

A Summary of the Weather in the Tallong Region - 2021

Rainfall and significant storm events observed during 2021 will be discussed together with temperatures later in the report. Details of the weather data available from the Tallong Region are noted in Table 1; there is also an image of the region from Google Earth seen in Figure 1.

Rainfall

In Table 2 the 2021 monthly and annual rainfall totals together with the long term median values from all stations in the observer network through the Tallong region indicate the following:

1. At most stations the annual totals of rain were the second highest on record, only exceeded by those in 2020.
2. Rainfall in the months of March and November were the highest on record and will be the subject of further discussion in the section on of Significant Weather Events below.
3. The highest recorded rainfall in March at all stations was followed by the lowest or near lowest (within 1-2 mm) recordings in April.
4. Although there was a trend in lower annual totals away from the coast (Black to Darda to Woods) this was reversed with the observations of Leese and Botticchio closer to the Tallong village. This might be explained by the influence of heavier falls from more local thunderstorms which develop inland and meander north-east towards the coast - see the next section.

Significant Weather Events in 2021

The significant rainfall events during 2021 are shown in Table 3. These will now be discussed with assistance from the Bureau of Meteorology (BOM) rainfall radar images and synoptic maps.

February 2

Around 1930 AEDT on February 1, a line of significant thunderstorms moved through the region from the W to E (Figure 2). In one 15 minute period at the weather station on Mulwaree Drive, 16.4 mm was recorded at an instantaneous rainfall rate of 172 mm per hour. In the hour to 1900 AEDT, the South Marulan weather station recorded 26.5 mm. Apart from the Peppertree Quarry weather station (28.5 mm), there was a reasonably uniform distribution of rain across the region with the other stations recording 35-41 mm of rain in the 24 hours to 0900 AEDT on February 2. There was an inland trough of low pressure which spawned this line of thunderstorms (Figure 3).

March 17 to 24

Over the period March 17 to 24, 2021 NSW was deluged with heavy rain which caused extensive flooding along the east coast from Queensland to the Victorian border. It was caused by two features: first a N-S trough line along the coastline with a high pressure system in the south Tasman Sea feeding moisture into the trough and second, a trough from NW Australia feeding moisture from the NW inland NSW to the SE coast. The NW trough brought a second rainfall peak at the end of the period. A more detailed analysis will follow.

March 17 to 20

The synoptic pattern during this period featured a general on-shore flow from the East with a trough inland (Figure 4); an example radar image is seen in Figure 5. During this period showers brought patchy rain across the Tallong region. For example, on 19/3/2021 the Black and Woods stations recorded in excess of 34 mm while Clark and South Marulan only had 20.2 and 19 mm respectively.

March 20 to 21

The synoptic pattern became more complicated between March 20 and 21 with two troughs developing, one along the NSW coastline and the other further inland moving towards the coast (Figure 6). There was a strong inflow of moisture from the NE with consistent showers observed over the Tallong region (Figures 7 and 8). Despite the radar images showing more consistent rain over the Sydney and northern part of The Illawarra regions, there was significant geographic variation over the Tallong region (Table 3); 89 mm (Black) to 72 mm (Leese) and lower again at the Boral stations (54 to 60 mm).

March 23 to 24

A low pressure system and cold front then developed inland where the inland trough was previously located (Figure 9). This caused the rain to develop inland rather than the NE and flow in a clockwise direction over the Tallong region (Figures 10 and 11). Rain totals on March 23 were again patchy varying from 27 mm (Woods) to 38 mm (Botticchio). By March 24 the inland low pressure centre had moved SW to central Victoria (Figure 12) and the more uniform rain images (Figure 13) had cleared the Tallong region by 1344 AEDT March 23. As a result there was a more uniform distribution of rain across the Tallong region (Table 3).

August 24, 25

Fairly uniform rainfall recorded across the region on the 24/8/2021 (30-38 mm - Table 3) resulted from an inland trough which advected the rain down from the NW. This can be seen in the synoptic map (Figure 14) at 1600 AEST on 23/8/2021 and the radar image taken at 1949 AEST when there was moderate rain over Tallong (Figure 15). The responsible cold front with a SE to NW orientation was moving rapidly to the NE (Figure 16) and then formed a low pressure centre off the coast in SE NSW (Figure 17) later deepening into a complex low pressure system with cold and warm fronts leading to a clockwise circulation pattern of rain showers over the Sydney region (Figure 18). As a result the rain over Tallong came in from the SE direction (Figure 19). Compared to other areas nearer Sydney, Tallong was on the fringe of much higher rainfalls to the NE (Figure 20).

November

November 5

There was a trough with a NNW orientation located inland (Figure 21) which brought consistent rain over the Tallong region from 1400 AEDT on the 4/11/2021 until about 1000AEDT on 5/11/2021. Rain initially moved down from the NW (Figure 22) and later from the SE and NE over the Tallong region.

Highest totals from the Tallong Observer Network (Table 3) indicated a stronger coastal influence (Black 34 mm) compared to the inland sites (Clark 19 mm).

November 12

There was an inland low pressure centre and cold front (Figure 23) which caused rain showers to be transported down from a NW direction over the Tallong (Figure 24). This resulted in a fairly uniform distribution of rain across the Tallong region [apart from the Leese station which seemed to have a problem] (Table3) with variations from 33 to 40 mm recorded at 0900 AEDT on 12/11/2021.

November 21

Intermittent showers were observed over the Tallong region from 1130 AEDT on 20/11/2021 until 0915 AEDT on 21/11/2021. The BOM radar images loop showed these showers were coming from the west. The synoptic pattern driving these showers (Figure 25) indicated an inland trough oriented NW to SE with light winds. A typical radar image during that period when there was rain over Tallong is seen in Figure 26. Again, when the rain originates inland there is a more uniform distribution across the Tallong region (Table 3) - varying from 26.5 at the Peppertee Quarry to 33.8 mm at the Black station.

November 25

A series of showers with embedded heavy falls (thunderstorms) moving down from the NW and crossing the Tallong region from 1630 AEDT on 24/11/2021 were driven by an inland trough (Figure 27). Examples of the radar images directly impacting the Tallong region are seen in Figures 28 and 29. The fairly narrow radar echoes indicated small intense storms. This was confirmed by the geographic variations in the network observations where the 24 hour totals varied from 28 mm at South Marulan to 43.8 mm at the Black rain gauge. In terms of rain intensity, a maximum instantaneous rainfall rate of 144 mm hr⁻¹ was observed in the 15 minute period from 2100 to 2115 AEDT when 10.6 mm were recorded on the weather station at 467 Mulwaree Drive.

December 4 and 10

December 4

An intense but very local thunderstorm was observed over the Tallong region on the evening of 3/12/2021. This was driven by a low pressure trough located in the NE of NSW with an orientation of SE to NW (Figure 30). Rain and hail were observed over a small area of Tallong, mainly in the Tallong Park Estate. The dramatic variations in the 24 hour rainfall totals from 0 to 29 mm (Botticchio) are seen in Table 3. A special report was written and is available for viewing at <http://tallong.com.au/tallong/weather-in-tallong/>. Two videos of the consequences of the storm can be seen at . <http://tallong.com.au/wp-content/uploads/2022/01/Ferme-1-video-1639112014.mp4> and <http://tallong.com.au/wp-content/uploads/2022/01/Ferme-2-video-1639112047.mp4>

December 10

Rain started in the Tallong region around 2100 AEDT on 9/12/2021 and lasted until about 0430 AEDT on 10/12/2021. There was a complex low pressure trough system over the central-east area of NSW which was driving the weather over the region (Figure 31). There were thunderstorms observed

from the BOM radar images over the Blue Mountains and the Central Coast of NSW (Figure 32). Those over the Blue Mountains moved south-east and then over Tallong from the NE (Figure 33) finally moving towards the coast and joining with the Central Coast storm system which had come down from the north (Figure 34). The 24 hour totals did show widespread rain across Tallong with some variability - [Darda 25 mm to 33 mm Botticchio] (Table 3).

Rainfall Summary

Analysis of the annual variations and significant rainfall events from the Tallong observation network during 2021 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. Such a thunderstorm was observed on the evening of December 3, 2021.

Temperatures

The 2021 monthly temperature statistics from the weather station operating at 467 Mulwaree Drive, Tallong are shown in Table 4 with the long statistics (10 years from 2012 to 2021) in Table 5. The Annual and Winter averages are shown in Table 6. The following observations can be made:

1. The summer months of 2021 indicated lower average minimum and maximum temperatures.
2. Likewise the 2021 autumn was cooler than average.
3. During the winter the average minimum temperatures were similar or a little higher than the long term statistics but the maximum temperatures were slightly lower in June and July but higher by 0.5°C in August. Over all times, in winter 2021 was near mid-range in terms of the long term statistics (Table 6).
4. In Spring the 2021 average maximum temperatures were cooler with November significantly lower by 4.6°C.
5. Considering all times and months, 2021 was the coolest year observed so far at 467 Mulwaree Drive (Table 6).

Geoffrey Clark

March 8, 2022

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 Sharon Makin from Boral, Peppertree Quarry for allowing access to the detailed weather station data at the Peppertree quarry and the 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 2020	Daily rainfall
Darda	150.11468	-34.76478	627	235919.5	6149247.9	1999 to 2020	Daily rainfall
Clark	150.09201	-34.69578	634	233622.1	6156843.5	2006 to 2020	T,RH,Dew,u, θ ,Rain, Daily rain
Botticchio	150.10297	-34.71486	629	234686.9	6154755.4	1998 to 2020	Daily rainfall
Leese	150.10872	-34.72306	685	235239.9	6153861.1	2001 to 2020	Daily rainfall
Woods	150.12735	-34.72105	676	236940.3	6154133.2	2002 to 2020	Daily rainfall
Montgomery	150.05625	-34.75513	614	230538.3	6150163.1	1966 to 2020	Daily rainfall
Boral Peppertree	150.02472	-34.74641	607	227623.0	6151046.0	2019 to 2020	T,RH,u, θ , σ_θ ,Rain,Radiation
Boral South Marulan	150.01190	-34.76770	618	226518.9	6148648.8	2008 to 2020	T,RH,u, θ , σ_θ ,Rain

Where

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

Table 1

Observer	Location	Observations (years)	Jan	Feb	Mar	Apr	May	June	July	August	Sept	Oct	Nov	Dec	Total
Dugald Black	1095 Caoura Rd	18	83.2	122.5	270.1	8.6	185.6	55	19.3	64.2	37.4	60.7	256.1	88.4	1251.1
	Median		83.7	117.4	90.2	50.7	39.6	91.5	31.0	61.7	39.2	56.4	87.8	87.4	833.5
Freda Darda	593 Caoura Rd	23	80.00	101.90	250.00	4.20	171.50	48.80	15.50	55.50	30.50	65.00	240.50	84.00	1147.50
	Median		57.00	99.65	58.50	32.90	23.00	45.80	26.20	37.50	34.30	45.75	65.75	63.00	719.50
David Woods	1183 Highland Way	21	52.0	91.5	256.0	3.0	177.0	47.0	7.0	57.0	26.0	32.0	202.0	94.5	1046
	Median		55.5	107.5	70.0	42.5	25.0	51.0	30.0	32.5	33.0	43.5	68.0	49.5	735.5
Christina Leese	957 Highland Way	23	68.5	101.0	256.0	3.0	177.0	51.0	21.0	61.0	32.0	63.0	229.5	118.5	1181.5
	Median		56.0	95.5	66.5	31.5	28.5	51.0	30.0	31.0	35.0	50.0	73.0	58.0	710.5
Margaret Botticchio	66 Railway Pde	24	72.5	111.5	277.5	0.0	181.5	50.0	23.0	66.0	34.0	57.0	249.5	119.5	1241.5
	Median		61.5	97.5	63.3	37.5	23.3	51.8	31.0	41.0	42.0	46.3	71.5	62.5	761.3
Geoff Clark	467 Mulwaree Dr	16	55.8	96.9	239.3	1.3	169.6	42.3	21.0	63.1	30.9	47.3	186.9	73.9	1028.3
	Median		53.1	97.2	51.3	33.9	31.8	50.3	28.6	44.8	33.7	45.8	60.2	70.7	778.8

Table 2

Date	Dugald Black	Freda Darda	David Woods	Christina Leese	Margaret Botticchio	Geoff Clark	Peppertree Quarry	Boral South Marulan
February								
2	40.5	35.5	36.0	37.5	41.0	35.0	28.5	38.5
March								
17	5.4	6.0	5.0	4.5	5.5	5.5	3.5	4.5
18	18.4	19.5	19.0	19.0	16.0	11.3	15.5	13.5
19	36.6	29.0	34.0	31.5	32.0	20.2	24.5	19.0
20	13.2	12.0	18.0	13.0	18.5	19.0	9.5	8.5
21	89.0	71.0	83.0	72.0	80.0	77.0	54.0	60.0
22	23.4	17.0	25.0	25.0	29.0	25.7	20.0	20.5
23	33.0	36.0	27.0	35.5	38.0	30.4	29.0	31.0
24	25.6	28.0	23.0	28.5	31.0	28.2	25.5	27.0
Total	244.6	218.5	234.0	229.0	250.0	217.3	181.5	184.0
August								
24	33.2	30.5	34.0	53.5	38.0	34.4	32.0	36.5
25	18.3	16.5	20.0		19.0	18.2	11.0	12.0
Total	51.5	47.0	54.0		57.0	52.6	43.0	48.5
November								
5	34.2	28.0	21.0	x	24.0	19.0	19.0	25.0
12	38.8	37.0	33.0	10.0	40.0	33.1	37.0	37.5
21	33.8	29.0	35.0	30.5	33.0	27.6	26.5	28.0
25	43.8	38.0	30.0	33.5	36.0	31.0	40.0	28.0
December								
4	<2	<2	20.0	20.0	29.0	1.5	0.0	0.0
10	30.7	25.0	32.0	27.5	33.0	29.0	26.0	25.0

Table 3 Significant rain events in 2021

Tallong at 1.2m Dates : 010121 to 311221

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	14.6	13.8	16.7	22.2	24.3	23.0	18.5	16.0	12.9	25.9	6.8	38.3
	2.9	2.9	4.2	6.1	7.0	6.8	4.5	3.2	standard	deviations		
	372	372	370	372	372	372	372	372	number	of	observations	
February	14.6	13.9	15.1	19.4	22.0	20.3	16.6	15.3	13.0	23.5	9.9	30.2
	1.9	2.0	2.4	4.0	4.5	4.1	2.8	2.1	standard	deviations		
	336	336	336	336	336	336	336	336	number	of	observations	
March	12.7	11.9	13.1	18.1	19.9	18.4	15.0	13.6	10.6	21.2	2.9	29.9
	3.2	3.5	3.5	3.7	4.2	4.0	2.9	2.8	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	
April	8.2	7.3	8.4	15.3	18.9	17.1	12.1	9.8	5.8	19.8	-0.6	27.6
	4.0	4.4	4.3	4.0	3.7	4.0	3.3	3.5	standard	deviations		
	360	360	360	360	360	360	360	360	number	of	observations	
May	6.4	5.8	6.3	11.3	14.3	12.4	8.3	6.8	3.9	15.1	-4.2	21.8
	4.7	4.8	4.5	3.4	3.1	3.4	3.8	4.4	standard	deviations		
	372	372	372	370	360	360	360	362	number	of	observations	
June	4.7	4.3	4.5	8.7	11.0	9.4	6.7	5.6	2.6	11.9	-2.8	17.8
	2.7	3.0	3.1	2.7	2.6	2.5	1.8	2.2	standard	deviations		
	360	360	360	360	360	360	360	360	number	of	observations	
July	3.9	3.7	4.0	8.2	10.4	8.9	5.9	4.8	1.5	11.5	-5.5	19.3
	3.6	3.7	4.0	3.2	2.7	3.0	2.8	3.4	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	
August	4.3	3.5	4.5	10.8	13.1	11.5	7.5	5.5	1.6	14.0	-3.6	21.7
	3.2	3.5	3.9	3.7	3.3	3.4	2.7	2.7	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	
September	7.0	5.8	8.0	14.1	15.9	14.1	10.1	8.3	3.8	17.3	-1.2	22.7
	3.8	4.3	4.4	3.7	4.1	4.1	3.4	3.6	standard	deviations		
	360	360	360	360	360	360	360	360	number	of	observations	
October	8.5	7.6	11.0	16.3	17.8	16.0	11.9	9.7	6.2	19.4	0.4	27.9
	2.6	3.1	3.9	3.7	4.5	4.3	3.1	2.8	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	
November	11.2	10.8	12.7	16.2	17.9	16.0	13.2	11.9	9.9	19.1	3.6	25.1
	2.8	3.2	3.1	4.0	4.6	4.2	3.2	2.9	standard	deviations		
	360	360	359	360	360	360	360	360	number	of	observations	
December	12.6	12.0	14.9	19.9	21.2	19.3	15.7	13.5	10.9	23.0	4.7	31.9
	3.0	3.3	3.9	5.5	6.1	5.7	4.1	2.9	standard	deviations		
	372	372	372	372	372	372	372	372	number	of	observations	

Table 4 Temperature analyses at 467 Mulwaree Dr, Tallong - 2021

Tallong at 1.2m Dates: 010112 to 311221
 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	18.1	24.2	26.6	24.5	19.8	17.1	13.8	28.3	2.5	42.0
	3.4	3.6	4.6	6.2	6.8	6.6	5.0	3.7	standard	deviations		
	3720	3720	3718	3720	3720	3720	3720	3720	number	of	observations	
February	14.9	14.1	16.3	21.6	24.1	22.5	18.2	16.0	13.1	25.7	3.4	41.9
	2.9	3.0	3.7	5.0	5.6	5.6	4.1	2.9	standard	deviations		
	3396	3396	3396	3392	3396	3396	3396	3396	number	of	observations	
March	13.4	12.7	14.2	19.5	21.7	20.1	16.1	14.3	11.4	23.2	1.2	35.4
	3.1	3.3	3.6	4.2	4.8	4.7	3.3	3.0	standard	deviations		
	3720	3720	3720	3720	3720	3720	3720	3720	number	of	observations	
April	10.2	9.3	10.4	16.5	19.2	17.3	13.0	11.2	7.9	20.4	-0.6	32.5
	3.5	3.8	3.8	3.9	4.2	4.2	3.2	3.2	standard	deviations		
	3600	3600	3600	3599	3600	3600	3600	3600	number	of	observations	
May	6.2	5.6	6.4	12.3	15.3	13.0	8.8	7.1	3.8	16.1	-4.2	24.2
	3.8	4.0	4.0	3.6	3.5	3.7	3.1	3.4	standard	deviations		
	3432	3439	3431	3411	3408	3408	3408	3421	number	of	observations	
June	4.6	4.1	4.3	8.9	11.6	9.8	6.5	5.2	2.3	12.5	-5.5	18.7
	3.6	3.9	3.9	2.7	2.3	2.6	2.6	3.2	standard	deviations		
	3588	3588	3588	3588	3587	3588	3588	3588	number	of	observations	
July	3.9	3.4	3.7	8.9	11.6	9.8	6.1	4.8	1.5	12.6	-7.1	20.4
	3.7	3.9	4.0	3.0	2.6	3.0	2.8	3.3	standard	deviations		
	3720	3720	3720	3716	3719	3720	3720	3720	number	of	observations	
August	4.0	3.2	4.3	10.1	12.5	10.8	6.9	5.0	1.4	13.5	-6.2	22.4
	3.7	3.9	4.0	3.1	3.2	3.4	2.8	3.2	standard	deviations		
	3708	3708	3708	3708	3708	3708	3708	3708	number	of	observations	
September	6.6	5.7	7.9	14.2	16.5	14.7	10.2	8.0	3.9	17.7	-4.7	31.4
	3.9	4.2	4.4	4.0	4.3	4.3	3.4	3.5	standard	deviations		
	3600	3600	3600	3600	3600	3600	3600	3600	number	of	observations	
October	9.3	8.3	11.9	17.9	19.9	18.1	13.2	10.7	6.7	21.3	-2.6	32.1
	3.7	4.0	4.5	5.0	5.3	5.4	4.1	3.6	standard	deviations		
	3720	3720	3720	3717	3720	3720	3719	3720	number	of	observations	
November	11.5	10.8	14.8	20.2	22.2	20.0	15.3	12.8	9.4	23.7	0.6	39.4
	3.5	3.8	4.4	5.3	5.6	5.7	4.3	3.4	standard	deviations		
	3600	3600	3598	3600	3600	3600	3600	3600	number	of	observations	
December	13.9	13.2	17.0	22.7	24.6	22.5	17.9	15.3	11.9	26.4	1.6	41.9
	3.4	3.5	4.5	5.8	6.2	6.2	4.8	3.7	standard	deviations		
	3720	3720	3720	3718	3718	3720	3720	3720	number	of	observations	

Table 5 Temperature analyses at 467 Mulwaree Dr, Tallong - 2012 to 2021

Annual Average Temperatures		
Year	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
Winter Average Temperatures		
Year	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

Table 6: Annual and Winter Average Temperatures at

467 Mulwaree Dr., Tallong - 2012 to 2021

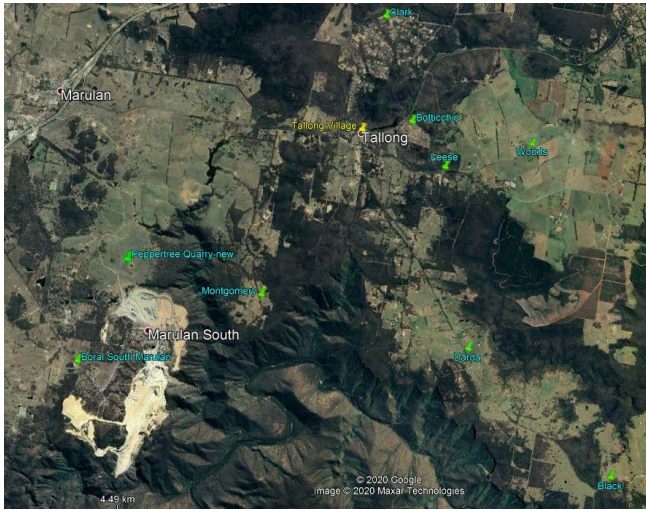


Figure 1: Google Earth image of the Tallong region



Figure 2 BOM radar image 1934 AEDT 1/2/2021

MSLP Analysis (Manual) Australian Region

06 UTC 01/02/2021

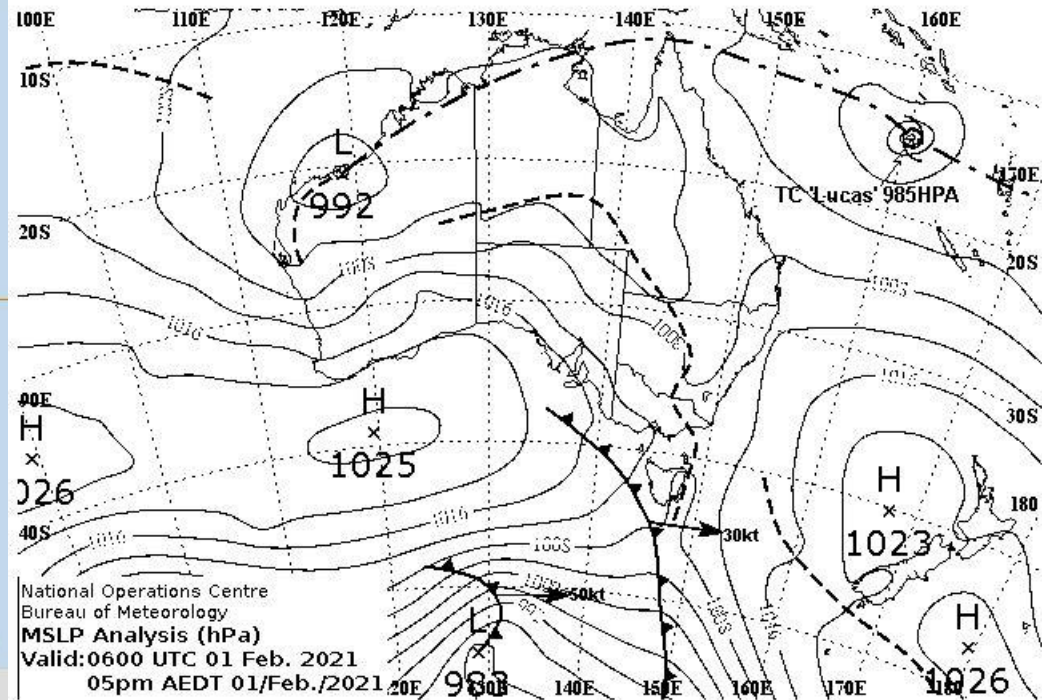


Figure 3 Synoptic Map 1700 AEDT 1/2/2021

MSLP Analysis (Manual) Australian Region

00 UTC 17/03/2021

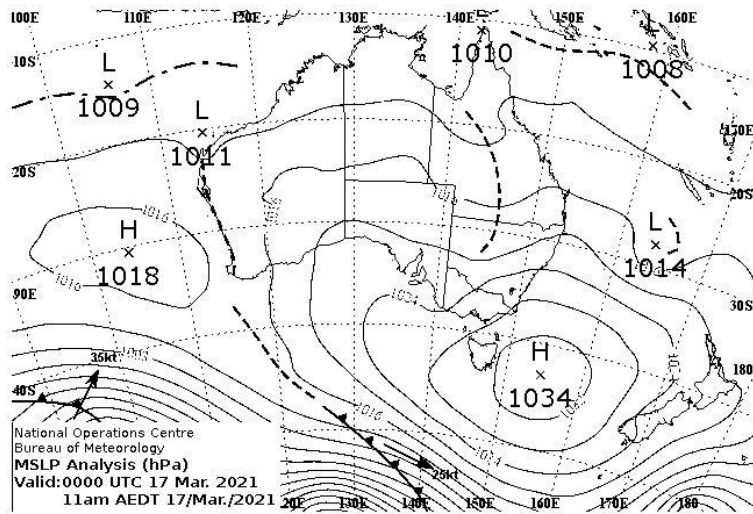


Figure 4 Synoptic Map 17/3/2021, 1100 AEDT



Figure 5 BOM Radar image 18/3/2021 1444 AEDT

MSLP Analysis (Manual) Australian Region

06 UTC 20/03/2021

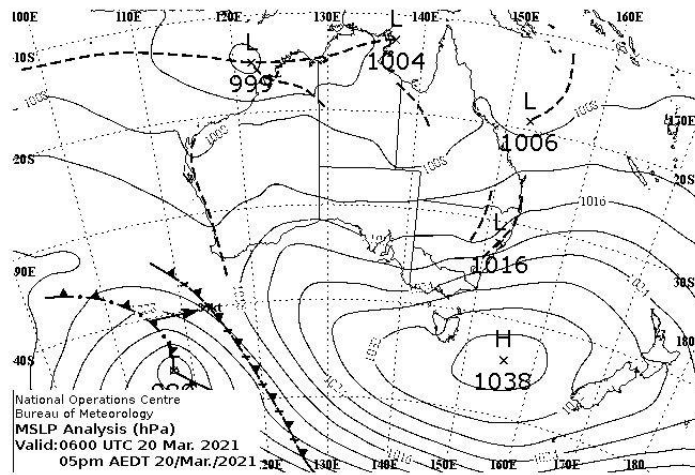


Figure 6 Synoptic Map 20/3/2021, 1700 AEDT



Figure 7 BOM Radar image 20/3/2021 1049 AEDT



Figure 8 BOM Radar image 20/3/2021 2219 AEDT

MSLP Analysis (Manual) Australian Region

00 UTC 23/03/2021

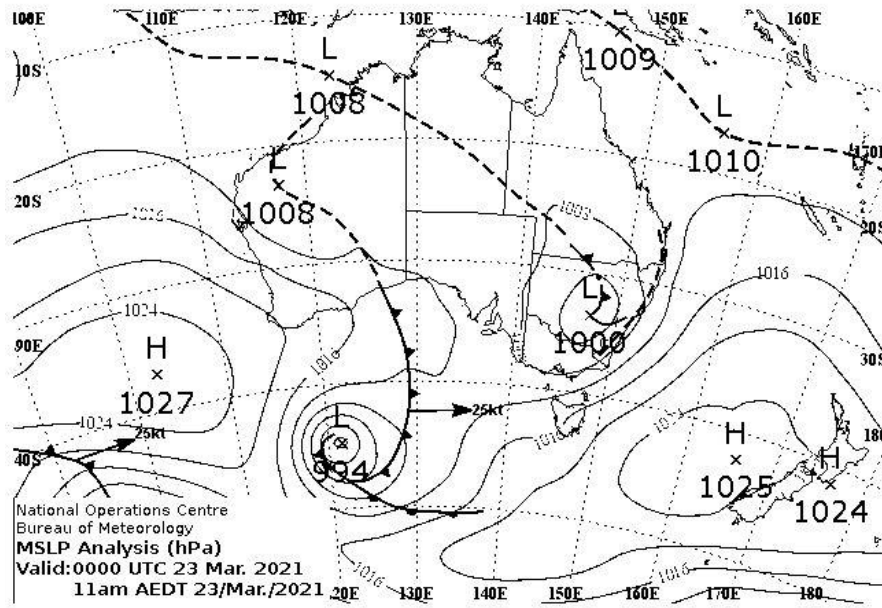


Figure 9 Synoptic Map 23/3/2021, 1100 AEDT

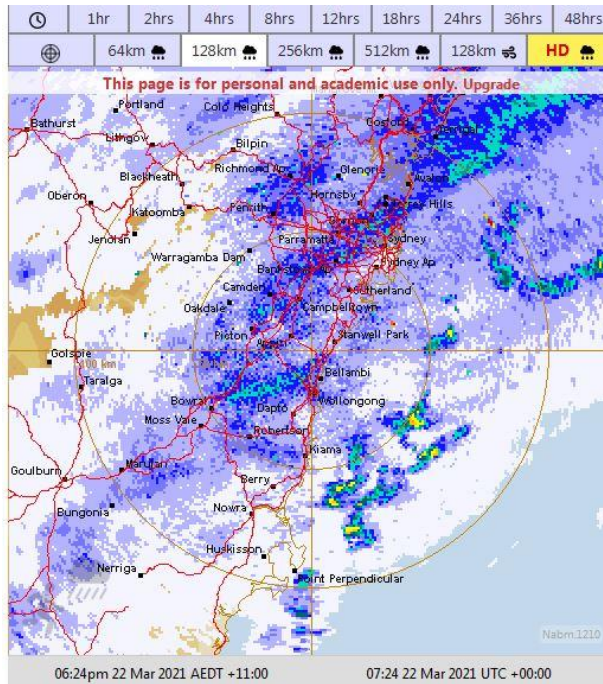


Figure 10 BOM Radar image 22/3/2021 0624 AEDT

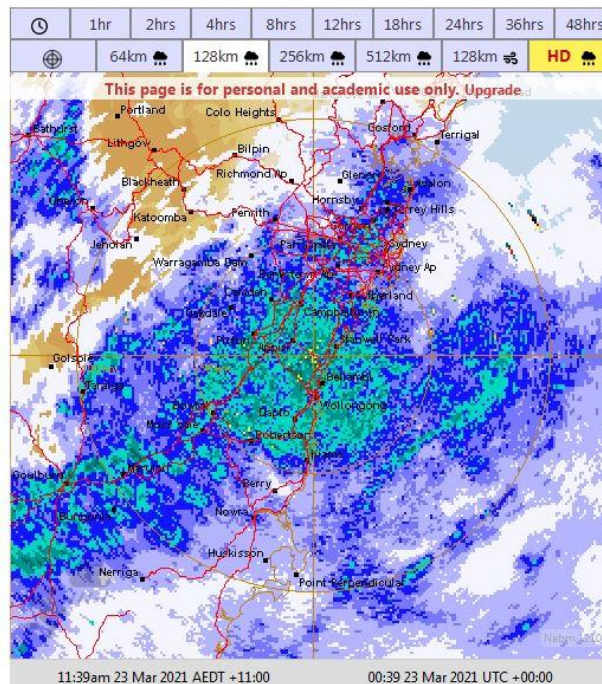


Figure 11 BOM Radar image 23/3/2021 1139 AEDT

MSLP Analysis (Manual) Australian Region

00 UTC 24/03/2021

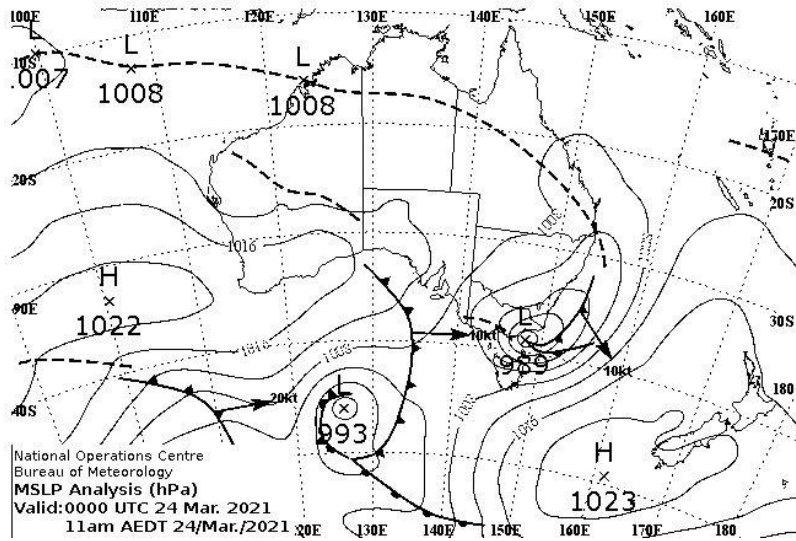


Figure 12 Synoptic Map 24/3/2021, 1100 AEDT

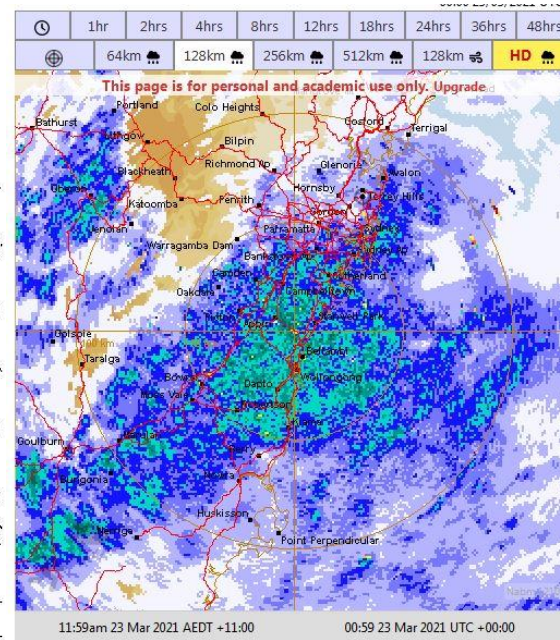


Figure 13 BOM Radar image 23/3/2021 1159 AEDT

MSLP Analysis (Manual) Australian Region

06 UTC 23/08/2021

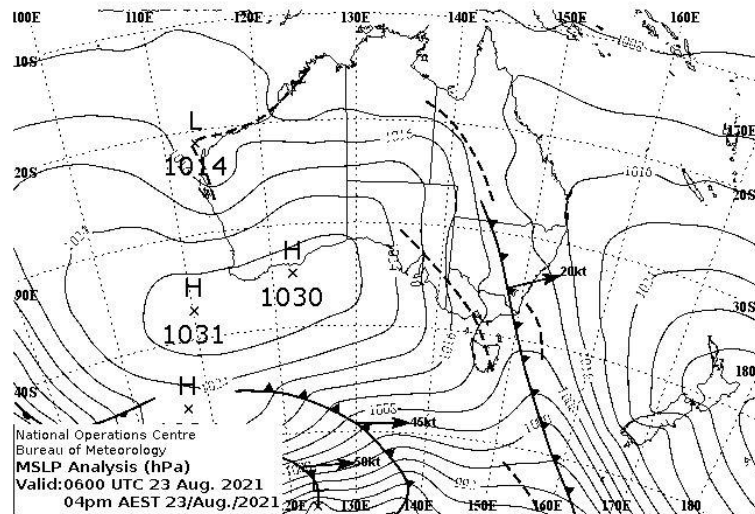


Figure 14 Synoptic Map 23/8/2021, 1600 AEST



Figure 15 BOM Radar image 23/8/2021 1949 AEST

MSLP Analysis (Manual) Australian Region

12 UTC 23/08/2021

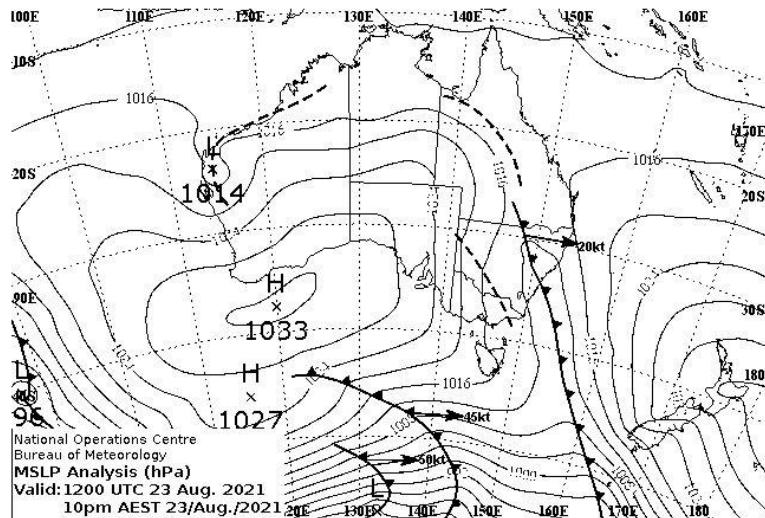


Figure 16 Synoptic Map 23/8/2021, 2200 AEST

MSLP Analysis (Manual) Australian Region

00 UTC 24/08/2021

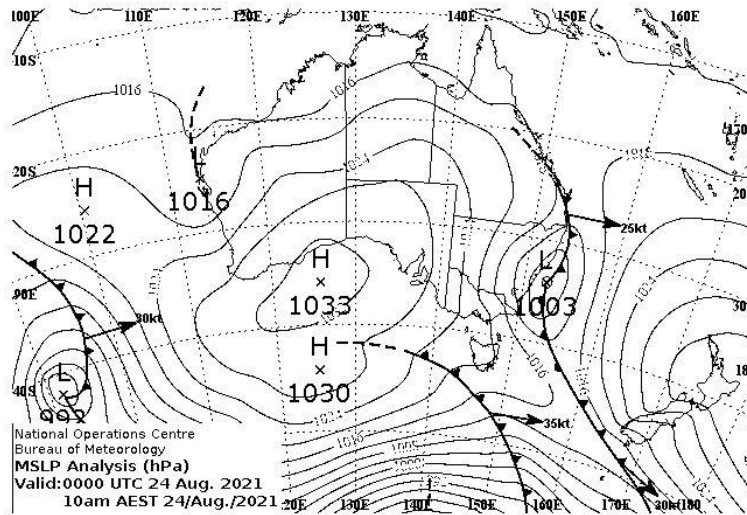


Figure 17 Synoptic Map 24/8/2021, 1000 AEST

MSLP Analysis (Manual) Australian Region

12 UTC 24/08/2021

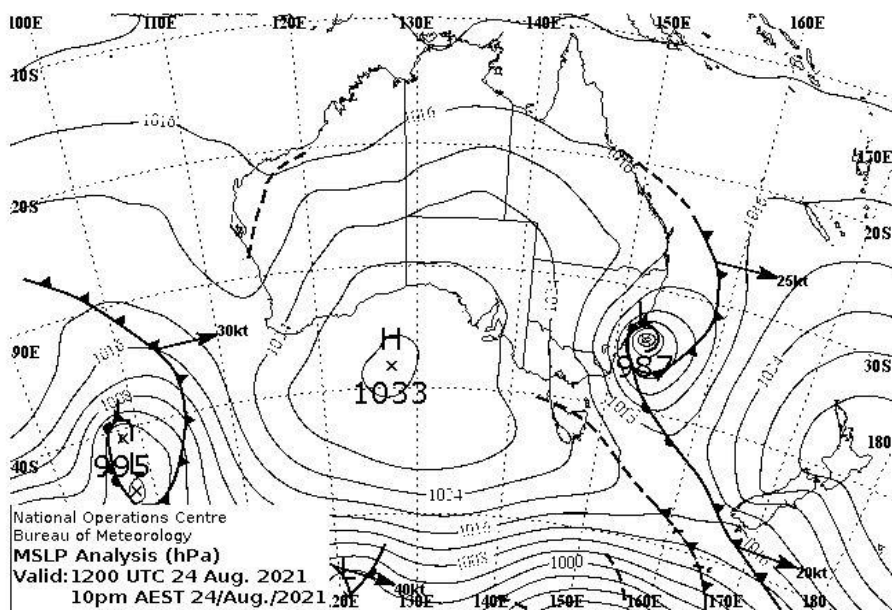


Figure 18 Synoptic Map 24/8/2021, 2200 AEST

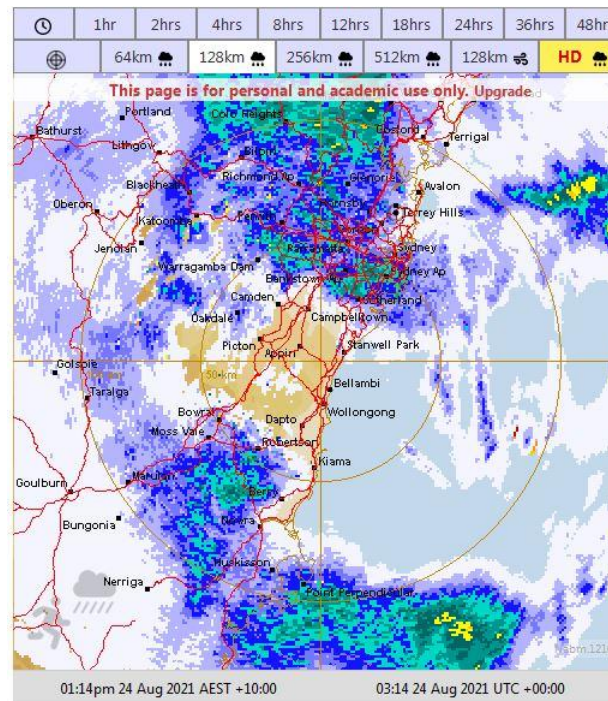


Figure 19 BOM Radar image 24/8/2021 1314 AEST

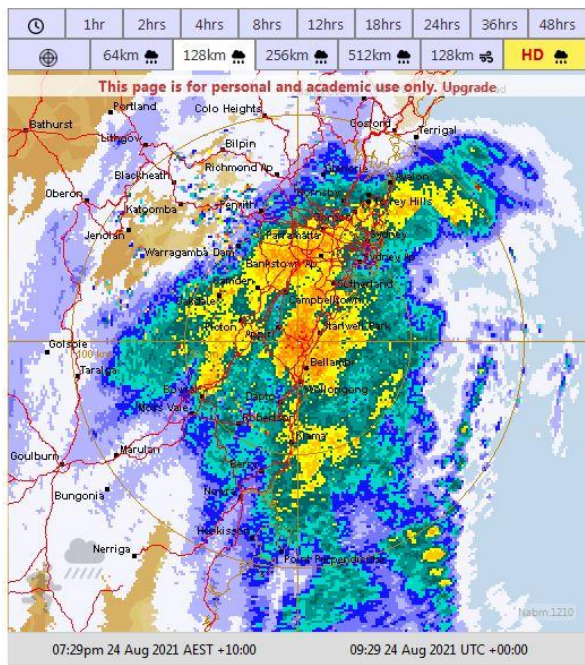


Figure 20 BOM Radar image 24/8/2021 1929 AEST

MSLP Analysis (Manual) Australian Region

12 UTC 04/11/2021

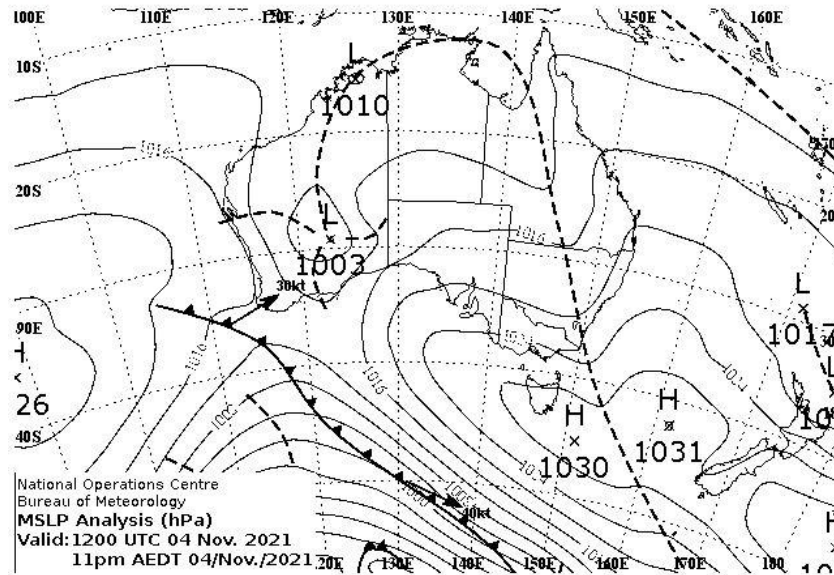


Figure 21 Synoptic Map 4/11/2021, 2300 AEDT



Figure 22 BOM Radar image 4/11/2021, 1844 AEDT

MSLP Analysis (Manual) Australian Region

06 UTC 11/11/2021

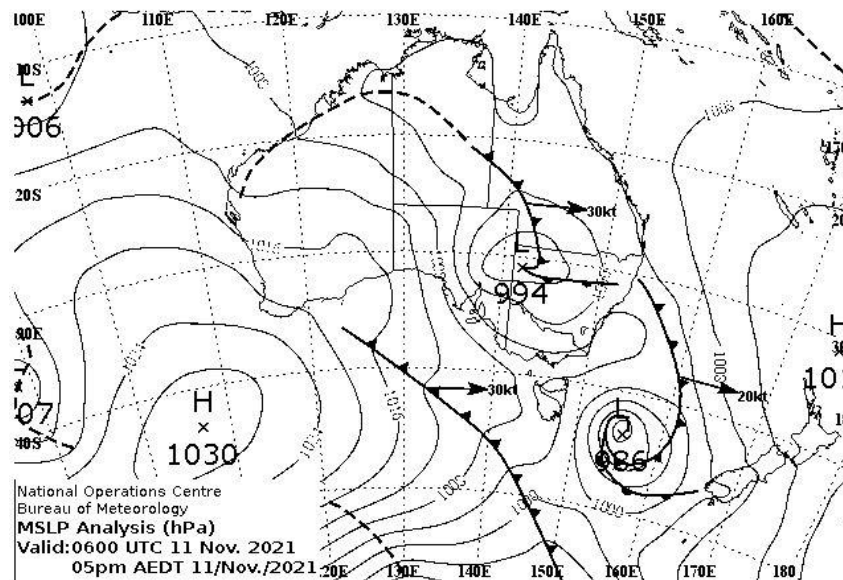
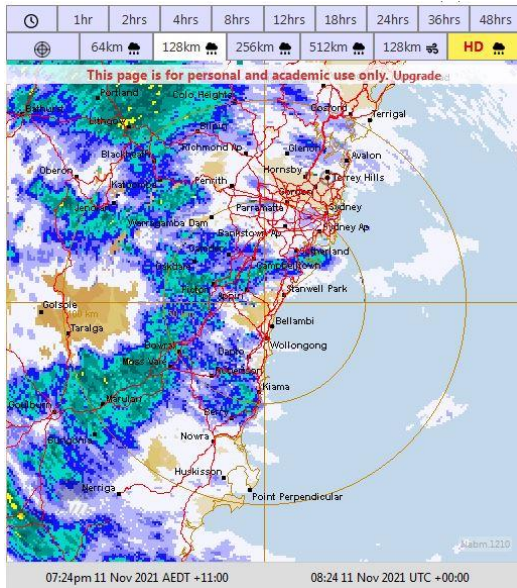


Figure 23 Synoptic Map 11/11/2021, 1700 AEDT



MSLP Analysis (Manual) Australian Region

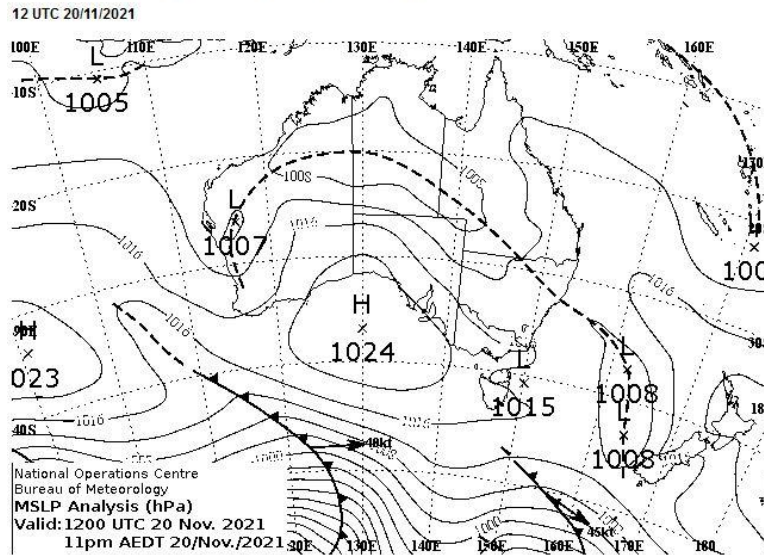


Figure 24 BOM Radar image 11/11/2021, 1924 AEDT Figure 25 Synoptic Map 20/11/2021, 2300 AEDT



MSLP Analysis (Manual) Australian Region

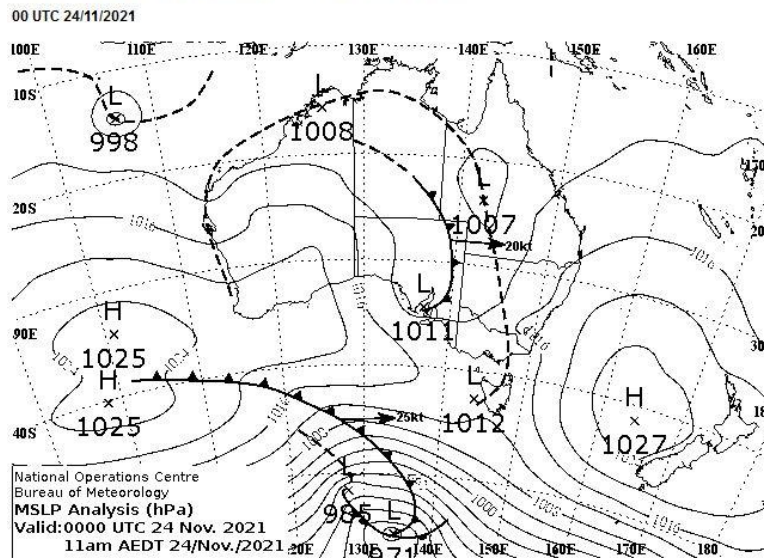


Figure 26 BOM Radar image 21/11/2021, 0159 AEDT Figure 27 Synoptic Map 24/11/2021, 1100 AEDT



Figure 28 BOM Radar image 24/11/2021, 1644 AEDT



Figure 29 BOM Radar image 24/11/2021, 2044 AEDT

MSLP Analysis (Manual) Australian Region

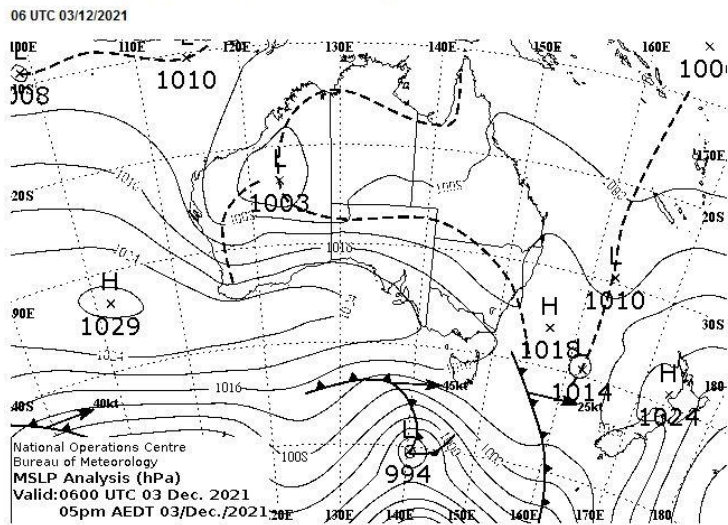


Figure 30 Synoptic Map 3/12/2021, 1700 AEDT

MSLP Analysis (Manual) Australian Region

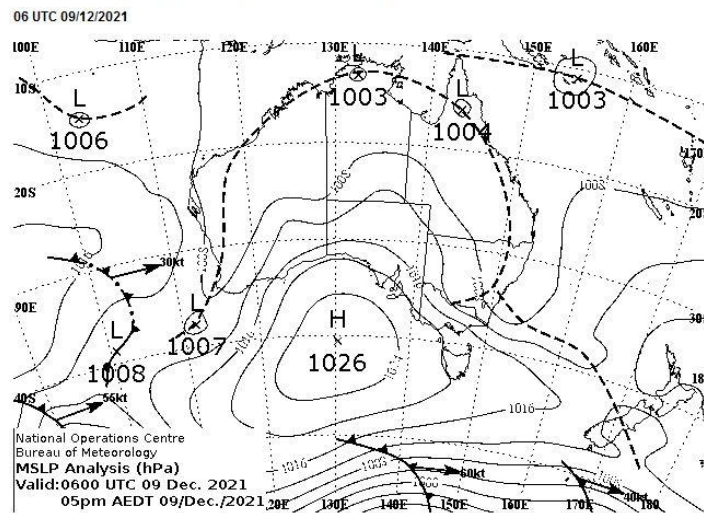


Figure 31 Synoptic Map 9/12/2021, 1700 AEDT

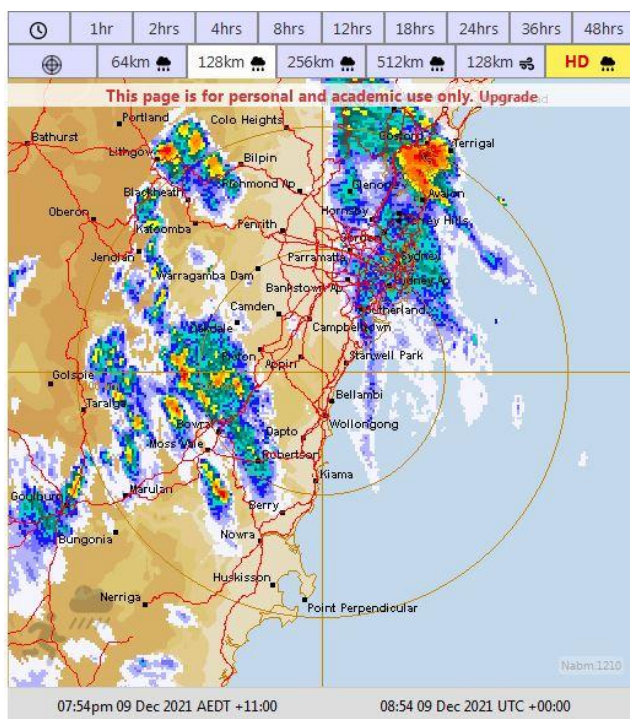


Figure 32 BOM Radar image 9/12/2021, 1954 AEDT



Figure 33 BOM Radar image 9/12/2021, 2324 AEDT



Figure 34 BOM Radar image 10/12/2021, 0354 AEDT