Weather Forecasting for Amateur Astronomers

Making sense of conflicting weather predictions

Roger Powell

Where weather data comes from. Image source: Australian Bureau of Meteorology

Like all amateur astronomers I want to know if the atmospheric conditions over the next few days will provide a good opportunity to plan an observing session.

When setting up at home, it's somewhat handy to know if clouds will appear. When packing the car to travel to a remote location, it is vital!

So, what information is at our disposal here in Australia?

The Bureau of Meteorology

BOM has all the information to be very accurate when it comes to predicting imminent and severe weather conditions but it's written day to day forecasts can also be agonisingly vague. They are not published with astronomers in mind.

Telling us it will be a sunny day is unsatisfactory for working out if the stars will be shining that evening and weather by icon does simply does not cut it for astronomy.

Often they will tell us, for example, that there is a 20% chance of rain or an 80% chance of a thunderstorm. What does this mean?

Is there a 20% chance of rain at your specific location or is there a 20% chance of some rain falling somewhere in the region? Does it mean that 20% of the region will get rain and 80% of it will not? Perhaps it means that 20% of the computer models are predicting rain and 80% are not.

I've often pondered the reasons for the vagueness from BOM and perhaps cynically I would put it down to either lack of human resources or not wanting to be proved wrong. Lately I've come to a third conclusion: that with so many computer models available, the difficulty they have is drawing a definitive conclusion from the output of so many models, which may be contradictory.

More about models later but bear in mind that while BOM uses it's own globalised modelling, it also compares various other global models from meteorological agencies around the world.

Will I use BOM?

> Yes. Whatever you may think of it, the BOM is the principal authority on Australian weather. Their forecasts are often vague but when seeking an overview of current day weather conditions, BOM should always be checked – but not exclusively.
>
> Read on...

General Weather Websites and Phone Apps

There are a number of websites and apps which can be useful for deciding whether to go on a picnic or if you need to take a brolly when you leave for work in the morning, in case it rains on your way home.

These websites are popular because they provide detailed graphics, including a couple of things which astronomers find most useful: hourly predictions of cloud cover and humidity.

More detail? Good graphics? Sounds great! These apps are great for astronomy must be better than BOM, right? Well, not necessarily...

It comes down to models again. Websites in this category come with all the impressive coloured graphics and hourly details, temperature graphs, humidity, cloud % etc. but they almost certainly come from only one computer model. They probably don't even reveal which one.

So whilst BOM publishes less intricate written forecasts (such as *"50% chance of rain"*) using the insight of local data and many other different computer models, general weather apps publish highly detailed information but from only one computer model.

Neither solution is really very satisfactory for astronomy purposes.

Would I use these general apps and websites?

> No, because I don't know which model they use to make predictions and that makes it hard to compare with other similar sites. If you choose one of these sites exclusively, because you like the graphics, then you you are not getting the benefit of alternate models.
>
> If you compare two of these sites and get the same result, that does not necessarily double down on the prediction because they may both using the same computed model.

Astronomy Weather Apps

There are a number of astronomy weather apps which are fairly similar to the general weather apps which I described above but their output may be more suitably presented for astronomers and thus more appealing. Like the general weather apps, their output is detailed but it is likely generated from only one computer model.

Some of these sites give useful output about upper atmosphereic wind speeds, seeing conditions and sky brightness etc. which can be very interesting to astronomers.

Would I use these astronomy apps and websites?

> *Not really, no. Perhaps if I am seeking to check up on seeing conditions and upper atmosphere stability, whilst remembering that, once again, the output likely comes from a single unidentified model. If it is a clear and moonless sky, the likelihood is that I will set up my telescope regardless of any prediction about upper atmospheric conditions.*

Computer Models

So, if you've got this far, you will have some inkling that:

- I will never rely on general weather prediction apps or websites.;
- I will base my observing sessions on the output of more than one computer model;
- I want to know which models they are; and
- One or more of those models should be specific to the Australian region.

Computer weather models, also known as '*numerical weather prediction*' models, are the main tools forecasters use. They each use super-computers to calculate for billions of points within the atmosphere around the Earth, taking the past and current weather observations of the atmosphere and ocean as the starting point, before calculating the weather into the near future.

What are all these models?

ACCESS (Australian Climate Community Earth Systems Simulator), is BOMs own global numerical weather prediction model – and it is specific to our region. When comparing weather models, it is surely important to look at the local models first. Your favourite weather app is unlikely to use ACCESS.

The ACCESS-G model covers the entire country, while the ACCESS-C model is a more detailed model which is scaled to cover capital cities in finer detail.

ECMWF is a global prediction model produced by a collaboration of over 30 European nations.

GFS (Global Forecast System) is a global weather prediction model run by the United States' National Weather Service.

UKMO is a global weather prediction model run by the British Meteorological Office.

GEM is the Global Environmental Multiscale model run by Canada.

ICON is the German weather prediction model.

All of these models extend to global weather predictions and include Australia and there is no reason to choose any one model over another.

There are more models. Here is a list of some of them:
https://en.wikipedia.org/wiki/Atmospheric_model#Domains

Why should I consider a European or North American weather model when I can use the Australian Access models?

Because sometimes the global models get it right and the Australian models get it wrong….

….and vice versa!

How Do I Compare Models?

I can recommend two handy sites which allow comparisons between models:

1. Cloud Free Night

This site is a great weather resource designed specifically for use by Australian astronomers. Until recently it has provided a direct comparison with the up to date ACCESS-G, ACCESS-C and GFS model predictions, providing astronomers with three models to compare. Unfortunately, in 2023, the site was denied further input from ACCESS-C and has been left with only two models. Relying on two models alone is insufficient, unfortunately.

Here is a link to the site: *https://www.cloudfreenight.com/index.html*. Select the meteogram icon and choose your location.

2. Meteologix

Meteologix provides you with enough models to make the best judgement.

It is not a site designed specifically for astronomers but - unlike most other general weather websites - it provides the ability to switch quickly between eight global weather prediction models, (including the two featured by *Cloud Free Night*) and publishes cloud coverage predictions for each model.

Campbelltown page: *https://meteologix.com/au/forecast/2172586-campbelltown/meteogram/aus*

The Oaks page: https://meteologix.com/au/forecast/2146903-the-oaks/meteogram/gbr

Conclusion

Your favourite weather app only tells you part of the story. Go closer to the source and compare as many of the world's super-computer *numerical weather prediction* models as you can. The outputs of each will not be identical. Observing the differences allows you to make the best decision.

My observation over several years is that each model is capable of being accurate for our location – but none more so than the others. The outputs will sometimes be contradictory. The weather can be very unpredictable and sometimes nature triumphs over processing power. By comparing the available models are you giving yourself the best chance of making an informed decision about setting up your gear.

See the appended example below.

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Cosmic Focus

Appendix 1

A typical example:

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Weather Prediction Model Analysis

Date: Saturday 3rd February 2024, (a Stargard night)

Tabulation of predictions for that evening

Model	Origin	Forecast the Day before	Forecast 3rd Feb Morning	Score
ECMWF 6	European Community	*Mostly clear*	*Clear*	☑
ECMWF 12	European Community	*Mostly clear*	*Clear*	☑
GFS	USA	*Clear*	*Clear*	☑
GEM	Canada	*Clear*	*Clear*	☑
ACCESS-G	Australia	*Cloudy*	*Cloudy*	☒
ICON	Germany	*Partly cloudy*	*na*	☒
Norway ECMWF	Norway	*Mostly clear*	*Clear*	☑
UKMO	United Kingdom	*High cloud*	*Clear*	☑

Outcome

Six models out of eight predicted *"clear"*.

The sky was clear all evening.

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