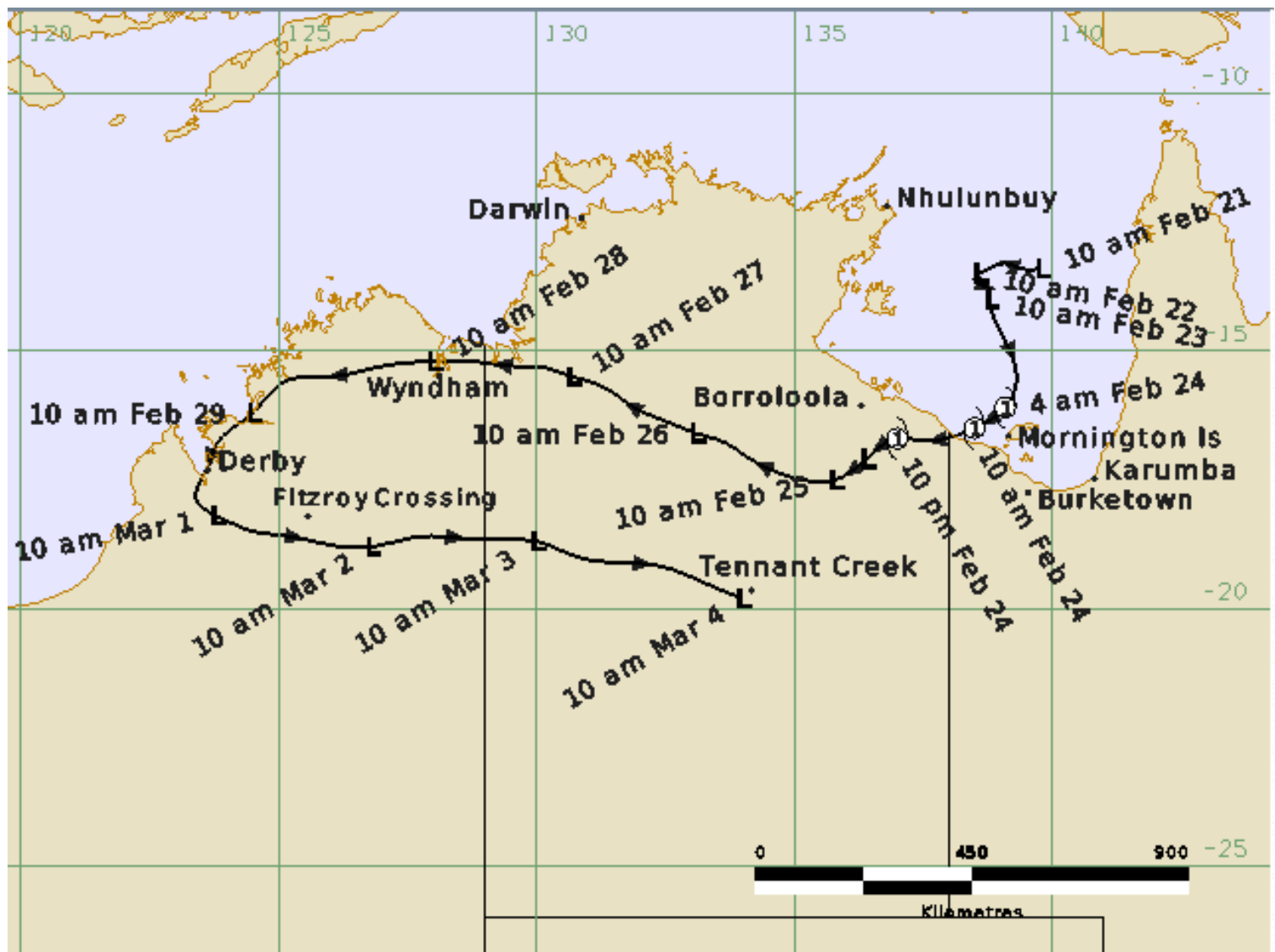




Tropical Cyclone Esther

21 February – 4 March 2020

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August 2022



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1. Summary

Tropical Cyclone Esther was a short-lived category one tropical cyclone that developed in the Gulf of Carpentaria and crossed the Queensland coast very close to the Northern Territory border. It was most notable for subsequently being a very long lived tropical low that traversed much of northern Australia before dissipating.

A low became evident in the Gulf of Carpentaria during 21 February. The low moved slowly west and then more rapidly south during 22 and 23 February. The small low developed quickly into a tropical cyclone about 60 kilometres (km) to the northwest of Mornington Island at 1800 Universal Time Co-ordinated (UTC) 23 February, (0400 Australian Eastern Standard Time (AEST) 24 February) (UTC= AEST-10 h; ACST-9.5 h) and maintained a 10-minute mean wind peak intensity of 35 knots (kn) (65 kilometres per hour (km/h)) until it weakened. Esther crossed the coast at around 0200 UTC 24 February near the Queensland and Northern Territory border and maintained tropical cyclone intensity until 1800 UTC 24 February. The remaining low continued to be steered westwards across the Northern Territory and Western Australia as a well-defined system with mean winds of between 20 and 30 kn (35-55 km/h) at times. Esther reached its most western point near Broome in Western Australia on 29 March and was then steered back eastwards and reached central parts of the Northern Territory before dissipating on 4 March.

There was no recorded wind impact damage though very heavy rainfall associated with the tropical low fell across both the Northern Territory and Western Australia, easing a prolonged dry spell. The McArthur River at Borroloola reached minor flood level from 26-29 February.

FIGURE 1 Best track of Tropical Cyclone Esther 21 February – 4 March 2022 (times in AEST, UTC+10).

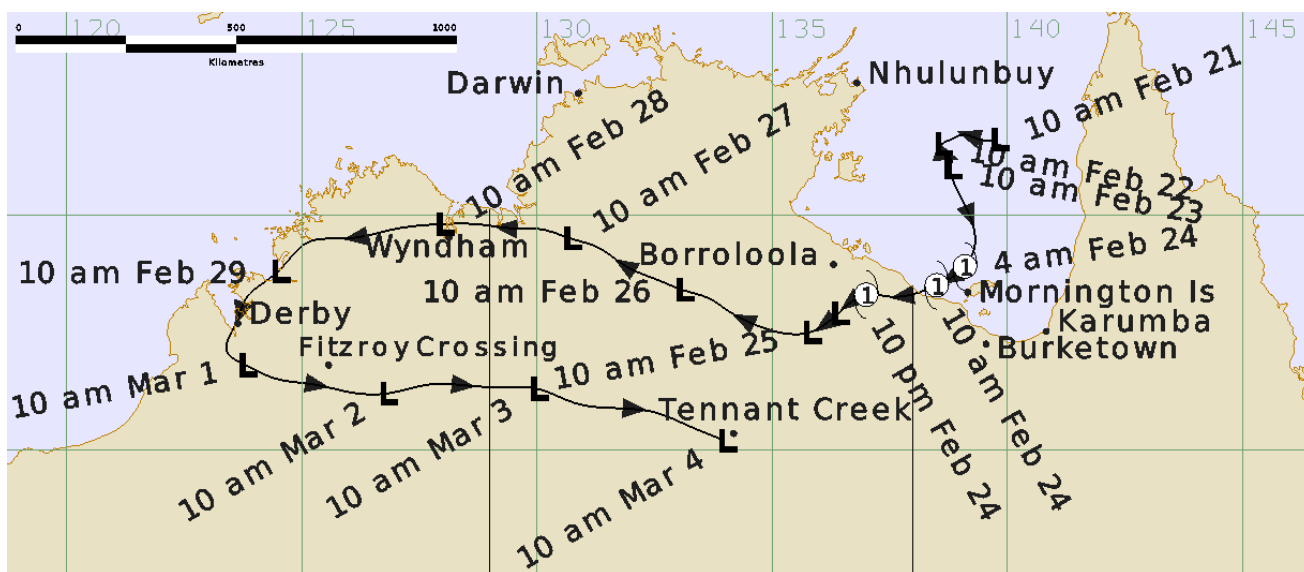
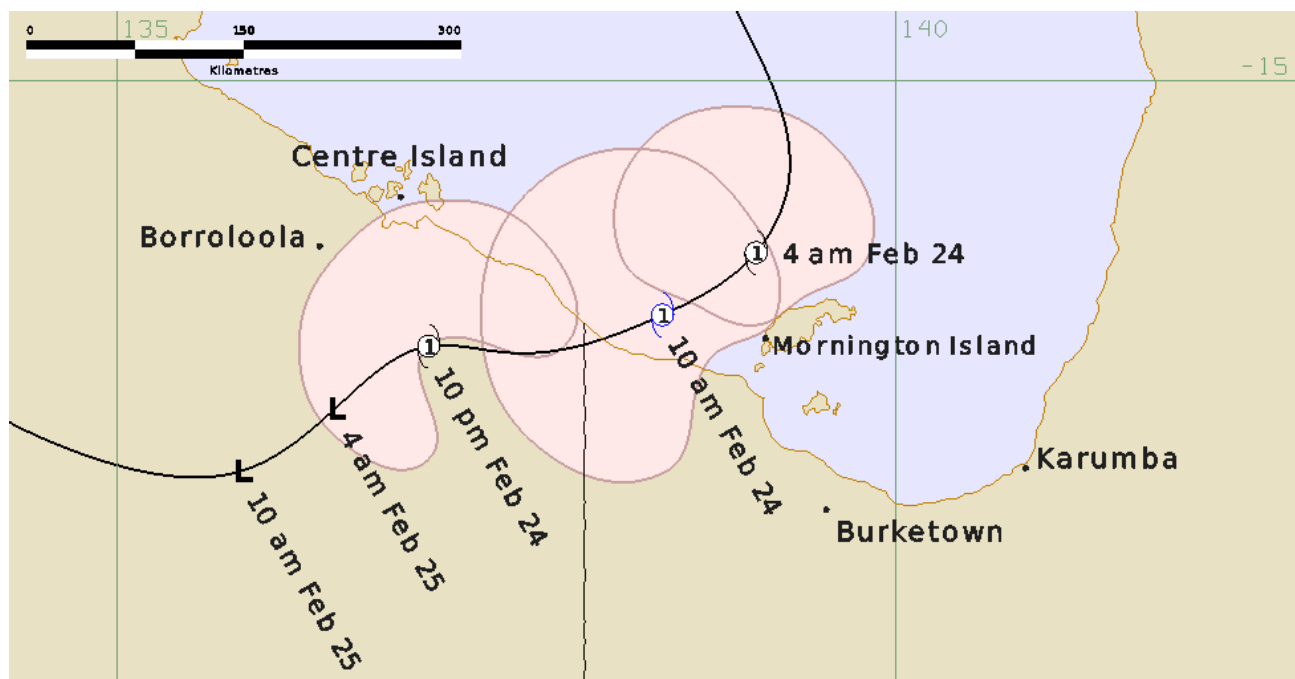


FIGURE 2 Best track of Tropical Cyclone Esther 23 -25 February 2022 at coastal crossing (times in AEST, UTC+10).



2. Meteorological Description

2.1 Intensity analysis

A very active monsoon trough developed across northern Australia during February and a low became evident in the central Gulf of Carpentaria during 21 February. The formation of the low was not associated with any pulse of the Madden-Julian Oscillation in the Australian region. An evening Advanced Scatterometer (ASCAT) pass showed a circulation present and a Dvorak Data-T (DT) number of 1.0 was assigned at 1800 UTC 21 February. ASCAT passes during 22 and 23 February showed a circulation around a low-level centre with stronger winds in the peripheral monsoon flow.

During 23 February satellite imagery showed an improved structure with deep convective bands more closely associated with the low-level centre. By 1200 UTC 23 February satellite imagery showed improved wrapping of the cold cloud around the centre. At this time the three-hour average DT reached 2.8 but the FT was constrained to 2.5. Esther was visible on the Mornington radar which showed a very broad circulation. A concurrent 1243 UTC ASCAT pass (Figure 3) showed 30 kn (55 km/h) winds in the southeast and northeast quadrants but no gale force winds present.

Convective banding continued to improve and the 1804 UTC Special Sensor Microwave Imager/Sounder (SSMIS) pass (Figure 4) showed deep cold cloud spiralling around the centre. The Mornington radar also showed a C shaped band wrapping more closely around the centre of rotation and Esther was deemed to have attained tropical cyclone intensity at this time. The three-hour average DT fell slightly to 2.7 giving a DT/FT of 2.5/2.5 however objective guidance was between 30 and 40 kn (55-75 km/h) supporting an assigned intensity of 35 kn (65 km/h) at 1800 UTC 23 February. Esther continued to show improvement in spiral banding as it approached the southwest coast of the Gulf of Carpentaria. A morning ASCAT pass at 2350 UTC 23 February (Figure 5) showed the centre very close to the coast with a swathe of 35 kn (65 km/h) gales in northern quadrants. The automatic weather station located on the western end of Mornington Island reported 10-minute mean wind speeds near to gale strength between 2100 UTC 23 February and 0000 UTC 24 February. A very low pressure of 989.1 hectopascals (hPa) was also recorded at 2212 UTC 23 February, given a pressure of outer closed isobar of 1004 hPa this low central pressure supports Esther being a tropical cyclone at this time.

Esther never attained a 10-minute mean wind peak intensity greater than 35 kn (65 km/h). A comparison of objective and subjective intensity estimates is shown in Figure 6. Objective guidance was not available until 1200 UTC 23 February and was of limited use due to the proximity to land and offshore islands during Esther's intensification into a tropical cyclone. Intensity was predominantly based on ASCAT passes and surrounding surface observations. Esther crossed the Gulf of Carpentaria coast near the Northern Territory and Queensland border about 0200 UTC 24 February as a Category 1 tropical cyclone.

Esther continued to hold a tightly wrapped structure as it moved inland and was deemed a tropical cyclone until 1800 UTC 25 February, when it was downgraded to below tropical cyclone strength with gales persisting in only the northeast quadrant. Centre Island and Borroloola, to the north of the centre, both reported near gale force winds at times and very

low pressures, making it likely that there were still gales closer to the centre of Esther while it was inland.

Esther maintained a good structure with winds near the centre of 25 kn (45 km/h) as it continued to move on a westward path across mainland northern Australia (refer Figure 7 for daily visible images). Winds near the centre increased to 30 kn as it passed to the north of Wyndham in Western Australia when the northern quadrants of the circulation were over the warm ocean of the Joseph Bonaparte Gulf. As the low moved southwest across land winds decreased back to 20 kn. A increase in intensity to 30kn occurred on 29 February as the low tracked close to the northwest Kimberley coast near Derby and the western quadrants were located over warm, tropical waters. From 1 March the remains of Esther were steered eastwards over the southern Kimberley and Northern Territory where it eventually dissipated on 4 March.

2.2 Structure

Esther had a radius to maximum winds (RMW) of 20-25 nautical miles (nm) (35-45 km). Gale radii ranged from 25 nm (45 km) in the southeast quadrant to 60 nm (110 km) in the northwest quadrant. As Esther crossed the coast the tropical cyclone became more asymmetric with no gales in the southeast quadrant and an increased gale radii in the northeast quadrant. This increased from 50 nm (95 km) initially to 80 nm (150 km) by the time Esther had weakened to below tropical cyclone strength.

2.3 Motion

Esther was located in a weak steering pattern which led to slow and erratic movement initially. During 23 February Esther moved southwards under the influence of an upper trough to the west and a strengthening ridge to the east. By late on 23 February the mid-level ridge became the dominant steering pattern and Esther moved southwest, crossing the Queensland coast and continuing across the Northern Territory. This steering pattern dominated until the 1 March when Esther was then steered back in a eastwards direction and eventually dissipated over land.

FIGURE 3. ASCAT pass at 1243 UTC 23 February showing the improvement in the circulation around the tropical low.

Images courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

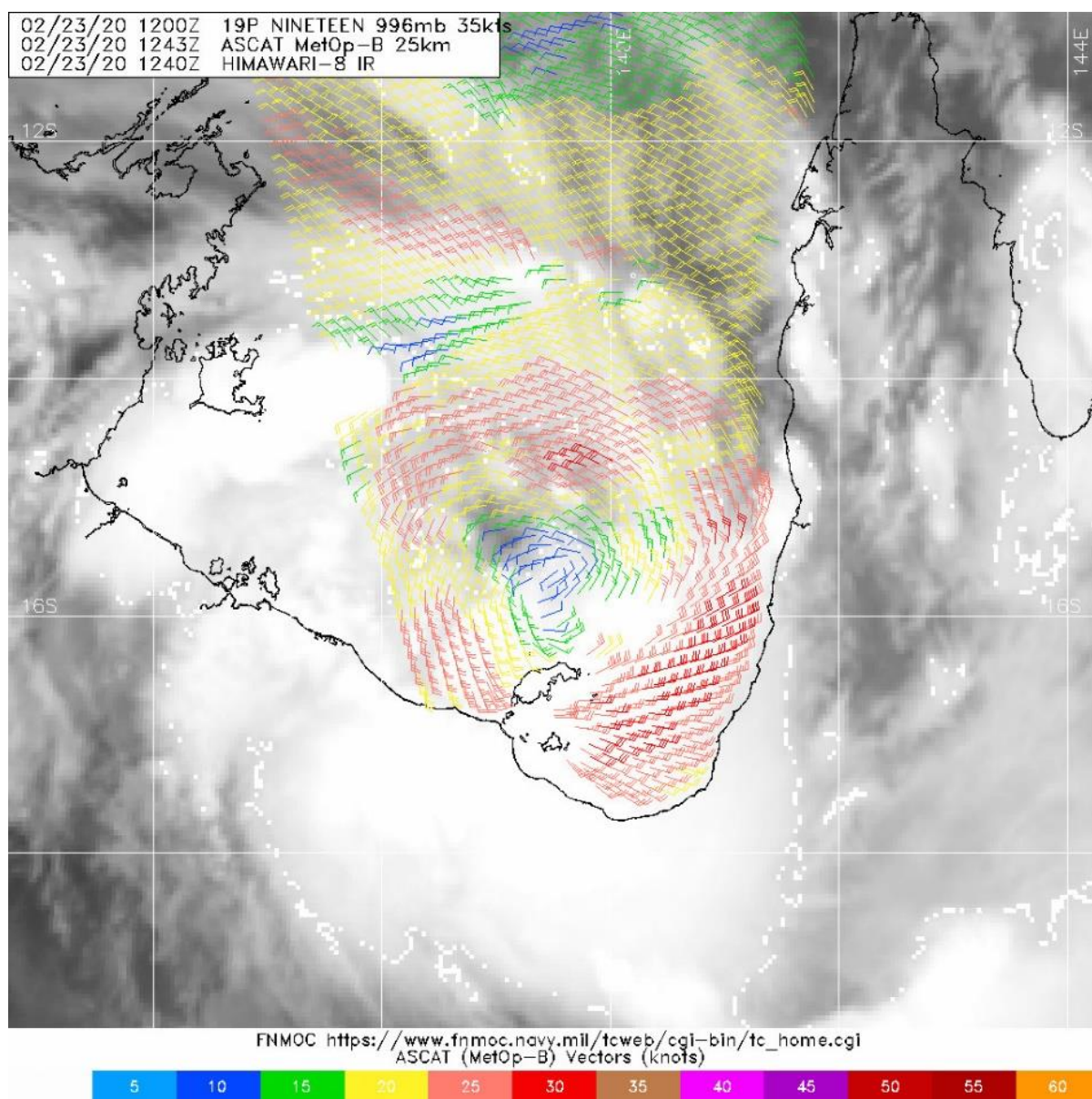


FIGURE 4. SSMIS microwave at 1804 UTC 23 February.

Images courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

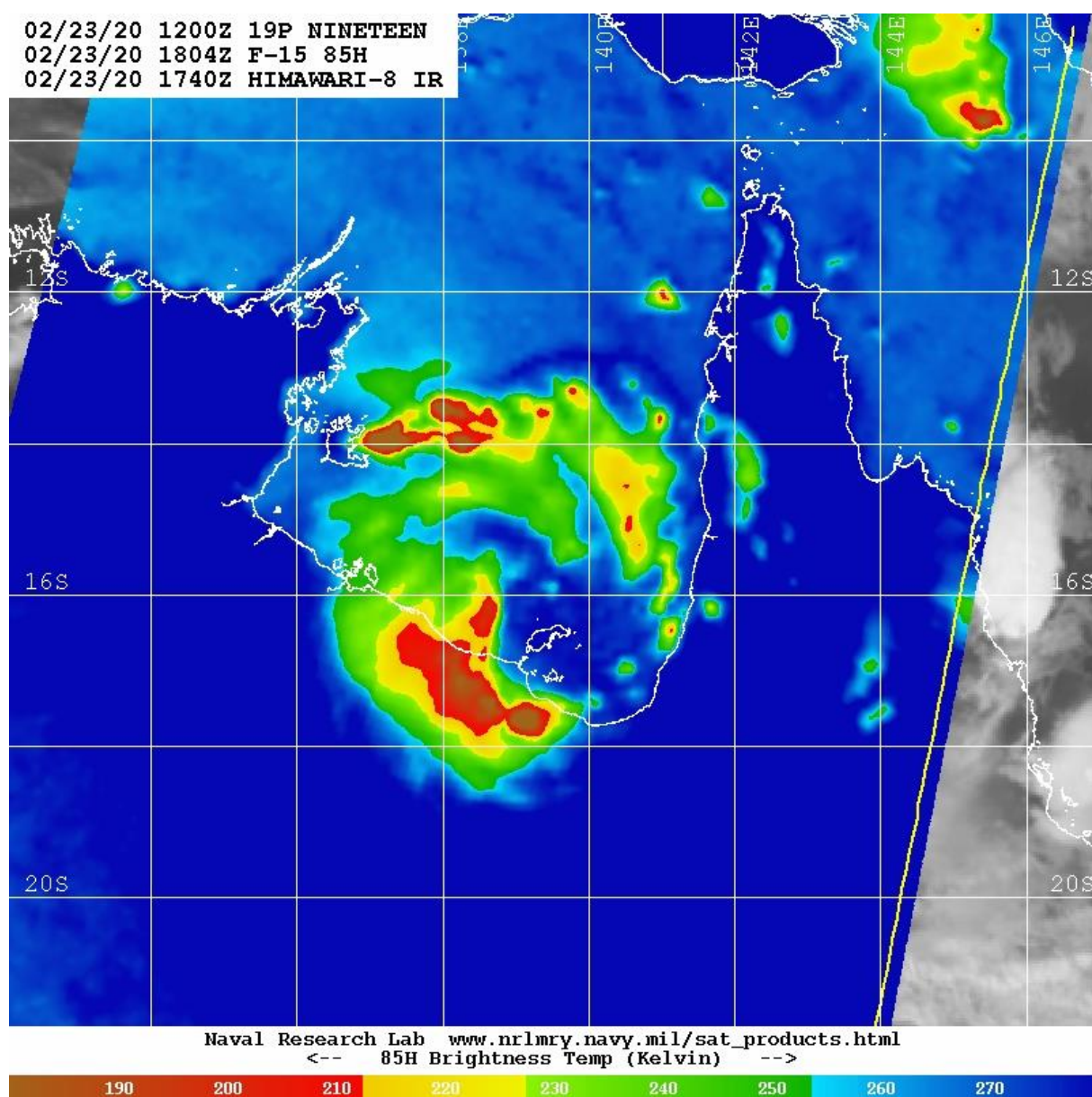


FIGURE 5 ASCAT pass at 2350 UTC 23 February showing gales present in northern quadrants.

Images courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

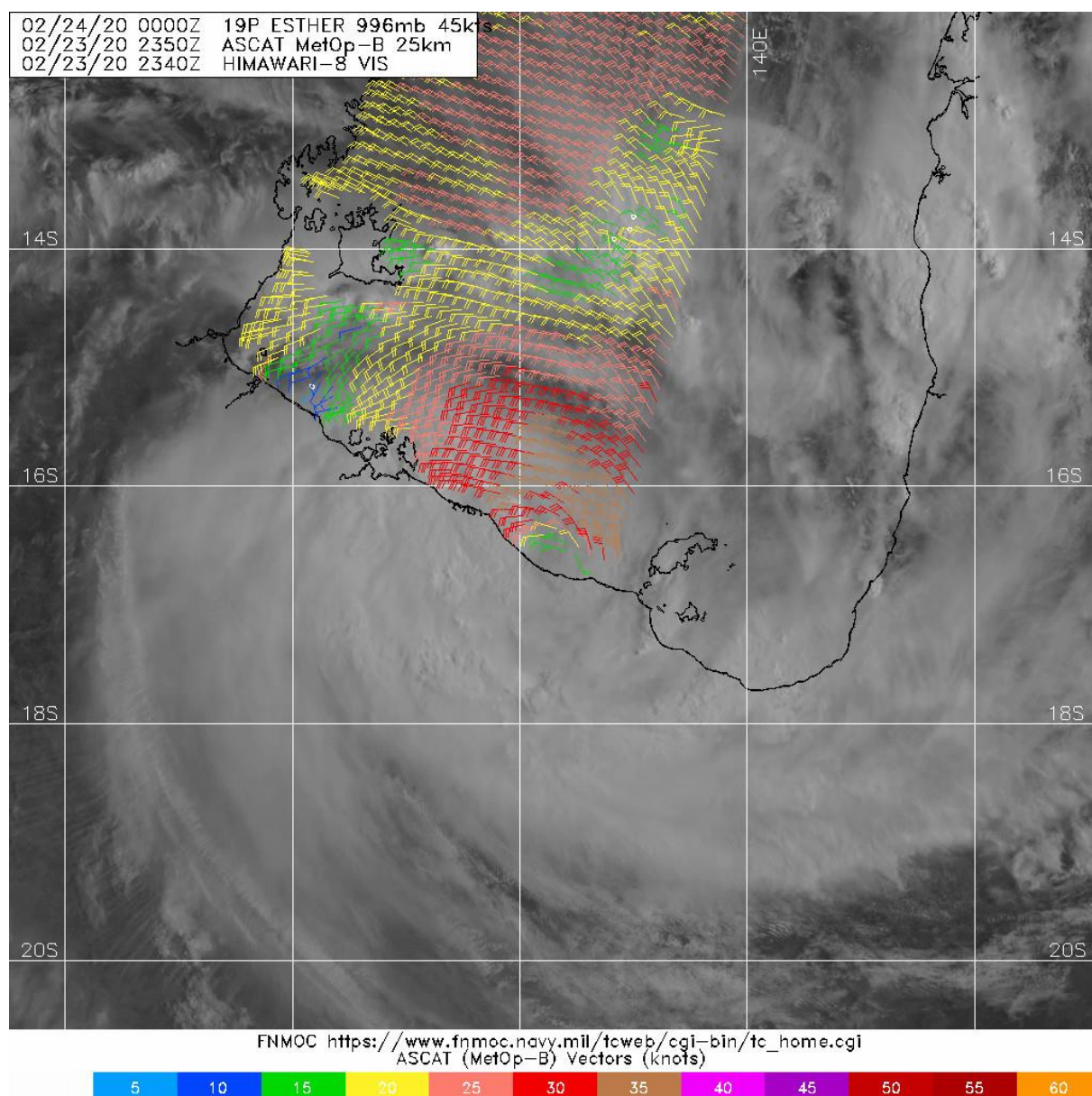


FIGURE 6. A plot of objective and subjective intensity for Tropical Cyclone Esther.

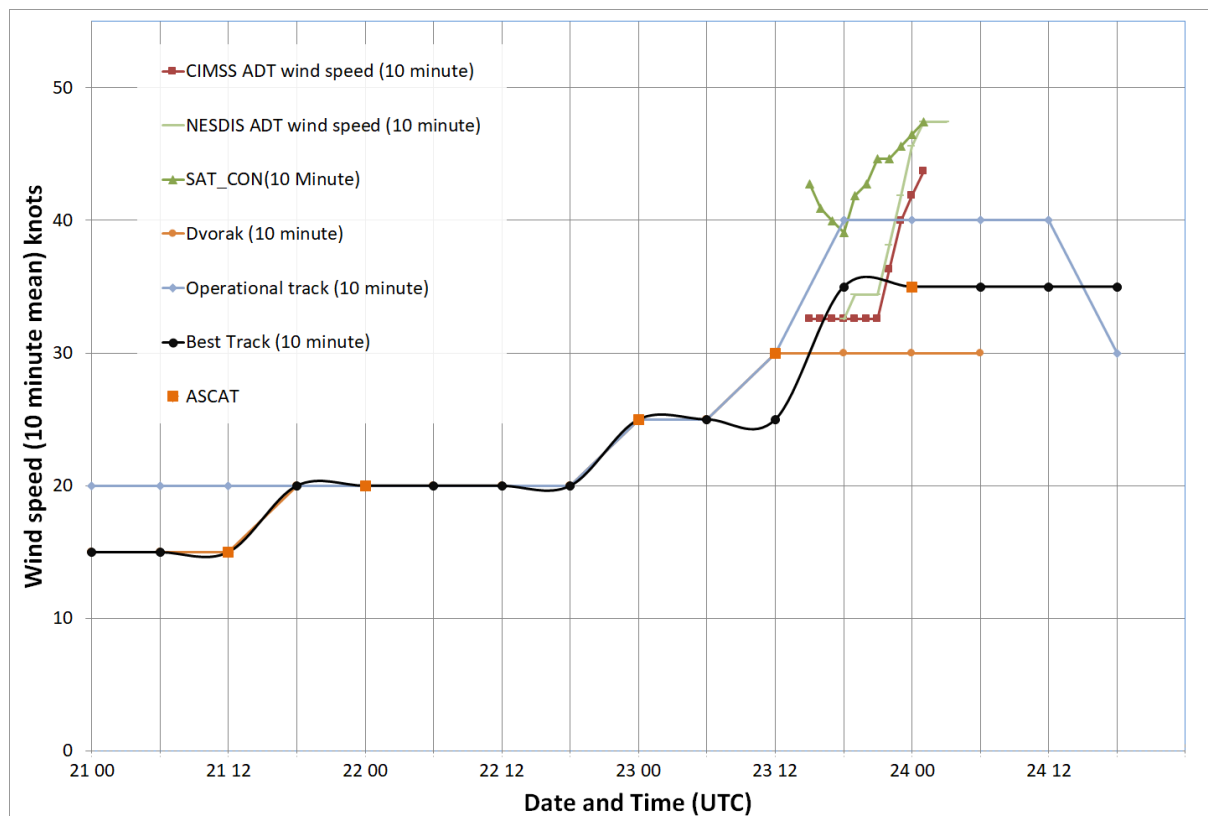
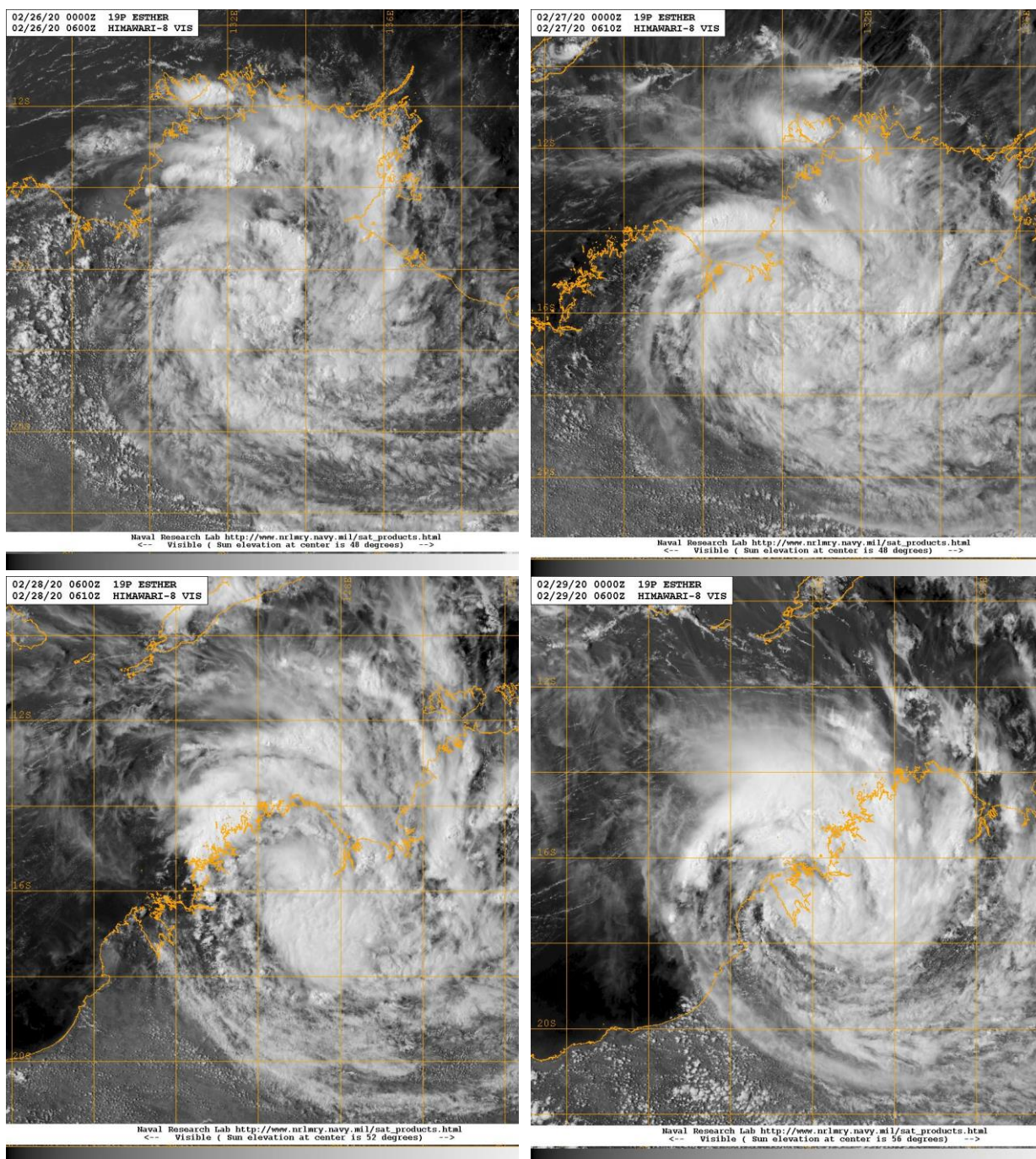


FIGURE 7. Visible images at 0600 UTC on 26 (top left), 27 (top right), 28 (bottom left), 29 (bottom right) February 2020 as the remains of Esther tracked across northern Australia.

Images courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>



3. Impact

There were no damage reports received from the communities along the southeast Gulf of Carpentaria as Esther crossed the coast. A storm surge was recorded at Karumba and Burketown during 24 February which was caused by the persistent northeasterly and northwesterly (onshore) winds which funnelled water into the base of the Gulf on the southern side of the Esther. There were no recorded impacts due to the storm surge. Very heavy rainfall associated with the system resulted in flood watches and warnings being issued in both the Northern Territory and Western Australia. Large river rises were observed in major rivers across the Top End resulting in minor incidents including a swift water rescue, but no fatalities or injuries were recorded. The McArthur River at Borroloola reached minor flood level from 26-29 February.

Roads throughout the two regions were impacted by the heavy rainfall and numerous towns and communities were isolated for an extended period, with a number of communities requiring resupply by air. Rainfall from ex-Tropical Cyclone Esther eased a prolonged dry period across northern and central parts of the Northern Territory and the Kimberley region of Western Australia but was still not enough to prevent a below average wet season.

4. Observations

4.1 Wind

Mornington Island Automatic Weather Station (AWS)

No gale force winds were recorded.

Maximum 10-minute mean wind recorded was 29 kn (54 km/h) at 2212 23 February.

Maximum 3-second wind gust recorded was 42 kn (78 km/h) at 2212 23 February.

Centre Island AWS

Gale force winds were recorded at 1600 UTC 24 February.

Maximum 10-minute mean wind recorded was 36 kn (67 km/h) at 1600 UTC 24 February.

Maximum 3-second wind gust recorded was 55 kn (102 km/h) at 1600 UTC 24 February.

4.2 Pressure

Mornington Island AWS

The lowest mean sea level pressure recorded was 989.1 hectoPascals (hPa) at 2212 UTC 23 February.

Wyndham AWS

The lowest mean sea level pressure recorded was 995.3 hPa at 2030 UTC 27 February.

Derby AWS

The lowest mean sea level pressure recorded was 990.0 hPa at 1230 UTC 29 February.

4.3 Rainfall

Some notable 24-hour rainfall totals from the event are:

To 9 am AEST 24 February

Sweers Island 156.0 millimetres (mm)

Wollogorang 133 mm

To 9 am Australian Central Standard Time (ACST) 25 February

McArthur River Station 172.0 mm

McArthur River Mine Airport 168.4 mm

King Ash Bay 146.8 mm

To 9 am ACST 26 February

Montejinni 137.0 mm

Nutwood Downs 128.0mm

To 9 am ACST 27 February

Walker Creek 250 mm

Labelle Downs 228 mm

Shoeing Tool Bore 140.8 mm a new highest annual and February daily rainfall record

To 9 am ACST 28 February

Buley Rockhole 310.0 mm a new highest annual and February daily rainfall record

Bullo River 226.0 mm a new highest annual and February daily rainfall record

Legune 168.4 mm

To 9 am Australian Western Standard Time (AWST) 29 February

Ellenbrae 190.8 mm a new highest annual and February daily rainfall record

Kingston Rest 172.6 mm

To 9 am AWST 1 March

Windjana Gorge 208.2 mm

Napier Downs 207.0 mm

Kimberley Downs 190.0 mm

To 9 am AWST 2 March

Lorrel Downs 223.0 mm

Larrawa 208.0 mm a new highest annual and March daily rainfall record

Margaret River Airstrip 197.8 mm a new highest annual and March daily rainfall record

To 9 am ACST 3 March

Supplejack Downs 193.0 mm

FIGURE 8 Rainfall totals for the week ending 27 February

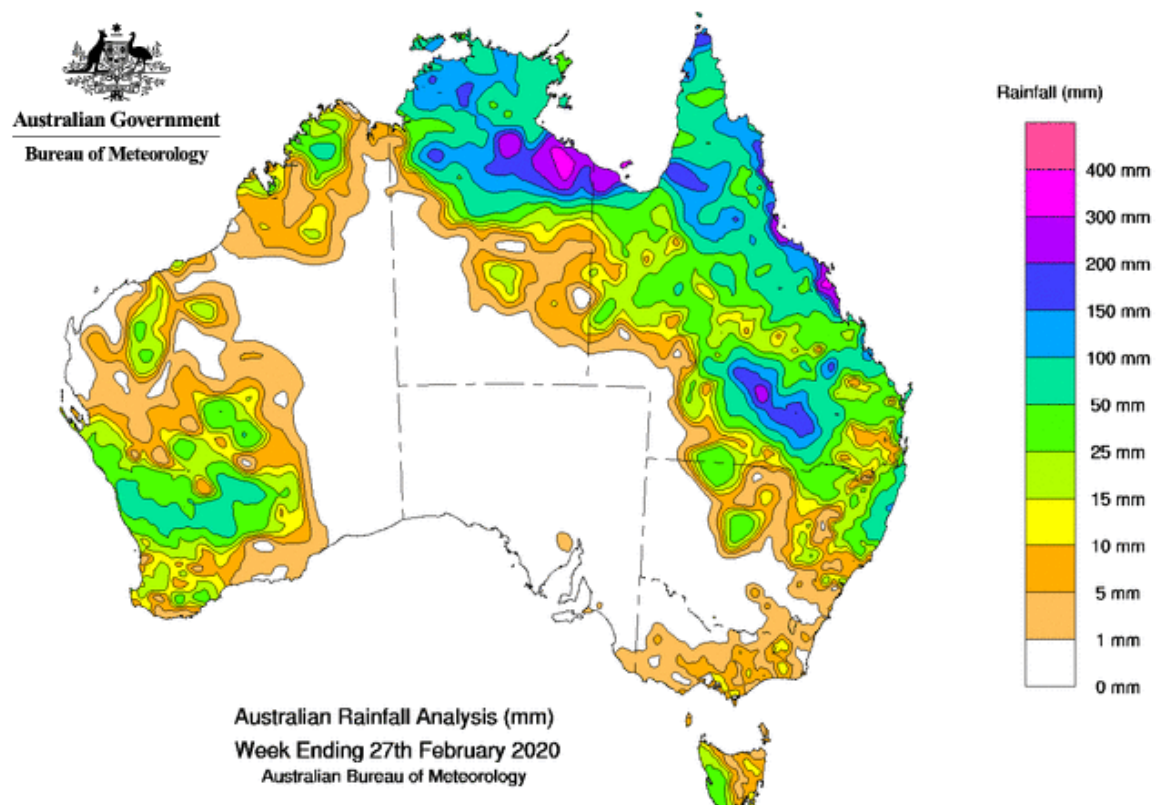
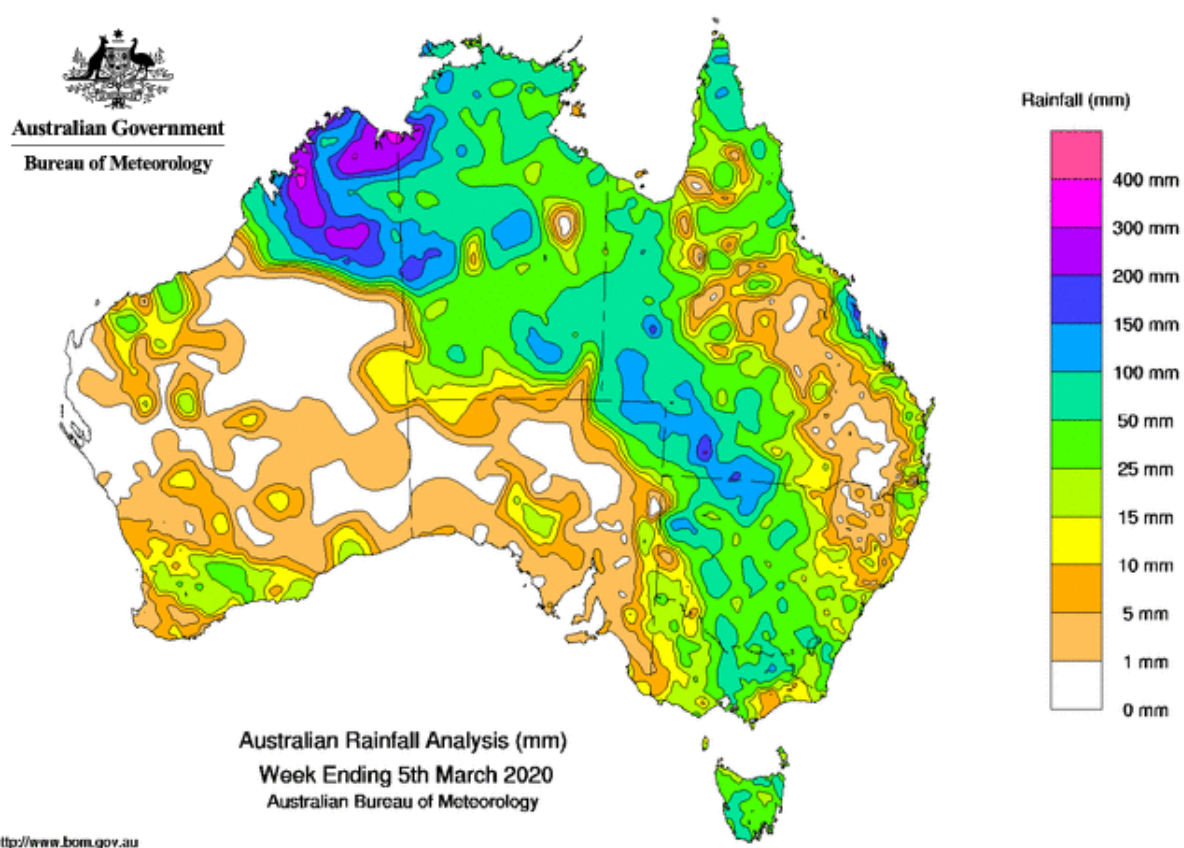


FIGURE 9 Rainfall totals for the week ending 5 March



4.4 Storm surge

A storm surge of approximately 1.3 metres (m) was recorded at Karumba and approximately 1.7 m at Burketown during 24 February as shown in Figures 10 and 11.

FIGURE 10 Storm surge recorded at Karumba.

Image courtesy of Queensland Government <https://www.qld.gov.au/tides>

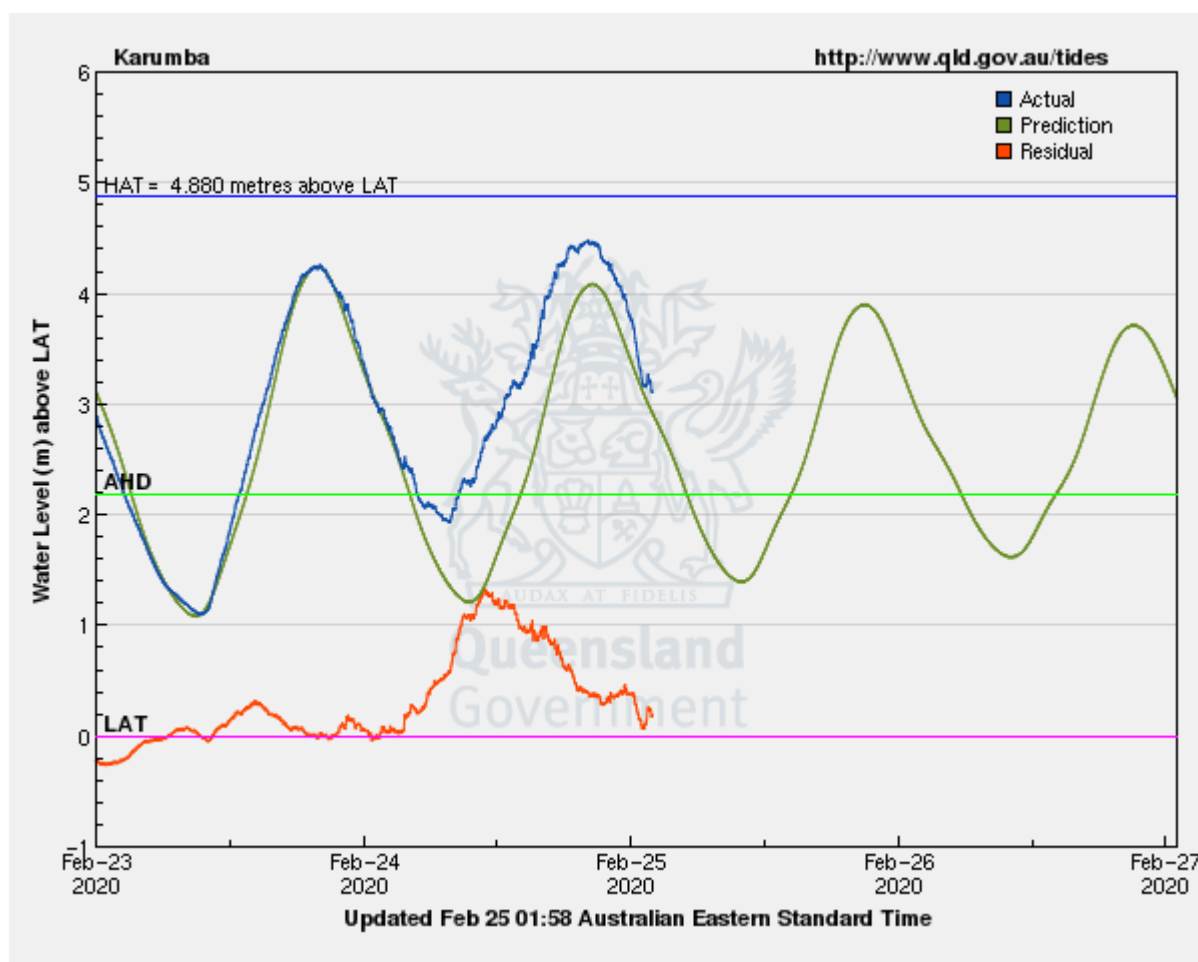


FIGURE 11 Storm surge recorded at Burketown.

Image courtesy of Queensland Government <https://www.qld.gov.au/tides>

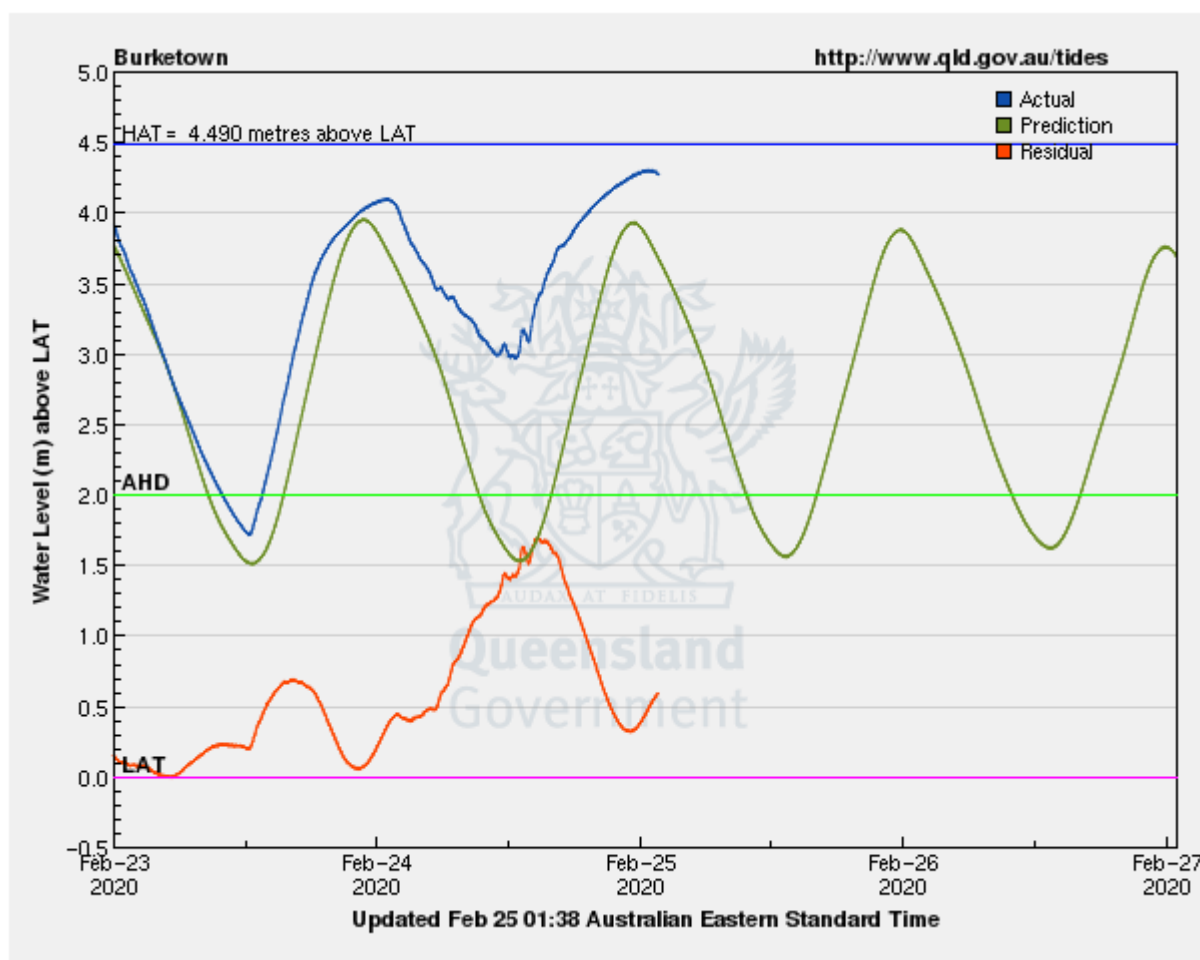


TABLE 1. Best track summary for Tropical Cyclone Esther 21 February to 4 March 2020.

Refer to the Australian Tropical Cyclone database for complete listing of parameters. Note: UTC is AEST - 10 h and ACST-9.5 h. *Denotes system has gales but not a tropical cyclone at this time.

Year	Month	Day	Hour UTC	Pos. Lat. S	Pos. Long. E	Pos. Acc. nm	Max Wind 10min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/ SW/NW)	Rad. of storm (NE/SE/ SW/NW)	RMW n mi
2020	02	21	00	13.4	139.8	60	15	45	1002			
2020	02	21	06	13.4	139.4	40	15	45	1002			
2020	02	21	12	13.3	139.1	40	15	45	1002			
2020	02	21	18	13.4	138.8	30	20	45	1002			
2020	02	22	00	13.5	138.6	25	20	45	1001			
2020	02	22	06	13.6	138.5	40	20	45	1001			
2020	02	22	12	13.7	138.6	40	20	45	1001			
2020	02	22	18	13.8	138.8	40	20	45	1001			
2020	02	23	00	14.0	138.8	30	25	45	998			
2020	02	23	06	14.4	138.9	25	25	45	995			
2020	02	23	12	15.7	139.3	25	30	45	990			
2020	02	23	18	16.1	139.1	25	35	50	990	50/25/30/60		20
2020	02	24	00	16.5	138.5	25	35	50	985	50/25/70/70		25
2020	02	24	06	16.7	137.5	20	35	50	985	60/0/40/50		25
2020	02	24	12	16.7	137.0	20	35	50	990	60/0/50/50		25
2020	02	24	18	17.1	136.4	20	35	50	990	70/0/0/0*		
2020	02	25	00	17.5	135.8	15	30	45	995			

Year	Month	Day	Hour UTC	Pos. Lat. S	Pos. Long. E	Pos. Acc. nm	Max Wind 10min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/ SW/NW)	Rad. of storm (NE/SE/ SW/NW)	RMW n mi
2020	02	25	06	17.4	134.8	15	30	45	995			
2020	02	25	12	17.0	134.0	20	25	45	995			
2020	02	25	18	16.8	133.7	20	25	45	995			
2020	02	26	00	16.6	133.1	20	25	40	995			
2020	02	26	06	16.4	132.6	25	25	45	995			
2020	02	26	12	16.1	131.9	30	25	45	995			
2020	02	26	18	15.7	131.3	20	24	45	995			
2020	02	27	00	15.5	130.7	20	25	45	995			
2020	02	27	06	15.3	130.0	20	25	45	995			
2020	02	27	12	15.3	129.7	20	25	45	995			
2020	02	27	18	15.2	128.7	15	30	45	995			
2020	02	28	00	15.2	128.0	15	30	45	992			
2020	02	28	06	15.3	127.0	15	25	45	995			
2020	02	28	12	15.5	126.0	20	20	45	995			
2020	02	28	18	15.6	125.1	25	20	45	995			
2020	02	29	00	16.2	124.5	20	25	45	990			
2020	02	29	06	16.8	123.8	20	25	45	990			
2020	02	29	12	17.3	123.6	20	30	45	988			
2020	02	29	18	17.9	123.4	15	30	45	990			
2020	03	1	00	18.2	123.8	20	25	45	992			

Year	Month	Day	Hour UTC	Pos. Lat. S	Pos. Long. E	Pos. Acc. nm	Max Wind 10min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/ SW/NW)	Rad. of storm (NE/SE/ SW/NW)	RMW n mi
2020	03	1	06	18.5	124.5	20	20	45	992			
2020	03	1	12	18.6	125.2	20	20	45	994			
2020	03	1	18	18.8	126.2	30	20	45	996			
2020	03	2	00	18.8	126.8	30	20	45	996			
2020	03	2	06	18.6	127.8	30	20	45	998			
2020	03	2	12	18.6	128.5	30	20	45	998			
2020	03	2	18	18.7	129.3	30	20	45	1000			
2020	03	3	00	18.7	130.0	30	20	45	1000			
2020	03	3	06	19.0	130.8	30	20	45	1000			
2020	03	3	12	19.2	132.5	30	20	45	1000			
2020	03	3	18	19.5	133.2	30	20	45	1000			
2020	03	4	00	19.8	134.0	30	20	45	1000			

5. Forecast Performance

Official tropical cyclone forecasts were issued between 0000 UTC 21 February and 0600 UTC 24 February. The position accuracy figures were slightly poorer than the 5-year average initially but from a lead time of 12 hours accuracy was considerably better than the long-term average. The intensity accuracy was better than the 5-year average at all time steps.

The accuracy figures for Tropical Cyclone Esther are shown in the table below and in Figures 12 a and b.

	00	06	12	18	24	36	48	72	96	120
Position Absolute error (km)	38	52	54	53	47	60	76	113	165	216
Intensity Absolute error (kn)	2	4	7	8	8	8	9	6	3	7
Sample Size	13	13	13	13	13	13	13	13	13	13

FIGURE 12 a. Position accuracy figures for Tropical Cyclone Esther.

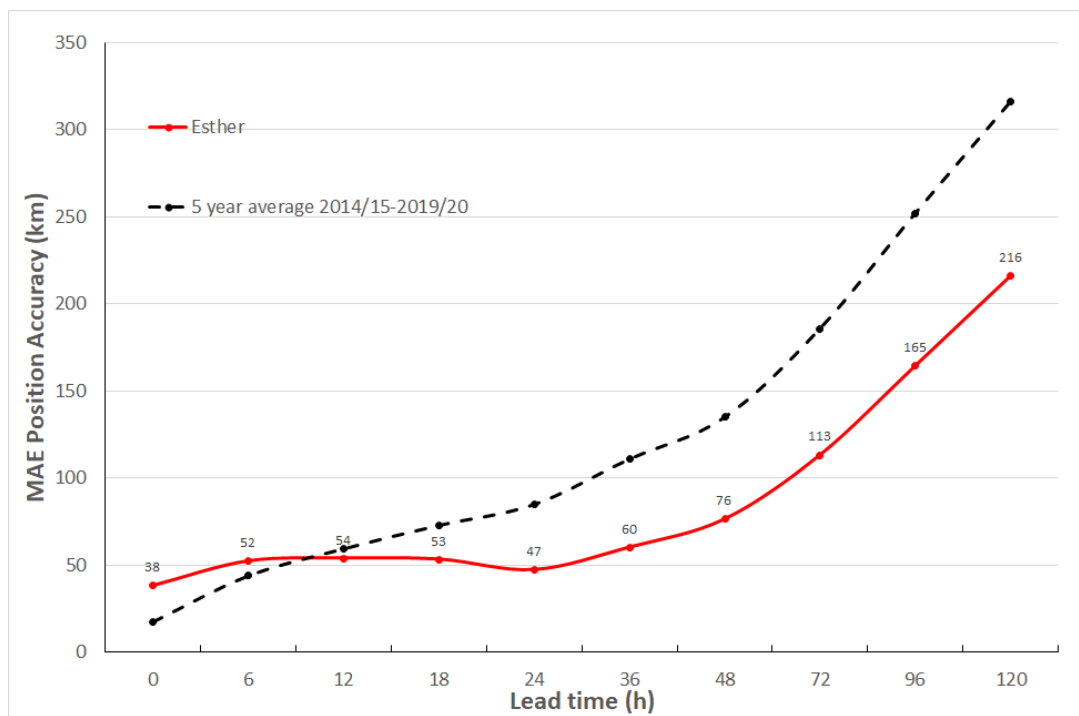


FIGURE 12 b. Intensity accuracy figures for Tropical Cyclone Esther.

