El Nino: ignore the media hype, it doesn't always mean drought

Introduction

There has been a lot of criticism of the Bureau lately: how could the forecasts be so wrong, when we were supposed to be in an El Nino, which means drought doesn't it?

Well, does an El Nino mean drought? No, in fact it can be quite the opposite. But typically El Nino can mean:

- Reduced rainfall
- Warmer temperatures
- Shift in temperature extremes
- Increased frost risk
- Reduced tropical cyclone numbers
- Later monsoon onset
- Increased fire danger in southeast Australia
- Decreased alpine snow depths

An El Nino may present all, some, or none, of the above features. It may or may not result in a dry season. And despite what you hear in the media, El Nino does not necessarily mean drought. It's just that a drought is more possible. There is an excellent page on the Bureau website that provides an analysis of every El Nino from 1902-03. It can be found at http://www.bom.gov.au/climate/history/enso/

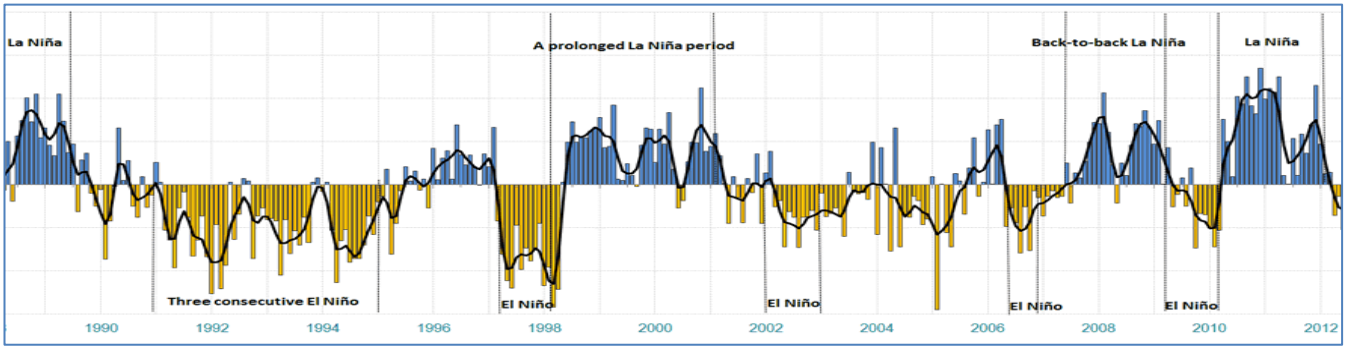
The main thing to remember, El Nino is a climatic condition, not a forecast. The media seems to not get this.

What is El Nino?

The term El Nino describes a particular phase of the ENSO climate cycle. ENSO is a coupled atmosphere-ocean phenomenon, which means that the transition between La Nina, El Nino and neutral conditions (neither El Nino nor La Nina) is governed by interactions between the atmosphere and ocean circulation.

In the ocean, ENSO is most commonly monitored through observed sea surface temperatures (SSTs) within a region of the central and eastern tropical Pacific known as NINO3.4.

In the atmosphere, ENSO is monitored via the Southern Oscillation Index (SOI), a measure of atmospheric circulation that takes the difference of atmospheric pressure between Darwin and Tahiti.



SOI chart from 1988 to 2012, showing El Nino and La Nina years

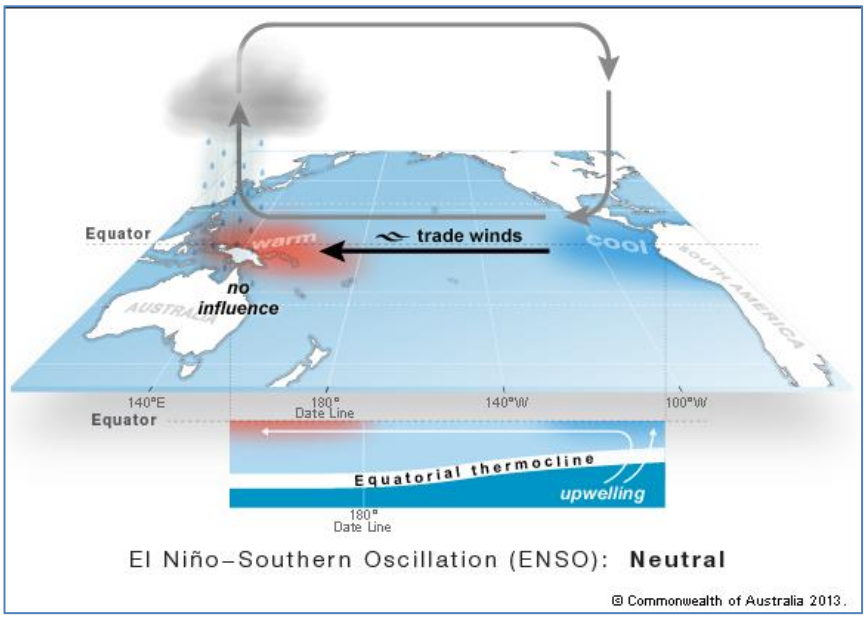
El Nino events are typically defined when SOI values fall below −7 and SSTs (measured in the NINO 3.4 region on the equator) are more than 0.8 °C above average.

Note: the Bureau uses 0.8 °C above average SST as the threshold for El Nino. Other agencies such as NOAA (United States) use a threshold of 0.5 °C, which explains why El Nino may be declared by other agencies some months before the Bureau, which was the case in 2023.

Events generally have an autumn to autumn pattern of evolution and decay. That is, they typically begin to develop during autumn, strengthen in winter-spring, then decay during summer and autumn of the following year. El Ninos can last for as little as six months, or for as long as two years.

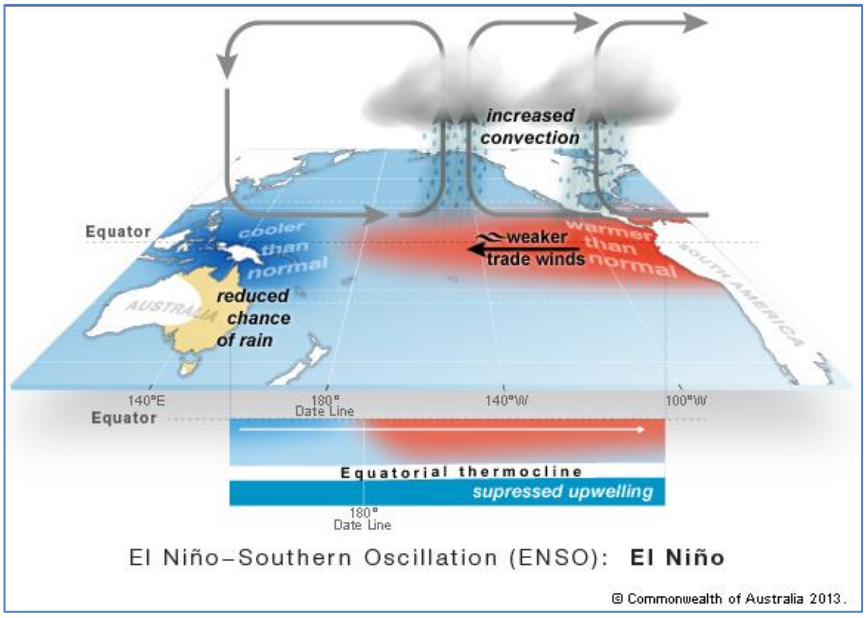
ENSO phases

ENSO (El Nino Southern Oscillation) has three phases: Neutral, El Nino, and La Nina.



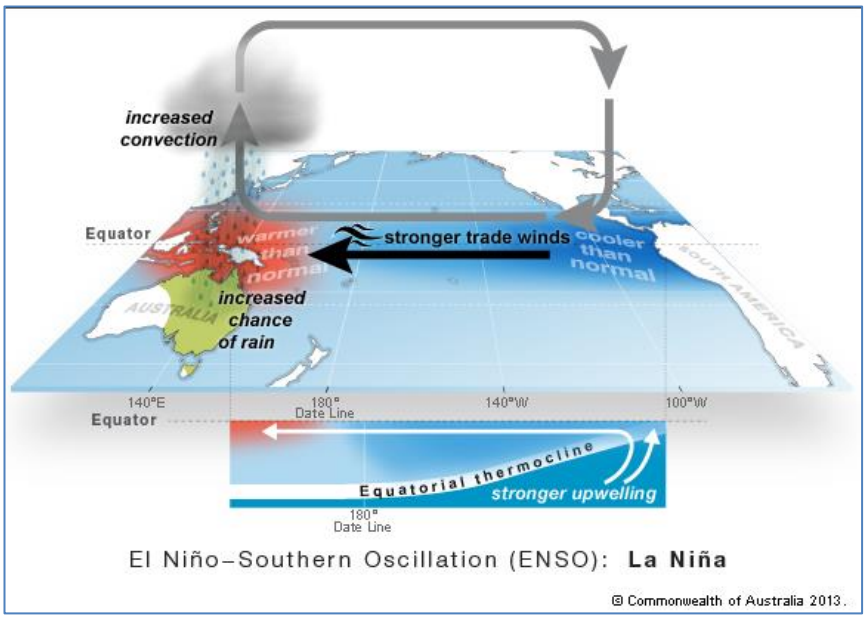
Neutral phase

Trade winds push warm surface water to the west and help draw up deeper, cooler water in the east. The warmest waters in the equatorial Pacific build up to the north of Australia and that area become the focus for cloudiness and rainfall.



El Nino phase

Trade winds weaken (or reverse) and warmer surface water builds up in the central Pacific. Cloudiness and rainfall north of Australia are supressed, typically leading to below average winter–spring rainfall for eastern parts of the country, and a drier start to the northern wet season.

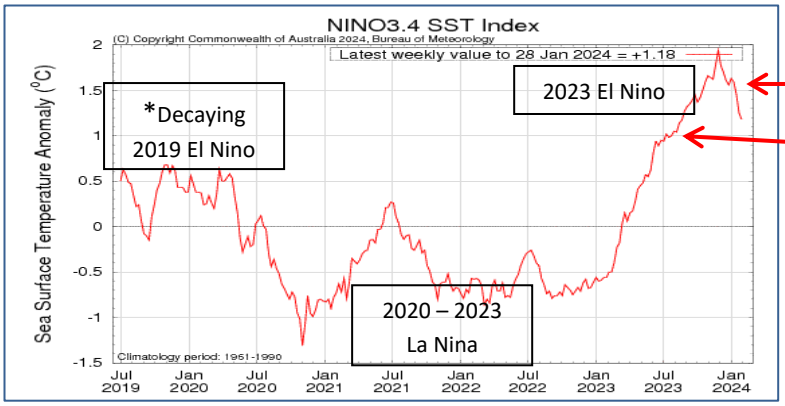


La Nina phase

Trade winds strengthen, increasing the temperature of the warm water north of Australia. Cloudiness and rainfall north of Australia are enhanced, typically leading to above average winter–spring rainfall for eastern and central parts of the country, and a wetter start to the northern wet season.

The 2023 El Nino SST anomaly and SOI charts

After three La Nina years, signs were starting to show an El Nino developing from early 2023. The SST anomaly chart and the SOI chart show La Nina and El Nino values from 2019 to January 2024.

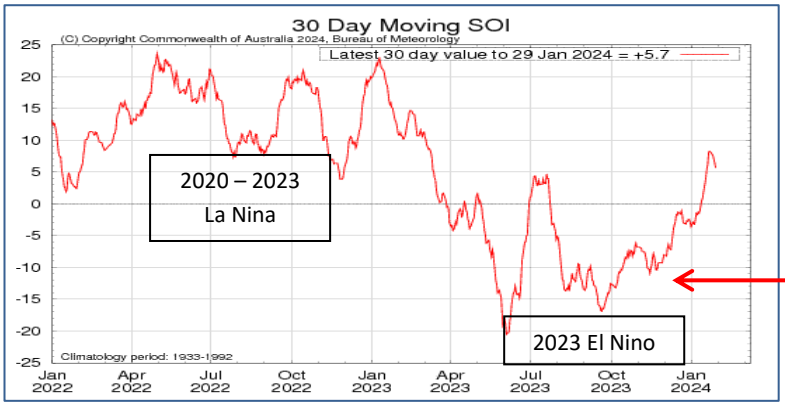


SST anomaly chart from July 2019 to January 2024

El Nino SST anomalies starting to decline in January 2024

El Nino of +0.8 °C threshold met around June-July 2023

*The drought year of 2019 was not officially designated El Nino, but conditions were very El Nino like. Climatologists were calling this a 'Modoki El Nino'. The warmer SSTs were more apparent in the central Pacific rather than the eastern Pacific.

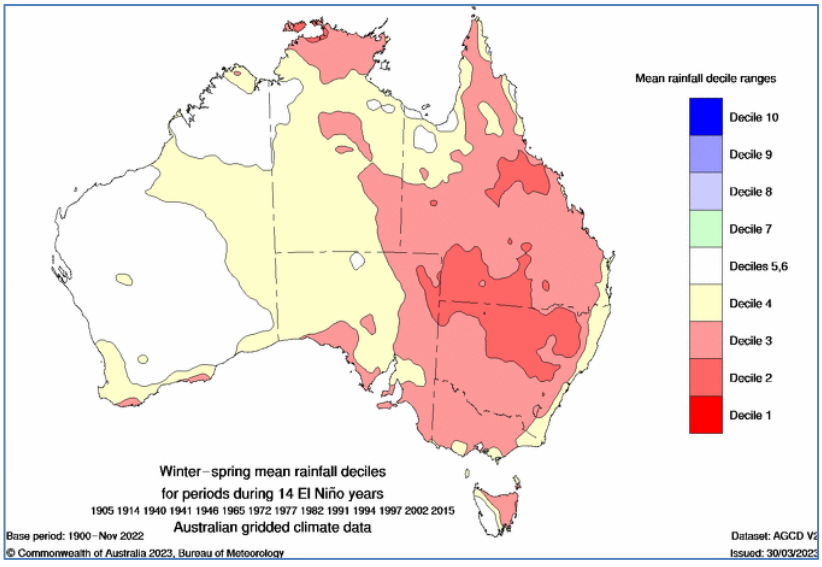


SOI chart from January 2022 to January 2024

Apart from a short detour into positive in July 2023, the SOI consistently exceeded El Nino threshold of -7 from May 2023 to January 2024

When and where does El Nino impact the Australian climate?

El Nino generally affects winter-spring rainfall over much of eastern Australia, but <u>has little influence on summer rainfall</u>. The rainfall decile map below shows how and where rainfall was impacted during 14 El Nino years.



The map to the left shows winter-spring rainfall deciles for 14 El Nino years: 1905, 1914, 1940, 1941, 1946, 1965, 1972, 1977, 1982, 1991, 1994, 1997, 2002, and 2015.

Not all of these El Nino years were drought years, but most producers in this region would remember the droughts in some recent El Nino years: 1982-83, 1991-92, 1994-95, and 2002-03.

Winter-spring rainfall averaged deciles for 14 El Nino years

Some interesting facts about El Ninos in Australia:

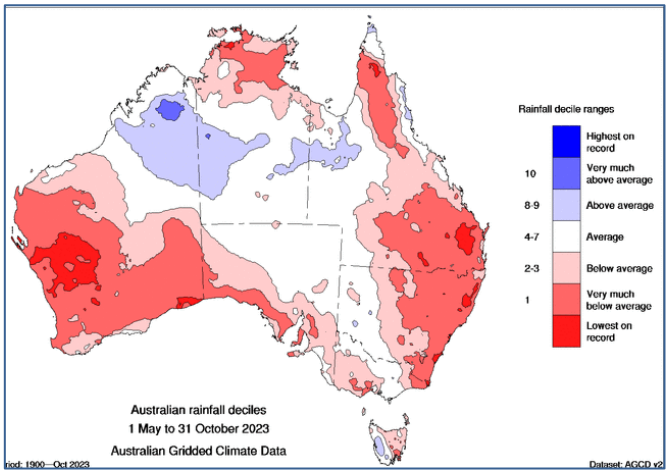
- 18 out of 27 El Nino events since 1900 brought drought to many areas
- 7 of the 10 driest years on record were during an El Nino
- Globally, 7 out of the 10 hottest years on record were El Nino years

What impact did the 2023 El Nino have on rainfall?

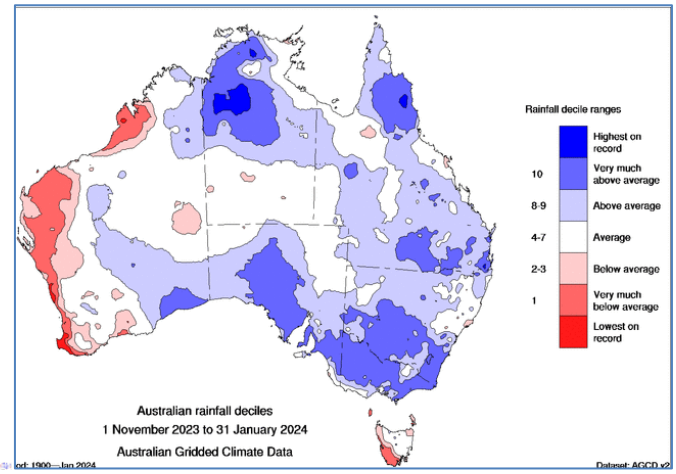
Rainfall impact was variable across the continent, and regions had either much below average rainfall or in some areas, significantly above average rainfall during the year of 2023.

However, if we look at the May to October rainfall, the picture is pretty stark. There was a classic El Nino below average rainfall result for much of eastern Australia. Remember, El Ninos usually develop during winter/spring, then peak late spring/early summer (Nov-Dec), and that's exactly what this one did. The much below average rainfall for the same period in Western Australia was probably more the result of a positive Indian Ocean Dipole (IOD) than the El Nino, although the two drivers operating at the same time can enhance the effect on rainfall.

The rainfall from November to January was above and beyond most expectations. There was significant rainfall right along the east coast, with major flooding in some areas. The Bureau has attributed much of this rainfall to a strongly positive Southern Annular Mode (SAM) in place through most of December and into January. In addition, two tropical cyclones were responsible for much of the rainfall in Queensland in late December and January.



Rainfall deciles May to October 2023



Rainfall deciles November 2023 to January 2024

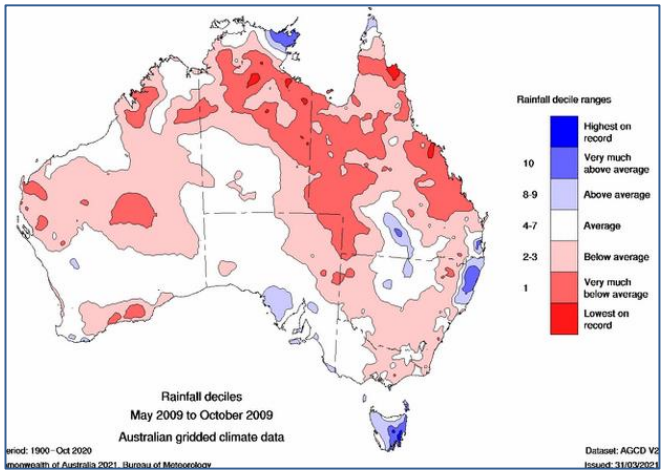
Deja Vu: remember 2009-10?

No two El Ninos are the same, but some El Ninos can result in very similar conditions. A case in point is the 2009-10 El Nino, which was very similar in effect to the 2023-24 El Nino.

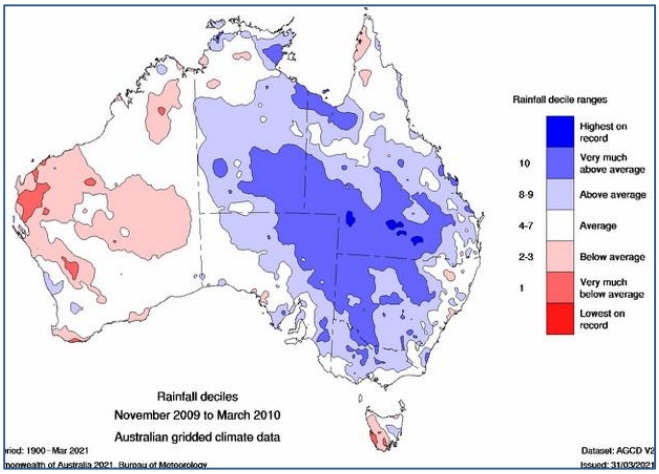
Consistent with the typical El Nino impact on Australia, May to October 2009 was very dry over much of the country, with Queensland and the NT having large areas with rainfall in the driest 10% of the historical record.

However, for the five months from November 2009 to March 2010, the NT, SA, Queensland, NSW and Victoria all had areas of rainfall in the top 10% (decile 10). Particularly active monsoon conditions occurred in February and March when a southward surge of tropical air brought heavy to flooding rains across central and southern parts of the NT, southern Queensland and northeast NSW.

Sound familiar?



Rainfall deciles May to October 2009



Rainfall deciles November 2009 to March 2010

So did the Bureau get it wrong?

There has been a lot of criticism of the Bureau forecasts in recent weeks, in particular regarding the Bureau more or less spooking producers into unnecessary selling off of livestock, which had a dramatic effect on cattle prices. Is this criticism justified? We need to look at the facts before reaching this conclusion.

Criticism 1: the Bureau went too early by calling the El Nino.

Incorrect. In fact the Bureau declared an El Nino a couple of months after other agencies had already done so. This was due to Bureau indicators not being met, as explained previously.

Criticism 2: it wasn't really an El Nino

Incorrect. Both the SST anomaly threshold and the SOI threshold were more than met, and both indicators were in El Nino trerritory for several months. It was in every sense of the word, an El Nino.

Once again, El Nino is a climatic condition, not a forecast.

Criticism 3: the forecasts were wrong

Yes and no. The forecasts for below median rainfall from May though to October were very accurate. However the forecasts during early October for a drier than normal November and December, and November to January forecasts were more or less the opposite to what actually occured.

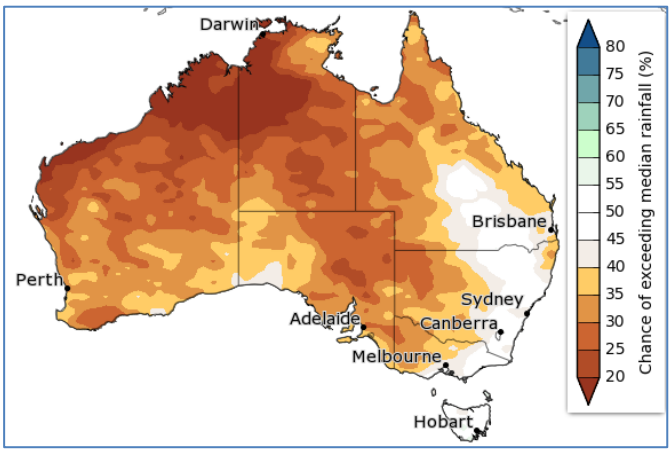
It needs to be remembered that long-term forecasts are based on probability. So if a forecast is saying there is a 60% chance of below median rainfall, then there is also a 40% chance of above median rainfall. Also, forecasts can be wrong simply from the effect of unforeseen events, such as what occurred in November: a stalled trough system and tropical moisture feeding in from the Coral Sea. As well as this the storm season can create a high degree of variability. In other words a probablisitic forecast is not necessarily right or wrong; the outcome may just not be in the range the forecast was indicating.

Producers in the Wide Bay Burnett region will remember just how dry it became during late winter and early spring. There were many serious bushfires in September and October, and by the end of October it really looked like a serious drought was coming. The rain in November saved the situation dramatically and quickly.

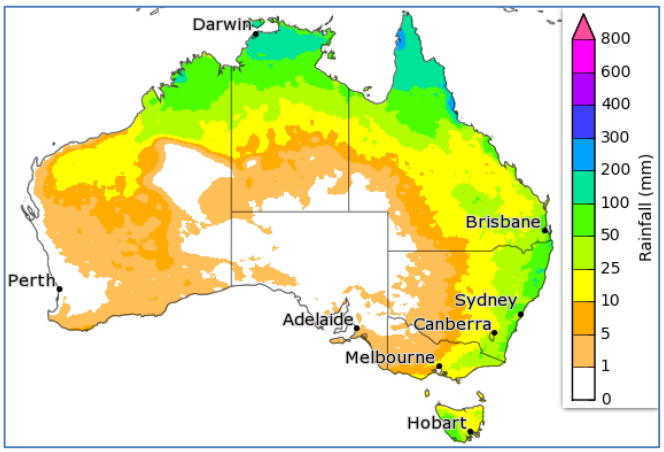
Sometimes it is the way forecasts are presented that causes confusion

There has been a degree of criticism of the way the Bureau presents seasonal forecasts. The default method is '*probability of exceeding median rainfall'*, which may not mean much for many people. A better method could be using a system similar to the ECMWF, which shows the likelihood of rainfall being in terciles, ie the upper, middle, or lower one-third according to records. Or maybe the default could be '*a high, or 75% chance of receiving'* which is an option available on the Bureau outlook page, as displayed in the image on the right below. In other words, the map shows a high likelihood of receiving a certain amount of rainfall during the selected period.

Which would you prefer?



Probability of exceeding median rainfall February 2024



High (75%) chance of receiving(mm) February 2024