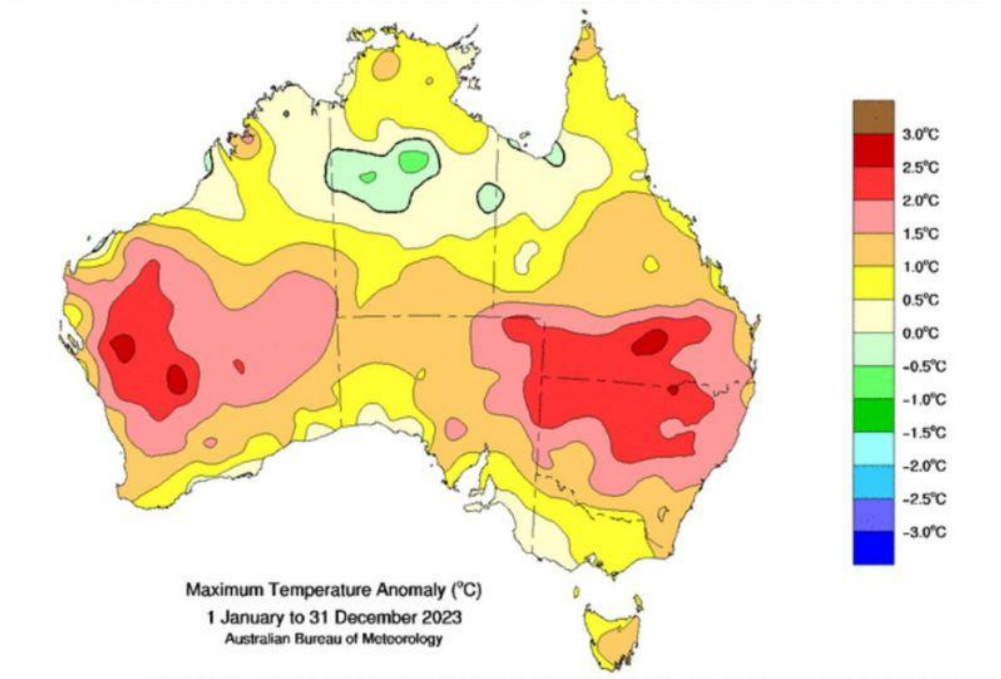
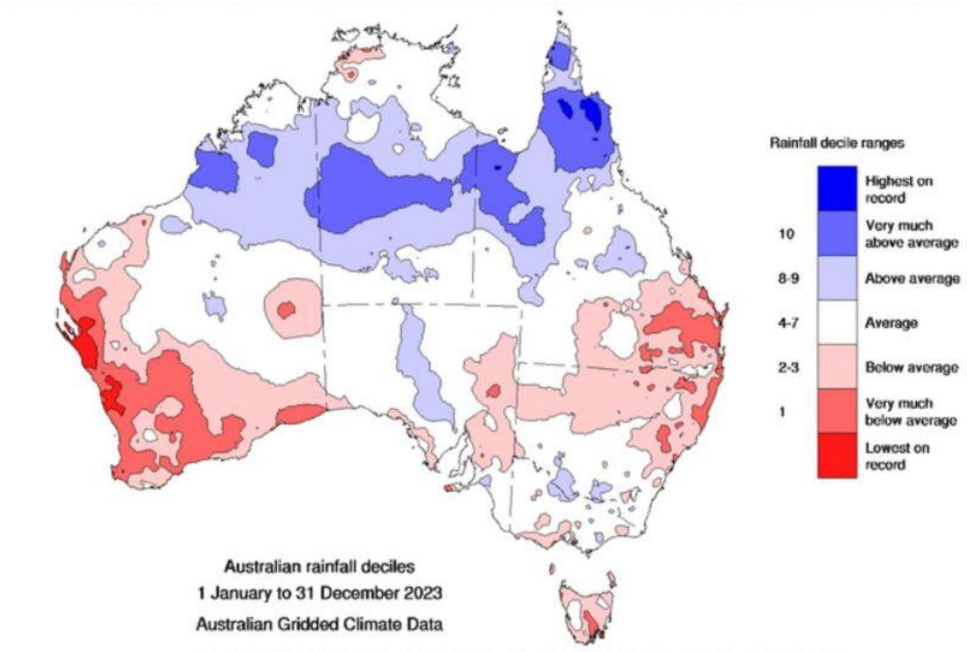
Draft - A Summary of the Weather in the Tallong Region - 2023

The Bureau of Meteorology (BOM) reported the following observations relevant to our region for 2023:

- Australia's equal eight-warmest year on record with the national mean temperature 0.98 °C warmer than the 1961–1990 average.
- Both the mean annual maximum and minimum temperatures were above average for all States and the Northern Territory.
- Widespread warmth throughout the second half of the year, as the mean national temperature was among the ten warmest on record for their respective month for June, July, August, September, November and December.
- Rainfall was above average for much of northern Australia, but below average for Tasmania, much of the south-eastern quarter of Queensland, parts of northern New South Wales and western and southern Western Australia, and parts of southern Victoria and eastern and south-western South Australia.
- The August to October period was Australia's driest three month period on record since 1900.
- The main climate drivers active during 2023 were La Niña, which weakened and dissipated through summer 2022–23 and El Niño and a positive Indian Ocean Dipole, which were established in early spring.
- Nearly all of Australia was warmer than normal in 2023 despite starting the year under the La Niña climate pattern, according to the Bureau of Meteorology (BOM).





The network of current observation stations and their weather measurements are shown in Table 1. There will now be a discussion of the observations in comparison to the overall BOM report for 2023.

Rainfall

The monthly observations at each station are shown in Table 2. It should be noted that the 2023 data at the Boral South Marulan site is actually from the Limestone-New site from February onwards - the Median values were determined from the combined databases at the old and new locations. At all stations the rainfall in January was well above the median values followed by much lower values in February. The two South Marulan stations were lower than the medians in March by contrast with the other Tallong stations. All stations were above the median values by at least a factor of two in April. Thereafter there was a period of three months when the all stations were well below the median values. The Winter rains will be discussed separately below. September and October recorded low rainfall totals while November and December were above average. Overall, the annual totals in 2023 were slightly lower than the long term median values at all stations except the Leese station and significantly lower at the Boral South Marulan site (maybe due to the Limestone-new location. By contrast with the BOM observation, August to October was not the driest period on record for the Tallong Region.

Winter rains during 2023

It had been found elsewhere in Australia that Winter in 2023 was the driest on record . It is interesting to have a look at weather data in the Tallong and South Marulan region to see if we observe similar behaviour. Rainfall data are available from six stations in the region as shown in the Table 3. This analysis show that even though we have a limited database, rains in Winter 2023 were not the lowest on record even though they were well below the median values at all stations.

The reasons for the exceptional monthly figures will now be discussed in terms of the significant rainfall events.

Significant Weather Events in 2023

The significant rainfall events during 2023 are shown in Table 4. Some of the days with very significant rain will be discussed in relation to the surface synoptic scale weather/pressure maps although availability of the rainfall radar data over the region is limited due to BOM expenses which limits the interpretations.

January 2023

Four days are listed as having significant rain during January. On the January 19 0900 AEDT readings there was significantly more rain in the north of the region at the Leese/Botticchio/Clark stations. In Figure 2 the Mean Sea Level (MSL) Pressure map indicates a high pressure system over the Australian Bight, a cold front in the Tasman Sea to the SE and a complex low pressure trough line running from the NW across the Central Coast of NSW. There was some complexity over our region leading to the lower observations nearer the coast and in the South Marulan area.

The pressure maps for the cases on January 30 and 31 are shown in Figures 3 and 4. On January 30 at 0500 AEDT there was a complex system of troughs with a low pressure centre off the south coast of NSW (Figure 3). These resulted in wind flow across the coast and higher totals in the southern stations of the network (Black, Darda, Peppertree, South Marulan). By contrast, as the trough and low pressure system moved up the NSW coast (Figure 4), the more inland stations (Leese, Botticchio) had the higher totals.

April 30

The MSL pressure map in at 0400 AEST in Figure 5 indicates an "East Coast" low had formed off the central coast of NSW with a trough line extending south along the coast and continuously NW up into Queensland. Such a system was likely to feed moist air in from the coast with the resulting heavy falls recorded across our region, up to 72 mm at Darda and Clark (Table 4) but only 47 mm in South Marulan. Without the detailed weather radar images it is difficult to explain those differences.

November 29 and 30

There was an inland low pressure system with a warm front and onshore flow over our region on the morning of November 29 (Figure 6). This lead to fairly uniform rainfall being observed over our region in the 0900 observations although they were slightly higher towards the coast. Later in the day the weather radar indicated a series of thunderstorms moved over the region (Figure 7) as the lower pressure centre moved SE towards the coast (Figure 8). The local nature of thunderstorms was seen in the higher observations of Leese/Botticchio at 0900 AEDT on November 30 (about 35 mm) compared lower observations at the other stations (15.5 to 26 mm) [Table 4].

December 20

The last day of significant rainfall to be discussed in 2023 occurred on December 20 when totals varied between 30 and 50 mm across the network. This corresponded to a complex system of inland and coastal troughs and a cold front to the south (Figure 9). The highest totals were observed in the southern stations and South Marulan grading to the lowest at Clark (30.5 mm) in the north. Again this indicates onshore flow and lifting of the moist air over the escarpment.

Rainfall Summary

Analysis of the annual variations and significant rainfall events in 2023 from the Tallong observation network similar to the observations of 2022 suggest that rain events which originate inland associated with low pressure troughs will lead to widespread, more uniform rain across the network. Rain originating with air movement from the coast will cause higher readings in stations closer to the coast. Thunderstorms can be spawned along trough lines and be limited in geographic size. These can cause local heavy rain events only affecting some stations and thus distorting the annual averages and larger geographic influences.

Temperatures

The 2023 monthly temperature statistics from the weather station operating at 467 Mulwaree Drive, Tallong are shown In Table 4 with the long term statistics (12 years from 2012 to 2023) in Table 5. The Annual and Winter averages are shown in Table 6 and the monthly Average Annual, Minimum and Maximum Temperatures in Table 7. The differences between Table 5 and Table 4 temperature statistics are seen in Table 8. The following observations can be made:

1. Overall 2023 was cooler than the long term averages during the months of January, February, April and May.
2. All statistics in Table 8 showed 2023 in March, June to September and December was warmer than the long term averages.

Following other observations elsewhere in Australia that Winter in 2023 was the warmest on record it is interesting to look at the those in the Tallong region. In the Table 9 Winter average temperatures from weather stations at 467 Mulwaree Dr, Tallong and the quarries at Peppertree and Boral South Marulan/Limestone have been compared.

This indicates from our limited databases that at Peppertree Quarry and the Tallong station, 2023 was the warmest year on record. The 2023 winter value for Boral South Marulan/Limestone station was taken at a different site to the 2008 to 2022 data. This shows that at the Limestone site 2023 was not the warmest year with 2009 and 2013 both recording 8.0 °C by comparison with 7.7°C in 2023. This could just be a geographic difference to be investigated as the records accumulate further at the Limestone-new site.

Geoffrey Clark

February, 2024

Acknowledgements

Through the continued dedication of the network of rainfall and weather observers in the Tallong region, this report has been able to describe the unique geographic features and variations of Tallong's weather. I would also like to again acknowledge Ijeoma Ehighibe from Boral, Peppertree Quarry and Therese Thomas/Hadjia from Boral, Limestone for allowing access to the detailed weather station data at the Peppertree quarry and the Limestone/South Marulan sites. Many thanks to all concerned.

Station Name	Rain gauge					Observation	Data Type
	Geographic co-ordinates °		Altitude m	UTM Co-ordinates m		Duration	
Black	150.14907	-34.79092	627	239150.2	6146438.5	2004 to 2023	Daily rainfall
Darda	150.11468	-34.76478	627	235919.5	6149247.9	1999 to 2023	Daily rainfall
Clark	150.09201	-34.69578	634	233622.1	6156843.5	2006 to 2023	T,RH,Dew,u,θ,Rain, Daily rain
Botticchio	150.10297	-34.71486	629	234686.9	6154755.4	1998 to 2023	Daily rainfall
Leese	150.10872	-34.72306	685	235239.9	6153861.1	2001 to 2023	Daily rainfall
Boral Peppertree	150.02472	-34.74641	607	227623.0	6151046.0	2012 to 2023	T,RH,u,θ,σ_θ,Rain,Radiation, Evaporation
Boral South Marulan	150.01190	-34.76770	618	226518.9	6148648.8	2008 to Jan. 2023	T,RH,u,θ,σ_θ,Rain
Boral South Marulan -New	150.01346	-34.76331	613	226647.2	6149139.9	Feb. 2023 onwards	T,RH,u,θ,σ_θ,Rain, Radiation, Evaporation

Where

T	RH	u	θ	Rain	σ_θ	Radiation
Temperature	Relative Humidity	Wind Speed	Wind Direction	Rain	Wind direction Standard Deviation	Solar Radiation

Table 1

Observer	Location	Observations (years)	Jan	Feb	Mar	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Total
Dugald Black	1095 Caoura Rd	20	113.7	30.9	71.8	111.3	28.9	20.9	12.3	55.1	21.1	34.1	126.7	154.6	781.4
	Median		81.6	93.5	59.1	40.5	28.3	49.5	28.6	40.3	39.7	58.2	74.4	76.7	815.3
Freda Darda	593 Caoura Rd	24	128.80	29.00	73.20	109.50	13.50	20.00	10.00	50.00	21.50	32.50	107.00	137.50	732.50
	Median		61.00	98.13	59.38	34.83	25.30	47.15	27.78	38.48	37.48	46.63	69.13	61.70	745.00
Christina Leese	957 Highland Way	24	129.0	28.5	75.0	115.0	22.5	25.5	13.0	50.5	24.5	40.0	124.5	131.0	779.0
	Median		68.5	95.0	68.0	33.0	28.5	49.5	30.0	37.5	35.0	50.0	76.0	58.0	733.0
Margaret Botticchio	66 Railway Pde	26	113.5	28.5	83.5	122.0	22.5	27.5	13.5	32.0	25.0	43.5	130.0	128.0	770.5
	Median		65.5	91.5	66.8	43.3	23.3	50.8	31.0	41.0	42.0	46.3	79.3	62.5	784.8
Geoff Clark	467 Mulwaree Dr	18	126.8	17.0	72.4	112.5	19.0	20.8	11.7	42.0	29.3	32.7	114.2	117.3	715.7
	Median		56.6	86.1	58.2	37.7	31.8	46.1	28.6	44.3	33.7	45.8	72.3	70.7	778.8
Peppertree Quarry	South Marulan	14	117.5	23.5	58.5	80.5	18.0	19.0	9.5	41.5	32.0	27.0	95.0	108.5	630.5
	Median		53.5	86	72.25	27.5	24.25	32	21.5	44	30.75	36.25	72	61	689.25
Boral	South Marulan	16	128.5	19.6	48.0	79.8	17.6	19.0	10.0	45.2	23.4	29.8	106.8	117.0	644.7
	Median		69.0	85.0	53.0	33.3	25.5	34.8	23.3	46.9	33.0	41.8	67.5	69.8	745.3

Table 2

		Winter Rainfalls mm			
Name	**Period of Observation**	**2023**	**Median**	**Lowest**	**Year**
1095 Caoura Rd	2004 to 2023	88.3	158.1	28.0	2004
593 Caoura Rd	1999 to 2023	80.0	135.5	53.5	2018
957 Highland Way	1999 to 2023	89.0	133.0	51.5	2004
467 Mulwaree Dr	2006 to 2023	74.5	146.9	57.7	2009
Peppertree Quarry	2012 to 2023	70.0	151.0	39.5	2018
Boral South Marulan	2008 to 2023*	74.2	127.5	46.5	2018

Winter rainfall analysis - 2023

Table 3

Date	Dugald Black	Freda Darda	Christina Leese	Margaret Botticchio	Geoff Clark	Peppertree Quarry	Boral South Marulan
January							
3	6.8	10.5	11.0	10.0	13.5	15.0	19.5
19	20.8	21.0	30.0	27.0	30.1	19.0	16.0
30	32.2	42.0	25.0	22.0	32.6	45.5	53.5
31	15.5	21.0	39.0	33.0	25.8	13.5	20?
March							**Limestone-New**
24		16.0	18.0	21.0	22.9	11.0	8.6
27	22.5	13.0	8.5	11.0	9.8	8.5	11.8
29	5.0	0.0	7.5	9.5	8.5	5.0	4.8
30	16.8	14.0	8.0	8.5	5.2	11.5	9.4
April							
30	59.2	72.0	67.0	67.0	72.0	46.5	47.2
November							
10	16.0	7.5	13.0	16.0	19.5	6.0	4.6
25	18.8	16.0	15.0	20.0	16.8	9.0	8.4
29	38.0	35.0	31.5	31.0	30.0	28.0	30.2
30	22.0	26.0	36.0	34.0	19.5	15.5	27.4
December							
20	50.0	45.0	32.5	35.0	30.5	49.5	50.4
21	14.0	13.0	16.5	18.0	15.3	14.5	17.2
26	?	27.0	22.5	18.5	23.0	23.0	26.2
28	6.0	9.0	12.0	12.0	16.0	5.0	4.0

Table 4 Significant rain events in 2023

Tallong at 1.2m Dates: 010123 to 311223

Dry Bulb Temperature (deg.c)

Time (EST.)

Month	0000-0300	0300-0600	0600-0900	0900-1200	1200-1500	1500-1800	1800-2100	2100-2400	Average		Extreme	
									Minimum	Maximum	Minimum	Maximum
January	14.3	13.8	15.8	20.8	23.0	20.9	17.1	15.2	13.0	24.2	6.9	34.1
	2.8	2.8	3.1	5.1	5.8	4.7	3.2	2.7	standard	deviations		
	372	372	372	371	360	359	360	361	number	of	observations	
February	14.8	13.7	15.5	22.6	25.2	22.1	18.2	16.0	12.7	25.4	7.8	35.7
	2.4	2.6	3.1	9.8	9.9	5.1	3.6	2.4	standard	deviations		
	336	336	336	336	336	336	336	336	number	of	observations	
March	14.5	13.6	14.9	20.3	22.4	20.9	17.2	15.2	12.4	23.7	5.0	38.3
	2.4	2.7	3.3	4.9	5.7	5.2	3.4	2.6	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	
April	9.4	8.7	9.3	14.6	17.1	15.7	11.9	10.3	7.1	18.3	2.7	23.2
	2.7	3.0	2.8	2.8	3.3	3.2	2.2	2.2	standard	deviations		
	360	360	360	360	360	360	360	360	number	of	observations	
May	5.0	4.4	5.1	11.1	13.8	11.8	7.9	6.2	2.9	14.3	-2.1	19.4
	2.6	3.2	3.5	2.6	2.6	3.3	2.5	2.6	standard	deviations		
	252	252	252	252	241	244	252	252	number	of	observations	
June	5.5	5.1	5.1	9.3	11.7	9.7	6.6	5.6	3.4	12.6	-6.4	19.1
	3.8	4.0	4.0	2.9	2.9	3.0	2.5	3.2	standard	deviations		
	360	360	360	360	360	360	360	360	number	of	observations	
July	4.3	4.1	4.3	10.2	13.3	11.4	6.8	5.0	1.7	14.2	-5.3	17.3
	3.9	4.6	4.8	3.4	2.2	2.8	2.4	3.1	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	
August	5.0	4.1	5.1	11.2	14.2	12.6	8.1	6.1	2.5	15.4	-1.8	20.3
	2.3	2.5	2.9	3.4	3.3	3.3	1.8	1.7	standard	deviations		

	372	372	372	372	372	372	372	372	number	of	observations	
September	7.1	5.8	8.3	16.8	20.1	17.9	11.9	8.7	4.0	20.9	-3.4	29.8
	4.8	5.1	5.9	5.2	4.9	5.4	4.5	4.3	standard	deviations		
	360	360	360	360	360	360	360	360	number	of	observations	
October	9.0	7.9	12.6	18.2	20.2	18.3	13.1	10.2	5.7	21.4	-1.1	29.8
	4.2	6.3	11.3	5.1	5.3	5.6	4.7	4.1	standard	deviations		
	372	372	368	372	372	372	372	372	number	of	observations	
November	9.5	9.4	13.8	18.8	19.5	19.5	15.4	14.2	10.4	18.8	5.2	21.4
	3.8	3.4	2.9	1.3	1.2	1.7	1.2	0.7	standard	deviations		
	24	24	24	24	23	13	24	24	number	of	observations	
December	15.2	14.4	17.8	23.0	24.9	22.7	18.4	16.3	13.4	26.5	7.6	37.1
	2.8	2.6	3.9	5.0	5.7	5.6	4.1	2.9	standard	deviations		
	372	372	372	371	372	372	372	372	number	of	observations	

Table 4 Temperature analyses at 467 Mulwaree Dr, Tallong - 2023

Tallong at 1.2m Dates: 010112 to 311223

Dry Bulb Temperature (deg.c)

Time (EST.)

Month	0000-0300	0300-0600	0600-0900	0900-1200	1200-1500	1500-1800	1800-2100	2100-2400	Average		Extreme	
									Minimum	Maximum	Minimum	Maximum
January	15.7	14.9	17.9	23.7	26.0	24.0	19.5	16.9	13.8	27.6	2.5	42.0
	3.3	3.4	4.4	6.1	6.6	6.4	4.8	3.6	standard	deviations		
	4464	4464	4462	4463	4452	4451	4452	4453	number	of	observations	
February	14.9	14.1	16.2	21.6	24.0	22.3	18.1	15.9	13.0	25.4	3.4	41.9
	2.8	2.9	3.6	5.5	6.1	5.5	4.0	2.9	standard	deviations		
	4068	4068	4068	4064	4068	4068	4068	4068	number	of	observations	
March	13.6	12.9	14.3	19.4	21.6	19.9	16.1	14.4	11.6	23.0	1.2	38.3
	3.0	3.2	3.5	4.2	4.8	4.6	3.2	2.9	standard	deviations		
	4464	4464	4464	4464	4464	4464	4464	4464	number	of	observations	
April	10.2	9.4	10.3	16.3	18.9	17.0	12.9	11.2	7.9	20.0	-0.6	32.5
	3.4	3.7	3.7	3.8	4.1	4.1	3.0	3.0	standard	deviations		
	4320	4320	4320	4319	4320	4320	4320	4320	number	of	observations	
May	6.3	5.7	6.4	12.2	15.1	12.9	8.8	7.2	3.9	15.9	-4.2	24.2
	3.7	4.0	4.0	3.5	3.5	3.7	3.1	3.4	standard	deviations		
	4056	4063	4055	4035	4020	4024	4032	4045	number	of	observations	
June	4.6	4.2	4.4	8.9	11.5	9.7	6.4	5.2	2.4	12.4	-6.4	19.1
	3.6	3.8	3.8	2.7	2.4	2.7	2.6	3.1	standard	deviations		
	4308	4308	4308	4308	4307	4308	4308	4308	number	of	observations	
July	4.0	3.5	3.8	8.9	11.6	9.9	6.2	4.9	1.6	12.6	-7.1	20.4
	3.7	4.0	4.1	3.0	2.7	3.0	2.7	3.3	standard	deviations		
	4464	4464	4464	4460	4463	4464	4464	4464	number	of	observations	
August	4.2	3.5	4.5	10.2	12.6	11.0	7.0	5.2	1.7	13.7	-6.2	22.4
	3.6	3.8	3.9	3.1	3.2	3.4	2.8	3.1	standard	deviations		
	4452	4452	4452	4450	4449	4452	4452	4452	number	of	observations	
September	6.7	5.7	7.9	14.3	16.6	14.7	10.2	8.1	4.0	17.8	-4.7	31.4
	3.9	4.2	4.5	4.1	4.4	4.5	3.5	3.6	standard	deviations		
	4320	4320	4320	4320	4320	4320	4320	4320	number	of	observations	
October	9.3	8.4	11.9	17.7	19.6	17.8	13.1	10.7	6.8	21.0	-2.6	32.1
	3.7	4.2	5.3	5.0	5.3	5.3	4.0	3.6	standard	deviations		

	4464	4464	4460	4461	4464	4464	4463	4464	number	of	observations	
November	11.3	10.6	14.5	19.9	21.8	19.7	15.0	12.6	9.3	23.3	0.6	39.4
	3.5	3.8	4.4	5.2	5.6	5.6	4.3	3.4	standard	deviations		
	3984	3984	3982	3984	3979	3973	3984	3984	number	of	observations	
December	13.8	13.0	16.8	22.5	24.4	22.3	17.7	15.1	11.8	26.1	1.6	41.9
	3.5	3.6	4.5	5.8	6.2	6.1	4.8	3.7	standard	deviations		
	4464	4464	4464	4461	4462	4464	4464	4464	number	of	observations	

Table 5 Temperature analyses at 467 Mulwaree Dr, Tallong - 2012 to 2023

Annual	average	temperatures
Average	No.	
2012	12.3	35135
2013	13.5	33252
2014	13.3	35040
2015	12.8	34942
2016	13.5	35131
2017	13.2	35037
2018	13.3	35040
2019	13.7	34379
2020	13.0	35126
2021	12.1	34989
2022	12.1	35030
2023	13.0	31307

Winter	average	temperatures
Average	No.	
2012	6.5	8831
2013	7.5	8736
2014	7.0	8832
2015	6.0	8736
2016	7.5	8828
2017	6.6	8832

2018	6.6	8832
2019	6.8	8831
2020	7.0	8832
2021	6.9	8832
2022	6.8	8827
2023	7.7	8832

Table 6: Annual and Winter Average Temperatures at

467 Mulwaree Dr., Tallong - 2012 to 2023

	Average monthly temperatures												
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
2012	17.9	17.0	15.1	12.9	8.2	6.9	6.0	6.6	10.2	13.1	16.2	17.7	12.3
2013	21.1	17.7	16.7	13.1	9.3	7.3	7.1	8.2	12.5	13.6	14.9	18.6	13.3
2014	20.1	18.6	17.1	13.3	10.0	7.8	6.5	6.7	10.5	14.3	17.4	18.0	13.4
2015	18.7	18.2	16.1	12.5	9.2	5.8	5.1	7.1	9.4	15.7	16.8	18.7	12.8
2016	18.8	19.6	18.3	14.9	11.0	7.5	7.5	7.4	10.1	11.9	16.1	19.8	13.6
2017	21.6	20.1	17.0	11.8	9.1	6.5	6.3	6.9	10.7	14.5	15.0	19.5	13.3
2018	20.8	18.9	16.8	15.6	9.3	6.5	6.4	6.9	9.7	13.3	15.5	19.6	13.3
2019	22.7	18.7	17.2	14.3	10.0	6.8	7.1	6.6	10.2	14.2	17.1	19.5	13.7
2020	20.9	18.7	15.5	13.4	8.5	7.0	7.0	6.9	11.2	13.8	16.8	16.5	13.0
2021	18.6	17.2	15.3	12.1	8.9	6.9	6.2	7.6	10.4	12.3	13.7	16.1	12.1
2022	18.8	17.3	15.8	13.2	9.8	6.1	6.3	8.1	9.5	12.4	13.2	15.4	12.2
2023	17.6	18.5	17.4	12.1	8.1	7.3	7.4	8.3	12.1	13.7	14.7	19.1	13.0
Overall	19.8	18.4	16.5	13.3	9.3	6.9	6.6	7.3	10.5	13.6	15.6	18.2	13.0

	Average monthly minimum temperatures												
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
2012	11.9	12.7	10.8	7.4	2.2	2.9	1.0	0.0	3.0	5.2	9.6	11.4	6.5
2013	14.1	12.8	10.9	7.5	3.0	3.1	1.9	2.6	5.9	5.0	8.0	10.7	7.1
2014	12.4	12.7	12.3	8.2	4.4	3.3	1.6	1.2	4.4	6.6	10.5	12.7	7.5
2015	13.9	13.2	9.8	8.5	4.7	0.6	0.2	1.7	3.3	8.9	10.6	10.9	7.2
2016	13.2	13.4	12.7	9.2	5.0	3.7	3.6	2.0	5.1	5.3	9.2	13.3	8.0
2017	14.8	13.8	13.2	6.0	2.8	1.1	0.2	1.1	3.1	7.7	8.8	13.3	7.2
2018	13.3	12.8	11.1	9.6	3.4	2.0	0.4	1.3	2.6	7.9	8.9	12.9	7.2
2019	16.4	12.1	11.8	8.1	4.7	1.7	2.1	0.5	2.6	5.7	8.8	11.4	7.2
2020	14.8	14.0	10.6	8.3	3.4	2.4	2.3	2.3	5.7	8.6	10.1	11.5	7.8
2021	12.9	13.0	10.6	5.8	3.9	2.6	1.5	1.6	3.8	6.2	9.9	10.9	6.9
2022	15.0	12.9	12.7	9.1	5.7	1.8	2.5	3.4	5.1	8.3	7.4	9.1	7.8
2023	13.0	12.7	12.4	7.1	2.9	3.4	1.7	2.5	4.0	5.7	10.4	13.4	7.4
Overall	13.8	13.0	11.6	7.9	3.8	2.4	1.6	1.7	4.1	6.8	9.4	11.8	7.3

	Average monthly maximum temperatures												
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Annual**
2012	25.2	23.0	20.9	19.9	15.9	11.8	12.3	13.8	18.3	21.7	24.4	25.9	19.4
2013	30.2	24.1	23.5	20.4	15.9	12.4	13.5	14.3	20.2	21.9	22.6	27.4	20.5
2014	29.0	26.6	23.5	19.6	17.3	13.3	12.5	13.6	17.4	22.7	26.4	25.4	20.6
2015	25.3	24.7	24.3	17.9	15.1	12.6	11.2	13.1	16.6	23.2	24.1	27.4	19.6
2016	26.4	27.9	26.3	22.5	17.4	12.2	12.2	13.8	15.8	18.3	24.2	27.5	20.4
2017	30.3	28.3	22.4	19.0	16.4	13.2	13.1	13.8	18.3	22.3	22.6	26.9	20.6
2018	29.9	27.5	23.9	23.6	17.0	11.7	13.4	13.0	17.5	20.3	22.6	27.8	20.7
2019	31.6	26.3	24.0	21.8	16.2	13.0	13.1	13.6	18.1	22.9	26.1	29.4	21.3
2020	29.0	24.6	21.5	19.5	14.5	12.7	12.8	12.4	17.8	20.2	24.6	23.2	19.4
2021	25.9	23.5	21.2	19.8	15.1	11.9	11.5	14.0	17.3	19.4	19.1	23.0	18.5
2022	24.3	23.3	20.1	18.2	15.0	11.1	10.8	13.5	15.0	17.2	19.8	22.5	17.6
2023	24.2	25.4	23.7	18.3	14.3	12.6	14.2	15.4	20.9	21.4	18.8	26.5	19.6
Overall	27.6	25.4	22.9	20.0	15.8	12.4	12.6	13.7	17.8	21.0	22.9	26.1	19.9

Average Annual, Minimum and Maximum Temperatures

Table 7

Tallong at 1.2m Differences: Long term-2023

Dry Bulb Temperature (deg.c)

Time (EST.)

Month	0000-0300	0300-0600	0600-0900	0900-1200	1200-1500	1500-1800	1800-2100	2100-2400	Average	
									Minimum	Maximum
January	1.4	1.1	2.1	2.9	3.0	3.1	2.4	1.7	0.8	3.4
February	0.1	0.4	0.7	-1.0	-1.2	0.2	-0.1	-0.1	0.3	0.0
March	-0.9	-0.7	-0.6	-0.9	-0.8	-1.0	-1.1	-0.8	-0.8	-0.7
April	0.8	0.7	1.0	1.7	1.8	1.3	1.0	0.9	0.8	1.7
May	1.3	1.3	1.3	1.1	1.3	1.1	0.9	1.0	1.0	1.6
June	-0.9	-0.9	-0.7	-0.4	-0.2	0.0	-0.2	-0.4	-1.0	-0.2
July	-0.3	-0.6	-0.5	-1.3	-1.7	-1.5	-0.6	-0.1	-0.1	-1.6
August	-0.8	-0.6	-0.6	-1.0	-1.6	-1.6	-1.1	-0.9	-0.8	-1.7
September	-0.4	-0.1	-0.4	-2.5	-3.5	-3.2	-1.7	-0.6	0.0	-3.1
October	0.3	0.5	-0.7	-0.5	-0.6	-0.5	0.0	0.5	1.1	-0.4
November	1.8	1.2	0.7	1.1	2.3	0.2	-0.4	-1.6	-1.1	4.5
December	-1.4	-1.4	-1.0	-0.5	-0.5	-0.4	-0.7	-1.2	-1.6	-0.4

Temperature Differences: Long term [2012 to 2023] - 2023

Table 8

	Winter Average Temperatures					
Date	Peppertree		Boral South Marulan/Limestone		Tallong	
	Average	No. of Obs.	Average	No. of Obs.	Average	No. of Obs.
2008			7.1	2207		
2009			8.0	2208		
2010			6.9	2232		
2011	7.5	5952	7.4	2208		
2012	7.1	8832	6.9	2208	6.5	8831
2013	8.2	8789	8.0	2208	7.5	8736
2014	7.6	7739	7.4	2205	7.0	8832
2015	6.9	8832	6.4	2232	6.0	8736
2016	8.2	8832	7.9	2184	7.5	8828
2017	7.4	8832	7.1	2208	6.6	8832
2018	7.5	8832	7.2	2208	6.6	8832
2019	7.6	8818	7.4	2208	6.8	8831
2020	7.6	8832	7.4	2184	7.0	8832
2021	7.6	8832	7.5	2208	6.9	8832
2022	7.5	8832	7.4	2208	6.8	8827
2023	8.4	8832	7.7	8832	7.7	8832

Winter Average Temperatures

Table 9

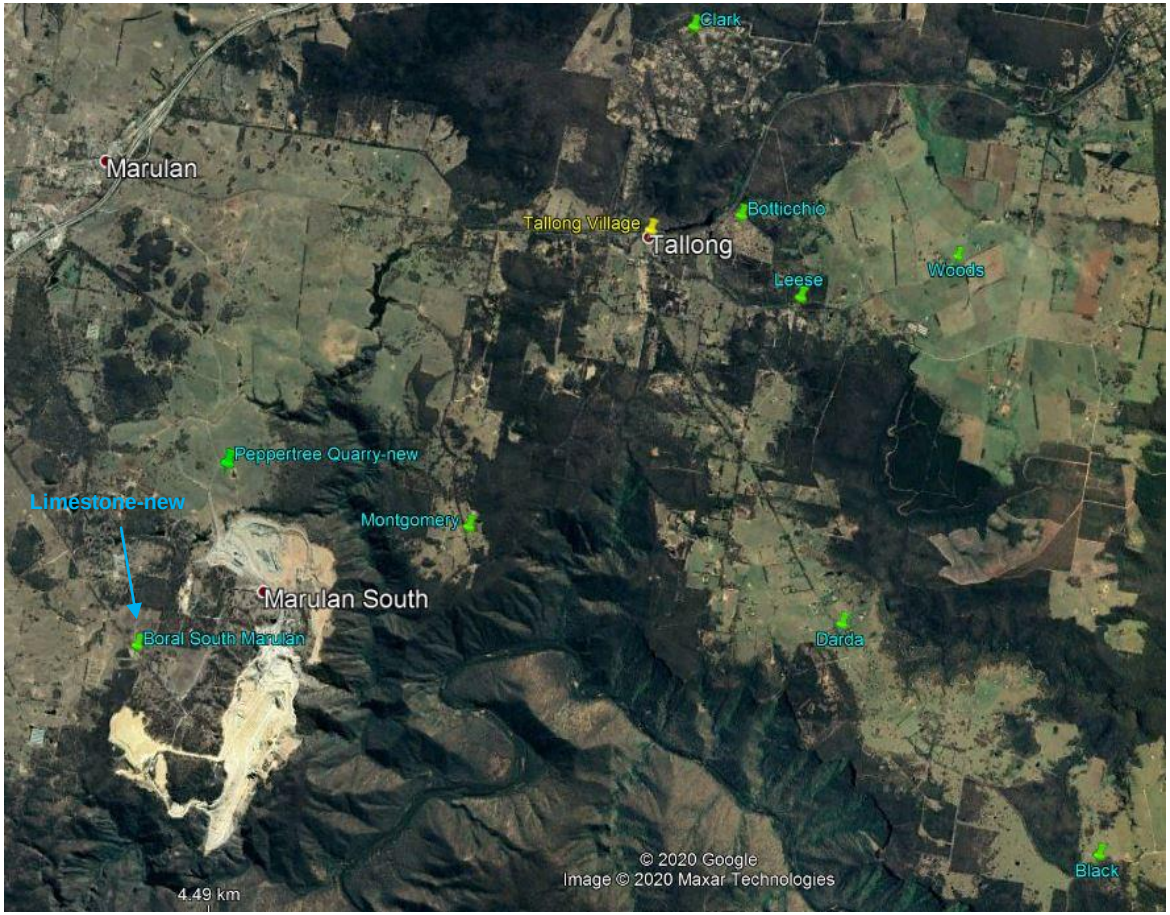
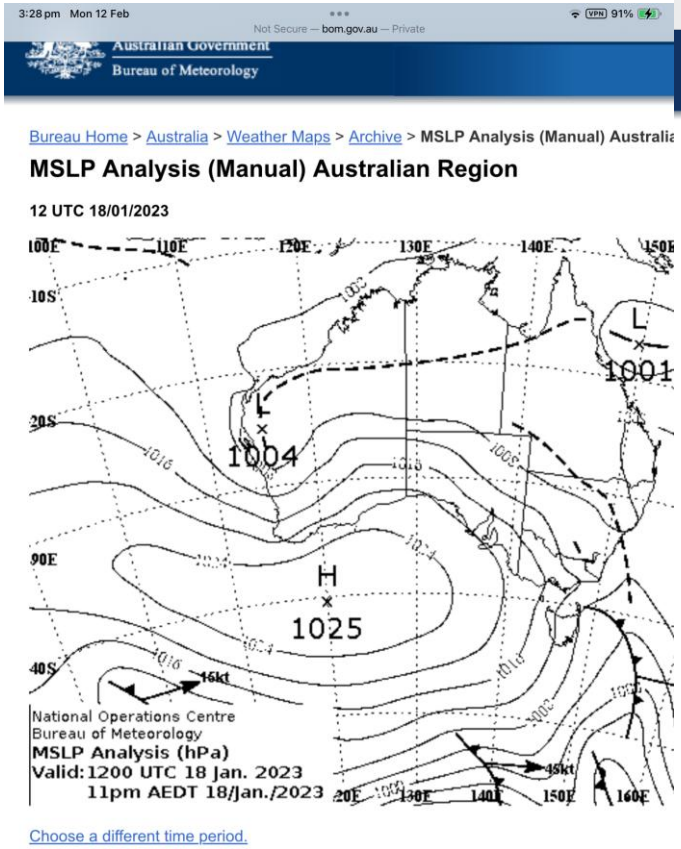
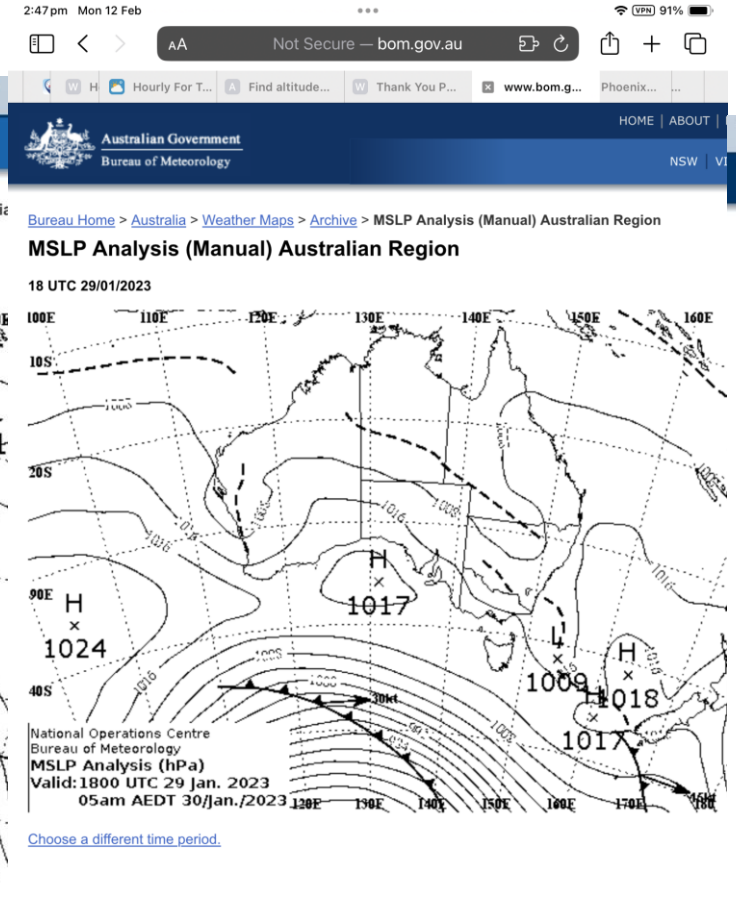


Figure 1: Google Earth image of the Tallong region



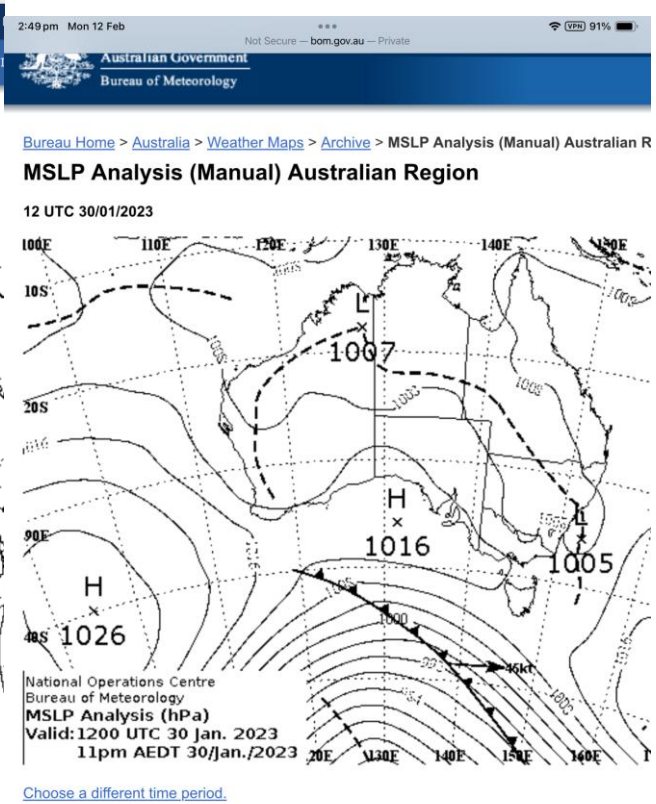
MSL Pressure Map 180123 2300 AEDT

Figure 2



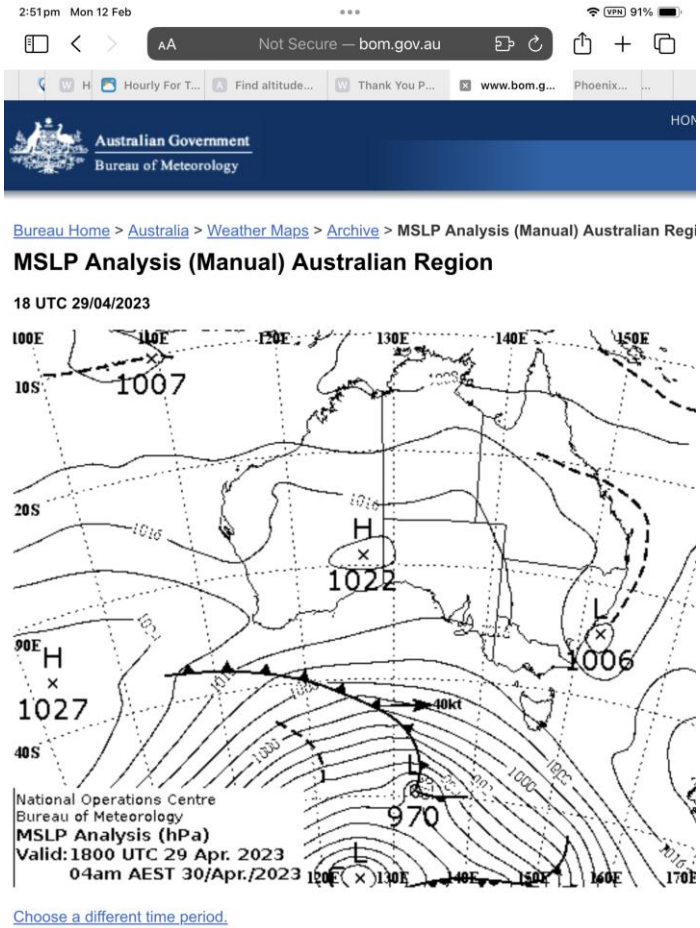
MSL Pressure Map 290123 0500 AEDT

Figure 3



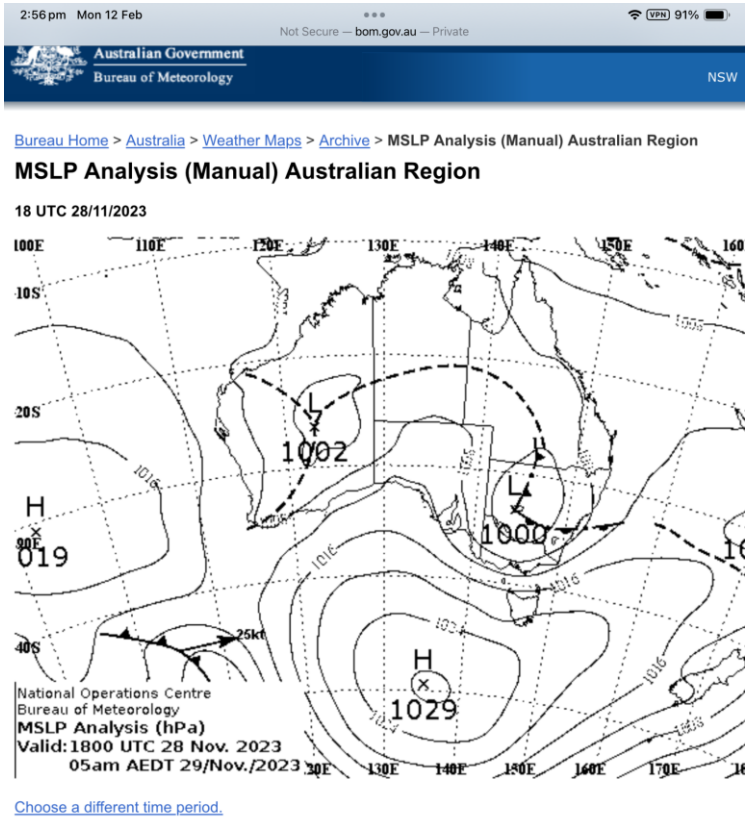
MSL Pressure Map 290123 2300 AEDT

Figure 4



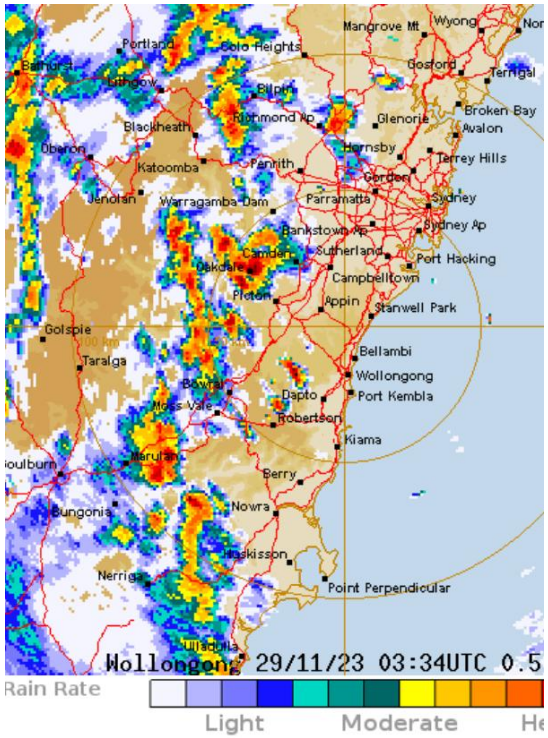
MSL Pressure Map 290423 0400 AEST

Figure 5



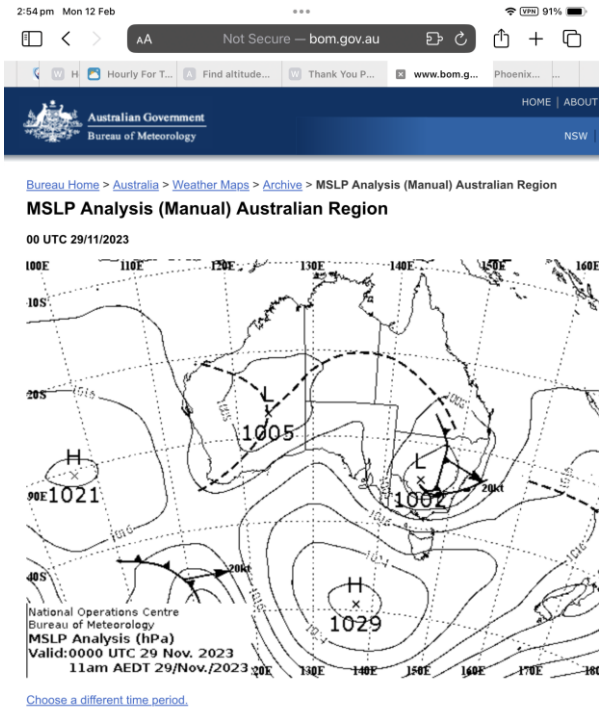
MSL Pressure Map 281123 0500 AEDT

Figure 6



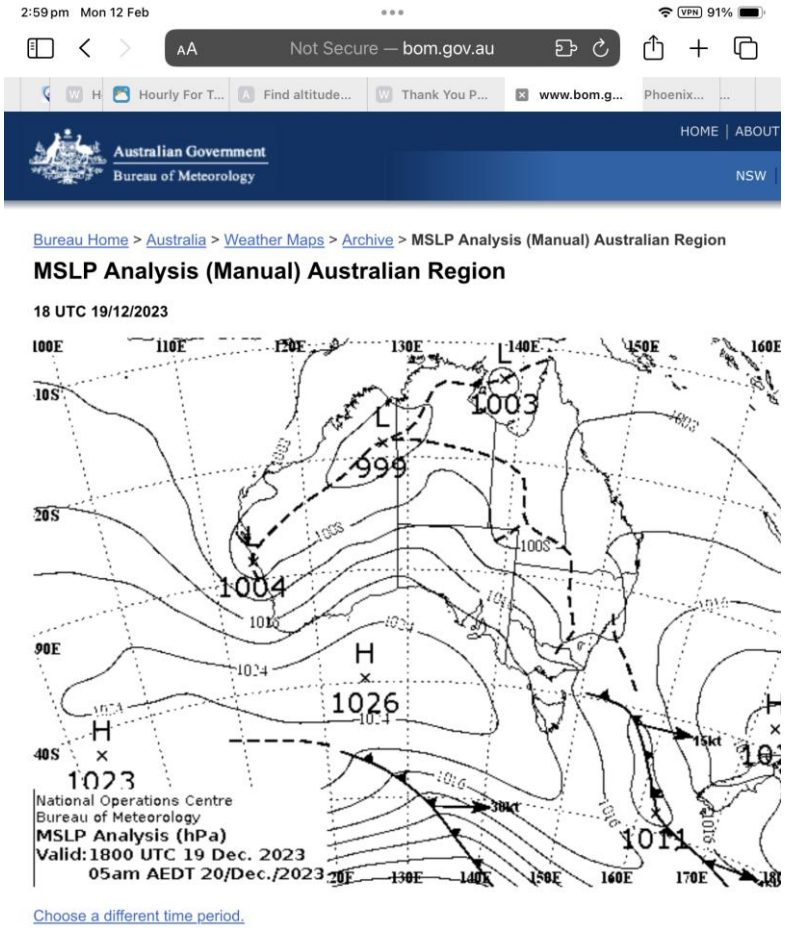
Weather radar November 29 at 1434 AEDT

Figure 7



MSL Pressure Map 291123 2300 AEDT

Figure 8



MSL Pressure Map 191223 0500 AEDT

Figure 9