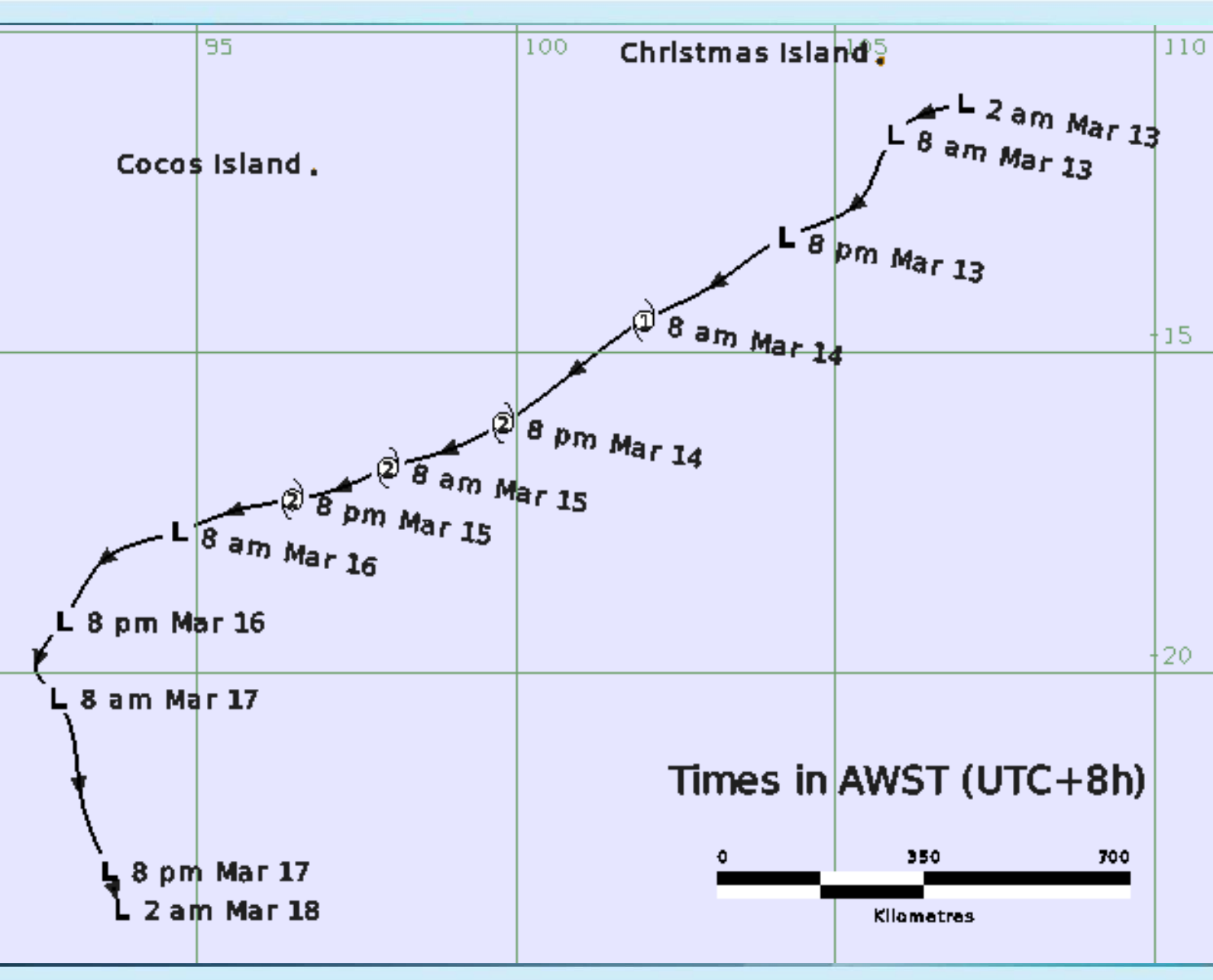
Australian Government
Bureau of Meteorology

Tropical Cyclone Billy

13 – 18 March 2022

Joe Courtney and Matt Boterhoven, Severe Weather Environmental Prediction Services
1 June 2022



Contact details:

Tropical Cyclone Team Lead
Severe Weather Environmental Prediction Services
Bureau of Meteorology
PO Box 1370, West Perth WA 6872
Email: tcwc@bom.gov.au

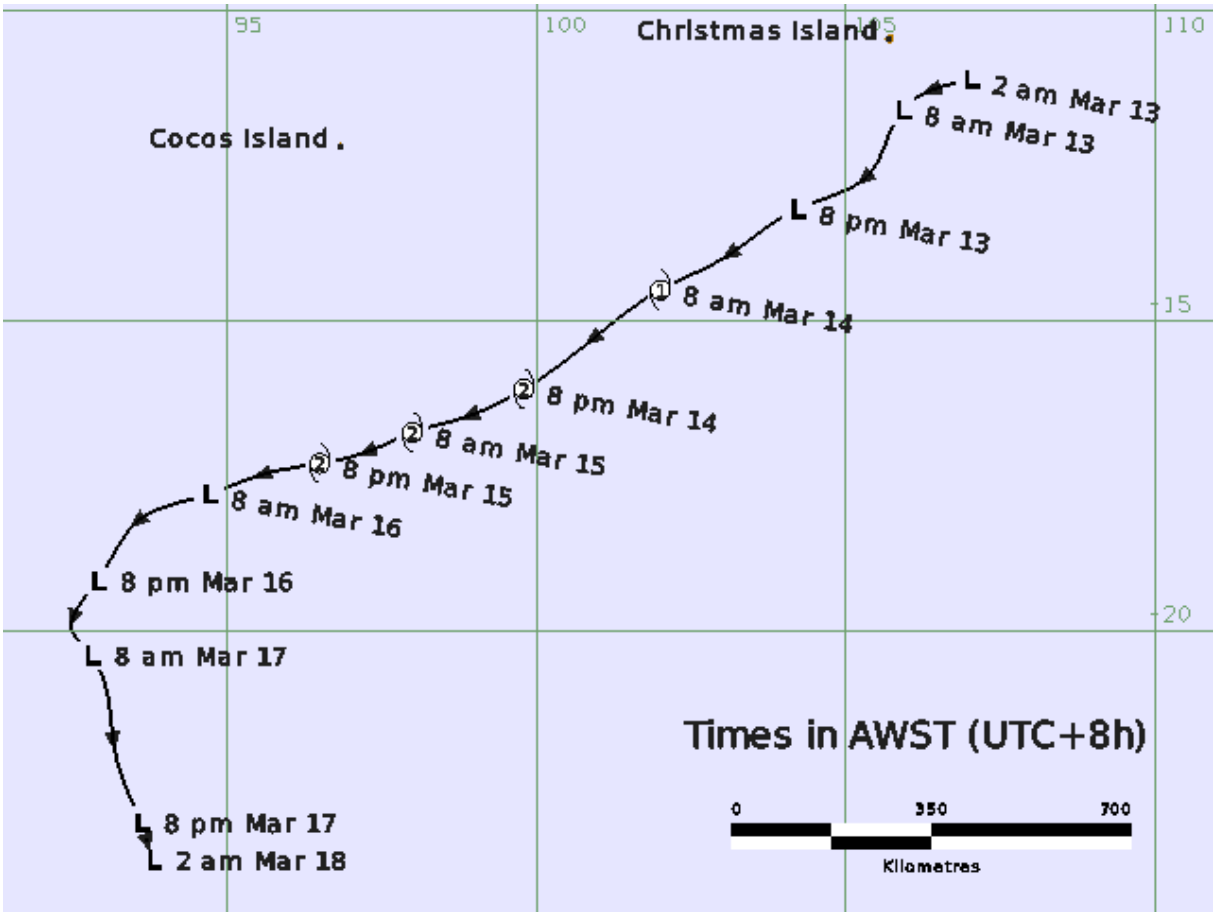
Table of Contents

1 Summary

Tropical Cyclone *Billy* tracked over open waters of the Indian Ocean and had no impact on the Western Australian mainland or island territories.

A tropical low formed to the southeast of Christmas Island on 12 March and tracked steadily to the west-southwest. The low improved during 13 March and reached tropical cyclone intensity at 0000 Universal Time Coordinated (UTC) 14 March (UTC=Australian Western Standard Time (AWST) - 8 hours). *Billy* reached a peak at category 2 intensity that night well to the south of Cocos Island. The cyclone weakened rapidly on 16 March, although gales continued in southern quadrants through to 17 March as the system tracked to the south.

FIGURE 1. Best track of Tropical Cyclone *Billy* 13 –18 March 2022 (times in AWST, UTC+8).



2 Meteorological Description

2.1 Intensity analysis

A low formed in the monsoon trough in the eastern Indian Ocean, southeast of Christmas Island on 12 March. Deep convection increased near the centre during 13 March in an environment generally conducive to intensification: warm sea surface temperatures over 28 degrees Celsius, low wind shear and moderate upper-level outflow especially to the south, and high moisture at low and mid-levels. The weak monsoon flow was a less favourable influence for intensification.

Tropical cyclone intensity is estimated at 0000 UTC 14 March based upon the following evidence:

- Dvorak estimates reaching a Current Intensity (CI) of 3.0 based upon a curved band pattern. The later visible imagery at 0600 UTC shown in Figure 2;
- Special Sensor Microwave Imager (SSMI) at 89 GHz at 2103 UTC 13 March showing a ring of deep convection as shown in Figure 3; and
- Soil Moisture Active Passive (SMAP) radiometer pass at 2252 UTC 13 March showing gales around the centre (Figure 4).

Further intensification occurred on 14 March to reach a peak intensity of 50 knots (kn, 93 kilometres per hour (km/h)) at 1200 UTC 14 March. The SMAP pass at 2329 UTC 14 March indicated storm-force winds (48 kn or 89 km/h) south of the centre as shown in Figure 4.

During 15 March the convection weakened northwest of the centre in response to increased northwesterly wind shear. TC *Billy* is estimated to have weakened below tropical cyclone intensity at 0000 UTC 16 March. Advanced Scatterometer (ASCAT) passes (ASCAT-B at 0232 UTC and ASCAT-C at 0325 UTC 16 March) confirmed winds were below gale-force. However, as convection subsequently redeveloped south of the centre, winds in southern quadrants increased to gale-force intensity from 1200 UTC 16 March to 1200 UTC on 17 March. From then convection.

Figure 5 plots the best track intensity against various subjective and objective intensity estimates. The best track estimates are above operational estimates on 14-15 March and more consistent with objective guidance. On 16 March the objective Advanced Dvorak Technique (ADT) increased, but this is at odds with other information such as ASCAT and subjective Dvorak and hence the intensity reduced.

2.2 Structure

Throughout *Billy's* lifetime the extent of gales was asymmetric about the centre, being larger to the south (to about 90 nautical miles (nm) (167 kilometres (km)) than to the north (50-60 nm (93-111 km)). The extent of storm-force winds was estimated at about 35 nm (65 km) in southern quadrants only. The asymmetry was caused by a stronger east southeasterly synoptic flow to the south than the monsoonal flow to the north. The steady southwesterly motion which averaged about 15-20 km/h also contributed to higher winds on the southeastern side. The SMAP passes in Figure 4 highlight this wind asymmetry. The radius

of maximum winds was estimated at 20 nm (28 km) increasing to 30 nm (56 km/h) at the end of its TC intensity stage.

2.3 Motion

Generally, the steering of the system was to the west southwest under the influence of a mid-level ridge to the east. From 16 March this steering influence eased slightly as the system approaches a col area between two mid-level anticyclones. The system then tracked to the southwest and then to the south southeast on 17 March.

FIGURE 2. Visible image at 0600 UTC 14 March, in the early stages of being at tropical cyclone intensity.

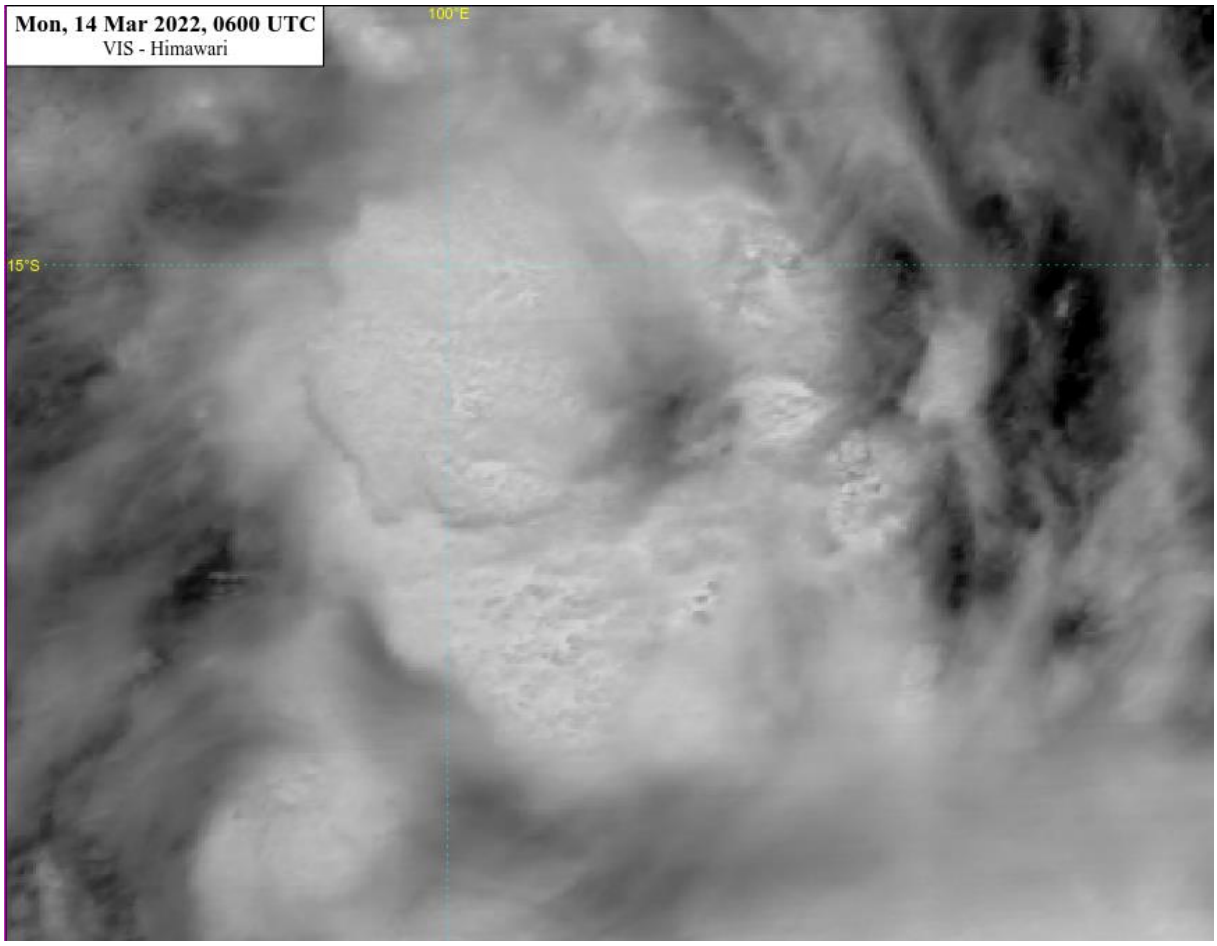


FIGURE 3. SSMI Microwave (89 GHz) at 2103 UTC 13 March near the time that Billy reached tropical cyclone intensity.

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

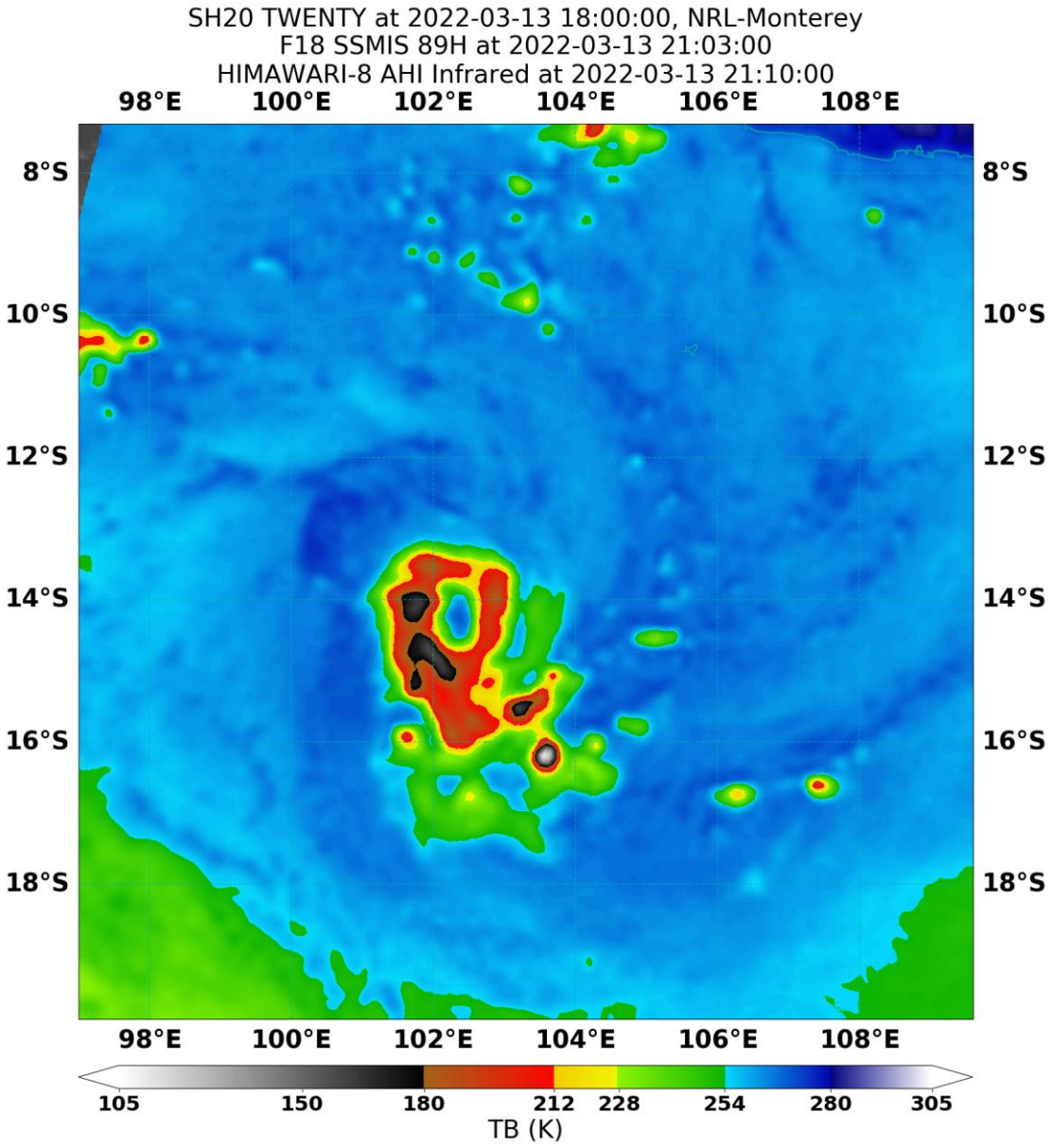


FIGURE 4. Wind speed distribution from SMAP radiometer: left at 2252 UTC 13 March and right at 2359 UTC 14 March. The centre is indicated by 'x'.

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

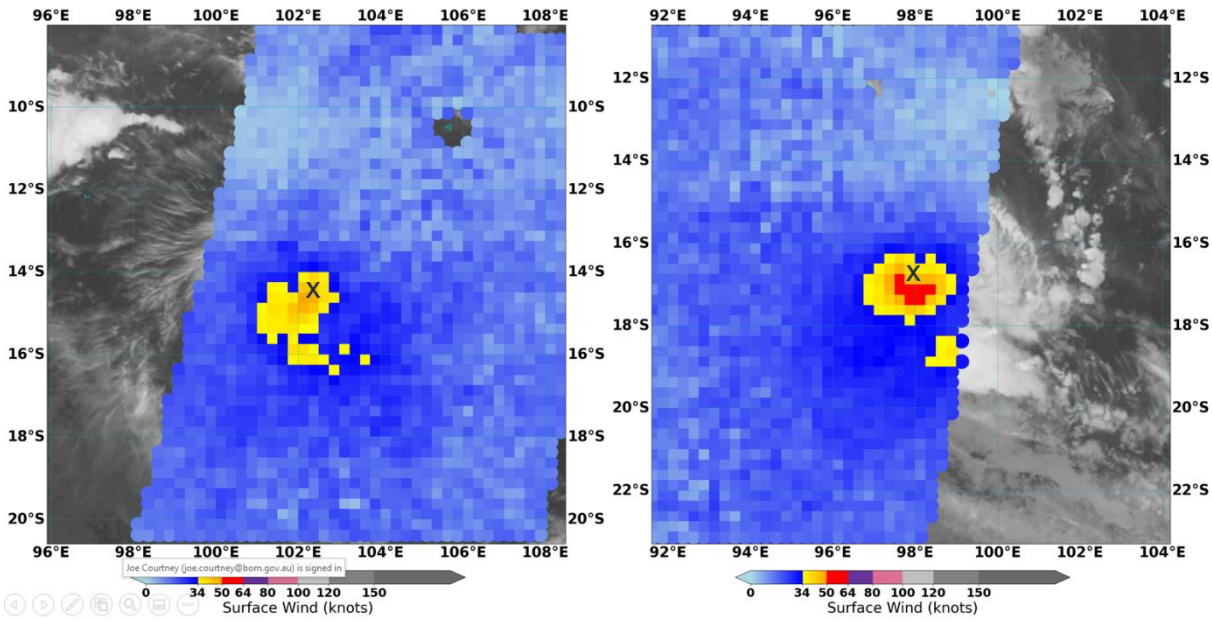
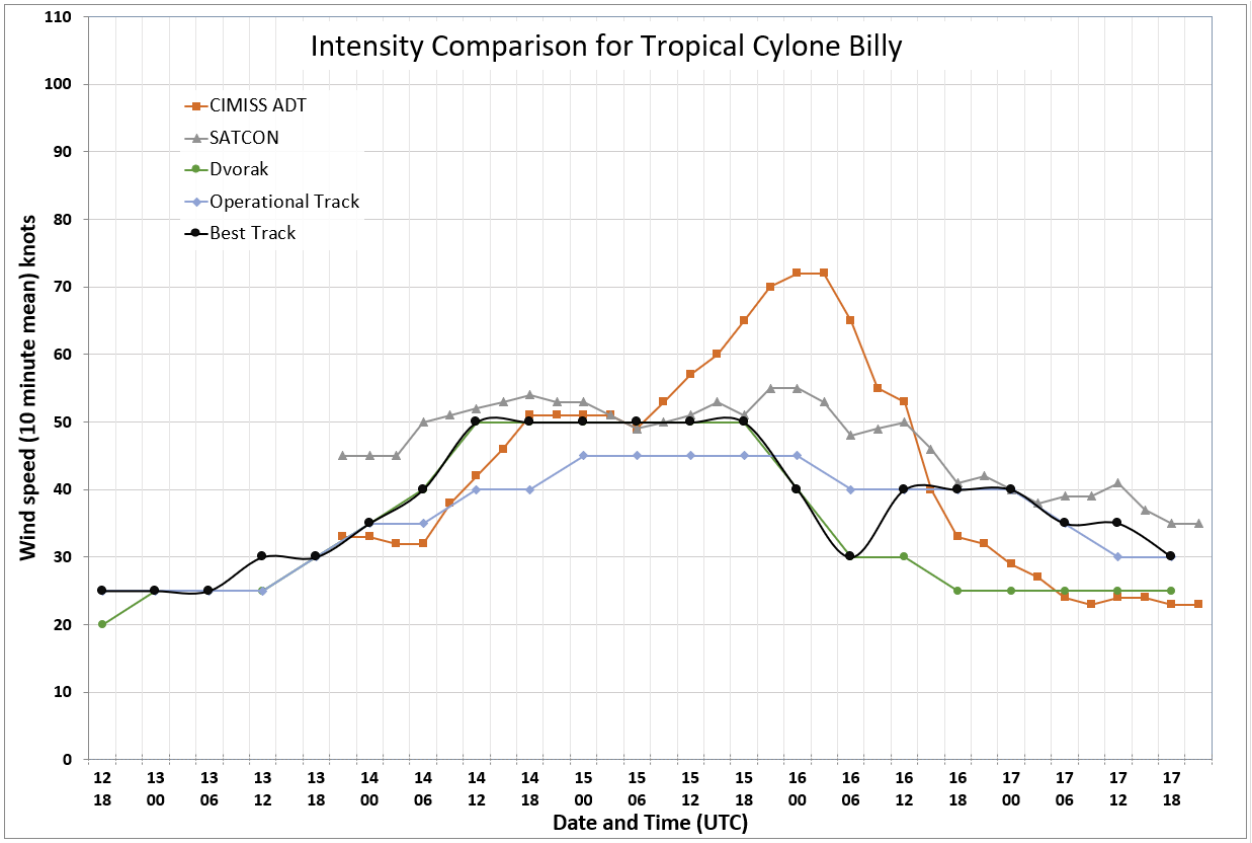


FIGURE 5. Plot of objective and subjective intensity estimates for TC *Billy.*



3 Impact

There were no known impacts from this cyclone.

4 Observations

There were no observations during this event.

TABLE 1. Best track summary for Tropical Cyclone *Billy* 13-18 March 2022.

Refer to the Australian Tropical Cyclone database for complete listing of parameters and track from 12- 18 March. Note: UTC is AWST - 8 hours.
*not at tropical cyclone intensity.

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
2022	3	12	1800	11.1	107.0	45	25	45	1002	0/0/0/0	0/0/0/0	-
2022	3	13	0000	11.6	105.9	30	25	45	1004	0/0/0/0	0/0/0/0	-
2022	3	13	0600	12.6	105.4	25	25	45	1004	0/0/0/0	0/0/0/0	-
2022	3	13	1200	13.2	104.2	20	30	45	1002	0/0/0/0	0/0/0/0	-
2022	3	13	1800	14.0	103.0	30	30	45	1002	0/0/0/0	0/0/0/0	-
2022	3	14	0000	14.5	102.0	30	35	50	999	50/90/80/50	0/0/0/0	20
2022	3	14	0600	15.3	100.9	30	40	55	997	50/90/90/60	0/0/35/35	20
2022	3	14	1200	16.1	99.8	30	50	70	991	50/90/90/60	0/0/35/35	20
2022	3	14	1800	16.6	98.7	25	50	70	991	50/90/90/60	0/0/35/35	20
2022	3	15	0000	16.8	98.0	20	50	70	989	50/80/90/60	0/0/35/35	20
2022	3	15	0600	17.1	97.3	25	50	70	989	50/80/90/60	0/0/35/35	25
2022	3	15	1200	17.3	96.5	20	50	70	988	50/90/90/50	0/0/35/35	30
2022	3	15	1800	17.5	95.5	25	50	70	990	50/90/90/50	0/0/0/0	30
2022	3	16	0000	17.8	94.7	25	40*	55	994	0/70/70/0	0/0/0/0	-
2022	3	16	0600	18.2	93.6	25	30	45	996	0/0/0/0	0/0/0/0	-
2022	3	16	1200	19.2	92.9	25	40*	55	996	0/0/80/50	0/0/0/0	-
2022	3	16	1800	20.0	92.5	35	40*	55	995	0/0/80/50	0/0/0/0	-
2022	3	17	0000	20.4	92.8	25	40*	55	994	0/60/80/0	0/0/0/0	-
2022	3	17	0600	22.0	93.2	20	35*	50	999	0/50/0/0	0/0/0/0	-
2022	3	17	1200	23.1	93.6	20	35*	50	1000	0/50/0/0	0/0/0/0	-
2022	3	17	1800	23.7	93.8	25	30	45	1002	0/0/0/0	0/0/0/0	-

5 Forecast Performance

Official tropical cyclone forecasts were issued from 13-16 March. Ocean wind warnings for a tropical cyclone in the Indian Ocean commenced at 0600 UTC 13 March and continued until 0000 UTC 16 March. The tropical cyclone information bulletin commenced 0049 UTC 14 March and was cancelled at 0105 UTC 16 March when there was confidence that the system had weakened below tropical cyclone intensity. The system continued to produce gales, in one or two quadrants, until 1200 UTC 17 March. There were no tropical cyclone advices issued for the Australian mainland or Islands.

The accuracy figures for Tropical Cyclone *Billy* are shown below and in Figure 6. The intensity forecast errors were consistent between 5-8 kn (9-15 km/h) across the forecast range out to 72 hours. The intensity errors in the first 24 hours of the forecast were higher than the five-year average due to the underestimate the observed intensity in the early stages of development. The forecast intensity errors were better than the five-year average between the 36-72 hour forecast range.

The track position errors were only slightly above the five-average in the first 24 hours of the forecast, however the position errors increased significantly between the 36-72 hour forecast range. The large positional errors in the 36-72 hours forecast range were due to the subtle steering influences on the 16-17 March where the system moved through a col area between two mid-level in anticyclones and tracked southwest and then to the south southeast. The errors were a consequence of the forecasts being biased to the model guidance that indicated that mid-level ridge would dominate the steering influences and continue to the track the system to the west to southwest.

	00	**06**	**12**	**18**	**24**	**36**	**48**	**72**	**96**	**120**
Position Absolute error (km)	39	50	71	88	110	185	260	456	-	-
Intensity Absolute error (kn)	5.6	8.2	7.8	8.2	7.6	6.6	6.7	7.6	-	-
Sample Size	12	12	12	12	12	12	11	7	-	-

FIGURE 6 a. Position accuracy figures for Tropical Cyclone Billy

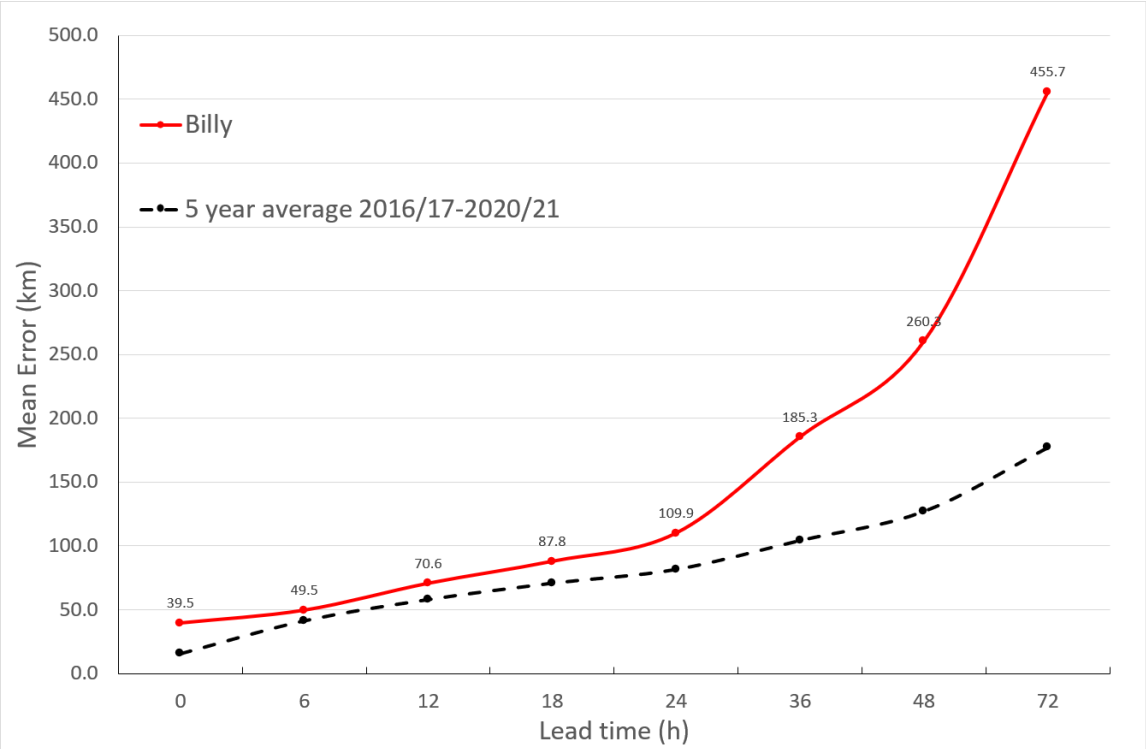


FIGURE 6 b. Intensity accuracy figures for Tropical Cyclone *Billy*.