



Australian Government
Bureau of Meteorology

Severe Tropical Cyclone *Olwyn*

March 08 – 14 2015

A. Summary

Severe Tropical Cyclone *Olwyn* was the most significant tropical cyclone to affect the Gascoyne coast in decades, tracking close to the coast from Exmouth to Shark Bay as a category three tropical cyclone.

Olwyn began as a tropical low in an active monsoon trough approximately 900 kilometres (km) north of Exmouth during 8 March 2015. The tropical low initially moved slowly towards the east before moving towards the south on 10 March. It then maintained a southerly track while slowly strengthening. The tropical low reached tropical cyclone intensity at 0600 UTC (1400 WST) 11 March. *Olwyn* then moved towards the south southwest and passed just to the west of Exmouth around 1800 UTC 12 March. The tropical cyclone reached a peak intensity of 75 knots (kn) (139 kilometres per hour (km/h)) at 1800 UTC 12 March while it was located near the North West Cape. Learmonth Airport reported a 10-minute mean wind of 75 kn (139 km/hr) and a maximum 3-second wind gust of 97 knots (180 km/hr) during this period.

Olwyn continued a southerly path straddling the upper west coast (refer Figure 2 for a map of the track and area). The tropical cyclone centre passed just to the west of Coral Bay and then passed around 25 kilometres (km) to the west of Carnarvon around 0600 UTC 13 March. Carnarvon Airport reported a 10-minute mean wind of 55 knots (102 km/hr) and a maximum 3-second wind gust of 79 knots (146 km/hr) during this period. *Olwyn* was then steered in a south southeast direction and crossed the coast over the Shark Bay area around 1200 UTC 13 March. *Olwyn* weakened below tropical cyclone strength by 0000 UTC 14 March, inland of Geraldton.

Heavy rainfall was recorded over the western Pilbara and western Gascoyne districts. The heavy rainfall was mostly concentrated near the coast and caused localised flooding and road closures in the western Pilbara and western Gascoyne districts. Widespread catchment rainfall of approximately 60 – 90 millimetres (mm) resulted in minor to moderate flooding within the Greenough and Irwin River catchments.

A storm surge of about 1.8 metres was recorded at Exmouth and about 0.7 metres at Carnarvon.

Minor to moderate damage to homes and infrastructure were reported and significant damage to plantations.

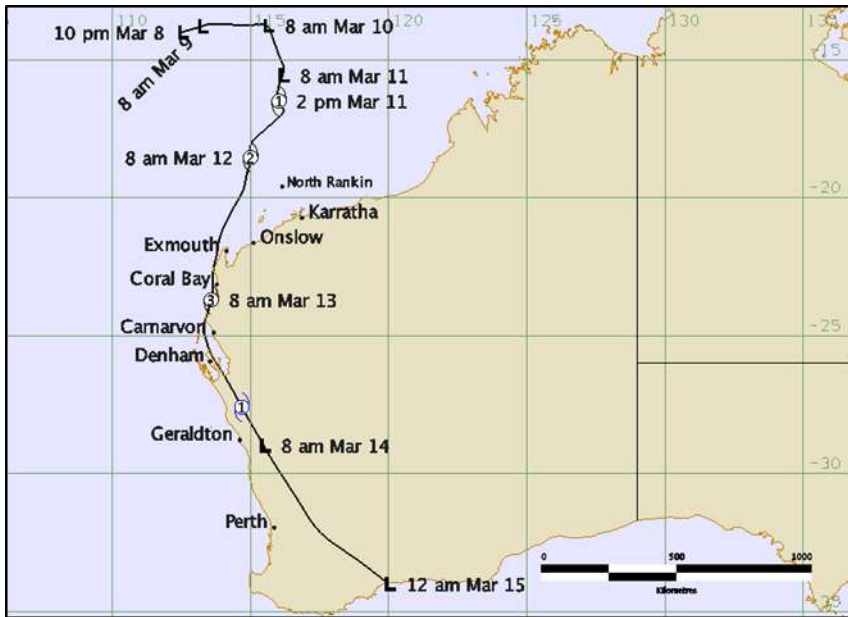


Figure 1. Best track of Severe Tropical Cyclone Olwyn 8 - 14 March 2015 (times in WST).

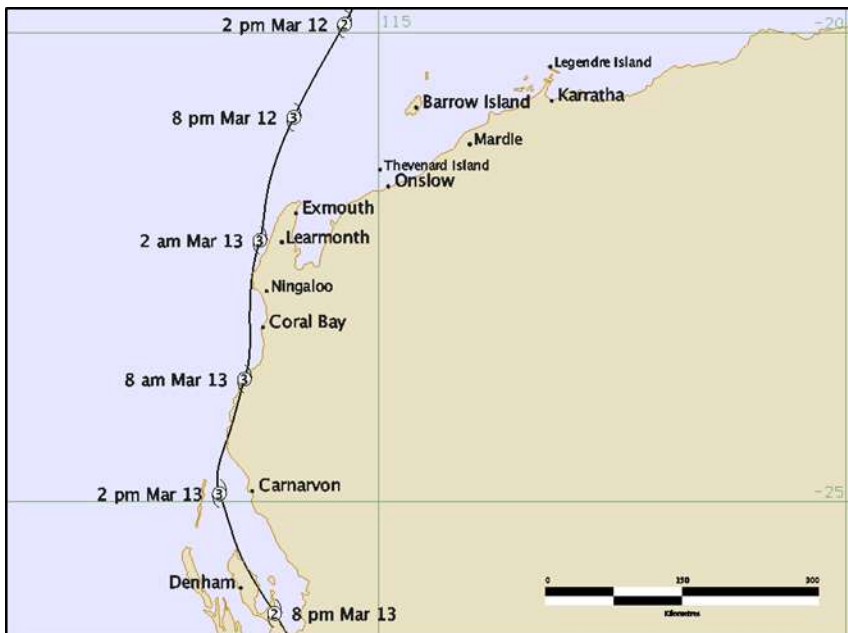


FIGURE 2. Enlargement of best track of Severe Tropical Cyclone Olwyn showing location of observation sites (times in WST).

B. Meteorological Description

Intensity analysis

A low formed in an active monsoon trough during 8 March. The low drifted east until 10 March when it began to move south. The low developed slowly and was classified a Dvorak T-number (DT) 1.0 around 1400 UTC 9 March. During 10 March the low pressure system only slowly intensified as deep convection gradually drew closer to the centre of rotation. Deep convection increased and became more curved around the centre during the overnight period. By 0000 UTC 11 March the tropical low had a DT number of 2.5. The 0149 UTC 11 March Advanced SCATterometer (ASCAT) satellite pass showed 35-40 kn (65-74 km/h) winds in the north eastern quadrant where microwave imagery showed convection was concentrated (refer Figure 4). Visible (VIS) imagery showed an increase in spiral banding during the day and a DT of 3.0 was reached at 0600 UTC 11 March. It is likely that at this

point gales were wrapping more than half way around the centre and it was upgraded to a tropical cyclone.

Olwyn continued to steadily intensify during 11 and 12 March as it moved south southwest towards the North West Cape of Western Australia. National Environmental Satellite, Data, and Information Service (NESDIS) Advanced Dvorak Technique (ADT) and Satellite Consensus (SATCON) intensity estimates increased steadily through this period and were in general agreement with Dvorak and operational estimates (refer Figure 3). From 0000 UTC 12 March Cooperative Institute for Meteorological Satellite Studies (CIMSS) ADT estimates decreased as the method was using a curved band and DT estimates were significantly lower than subjective Dvorak estimates which were applying an eye pattern. Raw Dvorak T-numbers were greater when an eye pattern was used but the method did not calculate a reliable maximum wind at times due to land interaction.

A peak maximum 10-minute mean wind speed of 75 kn (139 km/h) was reached at 1800 UTC 12 March as the southern eye wall traversed the North West Cape (refer Figure 5). It passed over Learmonth Airport which reported a 10-minute mean wind of 75 kn (139 km/h) and a maximum 3 second wind gust of 97 kn (180 km/h) during this period (refer Figure 6). While it is possible the peak winds may have been higher, Learmonth's observations were onshore winds in the strongest southeast sector when *Olwyn* displayed peak satellite signature. By 0000 UTC 13 March *Olwyn* was located north of Carnarvon straddling the upper west coast of WA. Microwave imagery showed *Olwyn* had lost its symmetric structure by this time. Conventional infrared (IR) and enhanced Dvorak imagery (EIR) showed an eye through until around 0600 UTC 13 March. The Dvorak eye pattern method is not designed to be used over land however in this situation it may maintain some applicability as *Olwyn*'s centre was still located over water. The land interaction makes all objective intensity guidance less reliable so the higher estimates of around 90-100 kn (167-185km/h) from the CIMSS and NESDIS ADT methods have been discounted. SATCON estimate at this time was 80 kn (148 km/h).

Olwyn passed just west of Carnarvon at about 0600 UTC 13 March. Carnarvon Airport recorded a 10-minute mean wind of 55 knots (102 km/h) and a maximum 3 second wind gust of 79 knots (146 km/h) during this period (refer Figure 7). Although Carnarvon Airport did not measure wind speeds higher than a category two tropical cyclone it is likely that sustained wind speeds were highest over open water off the coast south of the centre where frictional effects are reduced. The tropical cyclone continued southwards and moved inland over the Shark Bay area at around 1200 UTC 13 March. (Refer Figure 8 for wind and pressure observations). *Olwyn* weakened over land to below tropical cyclone strength by 0000 UTC 14 March.

Motion

Initially the tropical low was steered east by the strong monsoon northwest flow to the north. During 10 March a mid-level ridge strengthened over northern Australia and *Olwyn* was steered in a south southwest direction. An approaching trough from the Indian Ocean began to steer *Olwyn* south on 12 March and then southeast on 13 March before the low dissipated on 14 March.

Structure

Initially convection was located well away from the low's centre of rotation. During 10 March convection had increased but it was located in mostly the northern quadrants. Early on 11 March convection began to wrap more tightly around the centre with a large C shaped spiral band evident by 1200 UTC. During 12 March microwave imagery showed that cold convection wrapped around the centre at times but *Olwyn* struggled to maintain that structure as it partially traversed land and by 0000 UTC 13 March the northern eye wall was severely eroded.

The southern gale radii were larger than the northern until *Olwyn* impacted the NW Cape. As *Olwyn* moved south along the upper west coast the western radii were estimated to be slightly larger.

The radius to maximum winds (RMW) was initially 30 nautical miles (nm) (55 km), this contracted to 15 nm (28 km) at peak intensity. The eye diameter measured on microwave imagery was 30 nm (55 km) at 0000 UTC 12 March. The estimate from Learmonth radar at 1200 UTC 12 March was 40 nm (74 km). The radar subsequently failed and further measurements of 20 nm (37 km) from microwave imagery were made through until 1830 UTC. The last estimate of 15 nm (28 km) was made from an EIR image at 0000 UTC 13 March. After this the eye pattern on EIR imagery was too small and ragged to take a sensible measurement. There was no clear eye pattern on the VIS imagery.

C. Impact

Olwyn impacted the North West Cape around 1200 UTC 12 March but the centre of the tropical cyclone did not cross the coast until it was located just north of Cape Cuvier at 0000 UTC 13 March. The centre then moved south southwest out over water again until a south easterly movement steered it across Shark Bay just east of Denham. *Olwyn* crossed the base of Shark Bay at 1300 UTC 13 March.

The south eastern eye wall passed over the town of Exmouth located at the north eastern tip of the North West Cape. Exmouth reported damage to roofs, cars and caravans, fences and downed trees and power lines. A full damage assessment carried out by the Cyclone Testing Station stated there was significant damage to houses and buildings from wind driven rain entering through flashings, windows and doors. The report can be obtained from www.jcu.edu.au/cts/publications/content/technical-reports/tech-report-61/view.

The Department of Fire and Emergency Services reported minor to moderate damage to homes and infrastructure in Carnarvon, Coral Bay and Shark Bay. There was also significant damage to plantations. Horizon Power reported significant damage to the power network in Carnarvon and power outages in Denham and Carnarvon. The Water Corporation reported disruptions to the water supply at Carnarvon due to loss of power and a burst water main. It took several days to restore power and water supplies in Carnarvon which hampered the clean-up effort. There was disruption to offshore industries near the path of *Olwyn*.

Heavy rainfall was recorded over the western Pilbara and western Gascoyne districts. The heavy rainfall was mostly concentrated near the coast and caused localised flooding and road closures in the western Pilbara and western Gascoyne districts. Widespread rainfall of approximately 60 mm to 90mm across the catchment area resulted in minor to moderate flooding within the Greenough and Irwin River catchments.

Ex-Tropical Cyclone *Olwyn* produced moderate to heavy rainfall over central and northern parts of the Southwest Land Division as it moved on a southeasterly track. Perenjori recorded 43 mm in the 24 hours to 9 am WST 15 March.

Higher than normal tides occurred along the west coast though no reports of damage associated with this were received.

D. Observations

Wind

Legendre Island recorded gale force winds (winds equal to or greater than 34 kn or 63 km/h) between 2153 – 2218 UTC 11 March, 2334 UTC 11 March – 0048 UTC 12 March and 0135 – 1138 UTC 12 March.

Onslow Automatic Weather Station (AWS) recorded gale force winds between 0754 -0816, 0838 – 0905, 0917-2049 UTC 12 March. Storm force winds (winds equal to or greater than 48 kn or 89 km/h) between 1250 – 1316 and 1335 – 1336 12 March.

Mardie AWS recorded gale force wind between 0742 – 0801 and 1022 – 1028 12 March. Thevenard Island AWS recorded gale force winds between 0640 – 0652, 0706 – 0715, 0736 – 0738, 0753 – 0756, 0802 – 2036 UTC 12 March. Storm force winds between 1250 – 1259, 1403 – 1416 and 1427 – 1433 UTC 12 March.

Barrow Island AWS recorded gale force winds between 0202 – 0229, 0235 – 1258, 1312 – 1332 and 1349 – 1358 UTC 12 March. Storm force winds between 0634 – 0643, 0707 – 0741, 0753 – 1015 and 1031 – 1040 UTC 12 March.

Learmonth Airport AWS recorded gale force winds between 1142 – 2202 UTC 12 March. Storm force winds at 1441 UTC, 1445 and between 1448 – 1957 UTC 12 March. Hurricane force (winds equal to or greater than 64 kn or 118 km/h) winds between 1620 – 1858 UTC 12 March. The maximum mean wind recorded was 75 kn (139 km/h) between 1821 – 1826 UTC 12 March.

Carnarvon Airport AWS recorded gale force winds between 0157 -0957 UTC 13 March. Storm force winds between 0400 – 0722 UTC 13 March. The maximum mean wind recorded was 55 kn (102 km/h) at 0548 UTC 13 March.

Shark Bay AWS recorded gale force winds between 0701 – 0957 UTC and 1129 – 1333 UTC 13 March.

Location	Peak 3 second Wind Gust knots (km/h)	Time in UTC
Legendre Island AWS	52 (96)	0551 12 March
Onslow AWS	64 (118)	1327 12 March
Mardie AWS	51 (94)	0751 12 March
Thevenard Island AWS	65 (120)	1250 12 March
Barrow Island AWS	69 (128)	0950 12 March
Learmonth Airport AWS	97 (180)	1726 12 March
Carnarvon Airport AWS	79 (146)	0525 13 March
Shark Bay AWS	65 (120)	0840 13 March

Pressure

Onslow AWS recorded a lowest pressure of 997 hPa at 1030 UTC 12 March.

Learmonth Airport AWS recorded a lowest pressure 969 hPa at 1752 UTC 12 March.

Carnarvon Airport AWS recorded a lowest pressure 975.8 hPa at 0612 UTC 13 March.

Shark Bay AWS AWS recorded a lowest pressure 976.1 hPa at 1002 UTC 13 March.

Rainfall

Shark Bay AWS recorded 128.8 mm to 9 am WST 14 March.

Barrow Island AWS recorded 101.2 mm to 9 am WST 13 March.

Onslow Airport AWS recorded 87.8 mm to 9 am WST 13 March.

E. Forecast Performance

Model guidance was highly variable during *O/myn*. Model runs from as early as 1 March suggested a tropical disturbance could develop from around 6 March and impact the North West Cape. Subsequent runs showed variability in the predicted location of formation and motion of the low pressure system with some initialising a low over the north of Australia which tracked west, north of the Pilbara coast, some forming a low north of the Pilbara coast and moving it straight out to the west away from the Pilbara coast and other runs forming a low north of the Pilbara coast and moving it east and then south towards the coast. From around 5 March most models had centred formation of a low to the north of the Pilbara coast and were indicating the low could initially move east before turning south and moving at least close to the North West Cape if not impacting it. However there were still numerous model runs predicting a generally westerly motion away from the coast which reduced confidence in the forecast track.

The first Tropical Cyclone Advice was issued at 1300 WST 10 March which placed the coastline from Port Hedland to Ningaloo under a Tropical Cyclone Watch. The Advice was upgraded to a Warning at 9 am WST 11 March for the area between Roebourne and

Ningaloo this was later extended east to Port Hedland but not including the town of Port Hedland. The watch zone was extended south to Carnarvon. This watch zone was extended further south to Kalbarri during the afternoon 11 March. The final Advice was issued at 0900 WST 14 March indicating that *Olwyn* had been downgraded to below tropical cyclone strength inland of Geraldton.

The accuracy statistics obtained by comparing the forecast positions against the best track positions for Severe Tropical Cyclone *Olwyn* are

	0	06	12	18	24	36	48	72	96	120	144	168
Absolute error (km)	39	70	90	93	100	115	148	258	534	986	974	836
RMS error (km)	57	94	113	109	111	130	160	290	539	986	1114	838

Figure 9 is a plot of the accuracy figures for *Olwyn* compared to the five year mean. The accuracy figures for lead times greater than 72 hours are very large compared to the long term mean, this is a reflection of the variation in the model guidance over the longer term for *Olwyn*.

TABLE 1. Best track summary for Severe Tropical Cyclone Olwyn

Refer to the Australian Tropical Cyclone database for complete listing of parameters.

Year	Month	Day	Hour UTC	Pos. Lat S	Pos. Long. E	Pos. Acc. nm	Max Wind 10 min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/SW/NW)	Rad. of storm (NE/SE/SW/NW)	RMW nm
2015	3	08	1400	14.0	112.5	60	15	45	1008			
2015	3	08	1800	13.9	112.8	60	15	45	1008			
2015	3	09	0000	13.8	113.2	60	20	45	1008			
2015	3	09	0600	13.7	113.7	60	20	45	1008			
2015	3	09	1200	13.7	114.3	60	20	45	1008			
2015	3	09	1800	13.7	115.0	60	20	45	1008			
2015	3	10	0000	13.8	115.6	60	25	45	1005			
2015	3	10	0600	14.2	115.8	60	25	45	1005			
2015	3	10	1200	14.6	116.0	60	25	45	1005			
2015	3	10	1800	15.0	116.1	45	25	45	1005			
2015	3	11	0000	15.6	116.2	25	40	55	997	90/0/0/0		30
2015	3	11	0600	16.5	116.0	20	40	55	995	90/90/60/60		30

Year	Month	Day	Hour UTC	Pos. Lat S	Pos. Long. E	Pos. Acc. nm	Max Wind 10 min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/SW/NW)	Rad. of storm (NE/SE/SW/NW)	RMW nm
2015	3	11	1200	17.1	116.0	20	45	65	992	60/120/120/60		30
2015	3	11	1800	17.7	115.3	20	50	70	990	60/120/120/60	40	20
2015	3	12	0000	18.5	115.0	15	55	75	984	90/170/120/90	40	20
2015	3	12	0600	19.9	114.6	10	60	85	980	90/120/120/90	65	20
2015	3	12	1200	20.9	114.1	10	65	90	970	90/100/90/90	70	20
2015	3	12	1800	22.2	113.7	10	75	105	955	60/60/90/90	60	15
2015	3	13	0000	23.7	113.6	20	75	105	955	50/50/80/80	30	15
2015	3	13	0600	24.9	113.3	10	70	100	970	40/50/60/60	30	20
2015	3	13	1200	26.2	113.9	30	55	80	980	40/40/50/50	30	20
2015	3	13	1800	27.6	114.7	30	40	55	990	30		25
2015	3	14	0000	29.0	115.5	30	30	45	995			
2015	3	14	0600	31.1	116.8	30	30	45	1000			
2015	3	14	1200	32.9	118.6	30	20	45	1004			
2015	3	14	1600	34.0	120.0	30	15	45	1007			

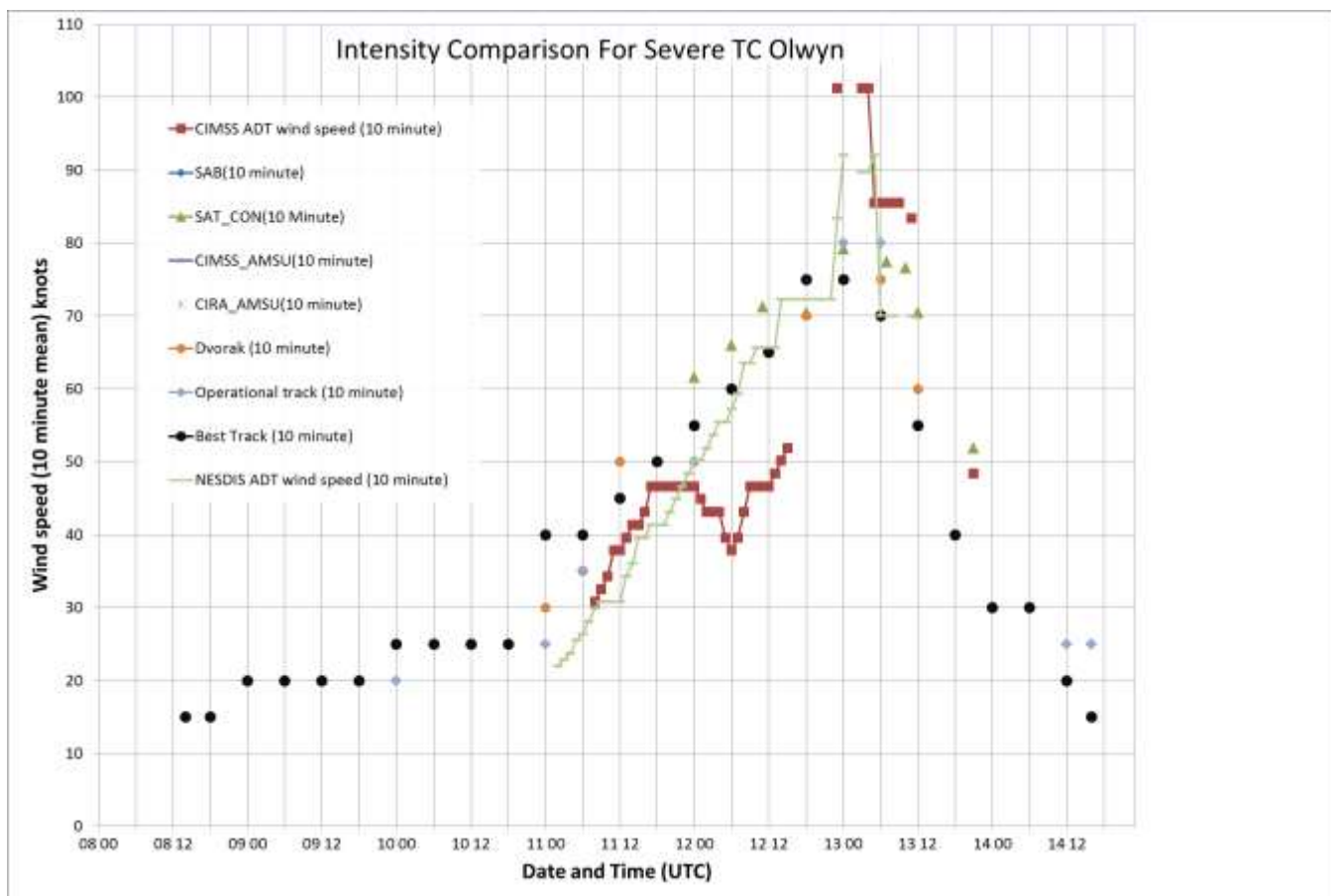
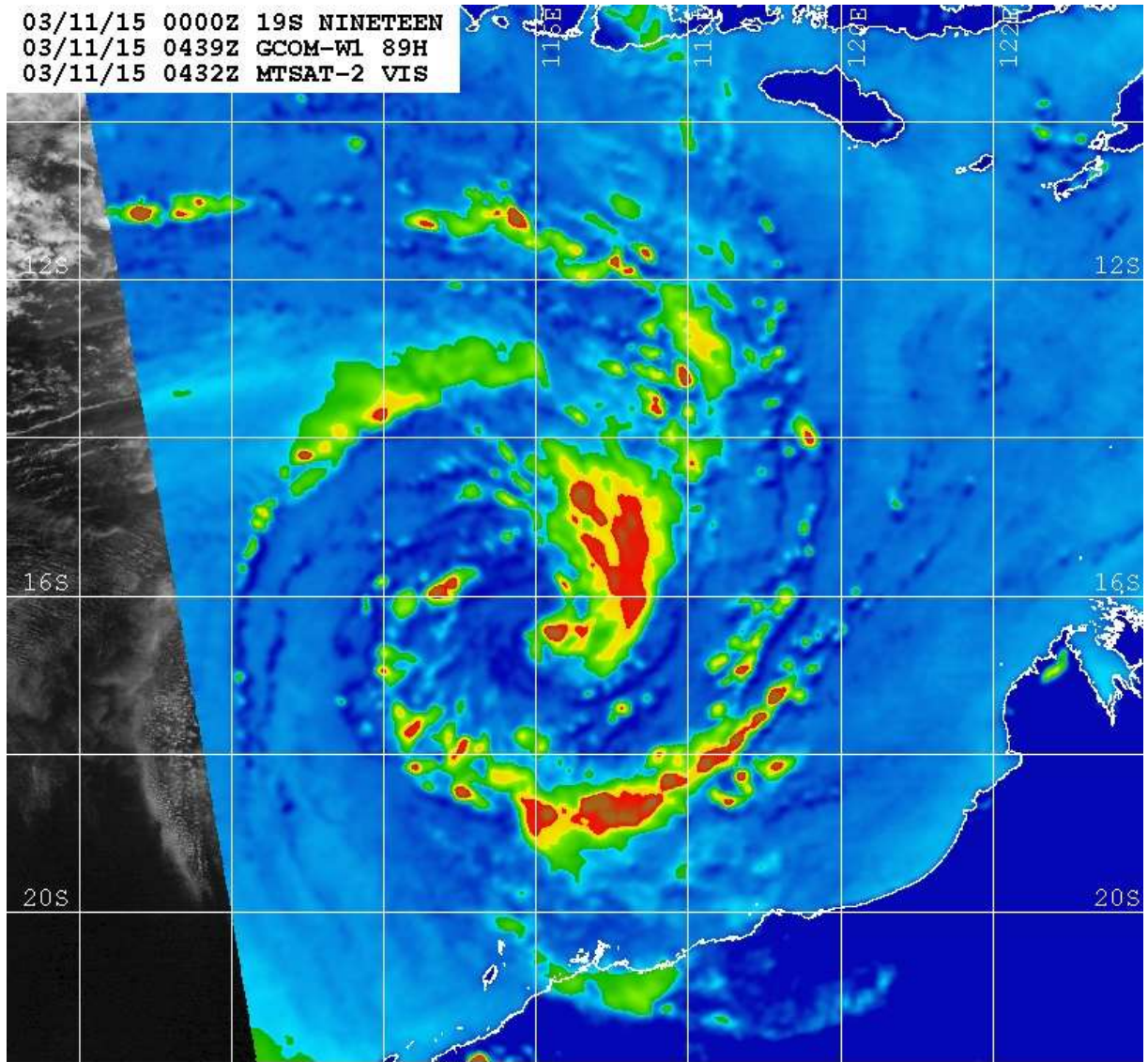


Figure 3. Comparison of objective and subjective intensity analysis techniques.

03/11/15 0000Z 19S NINETEEN
03/11/15 0439Z GCOM-W1 89H
03/11/15 0432Z MTSAT-2 VIS

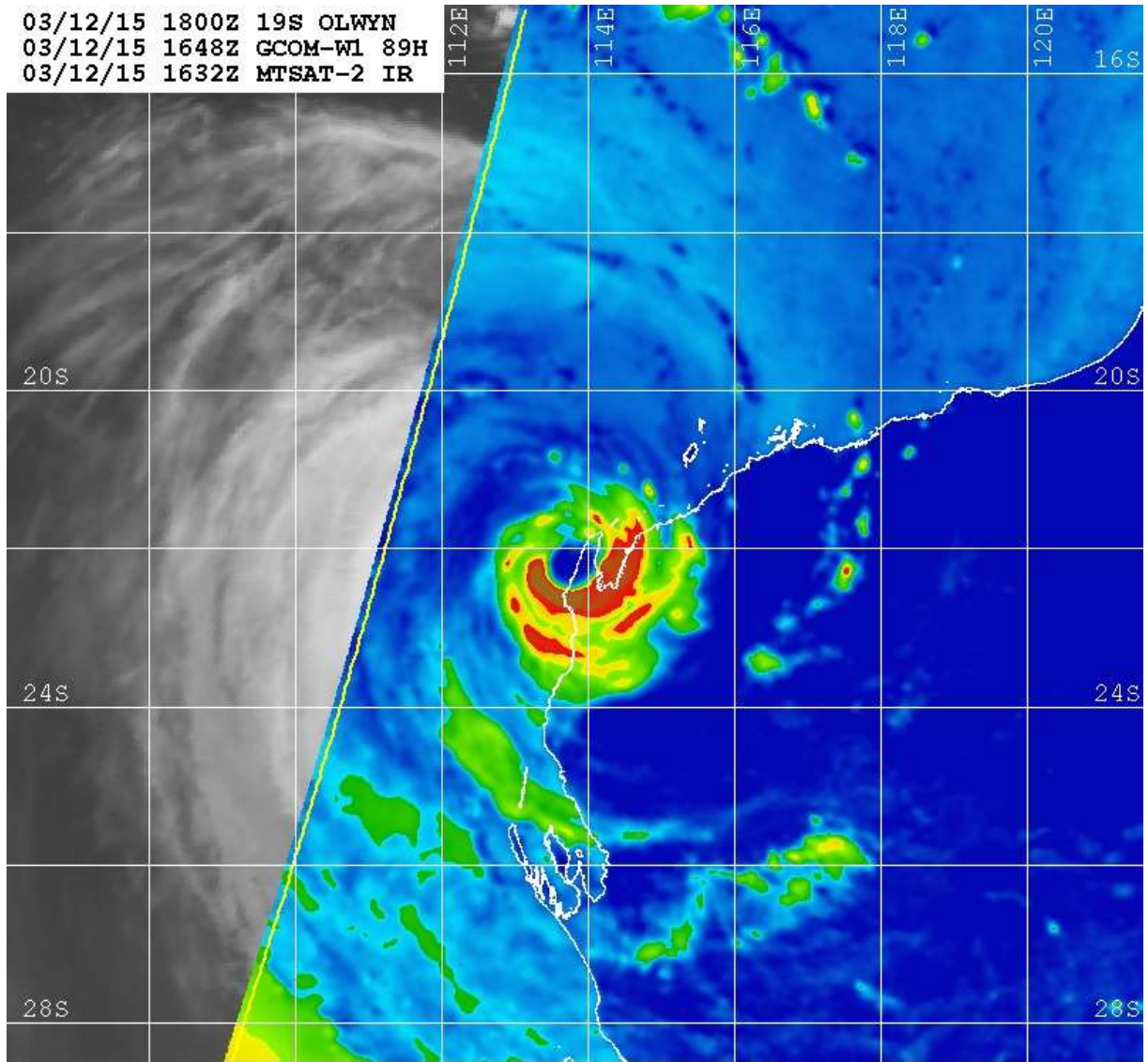


Naval Research Lab www.nrlmry.navy.mil/sat_products.html
<-- 89H Brightness Temp (Kelvin) -->



Figure 4. 85 GHz AMSR2 microwave image 0439 UTC 11 March 2015.
(image courtesy of NOAA NRL: <http://www.nrlmry.navy.mil/>)

03/12/15 1800Z 19S OLWYN
03/12/15 1648Z GCOM-W1 89H
03/12/15 1632Z MTSAT-2 IR



Naval Research Lab www.nrlmry.navy.mil/sat_products.html
<-- 89H Brightness Temp (Kelvin) -->



Figure 5. 85 GHz AMSR2 microwave image 1648 UTC 12 March 2015 near peak intensity.
(image courtesy of NOAA NRL: <http://www.nrlmry.navy.mil/>)

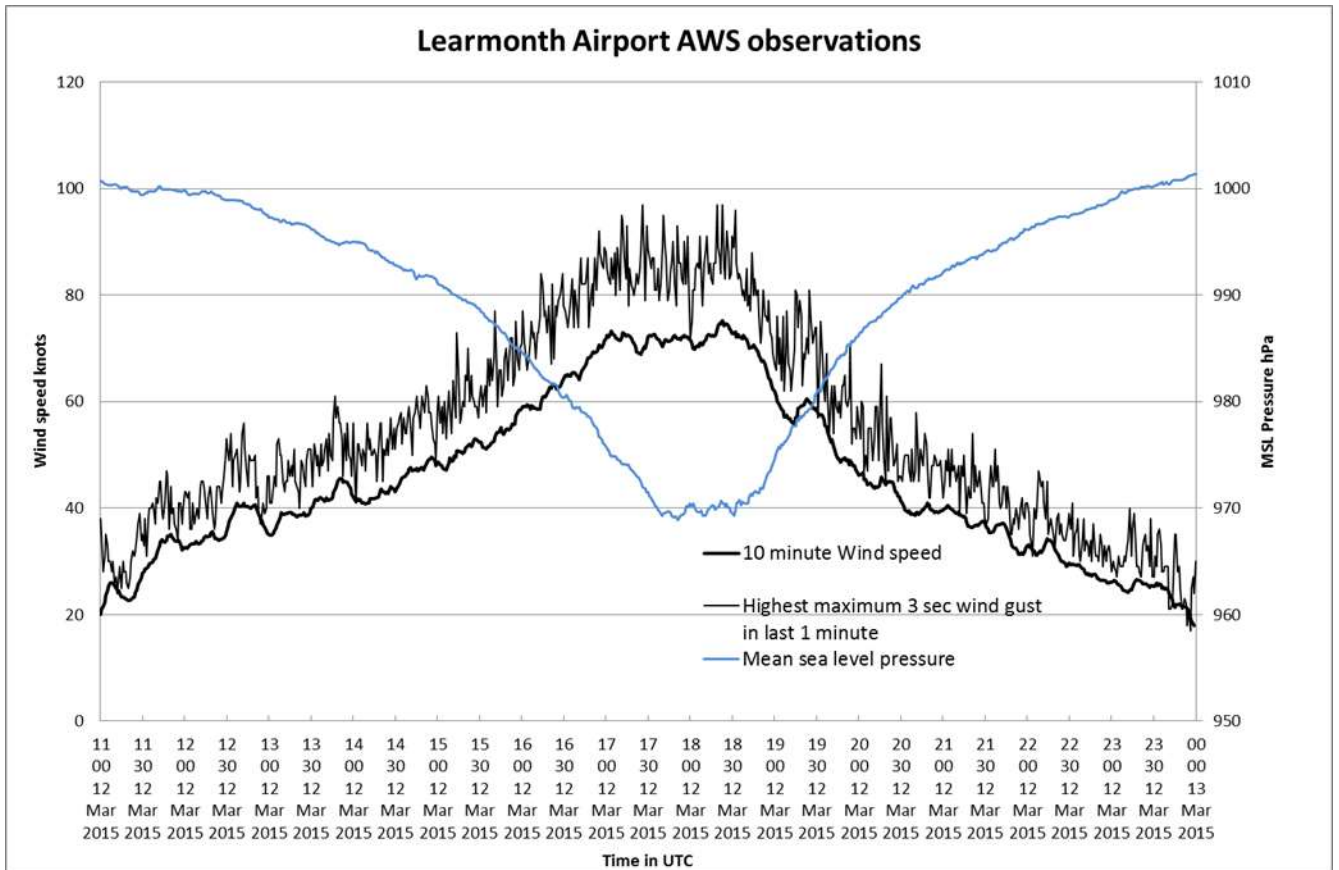


Figure 6. Plot of wind speed and pressure for Learmonth Airport

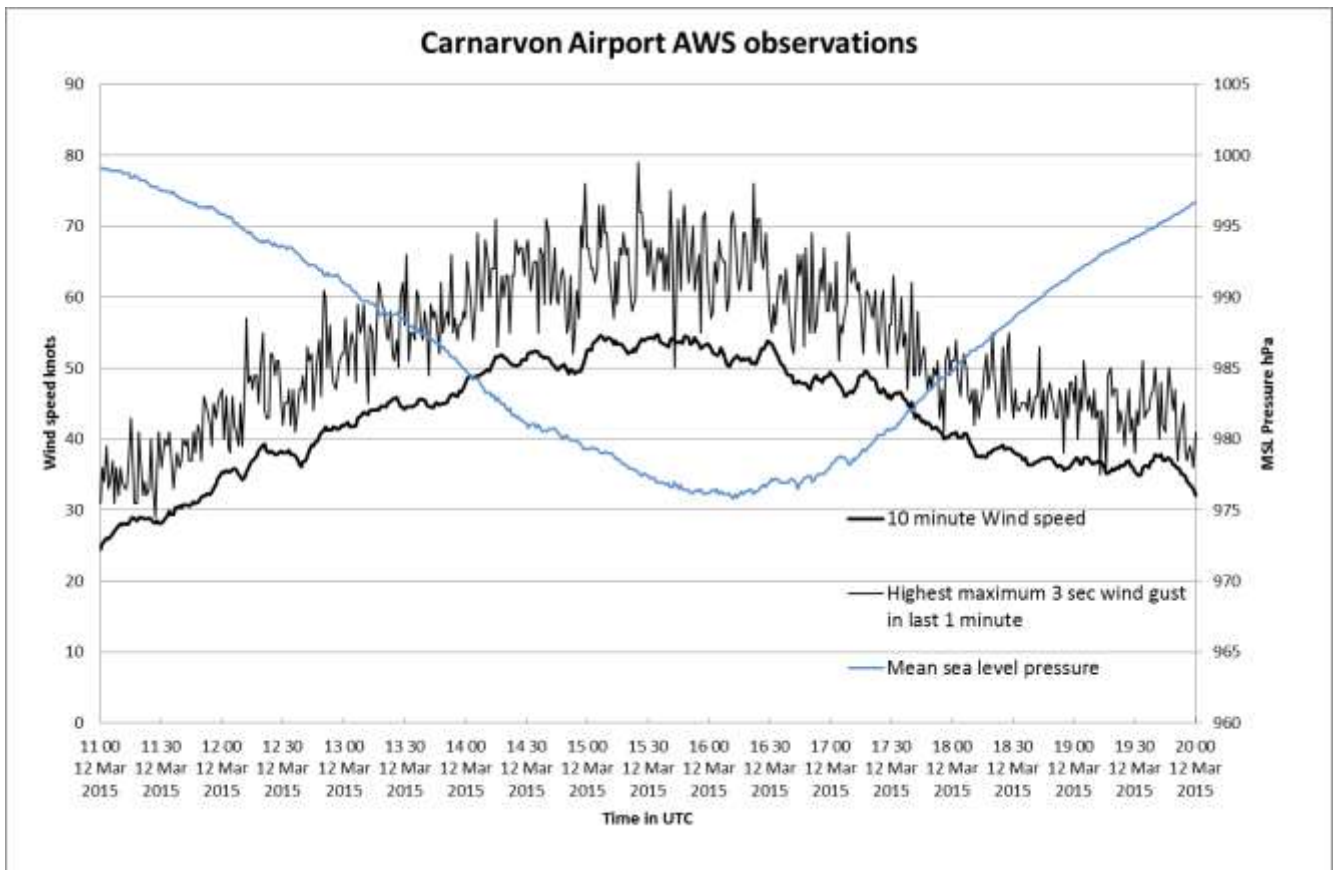


Figure 7. Plot of wind speed and pressure for Carnarvon Airport

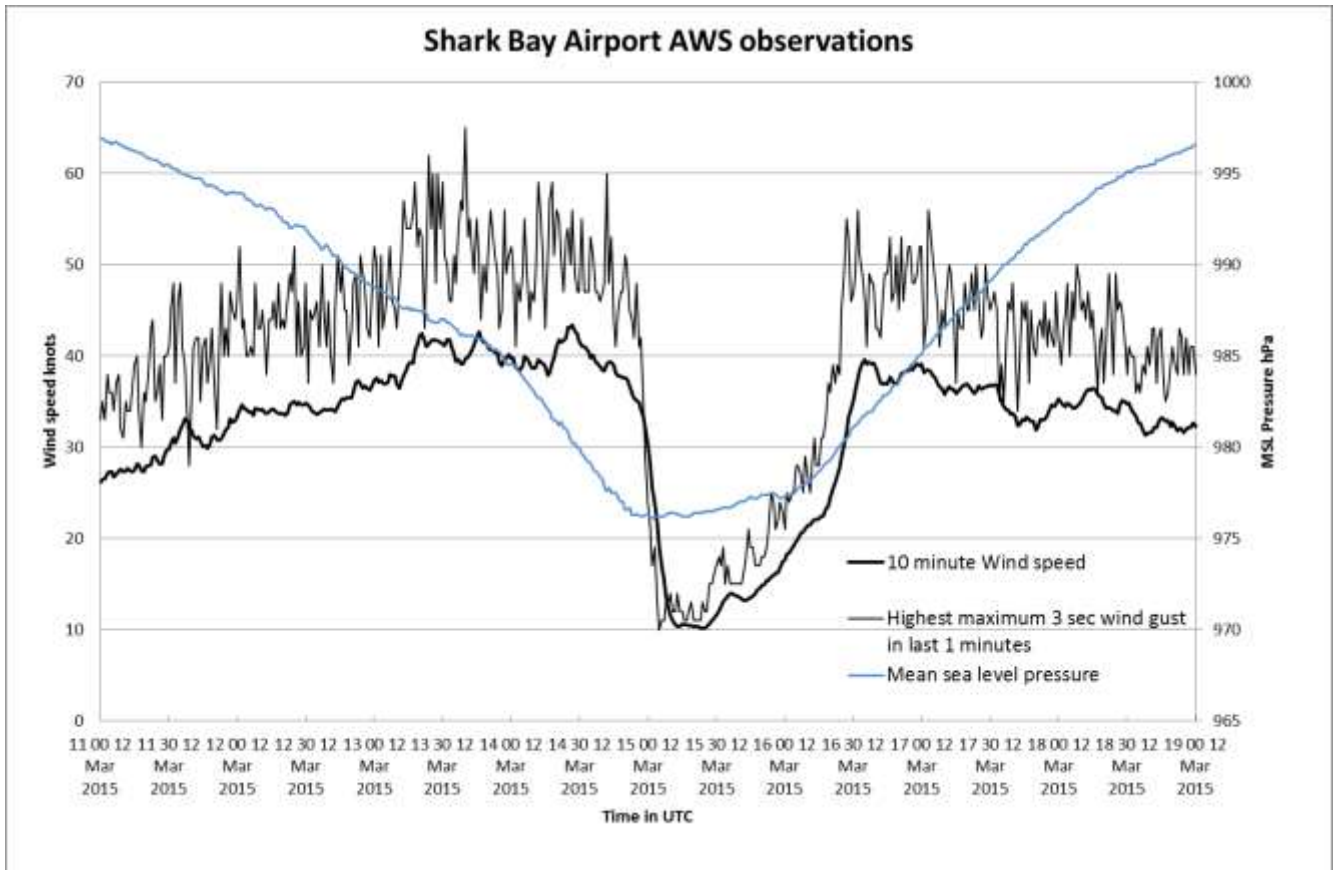


Figure 8. Plot of wind speed and pressure for Shark Bay (Denham) Airport

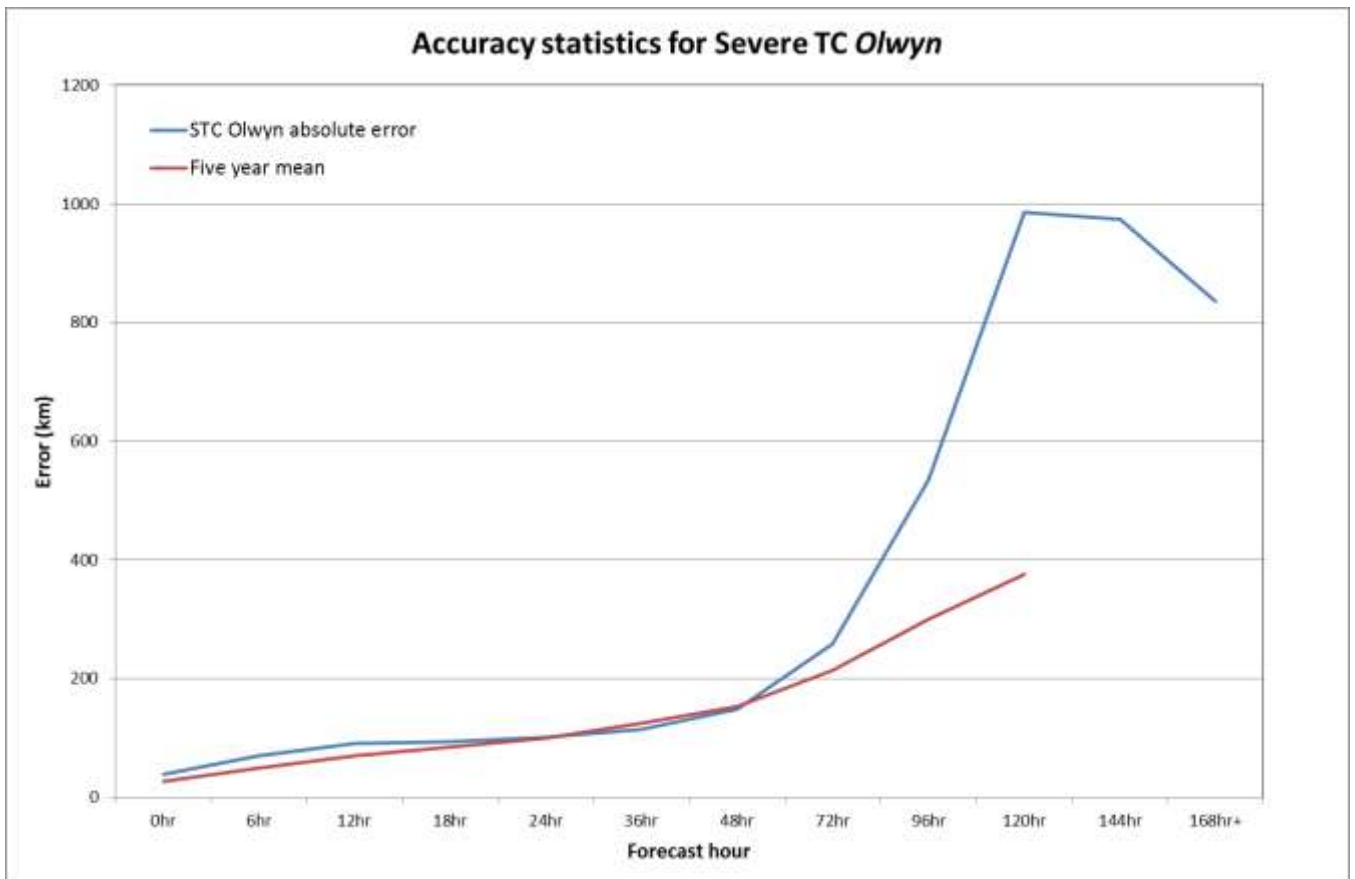


Figure 9. Accuracy statistics for Severe Tropical Cyclone *Olwyn*