Australian Government
Bureau of Meteorology

Tropical Cyclone *Yvette*

18 – 25 December 2016

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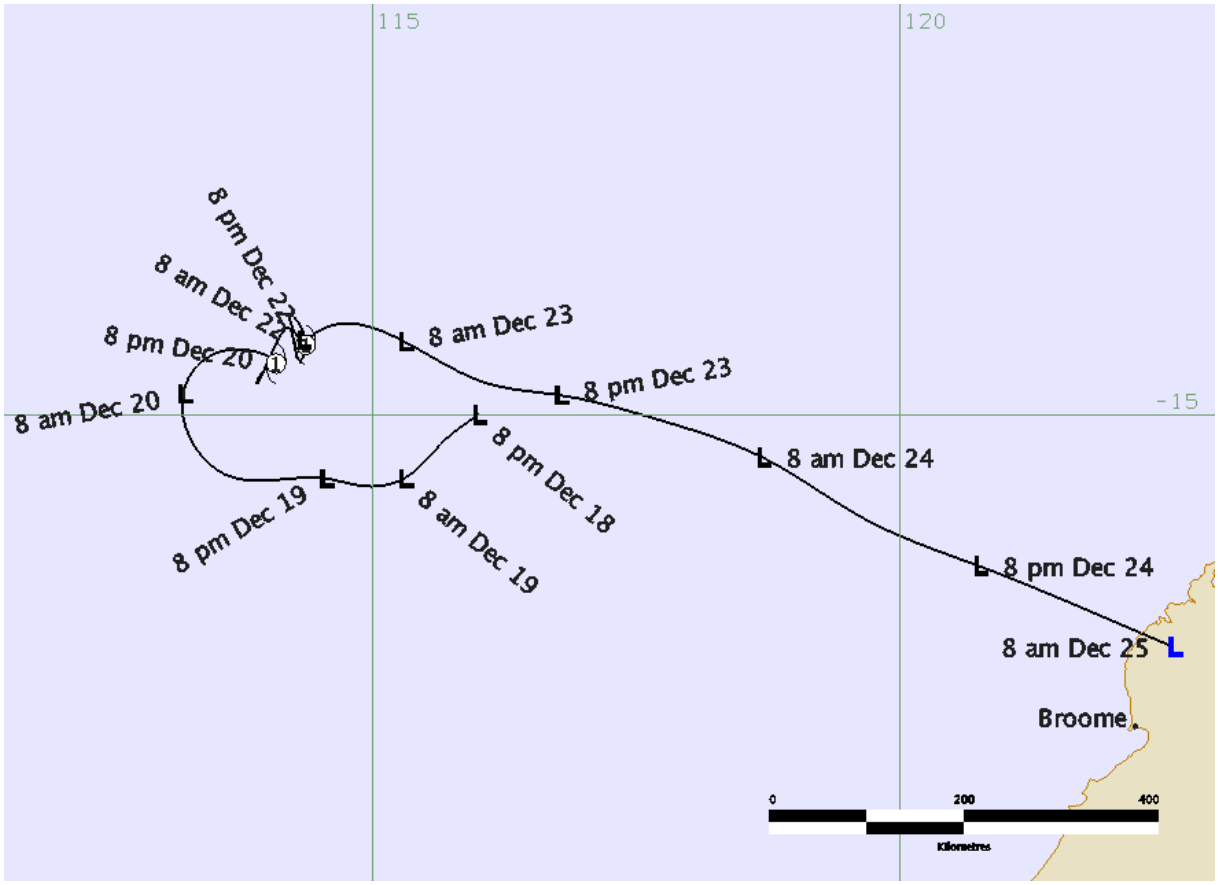
1 Summary

A low formed in an active monsoon trough approximately 645 kilometres (km) to the north of Karratha around 1200 Universal Time Coordinated (UTC) 18 December (2000 Australian Western Standard Time (AWST)=UTC+8 hours). The low drifted west and then north before being steered back to the east on 20 December. *Yvette* reached tropical cyclone strength at 1200 UTC 20 December and attained a ten-minute mean wind peak intensity of 45 knots (kn) (83 kilometres per hour (km/h)) at 0600 UTC 21 December. *Yvette* weakened quickly under increased vertical wind shear and was below tropical cyclone strength at 1200 UTC 22 December. During this period, the tropical cyclone had been under a light steering regime and had moved only slowly east. The remnants of *Yvette* steered towards the Kimberley coast of Western Australia before dissipating over land on 25 December. Ex-*Yvette* did not cause any wind damage as it made landfall but did produce areas of heavy rainfall. Yvette generated a swell event which caused significant disruption to industry along the Pilbara coast. Swell heights up to 3.5 metres (m) with a period of 10 seconds (s) were experienced late on 19 December.

FIGURE 1. Best track of *Yvette* 18 – 25 December 2016 (times in AWST, UTC+8).



2 Meteorological Description

2.1 Intensity analysis

A low developed in an active monsoon trough during 18 December and an initial Dvorak Data T-number (DT) of 1.5 was assigned at 1800 UTC. A 1412 UTC Advanced Scatterometer (ASCAT) pass (refer Figure 2) showed a circulation with 25 to 30 kn (46 – 55 km/h) northwest winds on the northeast side, most likely associated with the monsoon flow to the north of the tropical low. Early on 19 December DT numbers increased to 2.5 as the curved banding became more organised. An 0119 UTC ASCAT (refer Figure 3) partial pass showed an area of 35 kn (65 km/h) winds on the eastern side. A subsequent 0215 ASCAT partial pass showed 40 kn (74 km/h) winds in the southwest quadrant. A swell of around 3.5 m with a period of 10 s was recorded at various Pilbara coastal sites between 1400 and 2000 UTC 19 December. Analysis of the data revealed winds in the eastern quadrants must have been as high as 40 kn (74 km/h) through the period 0000 to 1000 UTC 19 December to have produced the recorded swell.

During 20 December visible (VIS) imagery showed an exposed low-level cloud centre (LLCC) until around 0800 UTC before renewed convection blew up and covered it. Curvature of the convective banding improved and a DT of 3.0 was reached by 1200 UTC 20 December. During the morning of 21 December, enhanced infrared imagery (EIR) showed the centre of *Yvette* located about a third into the cold cloud and peak DT of 3.5 was reached at 0600 UTC 21 December. *Yvette* reached a 10-minute mean wind peak intensity of 45 kn (83 km/h) from 0000 UTC to 1200 UTC 21 December (refer Figure 4). During 21 December vertical wind shear increased from around 30 kn (55 km/h) to 40 kn (74 km/h) and *Yvette* weakened rapidly to below tropical cyclone strength by 1200 UTC 22 December (refer Figure 5).

Objective guidance from Satellite Consensus (SATCON) and Cooperative Institute for Meteorological Satellite Studies (CIMSS) and National Environmental Satellite, Data, and Information Service (NESDIS) advanced Dvorak Techniques (ADT) are shown in Figure 6. The techniques provided reasonable guidance throughout with the exception of the SATCON from 1800 UTC 22 December which continued to increase intensity estimates when the system was clearly sheared with an exposed low level cloud centre during 23 December.

2.2 Structure

Yvette initially had gales in the southeast quadrant at 0000UTC 19 December, but by 0600 UTC gales extended to the entire southern half. Yvette then showed signs of weakening and gales were estimated to be present only in the southwestern quadrant. At 1200 UTC 20 December gales wrapped around the centre and the system reached cyclone strength. At this time the gale radii extended out to 75 nm (140 km). As *Yvette* reached peak intensity the largest sector gale radii increased to 90 nm (167 km). The

western quadrant radii further expanded to 100 nm (185 km) as the tropical cyclone quickly weakened. By 1200 UTC 22 December gales were only present in the western quadrants. Initially the radius to maximum wind (RMW) was 35 nm (65 km), this contracted to 20 nm (37 km) at *Yvette's* most intense and then expanded to 30 nm (55 km) as the tropical cyclone weakened.

2.3 Motion

Yvette was steered in a westerly direction by the mid-level ridge on the 19 and 20 December. A low over the north Kimberley eroded the mid-level ridge and *Yvette* moved slowly and erratically through the 21 and 22 December. By 23 December the low over northern Australia had moved further south and a generally northwest steering flow influenced the movement of *Yvette*. The weak low level centre was steered to the southeast and crossed the Kimberley coast on 25 December and dissipated.

3 Impact

Yvette generated a swell event which caused significant disruption to industry along the Pilbara coast. Swell heights up to 3.5 metres (m) with a period of 10 seconds (s) were experienced late on 19 December.

4 Observations

No observations of note were recorded during *Yvette*.

5 Forecast Performance

The accuracy figures for *Yvette* were at least as good as the 2010-2015 five year average.

The accuracy statistics obtained by comparing the forecast positions against the best track positions for *Yvette* are

	0	**06**	**12**	**18**	**24**	**36**	**48**	**72**
Absolute error (km)	34	73	90	103	108	114	135	187
RMS error (km)	49	85	106	117	120	128	155	212

Figure 7 is a plot of the accuracy figures for *Yvette* compared to the five year mean.

TABLE 1. Best track summary for Tropical Cyclone *Yvette*

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. n mi	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
2016	12	18	1200	15.0	116.0	60	30	45	996			
2016	12	18	1800	15.2	115.7	60	30	45	996			
2016	12	19	0000	15.6	115.2	30	30	45	996			
2016	12	19	0600	15.7	114.9	30	30	45	996			
2016	12	19	1200	15.6	114.5	30	30	45	996			
2016	12	19	1800	15.6	113.6	15	35	50	995	0/0/60/0		
2016	12	20	0000	14.8	113.2	20	35	50	995	0/0/60/60		
2016	12	20	0600	14.4	113.9	15	35	50	995	0/0/60/0		
2016	12	20	1200	14.5	114.1	20	40	55	990	40/75/75/75		
2016	12	20	1800	14.6	114.0	20	40	55	990	40/75/75/75		
2016	12	21	0000	14.7	113.9	30	45	65	989	40/60/60/60		
2016	12	21	0600	14.4	114.0	25	45	65	987	40/60/90/60		
2016	12	21	1200	14.2	114.2	20	45	65	987	60/60/90/60		
2016	12	21	1800	14.5	114.3	20	45	55	989	60/40/100/1 00		
2016	12	22	0000	14.3	114.4	20	35	50	989	40/40/90/90		
2016	12	22	0600	14.1	114.2	20	35	50	990	40/40/90/90		

Year	Month	Day	Hour UTC	Pos. Lat S	Pos. Long. E	Pos. Acc. n mi	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
2016	12	22	1200	14.3	114.3	20	35	50	990	0/0/90/90		
2016	12	22	1800	14.2	114.4	20	35	50	990	0/0/90/90		
2016	12	23	0000	14.3	115.3	15	30	45	990			
2016	12	23	0600	14.7	116.1	10	30	45	990			
2016	12	23	1200	14.8	116.8	20	30	45	990			
2016	12	23	1800	15.1	117.7	20	30	45	991			
2016	12	24	0000	15.4	118.7	20	30	45	994			
2016	12	24	0600	16.0	119.7	20	30	45	994			
2016	12	24	1200	16.4	120.8	25	25	45	996			
2016	12	24	1800	16.9	121.9	30	25	45	996			
2016	12	25	0000	17.2	122.6	20	25	45	998			

FIGURE 2. METOP-A ASCAT pass at 1412 UTC 18 December 2016 during the very early stages of *Yvette's* development.

Image courtesy of https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php

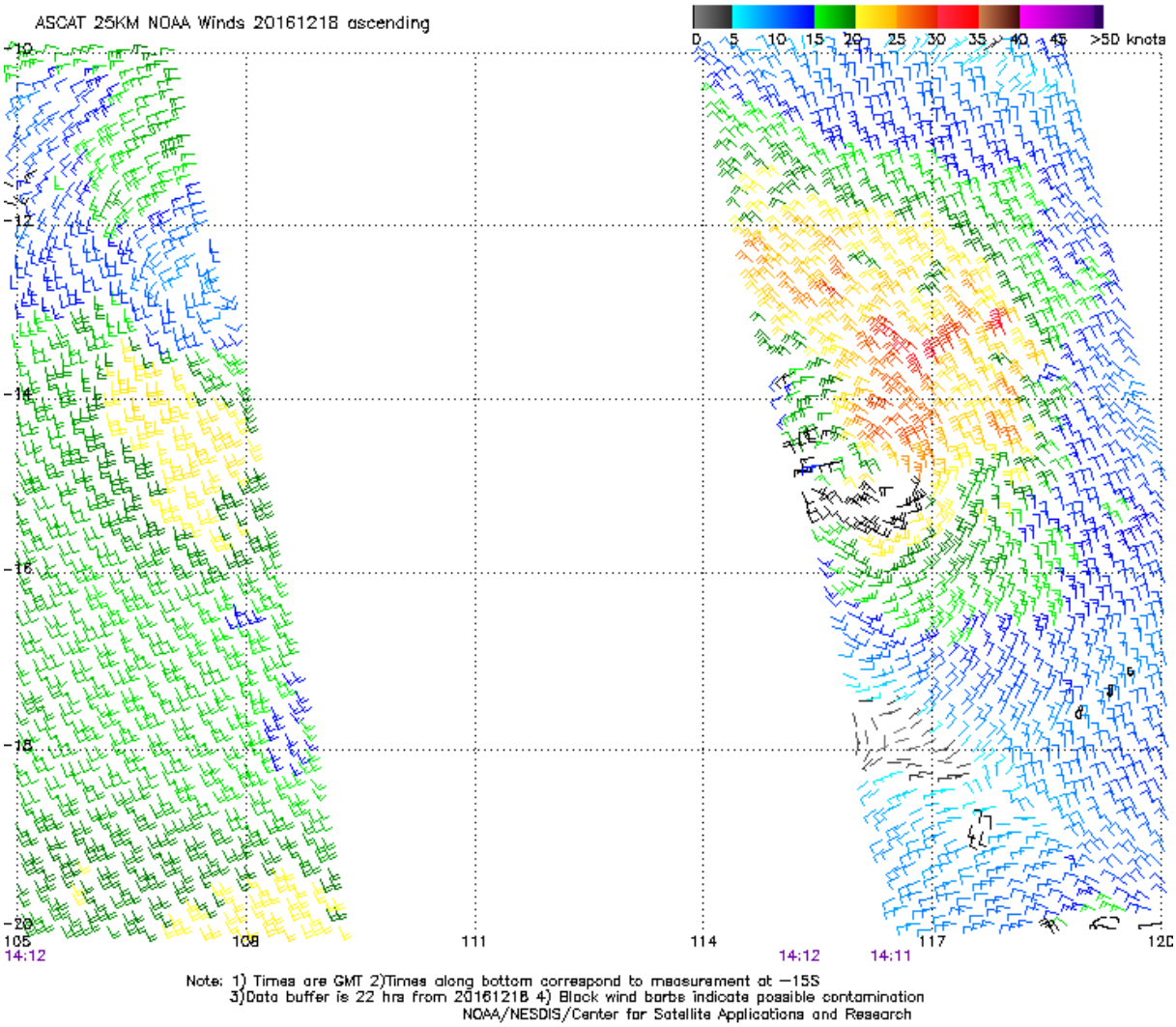


FIGURE 3. METOP-A ASCAT pass at 019 UTC 19 December 2016.

Image courtesy of https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php

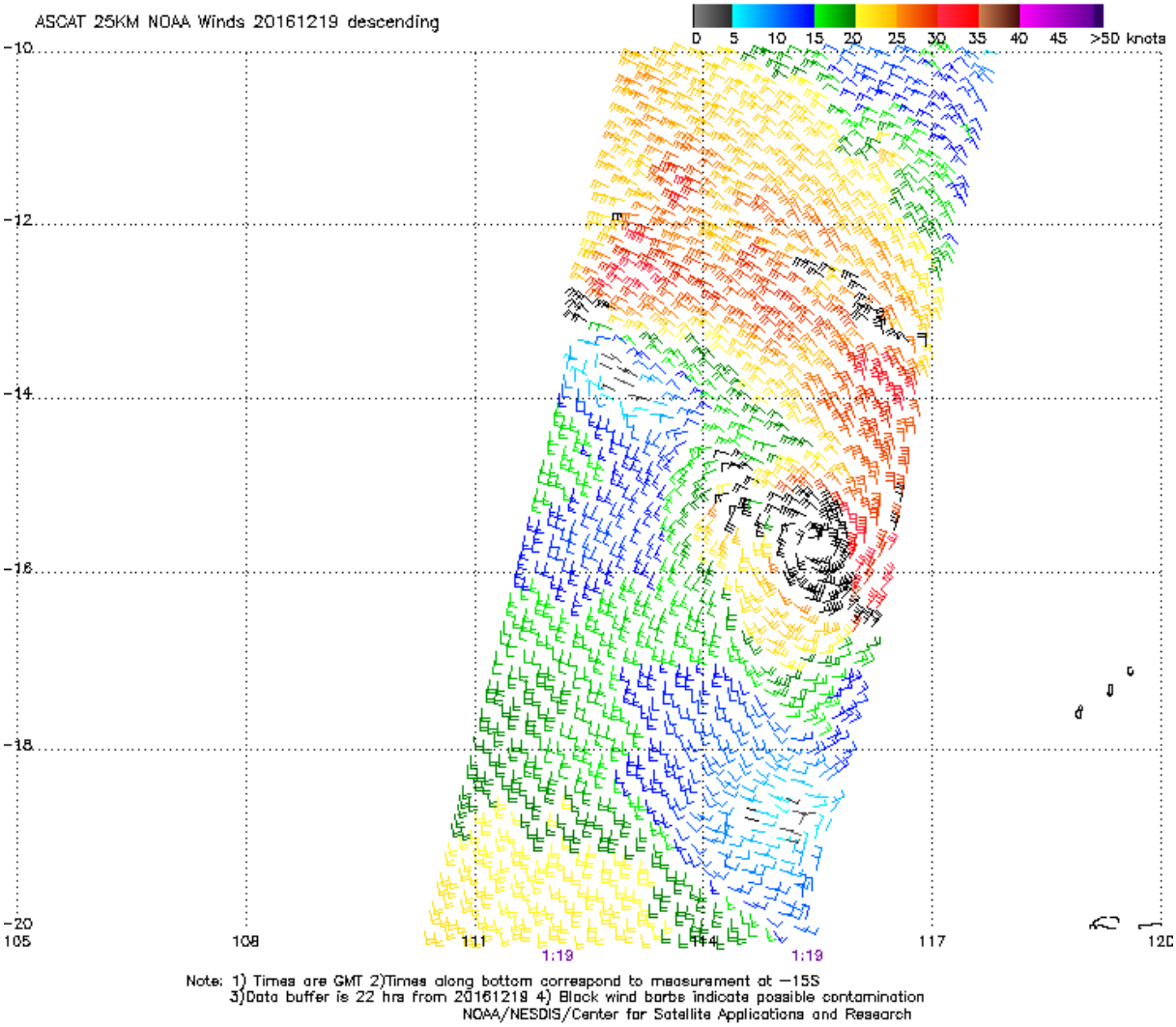


FIGURE 4. Himawari-8 Visible imagery at 0600 UTC 21 December during the time *Yvette* was at peak intensity.

Image courtesy of https://www.fnmoc.navy.mil/tcweb/cgi-bin/tc_home.cgi

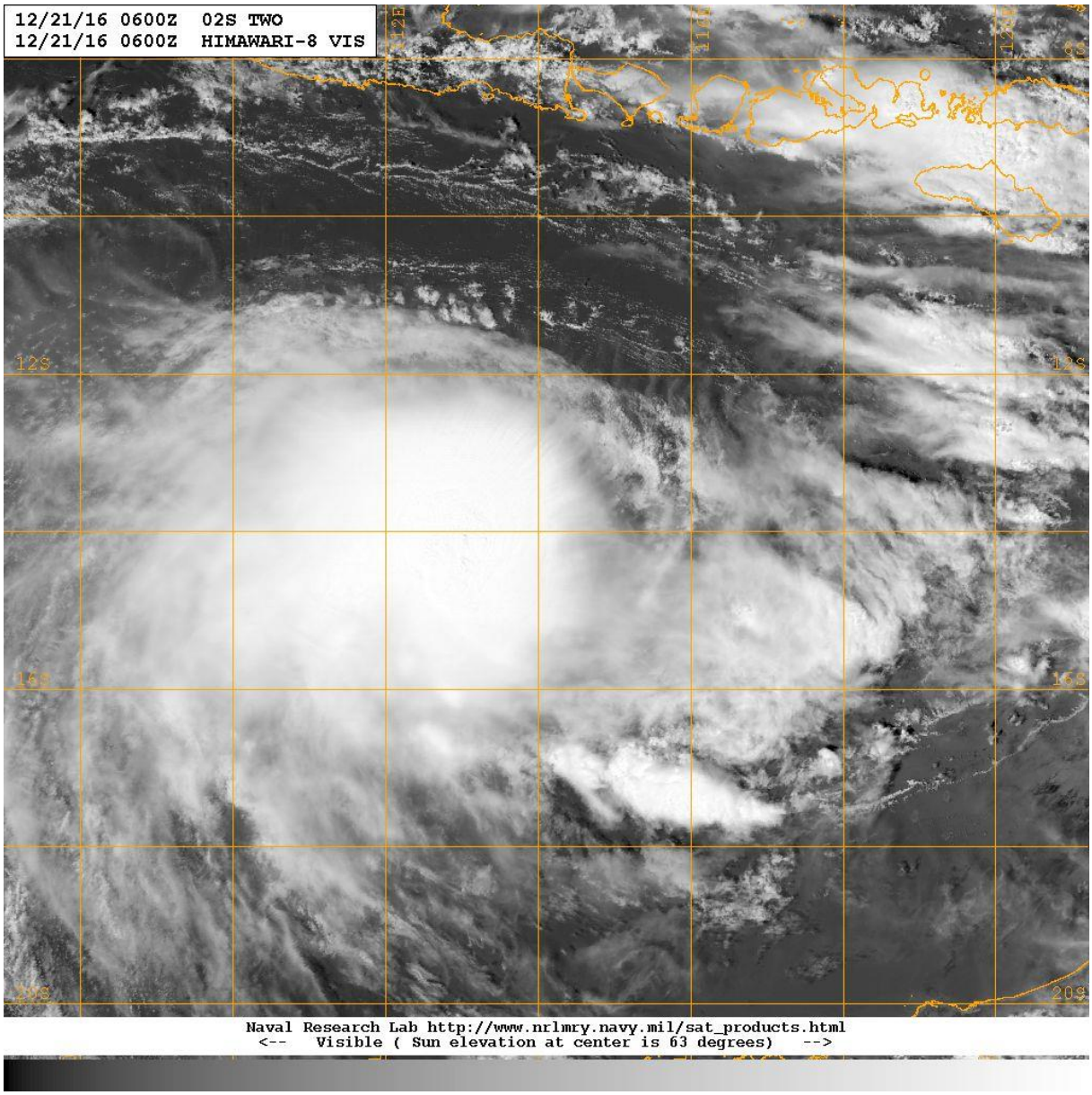


FIGURE 5. Plot of vertical wind shear and intensity for *Yvette*

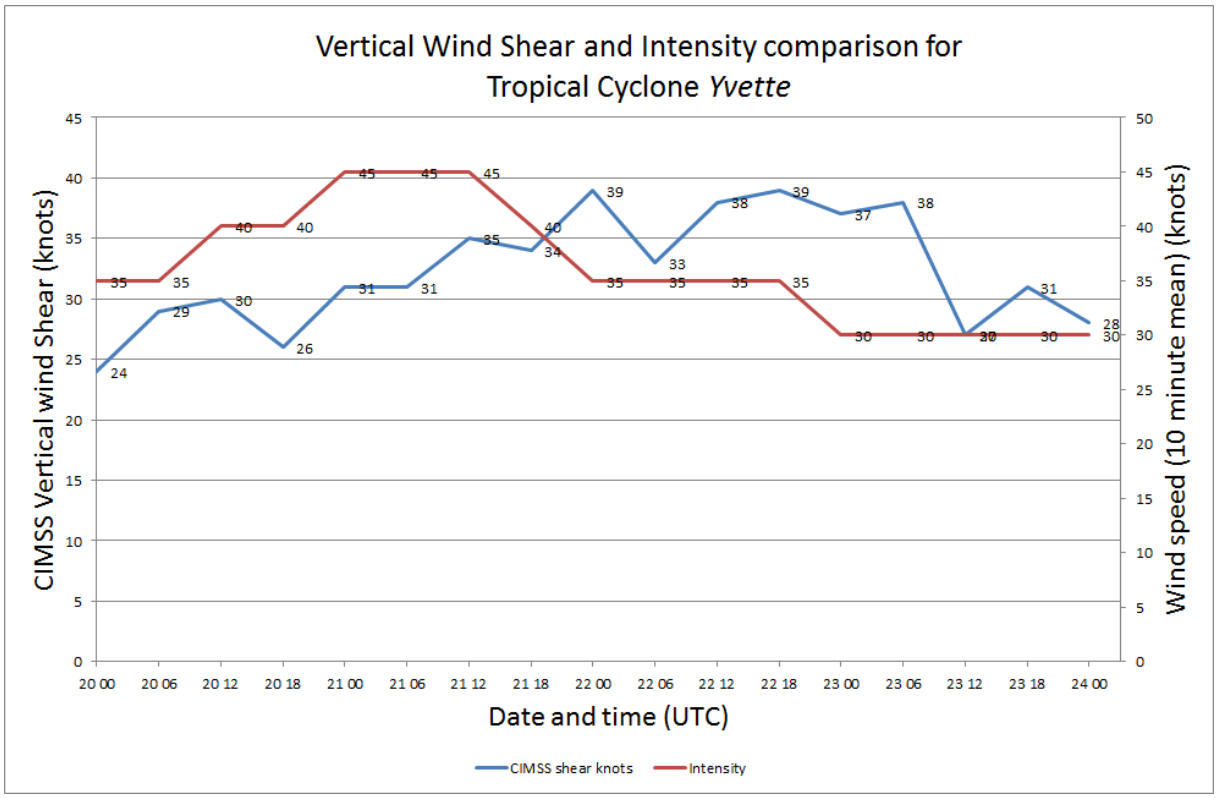


FIGURE 6. Comparison of objective and subjective intensity analysis techniques.

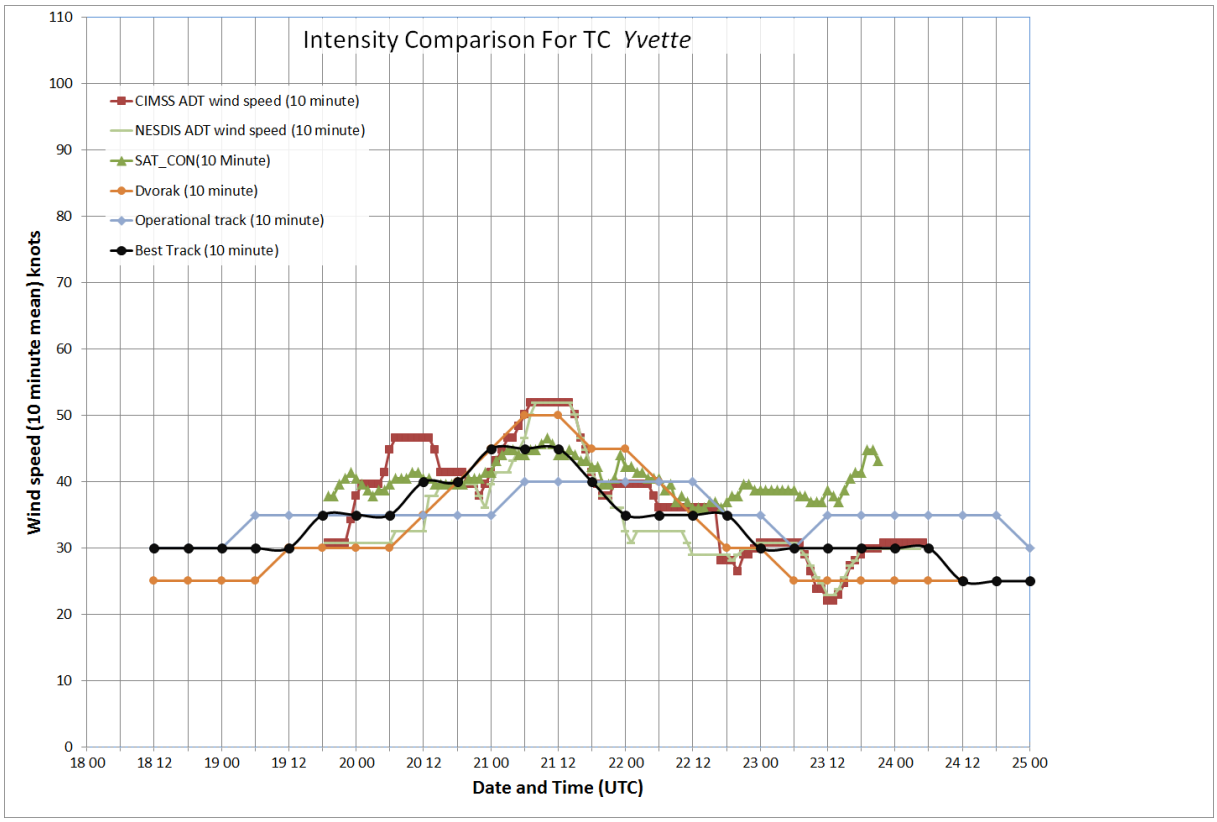


FIGURE 7 A plot of the accuracy figure for *Yvette* compared to the five year mean.