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Craig Kelly MP
Federal Member for Hughes
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Dear Craig

Re: Minimum Temperatures and Automatic Weather Stations

I write to you on the last day of the official Australian winter.

Recently, the Australian Bureau of Meteorology announced that this winter was likely to be the warmest on record – yet in parts of the south-east it has been bitterly cold: with record numbers of frosts, and blizzard conditions in the Australian Alps.

There is mounting evidence that the coldest minima measured by the Bureau's weather stations have *not* been entered into ADAM (Australian Data Archive for Meteorology). This is because of limits placed on the recording of temperatures below minus 10 degrees Celsius.

This is additional to the Bureau closing stations in cold locations, for example Charlotte Pass – while opening new stations in hot places.

Charlotte's Pass on Mount Kosciusko holds the record for the lowest daily minima of minus 23 degrees Celsius recorded on 19 June 1994.

Then there is the issue of how temperatures (above 10 degrees Celsius) are being recorded. Recent inquiries to the Bureau – consistent with observations of what is measured and then recorded by weather stations including at Thredbo, Goulburn and Borrona Downs – confirm that the reported minimum temperature is the coldest for the one-second reading. Because modern electronic probes react more quickly to second by second temperature changes this would make measurements from the automatic weather stations spread across the Australian continent since the 1990s, inconsistent with previous measurements. The documented Bureau policy is for these readings to be averaged over a 10-minute period to provide compatibility with measurements from liquid-in-glass thermometers.

Further, the Bureau is remodelling minimum temperatures in the creation of its new homogenised ACORN-SAT dataset. For example, cooling in temperature minima at both Rutherglen and Deniliquin associated with the development of irrigation has been remodelled to show a warming trend. The Bureau does not deny this remodelling, simply justifying it on the basis that this land-use change constitutes a 'non-climatic' factor and therefore 'a homogenisation process is justified'. I have

written about this in the past, and corresponded extensively with the Bureau on the same.

Almost every day we hear on the news that ever increasing electricity prices are hurting ordinary Australians. Since at least 1996, the Australian Bureau of Meteorology has been committed to the theory of human-caused global warming – and since then it has received hundreds of millions in additional funding in conjunction with the CSIRO, including to employ colleagues and attend overseas conferences in Copenhagen and Paris. Each of these conferences has helped reinforce the myth that these climate scientists have special knowledge, and can measure the Earth's temperature to a fraction of a degree.

In reality, the Bureau –that contributes data to the calculation of the Earth's temperature by NASA and the UK's Met Office – has lost all objectivity.

Since the installation of automatic weather stations in the 1990s, there is a growing list of anomalies. These anomalies are *not* with the weather but with how the Bureau records temperatures, chooses locations for weather stations, and more generally reports climate variability and change.

You have specifically requested that I detail my key concerns with automatic weather stations and minimum temperatures, and specifically that these be as questions: to be put honestly to the Bureau via the Minister.

ISSUES AND QUESTIONS

Issue 1: A limit of minus 10 degrees Celsius on minima is absurd

When the weather station at Goulburn airport (ID 070330) recorded minus 10.4 on Sunday morning 2 July the Bureau's 'quality control system', 'designed to filter out spurious low or high values' reset this value to minus 10.0 degrees Celsius.

To be clear, the actual measured value of minus 10.4 was 'automatically adjusted' so that it recorded as minus 10.0 in the key ADAM dataset.

After three-days, and specifically following an outcry from weather enthusiasts across the nation, the value of -10.4 was reinstated.

While it is reasonable to expect that the Bureau would have procedures in place to prevent the measurement of spurious temperatures, this automatic weather station has previously recorded lower temperatures including minus 10.9 degrees Celsius in 1994.

Which begs the questions:

Q1. When exactly was the limit of -10.0 degree Celsius set for Goulburn?

Q2. How was it determined that temperatures at Goulburn should not exceed a minimum of -10.0?

Q3. How many other weather stations have limits currently placed on the recording of minimum temperatures?

Q4. Could the Bureau advise whether or not the actual measured temperatures have been stored for the weather stations where limits were set (e.g. Goulburn)?

Q5. Could the Bureau make publicly available the stored values, which were not entered into the Australia Data Archive for Meteorology (ADAM) for all weather station for which limits have been in place?

Issue 2: Basic quality assurance lacking

While the Bureau has been placing absurd limits on how cold a temperature can now be recorded at Goulburn and other locations, it has not undertaken basic quality assurance of temperature data as recorded at this, and other, weather stations. For example, there are a series of zero values recorded through December 1990 in the ADAM dataset as minimum temperatures for Goulburn airport.

These are clearly erroneous values, and have perhaps been entered in lieu of 'blanks'.

Such basic quality assurance issues have been previously documented, particularly for the Bureau's homogenised datasets. Specifically, Joanne Nova and colleagues made a 61-page formal submission to the Australian National Audit Office in December 2010, which was never actioned.

Q.6. When will the Bureau replace the erroneous zero minimum temperature values for December 1990 with blanks for Goulburn airport in the ADAM dataset?

Q7. When will the Bureau fix the nearly 1,000 days where temperature minima are hotter than maxima in its homogenised dataset, with this issue first highlighted in December 2010?

Issue 3: Acknowledging when a weather station fails

A new automatic weather station was installed at Borrona Downs in far western New South Wales just six weeks ago, in July 2017. But in just the second week of operation it appears to have begun to fail: recording temperatures significantly hotter than nearby locations.

The problem was first noticed on 19 August when temperatures plunged, with -62.5 degrees Celsius recorded between 21:58:00 and 21:59:00. This value jumped-up to -37.5 degrees Celsius at exactly 21:59:00, and then to -4.4 degrees Celsius at 22:00:00.

This is an instance when a blank should clearly have been recorded as the minimum temperature at Borrona Downs. The Bureau instead recorded 2.4 degrees Celsius for the overnight minimum of 20 August 2017.

Here we have an instance of hardware failure, yet the Bureau is making 'corrections' – based on what specific policy?

The Borrona Downs weather station continued to record spurious values until 28 August, with values for temperature minima entered into ADAM. On 28 August, the issue was reported to the Bureau and only then were recordings from this weather station taken off-line, with an acknowledgment that there is a hardware fault.

Q8. Why was it only acknowledged that there was a problem with the weather station at Borrona Downs on 28 August 2017, when clearly it had been providing spurious recording for an entire month?

Q9. What criteria were used to calculate the daily minimum temperatures for Boronna Downs for the period 29 July until 28 August 2017?

Issue 4: Clarifying measurement intervals for temperature minima

At the 'Latest Observation Page' for any given weather station at the Bureau's website, a new minimum temperature is recorded every 30 minutes and refreshed every 10 minutes. It is assumed by many weather enthusiasts that this value represents the average of the air temperature as measured over that ten-minute interval. This would be in accordance with recommendations in the Bureau's own 1997 report (Instruments and Observing Methods Report No. 65, WMO/TD No. 862) published when automatic weather stations were being introduced across Australia.

Recent inquiries to the Bureau – consistent with observations of what is measured and then recorded by weather stations including at Thredbo, Goulburn and Borrona Downs – confirm that the reported minimum temperature is the coldest for the one second interval.

Because modern electronic probes react more quickly to second on second temperature changes this would make measurements from the automatic weather stations spread across the Australian continent since the 1990s, inconsistent with measurements from liquid-in-glass thermometers first installed in 1856.

Q10. Can the Bureau please confirm that the lowest one second reading at an automatic weather station for that 24-hour period is the minimum recorded in ADAM for that day?

Q11. On what advice did the Bureau adopt one-second readings, disregarding World Meteorological Organisation best practice of integrating readings over longer time periods?

Q12. Can the Bureau confirm that measurements from automatic weather stations as currently recorded in ADAM, are *not* comparable with measurements as previously recorded from liquid-in-glass thermometers.

Issue 5: Closing weather stations with record minima

While opening the new weather station at Borrona Downs in western New South Wales in July 2017, the Bureau is closing weather stations in other regions. For example, the Bureau recently closed Charlotte Pass on Mt Kosciusko. This weather station holds the lowest daily minima for Australia of minus 23 degrees Celsius recorded on 29th June 1994.

Borrona Downs is near Bourke in western New South Wales. Bourke holds the record for the hottest daily maximum temperature of 51.6 degrees Celsius - recorded at an official Bureau weather station, with standard equipment (mercury thermometer in Stevenson screen) on 3 January 1909.

Q13. What criteria does the Bureau use for opening new weather stations (e.g. Borrona Downs) and for closing existing weather stations (e.g. Charlotte Pass)?

Of the more 1,000 weather stations in existence – temperature series from only 112 locations are used to report on climate variability and change for Australia. Further, with the transition to ACORN-SAT in 2011 several very hot weather stations were added, specifically**,** Oodnadatta.

From the previous homogenised dataset (pulled when Joanne Nova and colleagues made their submission to the Auditor General in December 2010), the change in the mix of weather stations appears to have resulted in a large increase in the 2013 annual temperature for Australia – estimated at 0.56 degree Celsius.

Q14. What criteria is used to determine whether, or not, a weather station becomes part of ACORN-SAT?

IN CONCLUSION

Elsewhere I have suggested scrutiny of the methodology used by the Bureau in the remodelling of individual temperature series in the creation of ACORN-SAT, the need for scrutiny of the complex area weighting system currently applied to each of the individual series used in ACORN-SAT, et cetera. I understand that the Technical Advisory Forum established in 2014, specifically to consider such issues, is being disbanded, without investigating any of them – without the statisticians applying any of their expert analytical skills to any of the many problems at hand.

In this letter, I have highlighted new issues, specifically with the Bureau's handling of, and reporting on, minimum temperatures – not to mention the need for more transparency in its choice of location for new weather stations, and reasons for including a temperature series in ACORN-SAT.

The issue of the Bureau recording one-second readings, rather than following World Meteorological Organisation best practice and averaging readings over 10 minutes is raised by me for the very first time. It could be that in ignoring their own policies the last 20-years of temperature recordings by the Bureau, from automatic weather stations, will need to be discarded as not fit for purpose. Again, the issue is not with the equipment, but the method applied.

Furthermore, these issues are indirectly impacting the price of electricity, via measurements of global warming as compiled by the UK Met Office and NASA.

RECOMMENDATION

I ask you to facilitate the urgent establishment of a parliamentary inquiry through the House Energy and Environment Committee.

Your sincerely

Dr Jennifer Marohasy

This letter was compiled with the assistance of Warwick Hughes, Bob Fernley-Jones and Lance Pidgeon.

About me: I am a Senior Fellow at the Melbourne-based Institute of Public Affairs, though I reside in Noosa were I also work at the Climate Lab. The Climate Lab is a space dedicated to applying the latest big data techniques to better rainfall forecasts. I have a Batchelor of Science and Doctor of Philosophy from the University of Queensland. I have over a dozen publications in climate science including in the international peer-reviewed journals Atmospheric Research, Advances in Atmospheric Research and GeoResJ. The research associated with these publications was wholly funded by the B. Macfie Family Foundation.