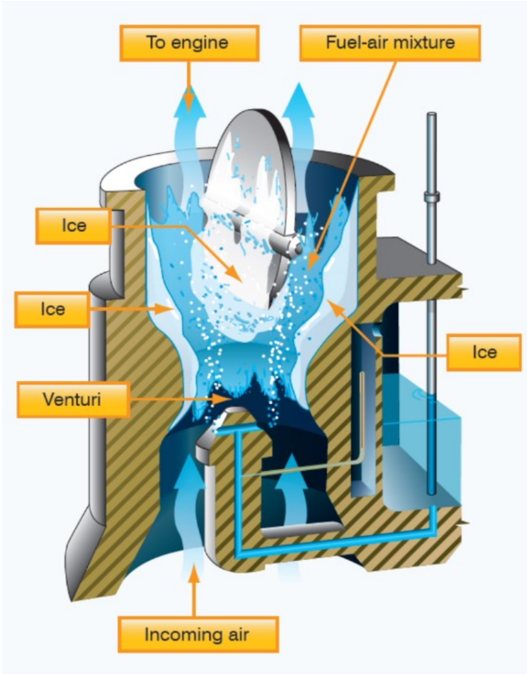


Figure 3: The formation of carburettor ice may reduce or block fuel/air flow to the engine. Source: FAA

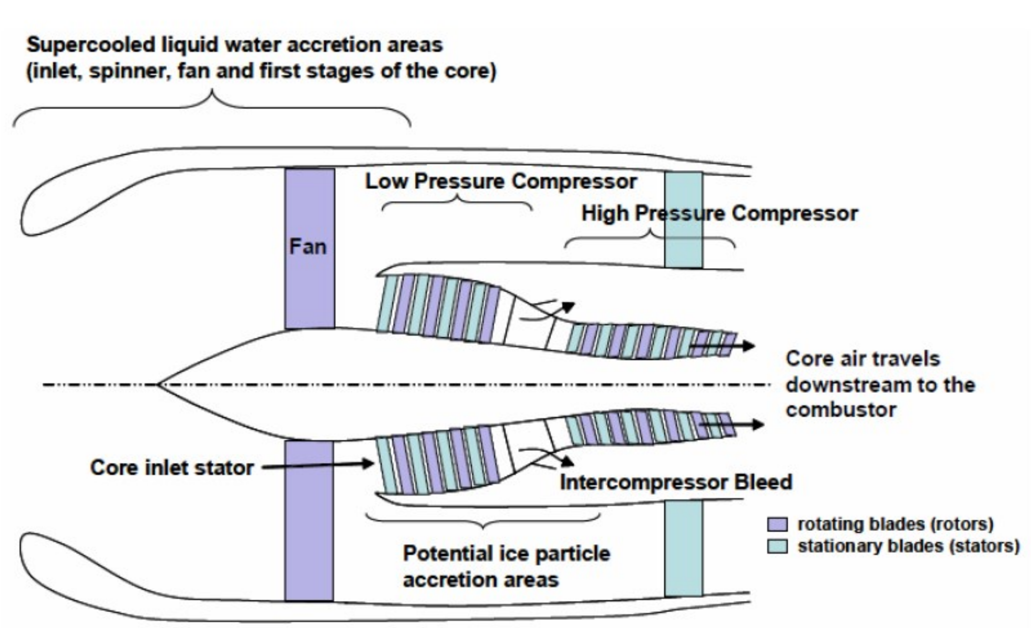


Figure 4: The schematic of potential ice accretion area in a typical jet engine. Source: Iowa State University

Hence a means of melting the ice is required. For piston engine aeroplanes this is achieved by using the exhaust system to heat up an alternate source of intake air. In jet engines air that has been heated by the compression process in the early engine stages is bled off to heat the engine nacelles. One drawback is that this anti-icing reduces power available from the engines.

Airframe icing normally occurs at low temperatures. Here I will only consider the major problems in flight through cloud. Airframe icing refers to ice that accumulates on the airframe, particularly the aerofoil surfaces of the wings.

An aeroplane in flight is under the influence of 4 basic forces. These are lift, weight, thrust and drag (see Figure 5). Airframe ice has a negative effect on each. It increases the weight. If it forms on a propellor (or reduces the airflow into a jet engine) it reduces the thrust. The major effects, however, are on lift and drag. Here ice changes the shape of the wing surface usually making it rougher. This increases the drag but, more importantly, alters the airflow over the wing reducing lift and hence increasing the stalling speed. Experiments have shown that as little as 1 cm of ice on the leading edge can reduce lift and increase drag, each by up to 50%. This would increase the stalling speed by more than 50%.

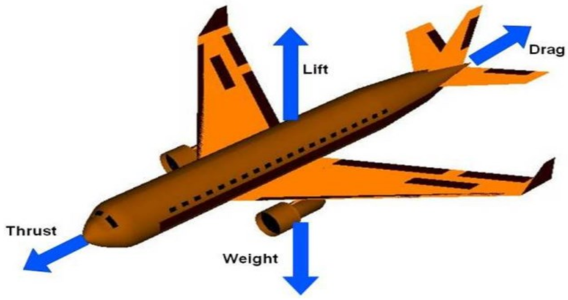


Figure 5: 4 Basic Forces of Flight . Source: NASA

One cm or more of ice can accumulate in a minute or two in heavy icing conditions. Tests conducted at NASA Glenn Research Centre on several modern aerofoils demonstrated that exposure to clear icing for 2 minutes could also reduce the critical (stalling) angle of attack by up to 8 degrees. Coupled with the extra weight this would further increase the stalling speed.

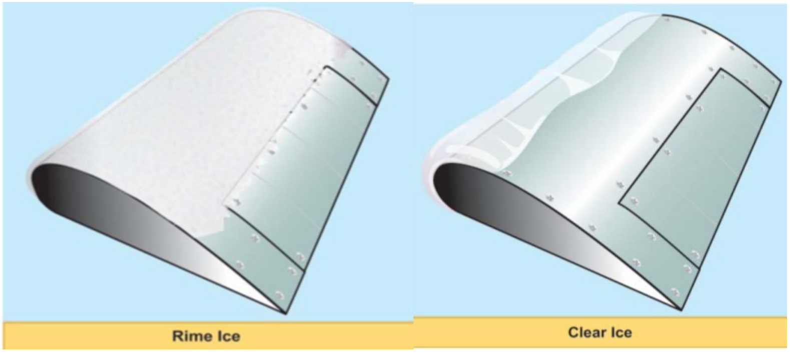


Figure 6: Rime & Clear Ice. Source: FAA

There are considered to be 3 major types of airframe ice that occur in cloud. These are rime, clear and mixed. They are formed when supercooled water droplets in the air impact on an airframe and immediately freeze.

Rime Ice (see Figures 6 & 7) has a granular, opaque 'white' appearance and is formed when super cooled water droplets rapidly freeze on impact with the airframe. The granular appearance is due to air being trapped within the ice. It tends to occur during flight through clouds consisting of small droplets (e.g., stratiform clouds) at temperatures well below freezing (see Figure 10). This type of ice is far easier to remove than clear ice.

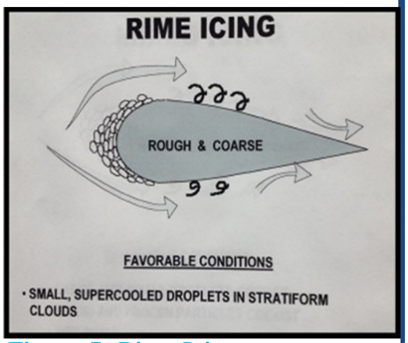


Figure 7: Rime Icing
Source: NOAA

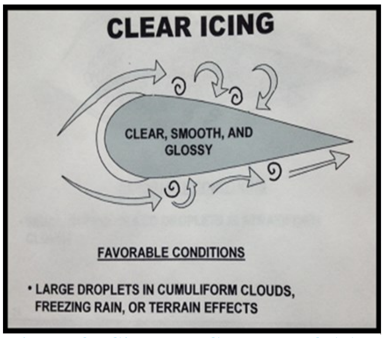


Figure 8: Clear Ice Source: NOAA

Clear Ice has a clear, glassy appearance (see Figures 6 & 8) and is formed by slow freezing of super cooled water droplets. A small amount of the droplet freezes on impact and the remainder flows back over the airframe surface slowly freezing. The latent heat released during the freezing process contributes to the spread of the ice. Clear ice tends to occur during flight through clouds with large droplets (e.g., cumulonimbus and nimbostratus) and at temperatures not far below 0^0C (see Figure 10). It is very dense & hard to remove.

The final form mixed ice (see Figure 9) is, as its name implies, a mixture of rime and clear ice. This is the most common form of airframe ice and most likely to form in cloud in the temperature range of -10ºC to -15ºC.

As with engine icing, for flight to occur through icing conditions a means of preventing / removing ice accumulation must be provided. [Strictly anti-icing refers to ice prevention whilst de-icing refers to ice removal. However, these 2 terms have come to be synonymous over the years and here I will use them interchangeably.]

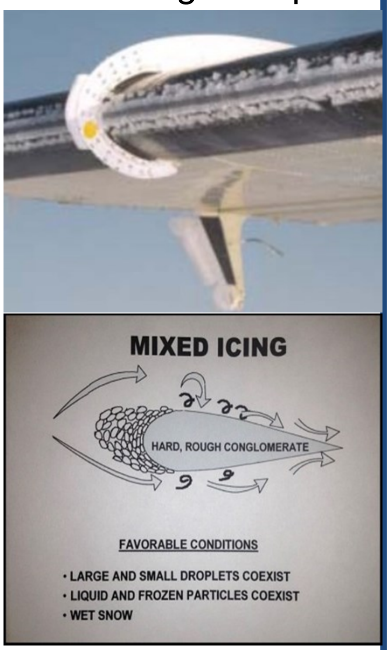
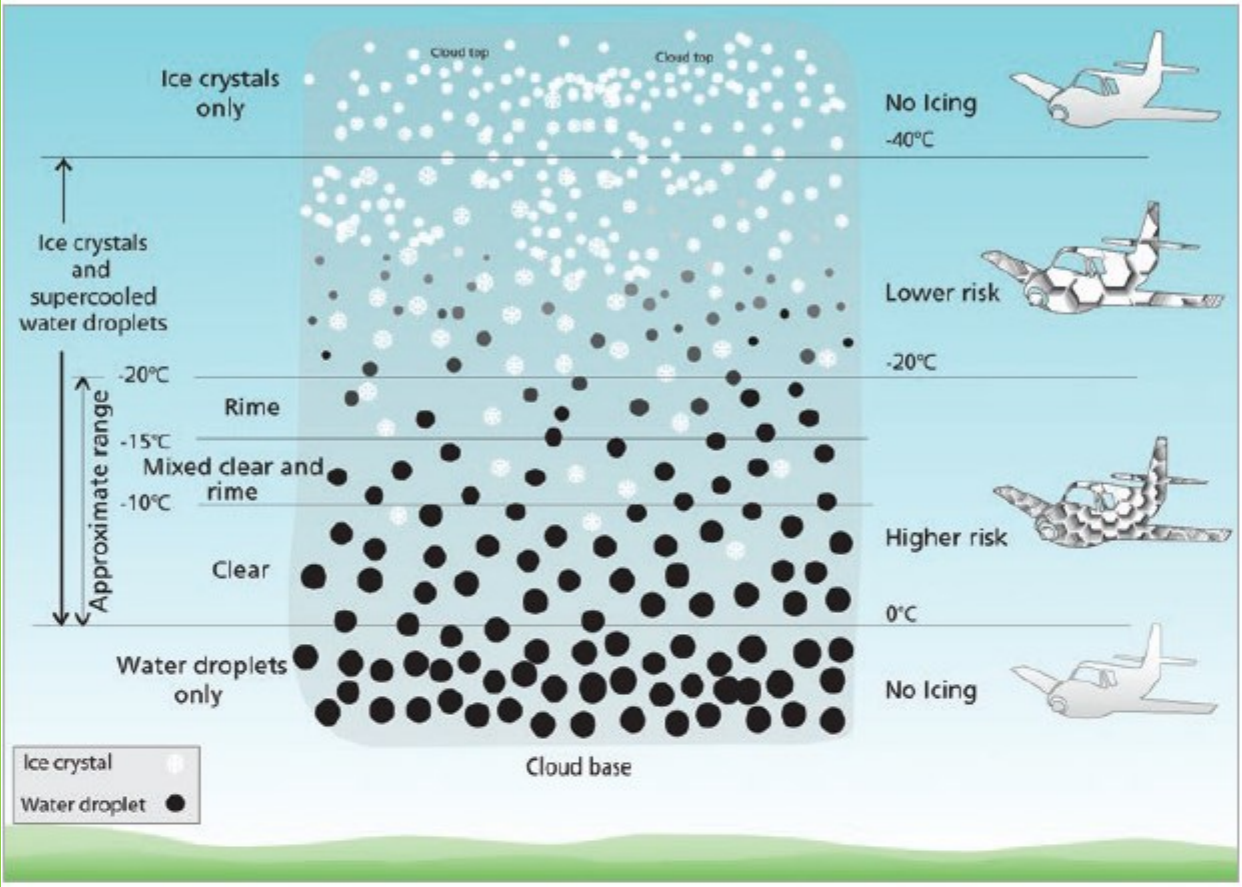


Figure 9: Mixed Ice
Source: NOAA

Such equipment is not very common on piston engine aeroplanes and so these are not normally certificated for flight in icing conditions. Sometimes electrical heating may be provided for the



Droplet size and concentration are characteristic of different cloud types. The broad relationship between cloud type and icing are:

Code	Cloud Type	Icing threat
CB	Cumulonimbus	Possible severe clear ice
TCU	Towering cumulus	Possible severe clear ice
NS	Nimbostratus	Moderate mixed icing in lower levels.
SC	Stratocumulus	Moderate rime when freezing level is low enough
AS	Altostratus	Light to moderate rime. Clear ice possible in lower levels.
AC	Altocumulus	Light to moderate rime
ST	Stratus	Nil to light rime

Figure 10: Airframe Icing Conditions. Source: BOM

propeller blades. In a way this seems strange as the propeller blades are probably the least likely components to ice up due to their rapid rotation "flinging" off any ice that forms.

In large jet aeroplanes bleed air is normally used to heat the leading edges of aerofoils. Air heated during the compression process is bled off from a compressor stage (see Figure 11). As the "bleed" process takes considerable energy and can affect engine temperature limitations, this process normally requires a large and powerful engine.

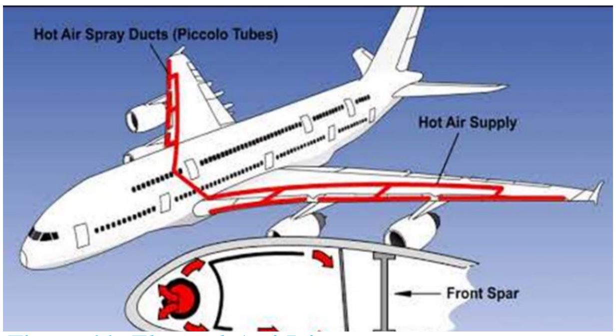


Figure 11: Thermal Anti Icing

Interestingly, for the B787 Dreamliner Boeing have replaced the air bleed ani-ticing with electrical heating mats bonded to the interior of aerofoil leading edges (ThermaWing) (See Figure 12). This has been made possible by the improved electrical generation now available and installed on this aeroplane. Boeing claim a considerable energy saving (about 50%) by doing this.

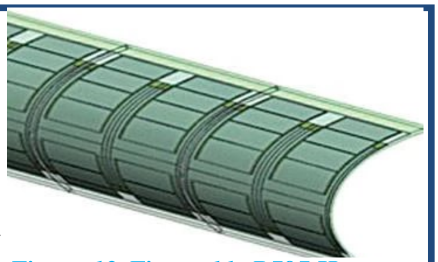


Figure 12:Figure 11: B787 Heater Mat Source: GKN Aerospace

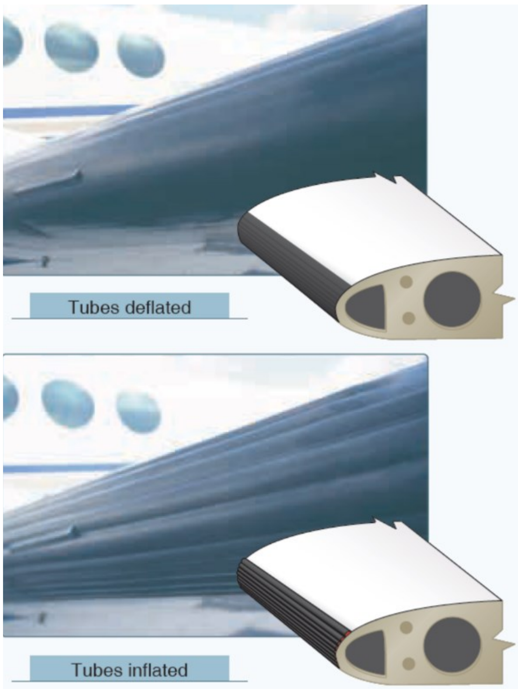


Figure 13: De-Icing Boots on the leading edge of a wing. Source: FAA

In turboprop aeroplanes (those most affected by icing) the most common system is the use of inflatable rubber boots. These consist of a rubber sheet bonded to the leading edge of the aerofoil. (See Figure 13). When ice builds up on the leading edge, an engine-driven pneumatic pump or engine bleed air inflates the rubber boots. Upon inflation, the ice cracks and should fall off the leading edge of the wing. The common wisdom used to be that boots were only activated after ice had formed (the theory being that if activated during ice formation, an ice bridge could form over it.). However, with modern boots such “bridging” does not occur. It has been found that delaying action can make the situation far worse and the ice too thick to be removed. Waiting too long has resulted in a number of accidents and fatalities worldwide. So, the procedure for most aeroplanes is to activate the boots as soon as an ice accumulation is suspected or observed.

Let us return to the incident involving Sol Líneas Aéreas Flight 5428 mentioned at the start of this article. The investigation showed that the cause of the accident was a stall due to severe airframe icing and subsequent loss of control.

No evidence of technical defects in the aircraft was found. It was determined that the icing conditions encountered were so severe that the aircraft's de-icing systems were overwhelmed.

Unfortunately, the response from the flight crew was inadequate. There was inadequate monitoring of warning signals such as temperature, cloudiness, precipitation, and ice accumulation The airspeed set was totally inappropriate for prolonged operations in icing conditions. The engines were never set to full power and the airspeed was allowed to dwindle until the aircraft stalled. A mitigating factor was that weather reports the crew received forecast minor icing, and hence they were not prepared for the conditions encountered. The crew's stall recovery technique was described as “inappropriate”. Pre-stall buffeting was assumed to be vibrations caused by ice contamination of the propellers.

Finally, if any reader is interested in just seeing how ice has affected flight in Australia, I would suggest a search of the ATSB archives (https://www.atsb.gov.au/publications/safety-investigation-reports/?mode=Aviation).

This makes chilling reading.

Greater Adelaide in August 2021: Mild days and nights, close to average rainfall

August rainfall was just below average at most locations across Greater Adelaide. Both daytime and night-time temperatures were above average.

For more information plus a summary of August's statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202108.adelaide.shtml

Adelaide (West Terrace / Ngayirdapira), South Australia
August 2021 Daily Weather Observations

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

Australian Government
Bureau of Meteorology

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	Su	8.4	15.1	12.2			NNW	26	13:37	9.9	93		NE	11	1013.9	14.8	59		NW	17	1013.1
2	Mo	9.7	14.9	0.2			NNW	52	12:43	13.4	46		NNE	19	1009.3	12.7	69		NW	24	1007.3
3	Tu	7.8	13.9	8.0			WSW	44	12:32	11.1	71		SW	20	1017.0	13.2	57		SW	19	1019.2
4	We	9.7	15.4	1.2			WSW	31	13:38	12.7	83		WSW	11	1024.7	14.1	78		WSW	17	1025.1
5	Th	10.1	14.8	0.4			W	26	11:24	12.1	91		W	11	1027.6	14.2	79		WSW	11	1026.5
6	Fr	11.1	15.8	1.2			W	28	14:18	12.3	95		NW	9	1028.9	14.8	78		W	11	1026.9
7	Sa	10.4	15.7	0.4			WSW	24	13:51	12.2	83			Calm	1030.9	15.0	60		WSW	11	1029.6
8	Su	8.5	16.7	0.2			NNW	33	11:30	12.9	65		NNE	13	1030.3	16.1	52		NNW	15	1026.4
9	Mo	10.2	18.8	0			NW	33	14:19	14.2	51		NNE	13	1024.3	18.3	40		NNW	22	1020.3
10	Tu	13.0	20.2	0			NNE	43	18:09	15.6	41		N	19	1017.7	19.7	39		NNE	15	1011.9
11	We	12.3	15.1	2.4			WSW	43	00:44	12.3	91		W	15	1013.7	14.8	71		WSW	19	1018.4
12	Th	9.1	16.3	6.0			WNW	28	13:00	10.8	92		N	9	1029.5	12.9	88		NNW	13	1028.7
13	Fr	9.0	16.9	0.4			WNW	22	14:52	10.4	99		N	9	1031.1	16.1	67		WNW	13	1028.5
14	Sa	5.9	17.8	0			NNW	24	12:41	11.9	75		NE	9	1029.3	17.5	46		WNW	13	1025.7
15	Su	7.6	17.8	0			W	30	13:26	12.9	63		N	7	1027.5	17.7	42		WNW	17	1026.5
16	Mo	10.7	15.8	0			SW	33	11:24	12.4	81		WSW	11	1030.9	14.4	65		SW	15	1029.9
17	Tu	8.4	15.4	0.2			W	24	14:16	11.1	93		W	7	1030.5	14.5	59		W	11	1027.6
18	We	5.7	16.7	0			NW	26	13:49	10.4	79		N	2	1025.7	16.2	57		NW	13	1021.5
19	Th	8.3	21.0	0			NNW	37	14:43	14.1	49		NNE	13	1019.7	20.6	34		NNW	19	1015.5
20	Fr	14.1	18.3	0			NNW	35	10:57	14.9	55		NNW	9	1015.4	18.2	61		NW	17	1013.3
21	Sa	8.9	18.0	0			W	30	14:25	13.7	71		NNE	9	1018.4	17.7	63		WNW	13	1016.4
22	Su	9.5	23.8	0			NNW	50	11:20	16.0	55		NNE	13	1012.4	22.8	33		NW	28	1005.7
23	Mo	7.7	13.9	4.6			SSW	46	13:35	10.5	76		SSW	15	1016.0	13.2	61		SSW	24	1018.6
24	Tu	4.7	14.1	1.8			SSW	35	13:30	10.5	72		S	7	1028.3	13.7	57		SW	19	1026.6
25	We	4.6	14.2	0.2			WSW	28	13:24	10.6	77		NW	6	1027.9	13.1	79		SW	13	1024.9
26	Th	5.9	14.2	0.8			SE	26	09:07	10.7	57		ESE	13	1024.6	13.0	44		ESE	13	1020.9
27	Fr	1.9	17.2	0			NNE	37	23:23	11.6	56		NE	11	1018.4	16.7	39		NNW	17	1013.9
28	Sa	8.8	16.4	0			NNW	46	12:09	11.6	60		N	13	1012.5	14.8	53		WNW	19	1009.9
29	Su	7.3	15.9	5.4			NNW	31	14:34	11.7	83		NNE	9	1014.5	15.1	54		WNW	17	1013.2
30	Mo	9.3	19.3	0			NW	41	12:54	13.3	70		N	11	1015.5	18.9	48		NNW	20	1012.1
31	Tu	12.2	22.2	0			N	31	00:43	15.6	55		N	13	1014.6	21.5	35		NW	15	1014.1
Statistics for August 2021																					
	Mean	8.7	16.8							12.4	71			10	1022.0	16.0	57			16	1019.9
	Lowest	1.9	13.9							9.9	41			Calm	1009.3	12.7	33		#	11	1005.7
	Highest	14.1	23.8	12.2			NNW	52		16.0	99		SW	20	1031.1	22.8	88		NW	28	1029.9
	Total			45.6																	

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.

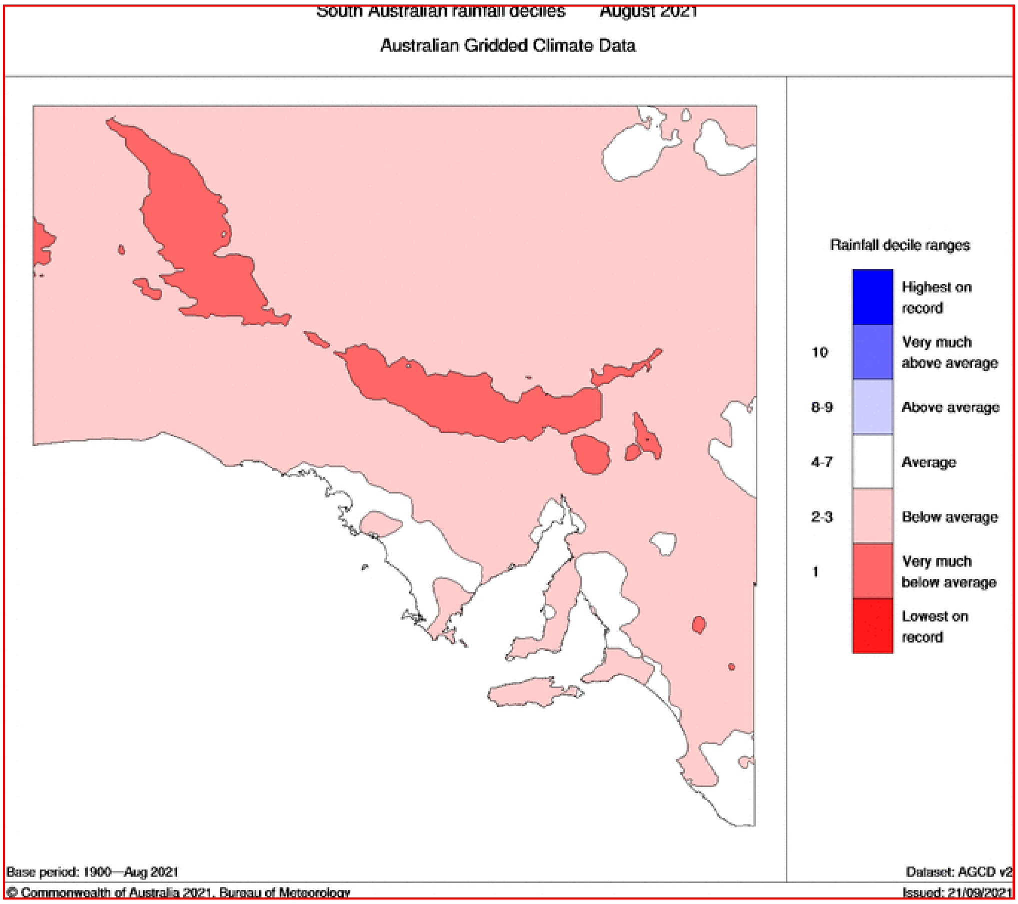
IDCJDW5081.202108 Prepared at 16:02 UTC on 16 Oct 2021

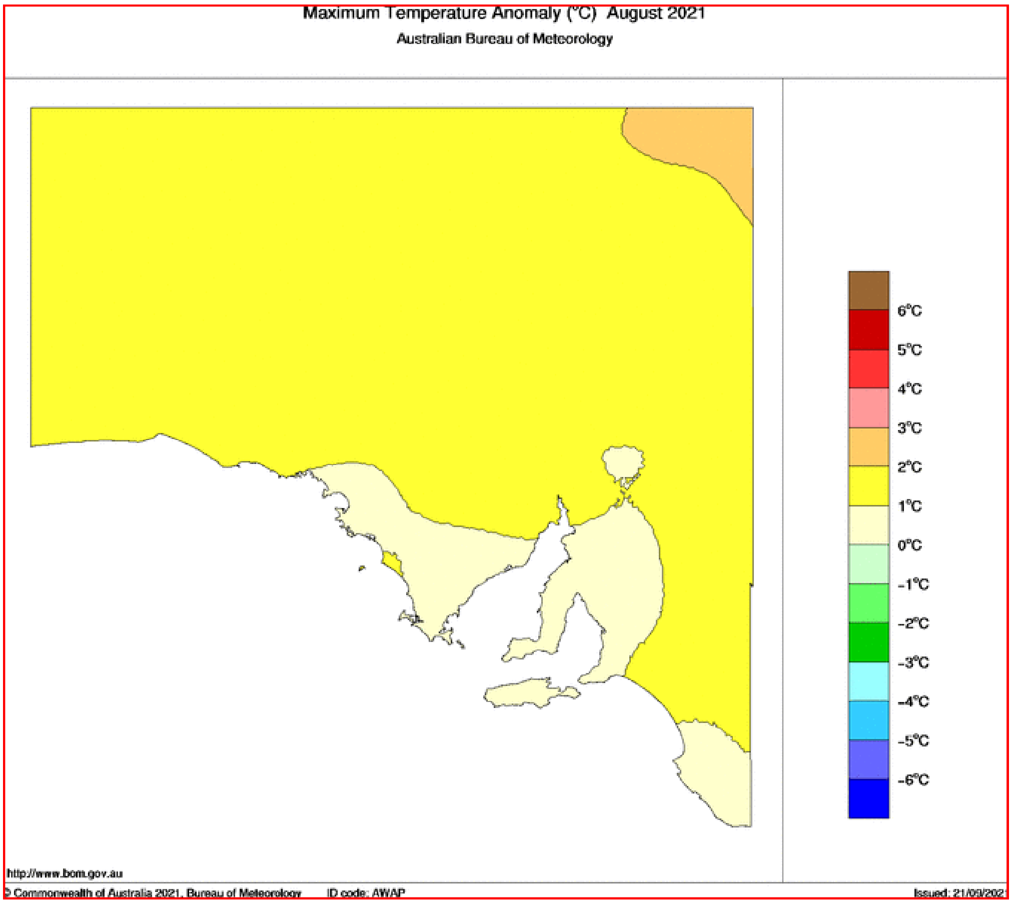
South Australia in August 2021: Below average rainfall, warm days and mild nights

Rainfall in August was below average across most of South Australia with areas in the north and north-west seeing very much below average rainfall. Daytime temperatures were above average across much of the state, though some central districts experienced daytime temperatures closer to average. Night-time temperatures were generally closer to average but areas in the state's lower south-east had warmer than average nights.

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

http://www.bom.gov.au/climate/current/month/sa/archive/202108.summary.shtml





Greater Adelaide in winter 2021: Warm days and nights, above average rainfall

Winter rainfall was above average at most reporting sites across Greater Adelaide. Despite a few cold spells during the season, both mean daytime and night-time temperatures were above average for Greater Adelaide.

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

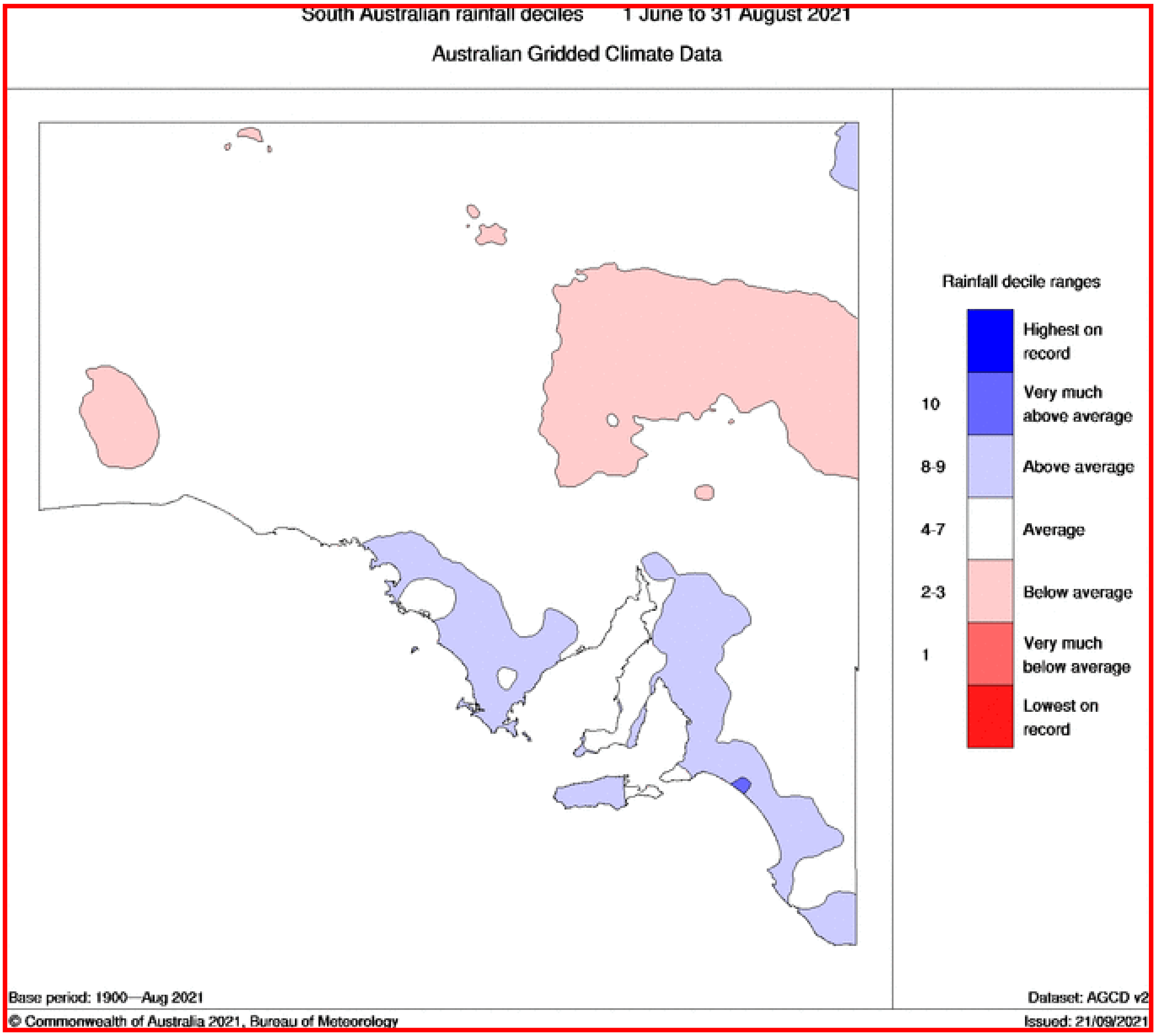
http://www.bom.gov.au/climate/current/season/sa/archive/202108.adelaide.shtml

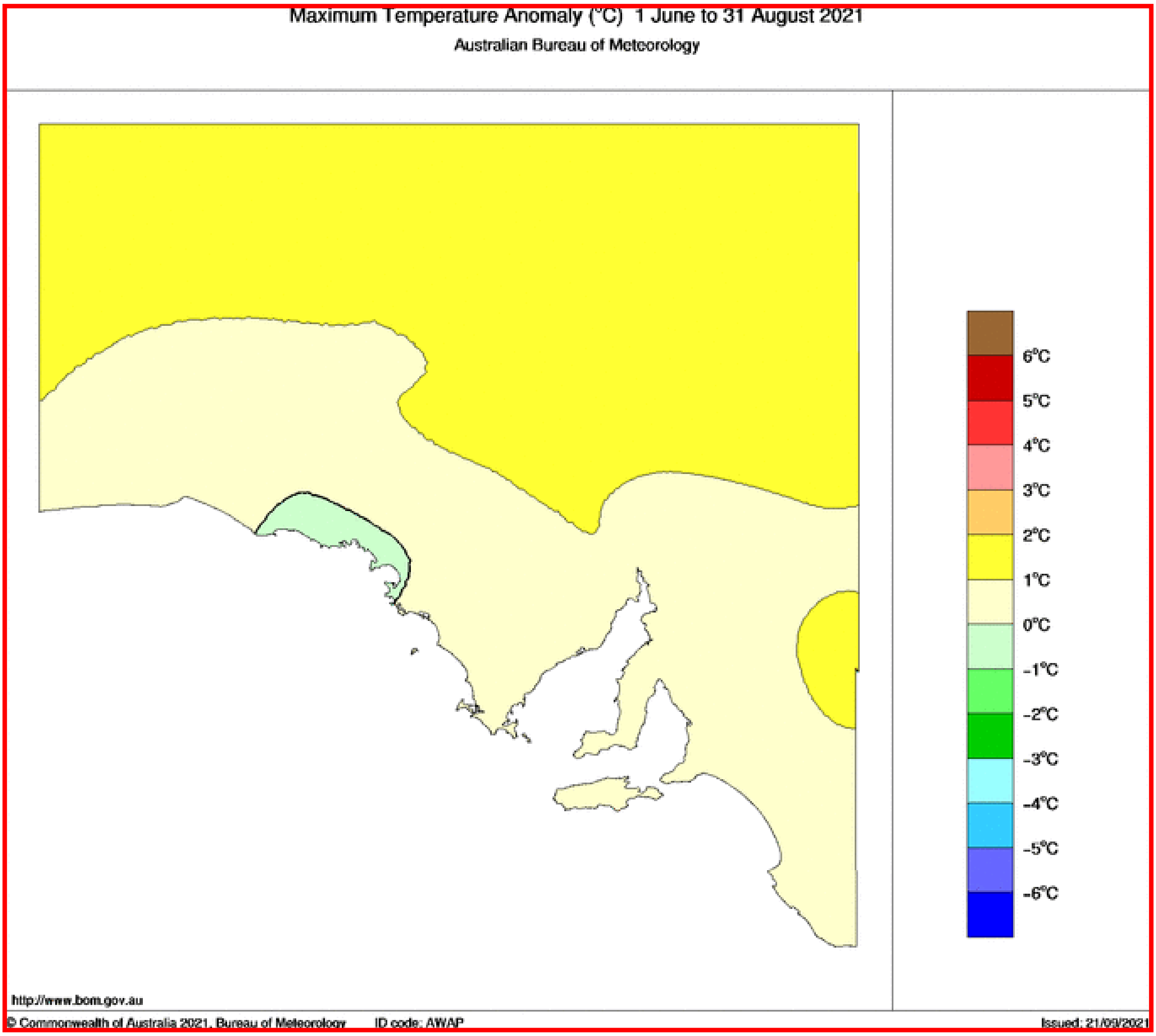
South Australia in winter 2021: Warm days and nights, mostly close to average rainfall

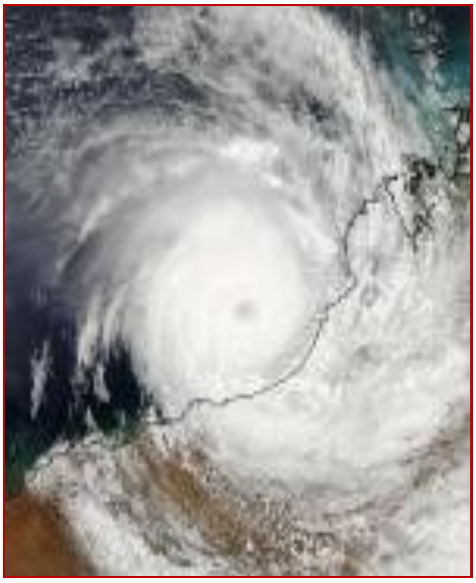
Winter rainfall was close to average across most of South Australia. Daytime temperatures were above average in most of the state, and very much above average in parts of the far north. Night-time temperatures were above average across most of South Australia, with coastal areas and parts of the southeast districts experiencing very much above average night-time temperatures. In terms of the mean temperature, it was the eighth warmest winter on record, and the warmest since 2013.

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

http://www.bom.gov.au/climate/current/season/sa/archive/202108.summary.shtml







☸ ATTENTION ALL SCRIBES AND PHOTOGRAPHERS ☸

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

Greater Adelaide in September 2021: very low rainfall for some sites

September was much drier than average for parts of Adelaide and the driest since at least 1987 for some sites. Days were warmer than average across Adelaide and nights were slightly warmer than average at some sites.

For more information plus a summary of Septembers statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202109.adelaide.shtml

Adelaide (West Terrace / Ngayirdapira), South Australia
September 2021 Daily Weather Observations

Australian Government
Bureau of Meteorology

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	We	8.8	26.5	0			NNE	37	21:20	17.9	60		NE	11	1020.9	26.0	28		N	17	1016.2
2	Th	17.9	31.2	0			N	61	12:47	24.9	19		NNE	26	1010.2	30.0	17		NNW	28	1005.6
3	Fr	11.6	16.8	0.6			WSW	41	16:41	13.1	83		W	13	1016.2	16.5	49		W	19	1015.5
4	Sa	7.7	14.6	4.2			SSW	41	14:10	11.2	81		NW	4	1022.4	12.9	67		S	19	1023.2
5	Su	4.9	15.1	3.6			SW	37	12:59	10.6	88		SW	6	1029.8	14.9	66		SW	15	1029.5
6	Mo	9.1	16.6	2.2			WSW	24	12:37	12.7	91		N	4	1035.2	15.9	64		WSW	13	1033.8
7	Tu	11.1	16.3	0			W	24	10:48	13.1	74		SW	7	1036.2	15.2	63		WSW	13	1033.4
8	We	6.2	22.7	0			NNW	30	12:52	15.0	64		NNE	13	1032.0	22.1	36		NW	17	1027.7
9	Th	13.4	26.1	0.2			NW	50	13:32	18.3	31		N	15	1025.4	25.6	17		NW	26	1021.2
10	Fr	8.6	27.9	0			NW	48	14:35	19.8	28		NE	13	1021.2	27.6	13		NNW	22	1015.6
11	Sa	12.8	19.0	0			WSW	43	22:47	16.0	65		NNW	11	1012.1	18.1	66		WNW	17	1010.2
12	Su	10.4	13.9	1.2			SW	59	14:03	11.3	70		WSW	24	1011.7	11.0	75		SW	17	1013.4
13	Mo	3.7	16.6	4.4			SW	35	11:35	12.6	76		S	11	1025.4	15.1	56		S	13	1024.1
14	Tu	4.5	15.9	0.2			WSW	24	14:21	13.1	61			Calm	1028.6	14.0	56		WSW	13	1025.6
15	We	6.1	19.2	0			E	26	21:57	15.1	49		ENE	9	1026.5	19.0	45		WSW	13	1021.8
16	Th	7.6	23.8	0			ENE	39	21:00	17.5	40		NE	15	1019.8	23.5	27		NNE	17	1014.0
17	Fr	17.4	22.4	0			NE	50	01:22	21.3	29		NW	17	1008.0	18.6	54		WSW	9	1008.9
18	Sa	11.3	17.1	0			W	43	09:19	13.7	64		W	24	1020.2	16.0	60		SW	11	1020.6
19	Su	7.8	20.0	0			NW	44	10:18	14.0	67		NNW	19	1021.2	19.1	46		WNW	24	1018.3
20	Mo	10.6	14.6	3.4			SW	56	10:57	13.0	58		SW	24	1022.7	12.0	58		SW	26	1023.5
21	Tu	5.4	15.5	1.6			SW	35	13:47	11.5	62		S	17	1033.1	13.9	59		WSW	20	1032.6
22	We	9.8	15.7	0.8			SW	24	00:51	11.8	84		WSW	13	1031.5	14.4	74		W	11	1028.1
23	Th	11.4	20.9	0			WNW	28	11:12	13.4	76		N	9	1024.3	20.6	39		W	15	1018.6
24	Fr	7.7	16.5	0			SW	43	13:15	15.3	74		WSW	17	1016.7	15.4	53		WSW	22	1017.0
25	Sa	7.2	17.6	0.2			W	28	11:52	13.6	69		SSE	13	1023.9	15.2	54		SW	19	1023.0
26	Su	9.1	19.6	0.2			ENE	33	07:16	13.9	49		ENE	19	1025.4	18.9	35		NNE	9	1020.8
27	Mo	13.1	24.6	0			NE	33	09:13	19.1	30		NE	13	1016.8	24.2	21		NNE	11	1012.5
28	Tu	18.5	24.0	0			NNE	44	13:40	22.7	23		NE	13	1008.9	21.6	34		ENE	15	1006.4
29	We	11.9	22.0	0			WSW	24	11:09	20.0	56		N	4	1011.3	16.4	82		SW	7	1009.4
30	Th	10.9	15.5	3.2			SW	33	16:05	13.8	93		WSW	9	1010.3	15.1	83		SW	15	1008.5
Statistics for September 2021																					
	Mean	9.9	19.6							15.3	60			13	1021.6	18.3	49			16	1019.3
	Lowest	3.7	13.9							10.6	19			Calm	1008.0	11.0	13		SW	7	1005.6
	Highest	18.5	31.2	4.4			N	61		24.9	93		NNE	26	1036.2	30.0	83		NNW	28	1033.8
	Total			26.0																	

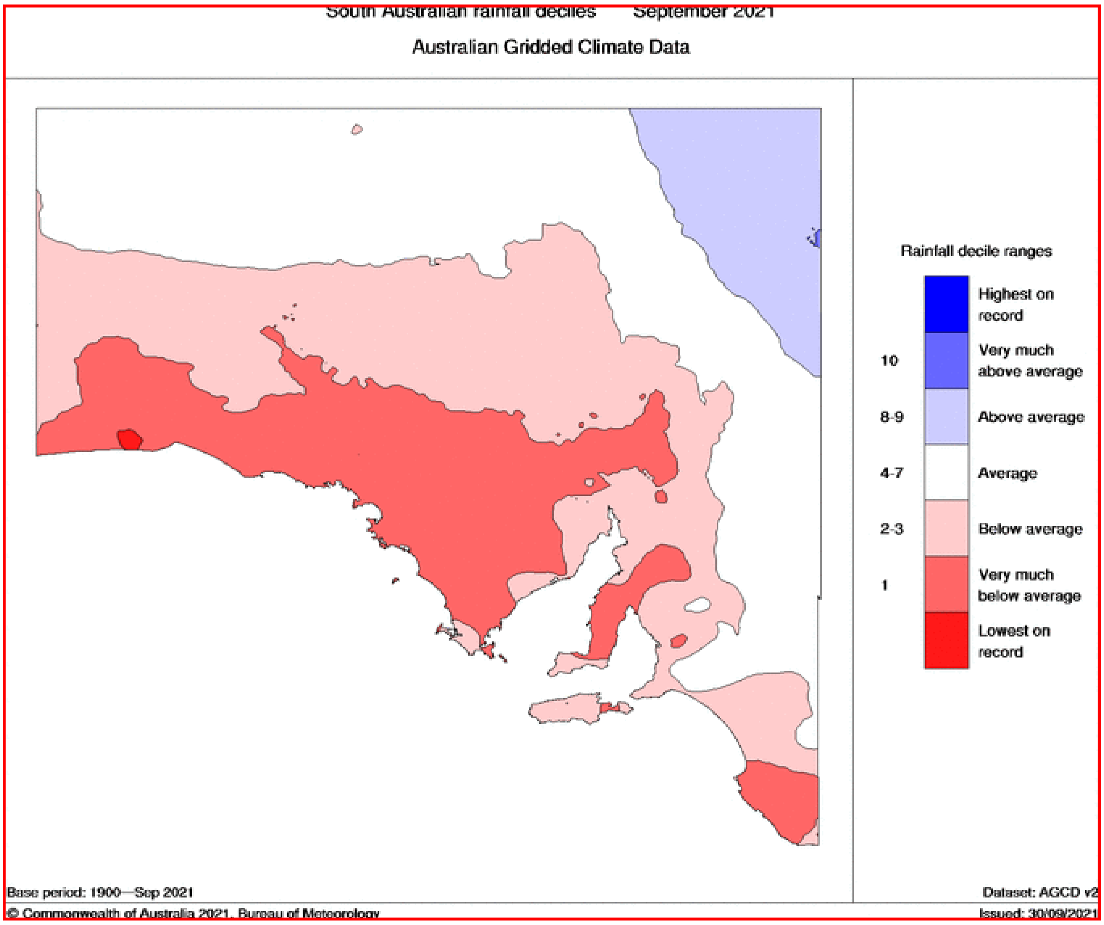
Observations were drawn from Adelaide (West Terrace / Ngayirdapira) {station 023000}
This is the "official" site for Adelaide, having reopened in May 2017. Observations are available from the Kent Town site {station number 023090} up until 31 July 2020.

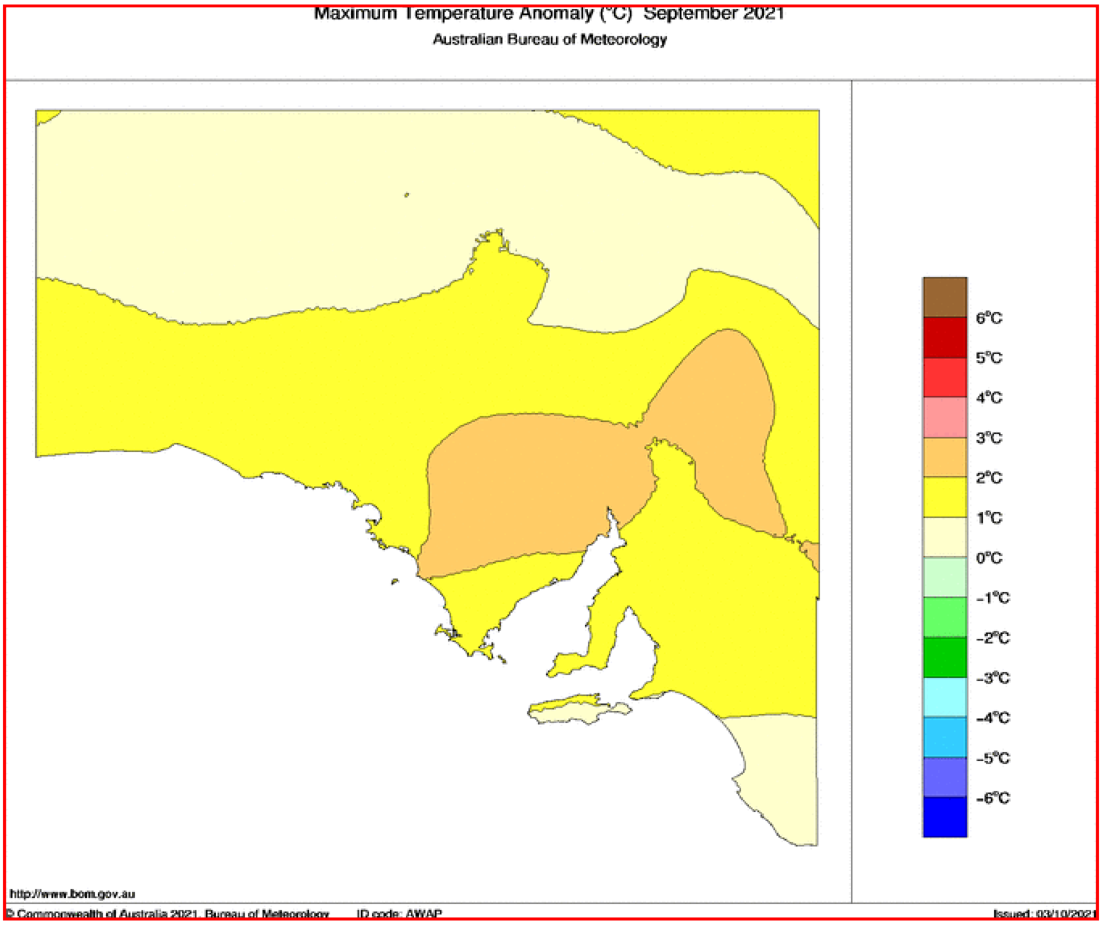
IDCJDW5081.202109 Prepared at 13:02 UTC on 14 Oct 2021

South Australia in September 2021: very low rainfall across the south

September was much drier than average across southern South Australia. Days were warmer than average across the southern half of the state, while nights were warmer than average in the west.

For more information plus a summary of July's statistics please see:
http://www.bom.gov.au/climate/current/month/sa/archive/202109.summary.shtml





Next Event:

What: The End of Year Function

When: Evening of Tuesday 23rd of November.

Where: Downstairs at the Benjamin-on-Franklin Hotel (see From The President's Pen).

Further details to follow.

This is the final Monana for 2021 and all that is left is to wish all readers a Merry Christmas and a Happy (and covid-19 free) New Year.

We will return in 2022 (exact month to be determined).

If in between now and next year, there is any comment / contribution / suggestion that you would like to make concerning Monana, please don't hesitate to forward it to the email address below.

For further information about AMETA & meeting details please contact:

Secretary	secretary@ameta.org.au

For newsletter contributions, comments or suggestions please contact monana@ameta.org.au