



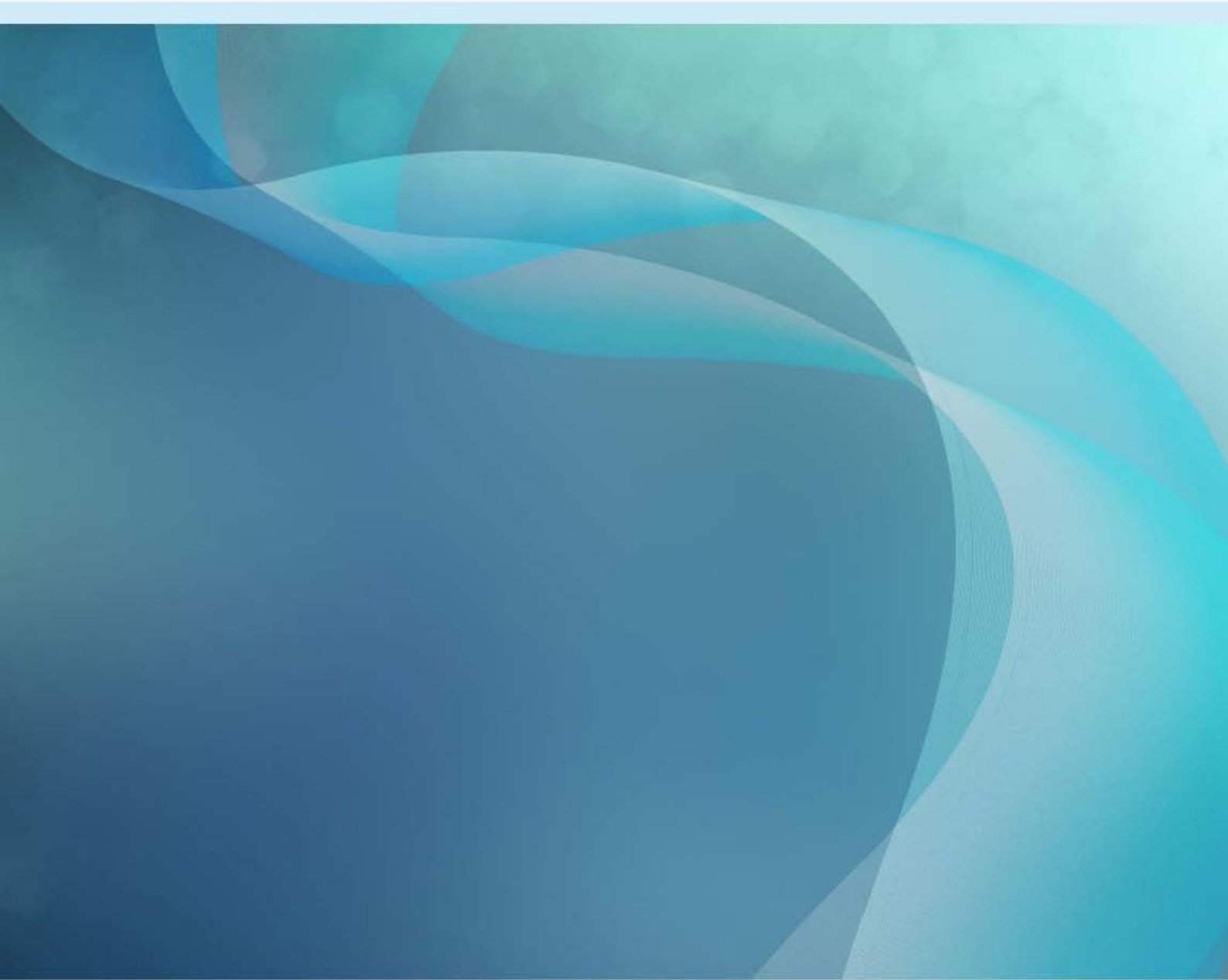
Australian Government

Bureau of Meteorology

Severe Tropical Cyclone *Quang*

27 April – 1 May 2015

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October 2015



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Table of Contents

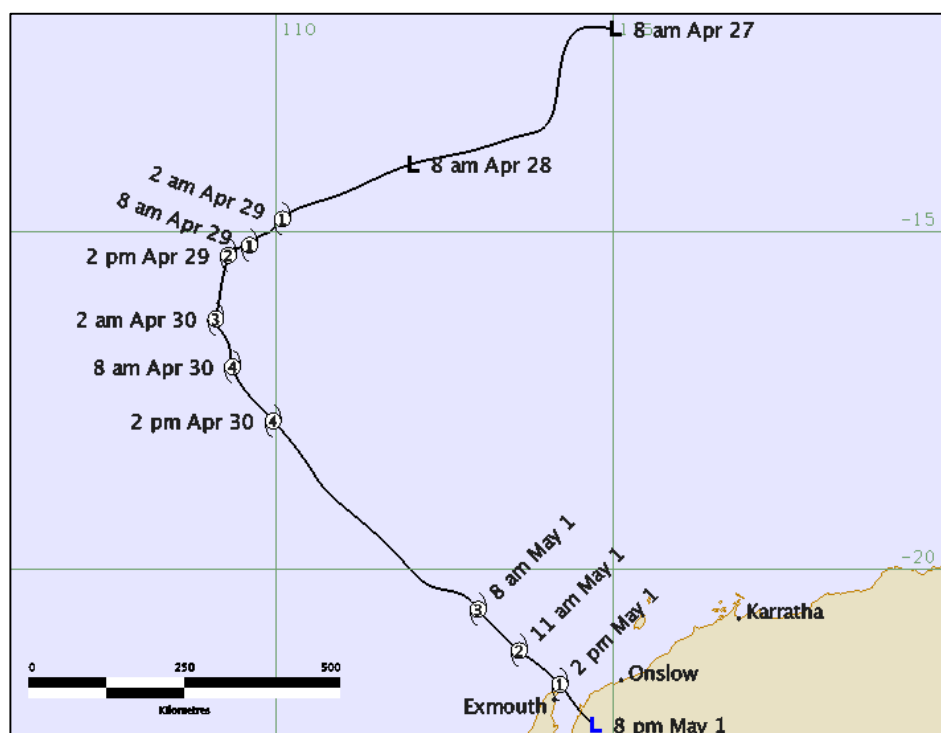
1	Summary	1
	FIGURE 1. Best track of Severe Tropical Cyclone <i>Quang</i> 27 April - 1 May 2015 (times in WST, UTC+8).....	1
2	Meteorological Description.....	2
2.1	Intensity analysis.....	2
2.2	Structure	2
2.3	Motion	3
3	Impact.....	4
4	Observations	5
4.1	Wind.....	5
4.2	Pressure	5
4.3	Rainfall.....	5
5	Forecast Performance	6
	TABLE 1. Best track summary for Severe Tropical Cyclone <i>Quang</i>	7
	FIGURE 2. Advanced Microwave Scanning Radiometer 2 (AMSR2) microwave pass at 1746 UTC 28 April 2015 during the early stages of <i>Quang</i> 's development.	9
	FIGURE 3. ASCAT Metop A pass at 0135 UTC 29 April 2015.....	10
	FIGURE 4. Comparison of objective and subjective intensity analysis techniques.	11
	FIGURE 5. 85 GHz TC Special Sensor Microwave Imager/Sounder (SSMIS) microwave image 2317 UTC 29 April 2015 near peak intensity.....	12
	FIGURE 6. Comparison of CIMSS vertical wind shear values and intensity.....	13
	FIGURE 7. 85 GHz AMSR2 microwave image 0510 UTC 30 April 2015.....	14
	FIGURE 8. Plot of wind speed recorded at Learmonth Airport AWS during <i>Quang</i>	15
	FIGURE 9. Accuracy statistics for <i>Quang</i>	16

1 Summary

Severe Tropical Cyclone (STC) *Quang* developed unusually late in the Australian tropical cyclone season from a tropical low in a moderately active monsoon trough on 27 April. Conditions were very favourable for development and *Quang* reached tropical cyclone strength late on 28 April. Initially the tropical cyclone was steered to the southwest but during 29 April *Quang* was steered to the southeast, towards the North West Cape of Australia. *Quang* intensified rapidly and reached a peak intensity of 100 knots (kn) (185 kilometre per hour (km/hr)) at 0600 UTC (Universal Time Coordinated 1400 WST=UTC+8 hours) 30 April when it was located about 650 kilometres (km) to the northwest of Exmouth.

Vertical wind shear increased during 30 April soon after *Quang* reached peak intensity. This caused *Quang* to begin weakening immediately. As the tropical cyclone approached the North West Cape *Quang* lost its eye structure and early on 1 May the remaining deep convection sheared away from the low level centre. This convective band was steered southeast over the town of Exmouth producing storm force (Category 2) winds for about an hour around midday on 1 May. Some damage to buildings and interruptions to power supply was reported from the town. *Quang* weakened below tropical cyclone intensity before crossing the Pilbara coast between Exmouth and Onslow around 1200 UTC 1 May.

FIGURE 1. Best track of Severe Tropical Cyclone *Quang* 27 April - 1 May 2015 (times in WST, UTC+8).



2 Meteorological Description

2.1 Intensity analysis

A tropical low became evident in an active monsoon trough to the north of Western Australia on 27 April. The low was located over warm Sea Surface Temperatures (SSTs) and in an area of low vertical wind shear. An initial Dvorak T-number (DT) 1.0 was assigned about 1200 UTC 27 April and subsequent development of the low was rapid. Curvature of the deep convection improved (refer Figure 2) and a Dvorak DT number of 3.0 was reached by 1800 UTC 28 April. The low reached tropical cyclone strength around this time. An 0135 UTC 29 April Advanced Scatterometer (ASCAT) (refer Figure 3) pass showed gales wrapped around the centre of *Quang* and 40-45 kn (74 – 83 km/h) winds in southern quadrants. Due to favourable conditions *Quang* intensified quickly and an eye became apparent on infrared imagery (IR) at around 0900 UTC 29 April. The eye pattern fluctuated, appearing and disappearing until becoming firmly established at 1800 UTC 29 April. Raw DT numbers reached 6.5 at times through the period 1800 UTC 29 April to 0600 UTC 30 April but Dvorak constraints meant the FT and CI were held to a peak of 6.0. Objective intensity estimates from the Advanced Microwave Sounding Unit (AMSU), Satellite Consensus (SATCON) and the Advanced Dvorak Technique (ADT) were similar though ADT showed the usual lag in DT numbers when the eye pattern was emerging (refer Figure 4). *Quang* reached a peak intensity of around 100 kn (185 km/h) near 0600 UTC 30 April (refer Figure 5). From 0600 UTC 30 April an amplifying mid-level trough to the west of *Quang* caused the wind shear to increase rapidly (refer Figure 6) and the effects could be seen on the cloud pattern. From around 1800 UTC 30 April the deep convection was displaced south of the centre. Early on 1 May the northwest wind shear had increased to around 40 kn (74 km/h) and the last remaining deep, cold convection on the southeast side of *Quang* separated from the low level centre. Learmonth Automatic Weather Station (AWS) recorded storm force winds for about an hour as this convection passed over. By 0600 UTC the remnants of the low level centre were still located to the north of the Australian mainland (refer Figure 7) with no gales detected around the centre. Wind observations suggest the low level centre made landfall between Exmouth and Onslow around 1200 UTC 1 May well below tropical cyclone strength.

2.2 Structure

Initially *Quang* was a reasonably symmetric though relatively small tropical cyclone with gale radii of around 70 nautical mile (nm) (130 km) and a radius to maximum wind (RMW) of 20 nm (37 km). As *Quang* intensified, the ASCAT passes showed the southern gale radii had increased to around 120 nm (222 km) while remaining at around 70 nm (130 km) in the northern semicircle. The RMW had decreased to 8 nm (15 km). Eye diameter was initially 30 nm (55 km) but decreased to 10 nm (19 km) at peak intensity. As the tropical cyclone experienced increased northwest wind shear the

northern gale radii decreased to around 30 nm (55 km) with the southern radii remaining larger at 90 nm (167 km).

2.3 Motion

From 27 to 29 April *Quang* was steered in a southwest direction by the mid-level ridge to the east. During 29 April a mid-level trough to the west amplified causing north-westerly steering flow to increase over *Quang*. Consequently *Quang* turned and began to move to the southeast from about 1800 UTC 29 April. The increasing north-westerly steering caused *Quang* to accelerate from around 6 kn (11 km/h) to around 15 kn (28 km/h) by 1200 UTC 30 April.

3 Impact

Severe Tropical Cyclone *Quang* impacted the town of Exmouth located on the tip of the North West Cape of Western Australia. Storm force winds and maximum wind gusts to 65 kn (120 km/h) were recorded at the Learmonth Airport AWS as convection from the rapidly weakening *Quang* passed over the area (refer Figure 8). There was a break in observations from 0530 UTC 1 May as winds were decreasing from storm force to gale force strength. When the observations came back online at 0749 UTC 1 May winds had dropped below gale force strength. Mostly minor damage was reported from Exmouth with some power supplies also interrupted.

4 Observations

4.1 Wind

Learmonth Airport AWS recorded gale force winds (winds equal to or greater than 34 kn or 63 km/h) between 0239 – 0533 UTC 1 May when the instrument stopped reporting. Storm force winds (winds equal to or greater than 48 kn or 89 km/h) were recorded between 0355 – 0500 UTC 1 May. The maximum 10-minute mean wind recorded was 51 kn (94 km/h) at 0443 UTC 1 May. The peak 3 second wind gust recorded was 65 kn (120 km/h) also at 0443 UTC 1 May.

4.2 Pressure

Learmonth Airport AWS recorded a lowest pressure 997.4 hPa at 0453 UTC 1 May.

4.3 Rainfall

Exmouth recorded the highest accumulated total of 84.0 mm.

5 Forecast Performance

Quang posed a challenge for the forecasters due to its relatively small size and rapid intensification. Model guidance for the *Quang* also varied in forecast intensity and track. Another difficulty posed by *Quang* was forecasting the weakening of an intense tropical cyclone prior to coastal impact. Initially respected models were not predicting *Quang* to become very intense and were weakening the tropical cyclone to the west of the Australian mainland. However one notable exception was the UK model which persistently predicted the tropical cyclone to turn to the southeast and cross the coast near Exmouth. Official forecast tracks were based on a consensus approach and had initially predicted the cyclone to weaken and cross the upper west coast between Exmouth and Carnarvon. However, from 30 April the forecast track was slowly biased towards the models analysing the stronger systems and as a result, the focus of the coastal crossing point began to shift further north, closer to Exmouth. This also implied that *Quang* could impact the NW Cape as a more intense tropical cyclone than initially thought.

The community of Exmouth were briefed to expect an impact from *Quang* later on 1 May. They were also briefed that even though *Quang* was undergoing weakening due to increased vertical wind shear it was possible the tropical cyclone may still be a Category 2 (storm force winds) intensity at the time of impact. *Quang* did undergo rapid weakening as it approached the coast and the last of the deep convection separated from the low level centre during the morning of 1 May. This convective band was rapidly steered to the southeast directly over the NW Cape and the town of Exmouth. This meant that Exmouth experienced a period of storm force winds about 6 hours earlier than originally predicted.

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

	0	06	12	18	24	36	48	72
Absolute error (km)	33	55	82	110	135	194	226	339
RMS error (km)	42	67	99	131	164	240	261	339

Figure 9 is a plot of the accuracy figures for *Quang* compared to the five year mean.

TABLE 1. Best track summary for Severe Tropical Cyclone *Quang*

Refer to the Australian Tropical Cyclone database for complete listing of parameters. WST is UTC + 8 hours.

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 n mi
2015	4	27	0000	12.0	115.0	60	20	45	1006			
2015	4	27	0600	12.0	114.5	60	20	45	1006			
2015	4	27	1200	12.8	114.2	30	20	45	1006			
2015	4	27	1800	13.6	113.7	30	20	45	1008			
2015	4	28	0000	14.0	112.0	30	25	45	1006			
2015	4	28	0600	14.2	111.5	30	25	45	1005			
2015	4	28	1200	14.5	110.8	20	30	45	1003			
2015	4	28	1800	14.8	110.1	10	35	50	1000	70		20
2015	4	29	0000	15.2	109.6	15	40	55	997	70		20
2015	4	29	0600	15.3	109.3	10	50	70	990	70	30	15
2015	4	29	1200	15.8	109.2	10	55	75	987	90	30	10
2015	4	29	1800	16.3	109.1	10	75	105	972	70/120/ 120/70	40	10
2015	4	30	0000	17.0	109.4	15	90	125	959	70/120/ 120/70	40	8
2015	4	30	0600	17.8	110.0	15	100	140	950	70/120/ 120/70	40	15
2015	4	30	1200	18.9	110.8	10	95	135	952	60/120/ 120/60	45	20

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 n mi
2015	4	30	1800	19.8	111.8	15	80	110	965	60/120/ 120/60	45	25
2015	5	01	0000	20.6	113.0	20	65	90	977	60/120/ 120/60	40	35
2015	5	01	0600	21.7	114.2	15	40	55	996	30/60/ 60/30		50
2015	5	01	1200	22.3	114.7	15	20	45	1000			

FIGURE 2. Advanced Microwave Scanning Radiometer 2 (AMSR2) microwave pass at 1746 UTC 28 April 2015 during the early stages of *Quang*'s development.

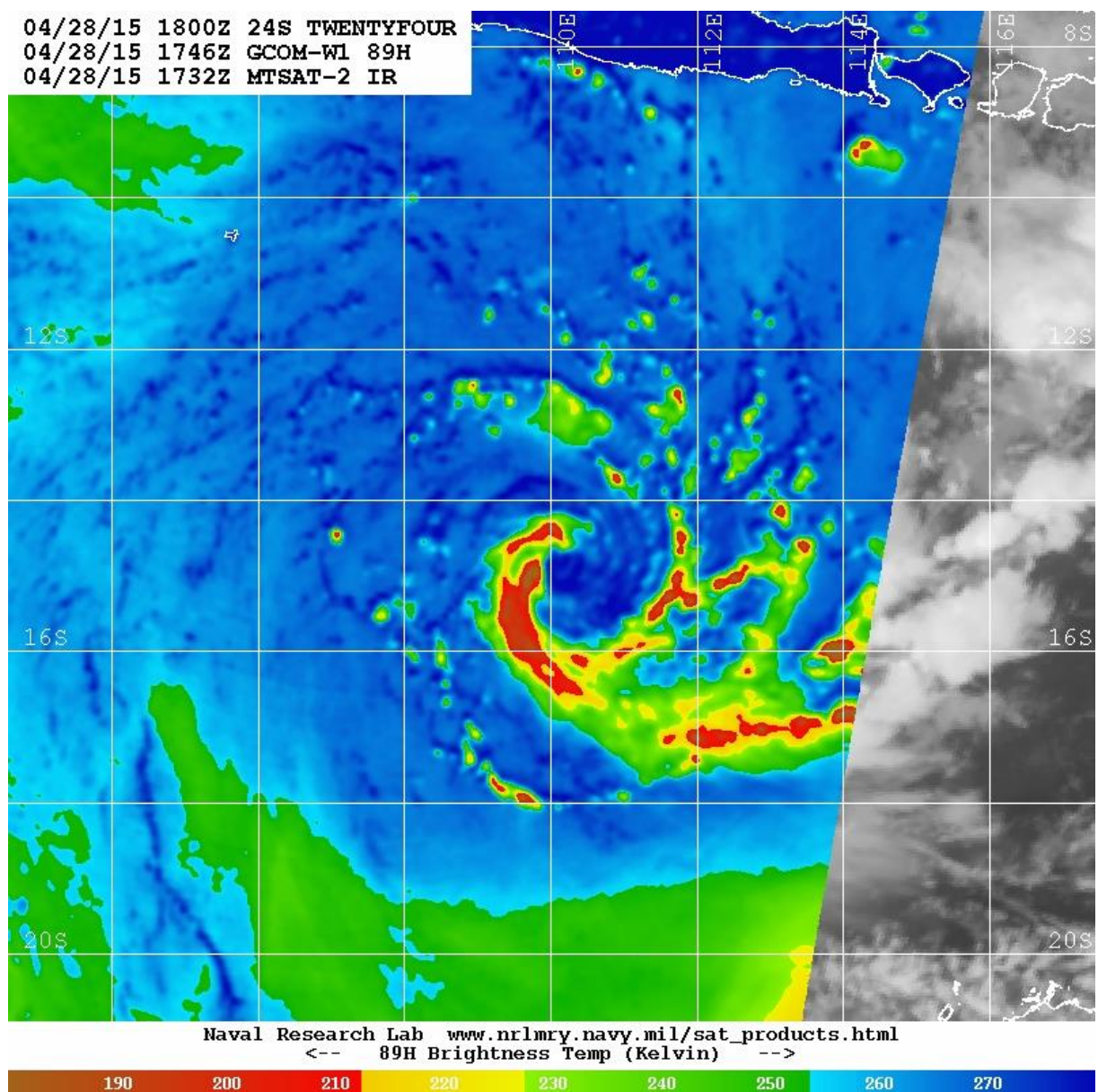


FIGURE 3. ASCAT Metop A pass at 0135 UTC 29 April 2015

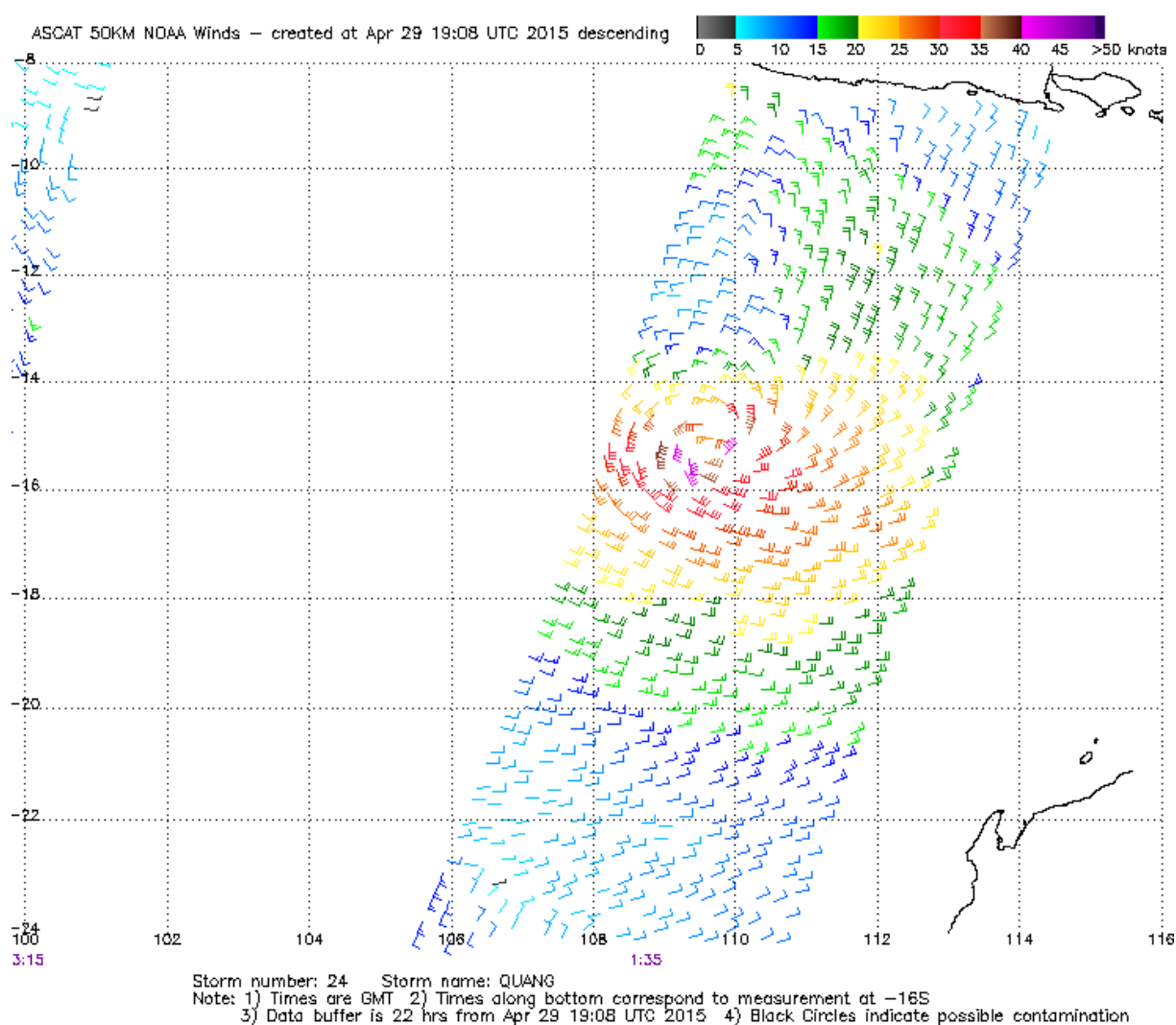


FIGURE 4. Comparison of objective and subjective intensity analysis techniques.

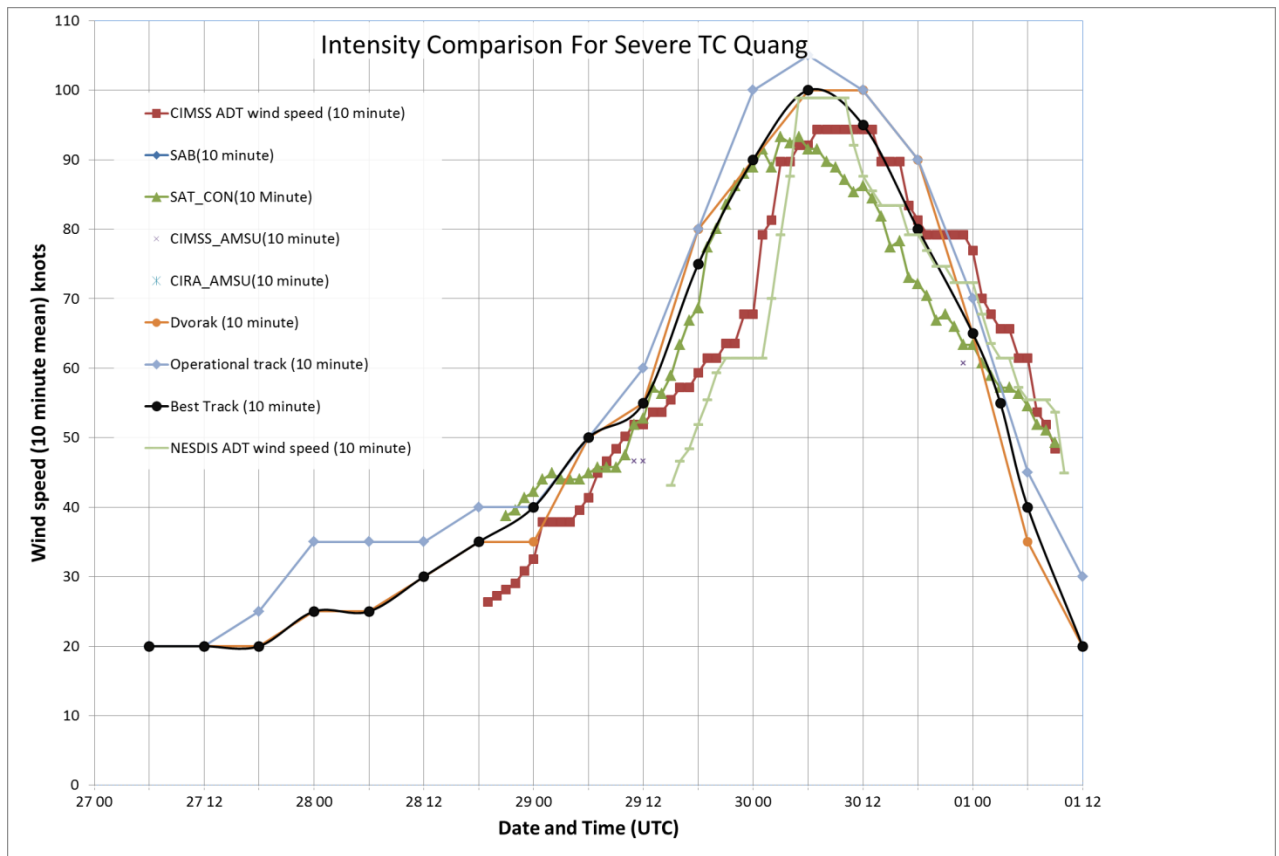


FIGURE 5. 85 GHz TC Special Sensor Microwave Imager/Sounder (SSMIS) microwave image 2317 UTC 29 April 2015 near peak intensity.

(image courtesy of NOAA NRL: <http://www.nrlmry.navy.mil/>)

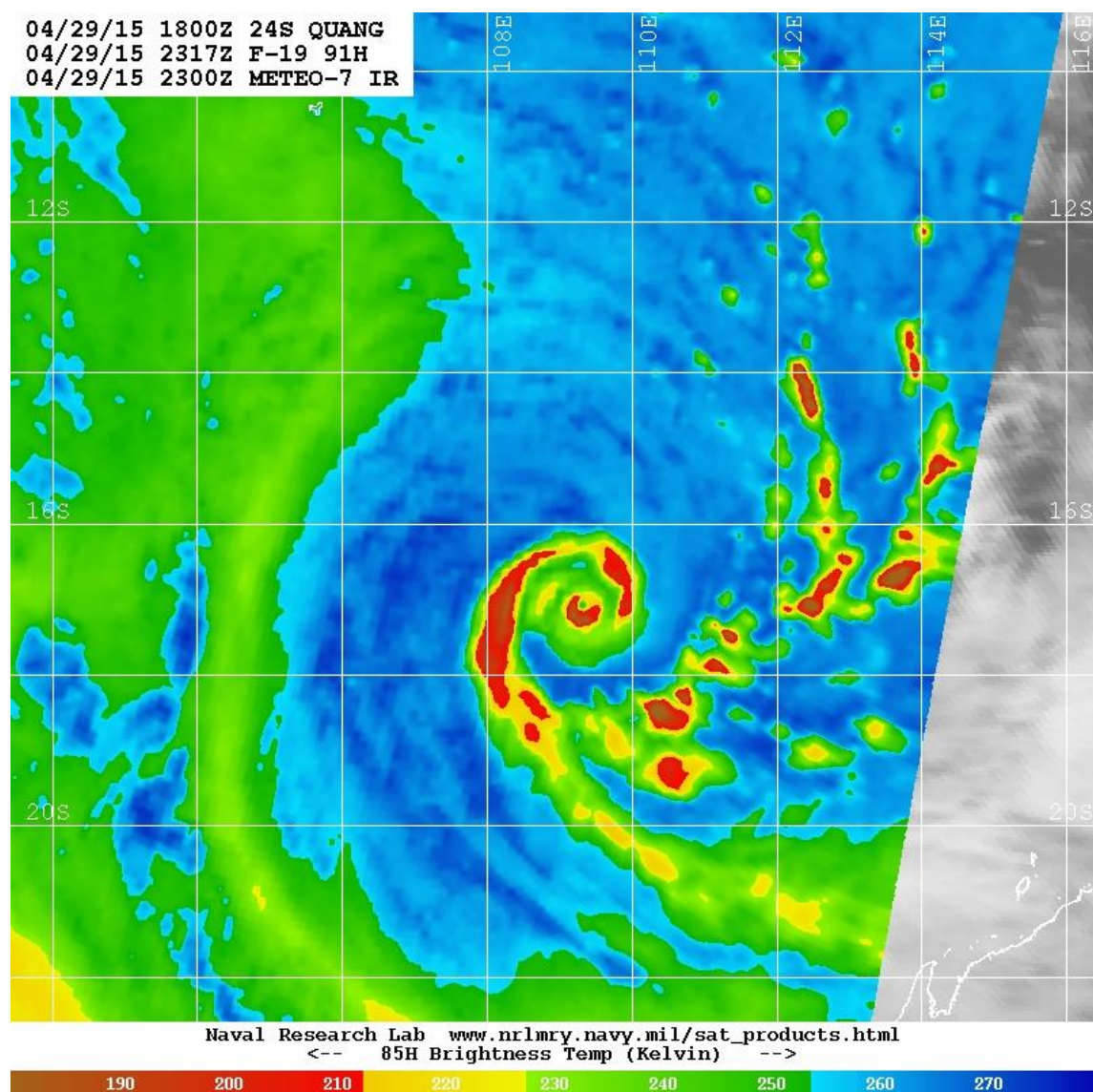


FIGURE 6. Comparison of CIMSS vertical wind shear values and intensity.

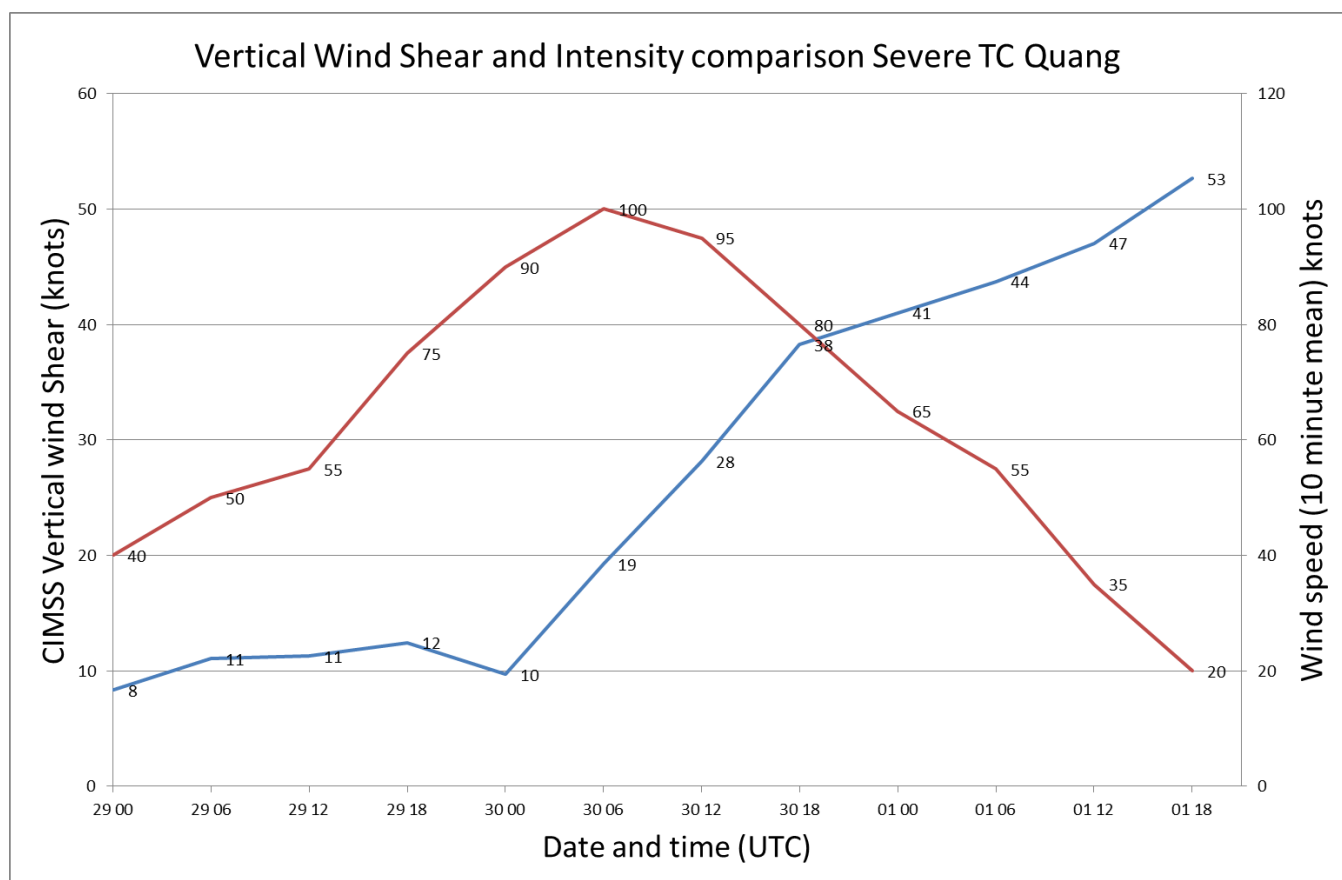


FIGURE 7. 85 GHz AMSR2 microwave image 0510 UTC 30 April 2015.

(image courtesy of NOAA NRL: <http://www.nrlmry.navy.mil/>)

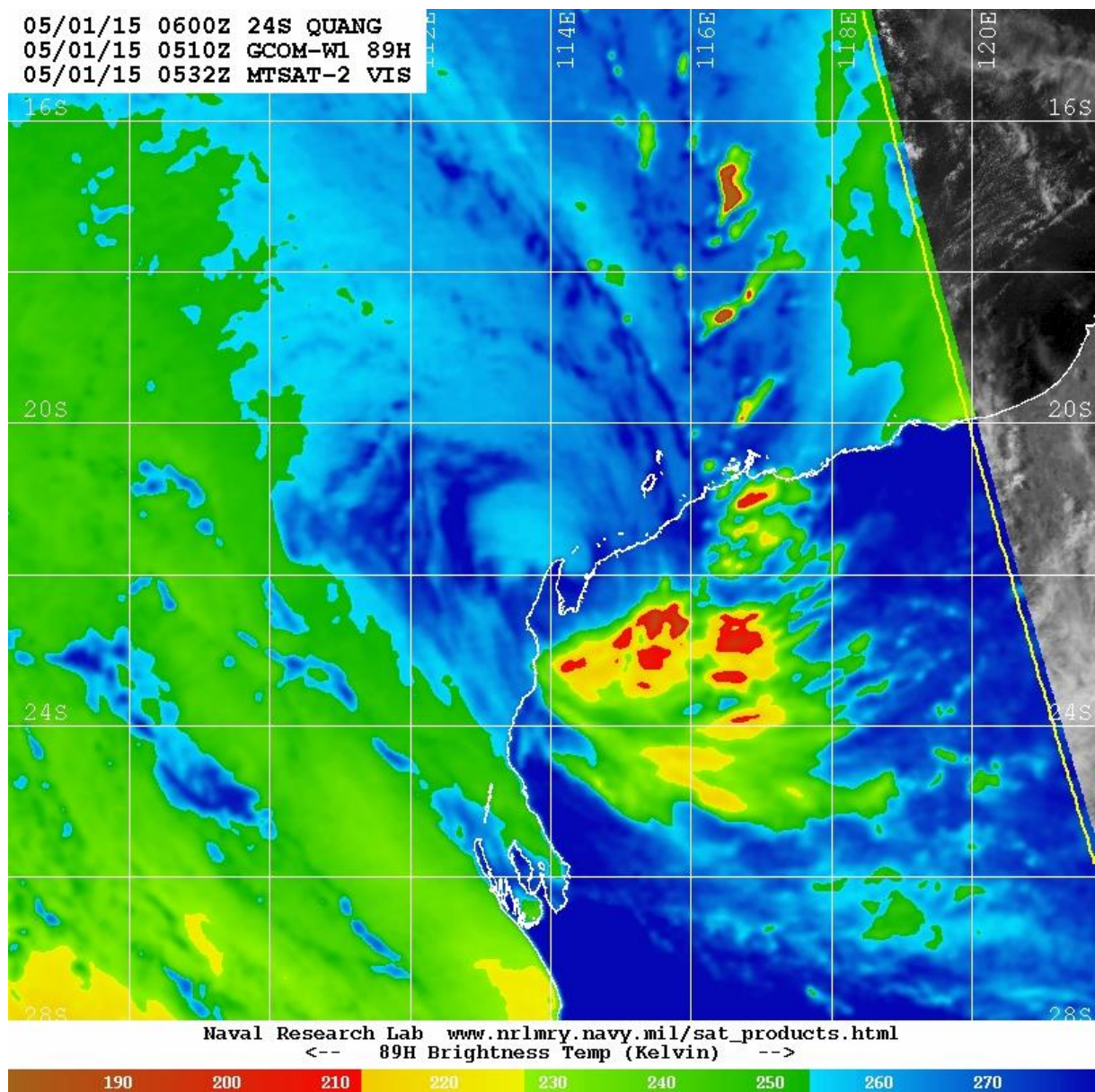


FIGURE 8. Plot of wind speed recorded at Learmonth Airport AWS during *Quang*

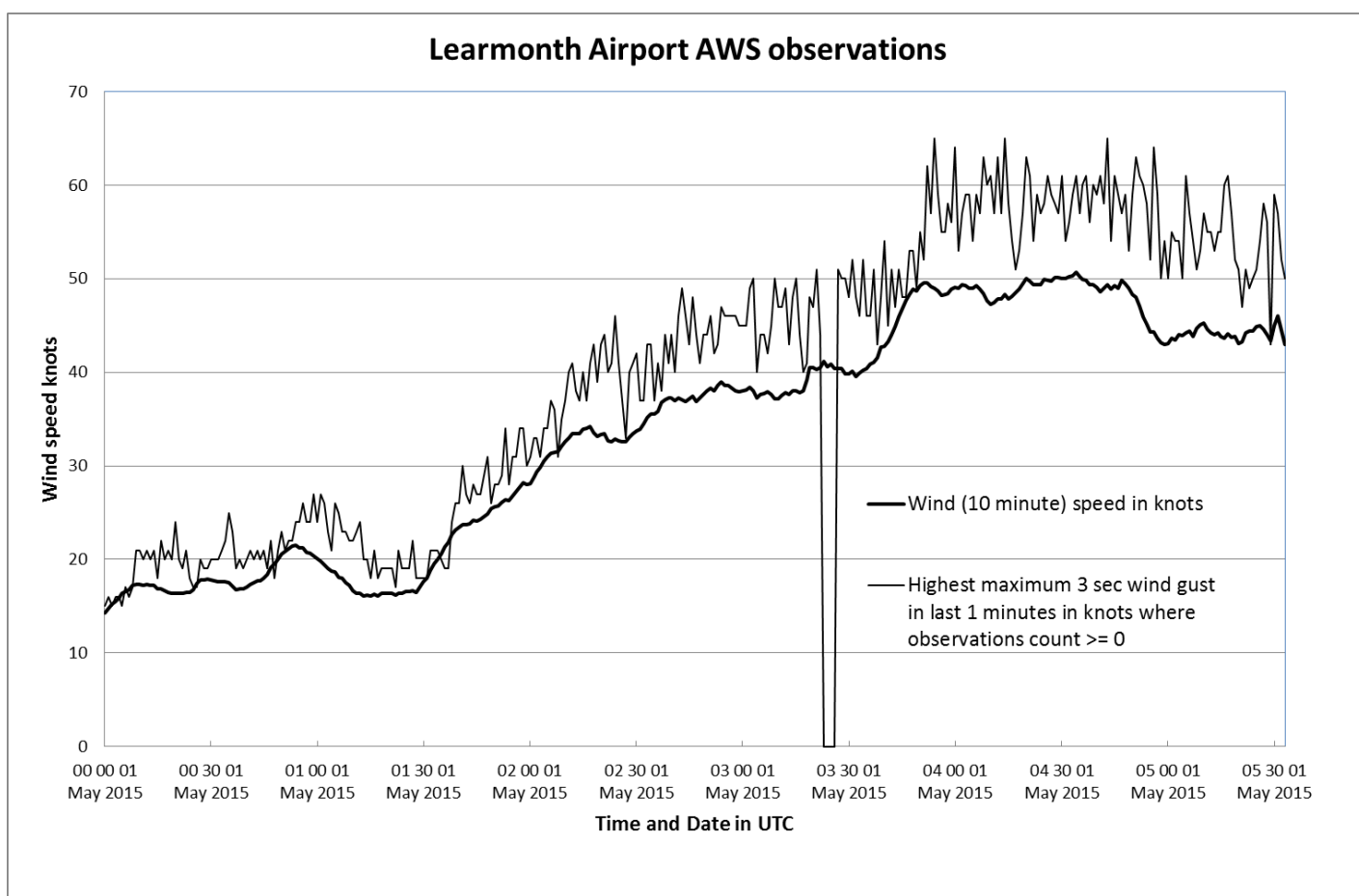


FIGURE 9. Accuracy statistics for *Quang*

