Interpreting seasonal forecasts

There are many different models with many different styles of outputs, following are examples of the most common types and how to interpret them.

Good models are never run in isolation, the best models are run multiple times to show the possibilities inherent in the chaotic climatic system. Figure 1 shows the output of the Bureau of Meteorology's (BoM) ACCESS-S model predicting Sea Surface Temperature (SST) anomalies for the NINO3.4 region (a large area of the central Equatorial Pacific Ocean). The graph shows the historic temperature to the left (black line) and the model predictions to the right (light grey lines). There are 99 different predictions in grey, each called an ensemble member that make up the ensemble plume (the collection of all the grey lines). The green line and dots make up the ensemble mean which is the average of all the 99 ensemble members. This is the average prediction of the model, but the spread of the grey lines shows that there is great variation in the prediction around the average. After starting the model, the individual predictions nearly always spread out becoming more uncertain over time. Sometimes plumes are more tightly bunched providing greater certainty, sometimes they start spreading greatly.

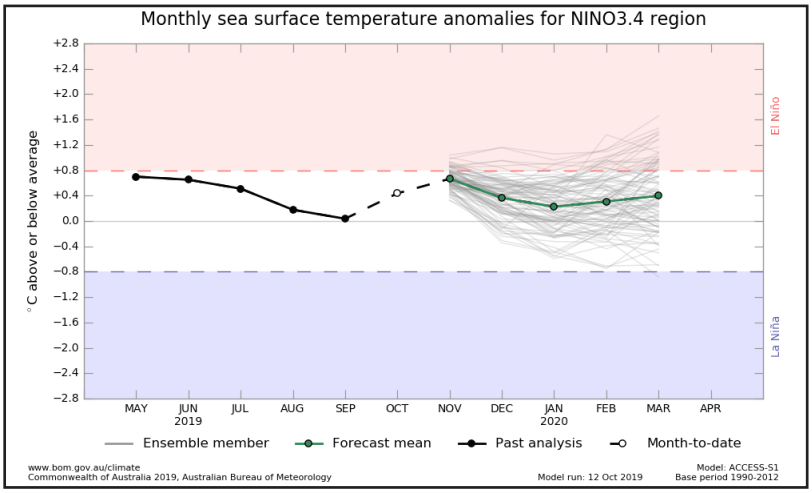

Figure 1. Monthly sea surface temperature anomalies for NINO3.4 region. Source: BoM.

The plume of results exists for any parameter the model is predicting for and rainfall is no different. For the BoM's ACCESS-S model 99 predictions of rainfall are generated for every location. When presenting model predictions for rainfall, climate researchers use a range of different images. The one we are most familiar with is the percentage chance of being above or below median shown in figure 2. By ranking all 99 ensemble members in all locations, the BoM than compares the outputs to the median (the middle value but usually close to the average). For an area to be shaded brown, less than 40 per cent of the ensemble members were greater than average, it also means the opposite that 60 per cent of the ensemble members were less than average. The map does not emphatically state that somewhere is going to be wet or dry, just the probability of it being wetter or drier based on the 99 ensemble members. If its shaded white the chances of being wetter or drier than the average are about the same; there were just as many wet ensemble members as there were dry ensemble members. This can best be interpreted as "plan for any possibility". This type of percentage chance forecast is called "probabilistic".

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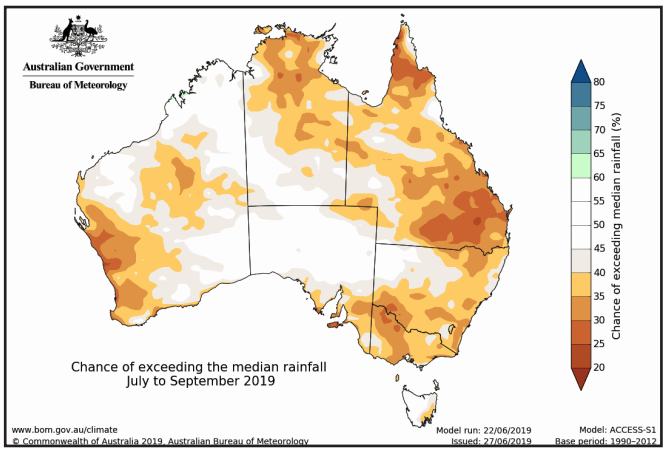


Figure 2. July to September 2019 chance of exceeding the median rainfall map. Source: BOM.

Another way of showing the range of climate outcomes is to use what's called a tercile map (tercile means three). Instead of comparing to the median or average, this compares the ensemble members to the lowest third, middle third or the wettest third of the record. The APEC Climate Center (APCC) map in figure 3 shows greater numbers of predictions in the lowest third of records in brown, more average or middle third forecasts in grey and wetter third forecasts in green. The white colour represents the areas where the ensemble members fell out in the classical climatological pattern of a third dry, third average or a third wetter.

The white is also best interpreted as "plan for any possibility" or all outcomes have a 33.3 per cent chance of occurring. Looking at Victoria, this map shows that 40-50 per cent of the ensemble members fall into a driest third of records prediction in the north. Southern areas had a slightly higher probability of 50-60 per cent. In my experience, the way the models are leaning is of more value than getting caught up in the percentage strength of the prediction. In the last 12 years many dry seasons have occurred when the models were only just sniffing drier in the wind.

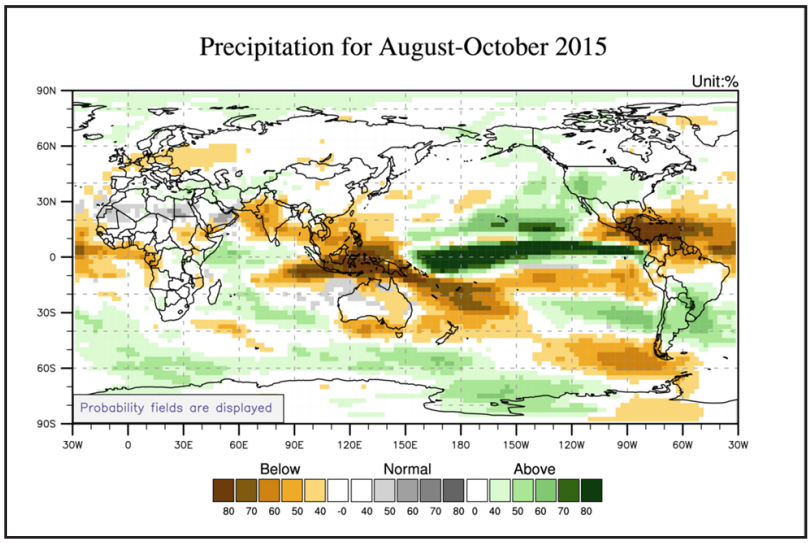


Figure 3. July to September 2019 chance of which tercile rainfall map. Source: APCC.

The final method of displaying predictions is to simply map the ensemble mean. Average out all the ensemble members for a particular grid point on the map and compare the rainfall to normal. This is called a "deterministic" forecast and is presented in an anomaly format. Rainfall is predicted to be either close to normal, or varying degrees of drier or wetter than normal. Figure 4 shows a prediction from the National Centers for Environmental Prediction (NCEP) showing an ensemble mean forecast, the scale is in mm/day. The mustard yellow colour shows a large area of SE Australia that is likely to receive 45-90 mm less than normal for the July to September period. Once again, it's important not to get hung up on how wet or dry the forecast is, just whether on average the model is predicting a shift in rainfall compared to normal.

I like forecasts that give you both deterministic and probabilistic outputs. They both tell you slightly different information, one in terms of dumbed down absolutes, but the other in terms of chances of occurrence.

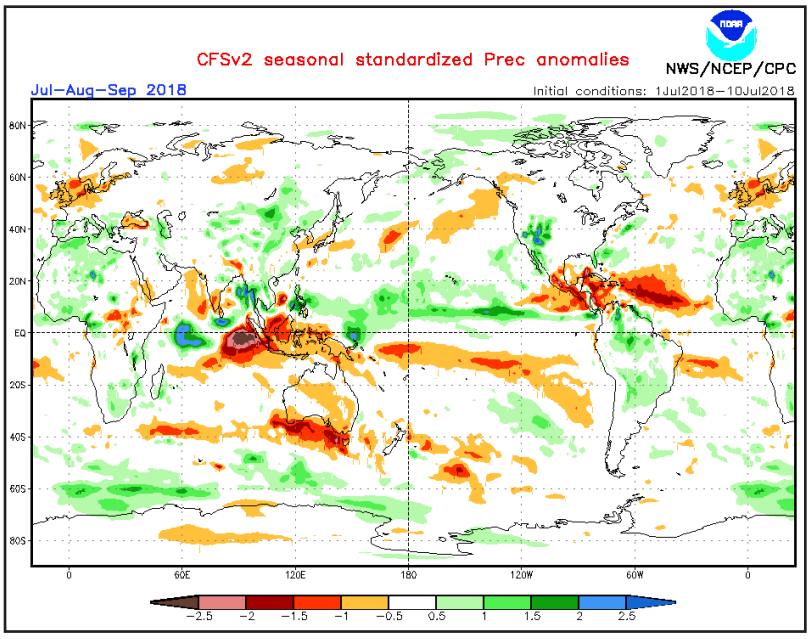
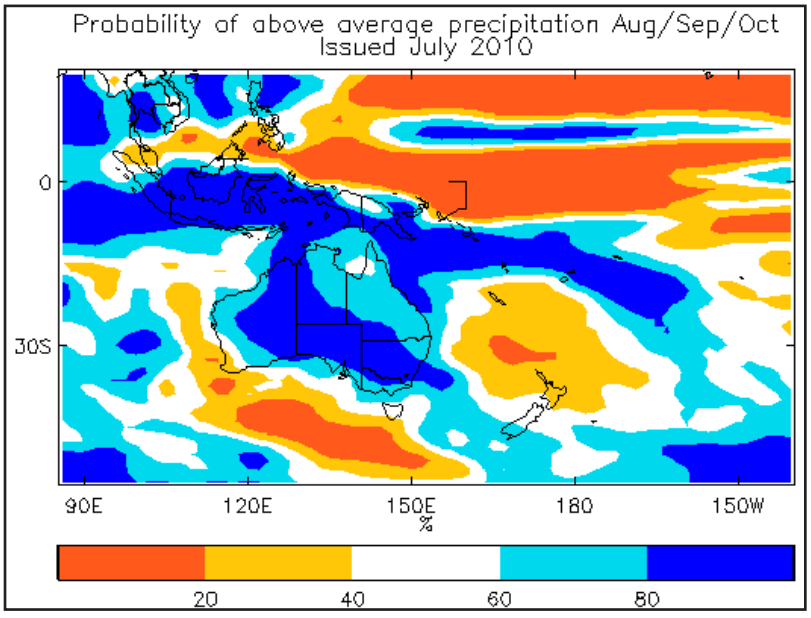


Figure 4. July to September 2018 rainfall anomaly prediction map. Source: NCEP.



For balance, here are some historic forecasts showing some wetter predictions for comparison.

Figure 5. Sept-Nov 2010 Probability of above average rainfall. Source: UK Met Office.

This map shows most of Australia was predicted to have a greater than 80 per cent chance of the rainfall being above average.

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Figure 6. Sept-Nov 2016 probability of wetter/normal/drier tercile rainfall. Source: National Oceanic and Atmospheric Administration (NOAA) North American Multi Model Ensemble.

This map shows much of Australia having 40-60 per cent chances of rainfall to be in the wettest tercile.

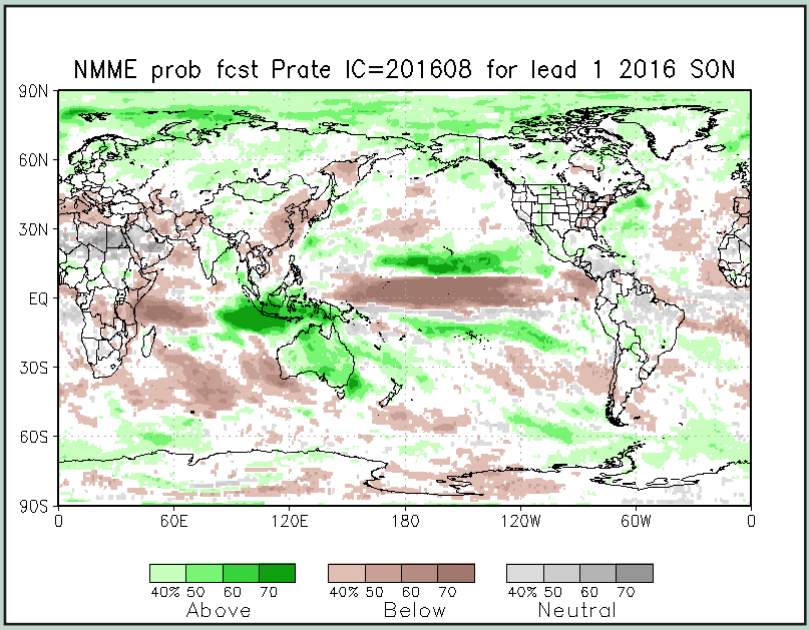
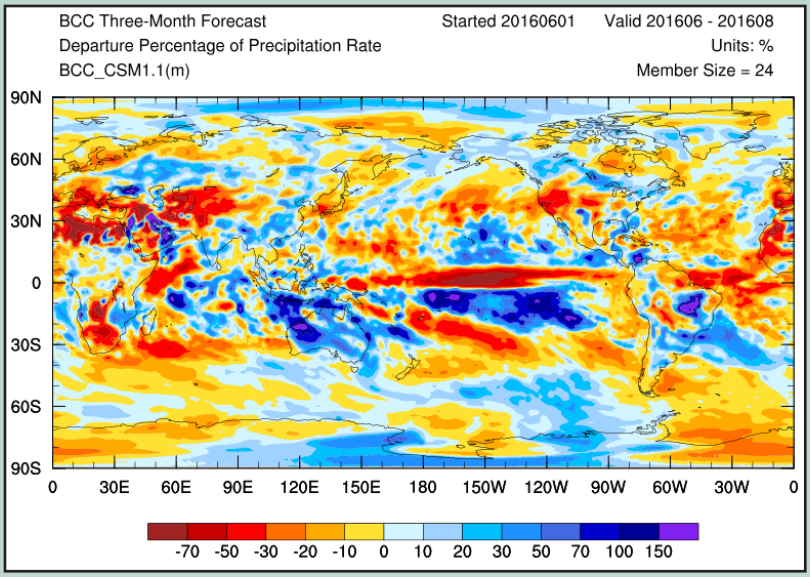


Figure 7. June-August 2016 rainfall percentage anomaly prediction map. Source: Beijing Climate Centre.

This map shows a deterministic forecast predicting it likely to be wetter than average over much of Australia.



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