Australian Government
Bureau of Meteorology

Tropical Cyclone Gretel

13–16 March 2020

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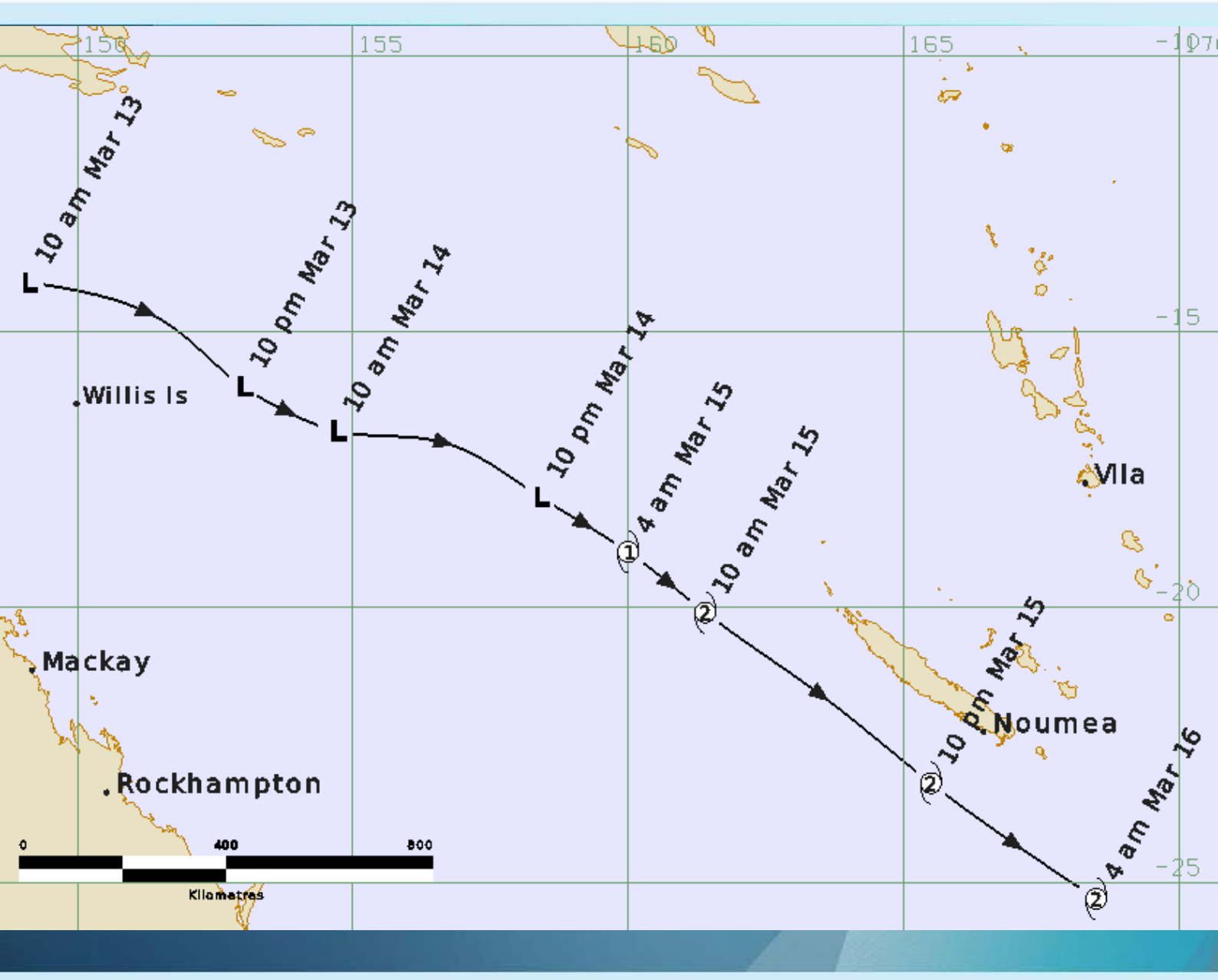

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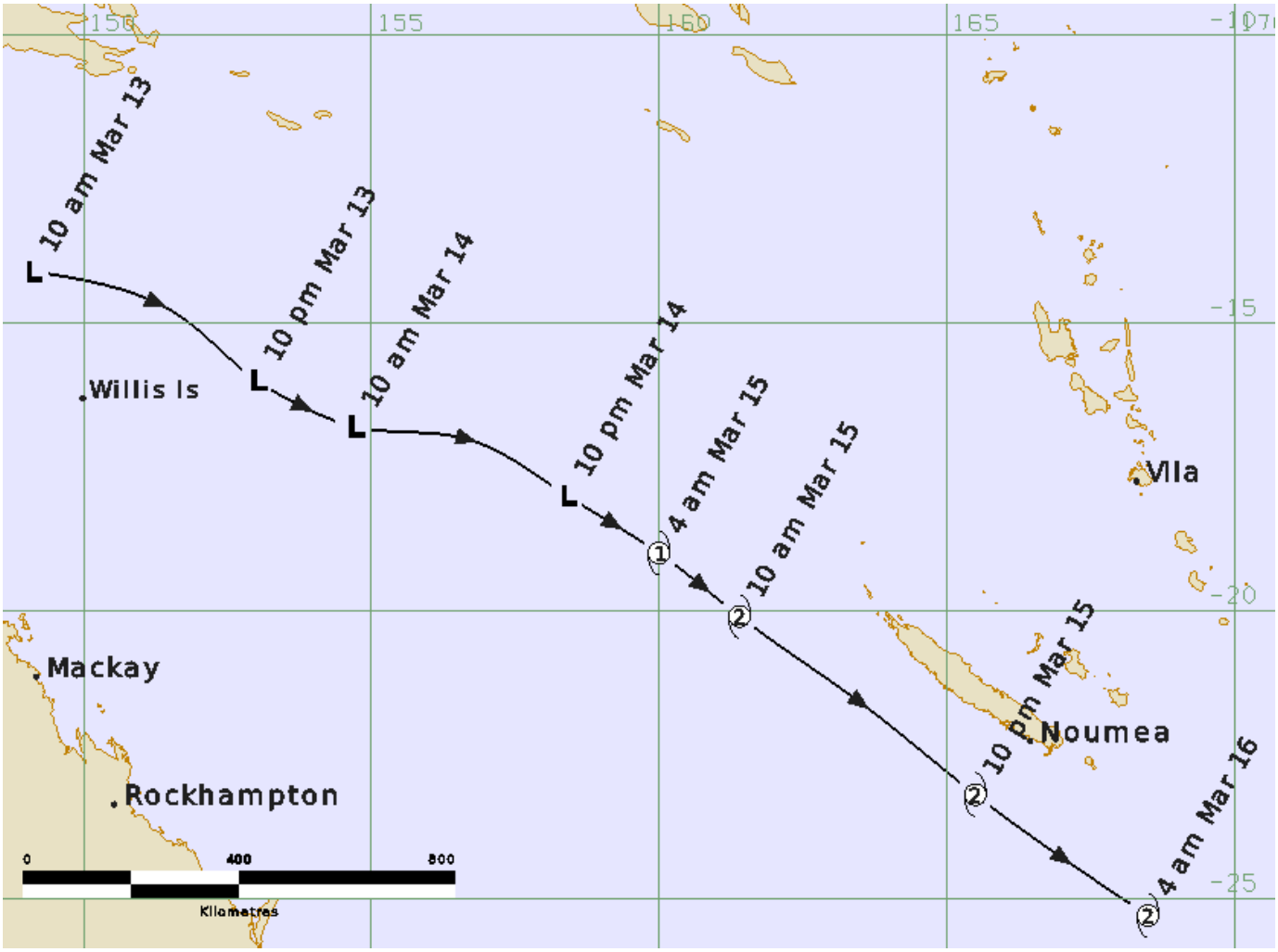
1. Summary

Tropical Cyclone Gretel formed offshore in the Coral Sea in March 2020 and reached category 2 intensity (outside of the Australian region) as it passed close to the south of New Caledonia (see Figure 1). Gretel caused abnormally high tides and large surf about the southeast Queensland and northern New South Wales coasts. A brief period of near gale force winds was also recorded at Norfolk Island as the system tracked to the northeast of the island.

The tropical low that became Gretel was first identified and tracked over northern Gulf of Carpentaria waters on 10 March before it became a broader low-pressure system embedded along the monsoon trough as it moved into the Coral Sea from 11 March. The system slowly consolidated itself as it tracked away from the Queensland east coast in the following days before it formed into a tropical cyclone and was subsequently named Gretel during the early hours of 15 March.

Shortly after being named, Gretel moved into the Fiji area of responsibility where it maintained a track towards the southeast into the Pacific Ocean before undergoing extra-tropical transition to the north of New Zealand.

FIGURE 1. Best track of Tropical Cyclone Gretel 13-16 March 2020 (times in AEST, UTC +10 hours)



2. Meteorological Description

2.1 Intensity analysis

Gale force winds developed well away from the centre of the broad low-pressure system that became Gretel from 13 March and these were evident on the Advanced Scatterometer ASCAT-A pass at 2303 UTC 12 March (see Figure 2). At this stage, the system was quite broad in nature and no initial Dvorak T-no. had been assigned.

During 13 March a more circular low-level centre became apparent on visible satellite imagery and persistent convection became established to the northwest of the system (see Figure 3). An initial Dvorak T-no. of 1.0 was assigned at 0600 UTC 13 March.

The system steadily developed from this point as it tracked away from the Queensland east coast before it attained tropical cyclone intensity at 1800 UTC 14 March. The Dvorak estimate at the time of naming was based on a curved band pattern with a 0.6 degree wrap and a white band addition, which yielded a DT of 3.5. However, a FT of 3.0 was assigned as the DT analysis was not completely clear.

An SSMIS microwave image at 1649 UTC indicated that convection was wrapping halfway around the system (see Figure 4), which supported the Dvorak analysis at the time of naming. An Advanced Scatterometer ASCAT-A pass at 2222 UTC 14 March indicated that gales were not as removed from the centre as the previous pass and that the gales were wrapping more than halfway around the centre of the system (see Figure 5).

Figure 6 shows the various intensity methods. Notably the objective SATCON and ADT estimates only commenced higher than the best track, SATCON being slightly higher than the best track. During 16 March (not shown) Gretel became sub-tropical.

2.2 Structure

Gale force winds developed well away from the centre of the broad low-pressure system that became Gretel from 13 March. These gales occurred in the monsoonal flow to the north of the system in the area approximately 90-200 nm (165-370 km) from the centre. The gale radius for Gretel consolidated primarily to the area within approximately 120 nm (220 km) in the northern semicircle and 90 nm (165 km) in the southern semicircle at the time of the system being named. After leaving the Australian region on 15 March, Gretel accelerated to the southeast and became sub-tropical leading to a more complex and asymmetric structure.

2.3 Motion

The southeast motion of Gretel was largely influenced by a combination of a burst of monsoonal winds to the north of the system and a mid-level trough situated to the west. Gretel accelerated to the southeast to approximately 30-35 km/h during 14 March as its motion started to be primarily influenced by the approaching mid-level trough.

FIGURE 2. Advanced Scatterometer ASCAT-A pass at 2303 UTC 12 March 2020.

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

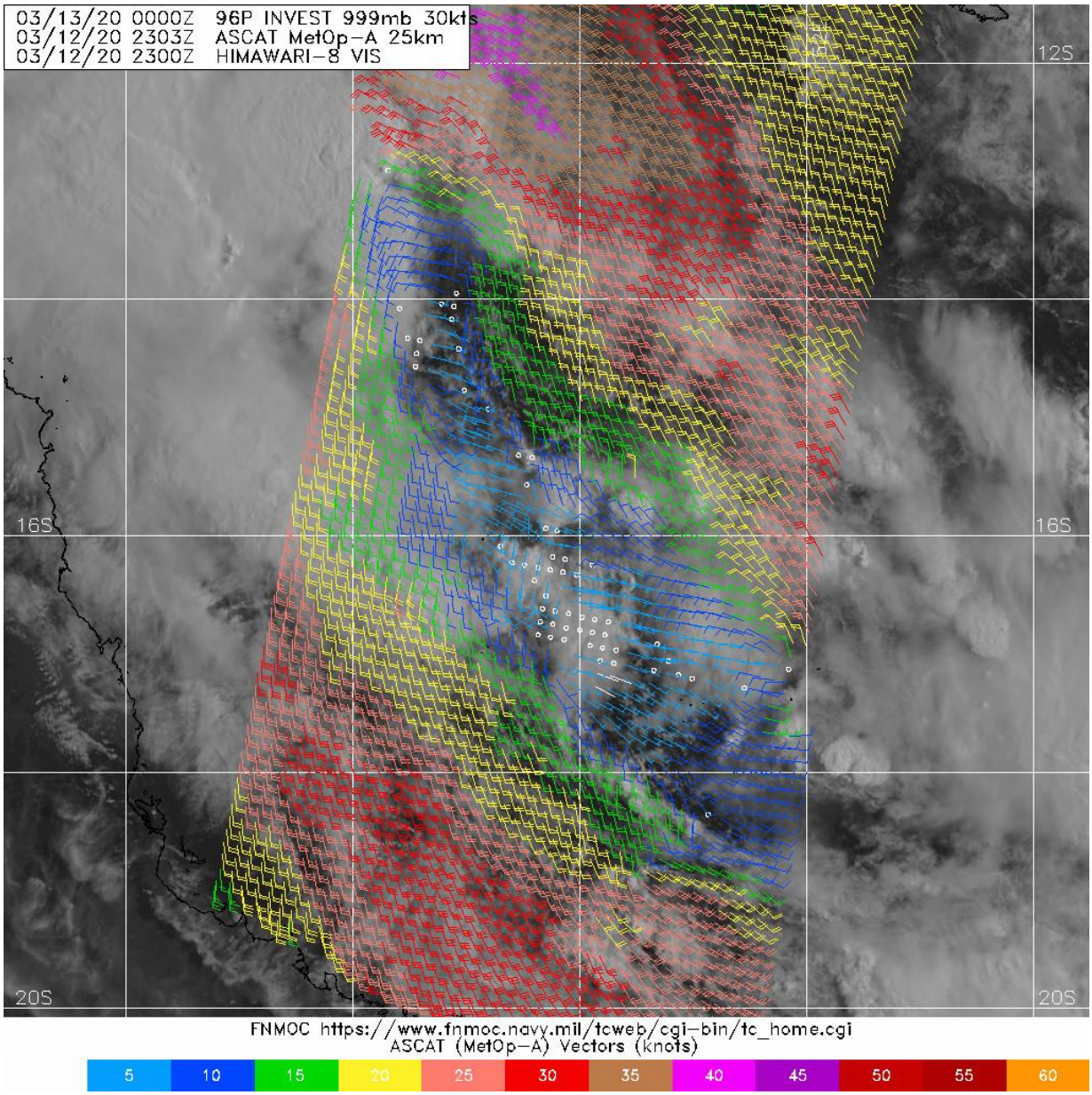


FIGURE 3. Himawari-8 visible satellite image at 0400 UTC 13 March 2020.

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

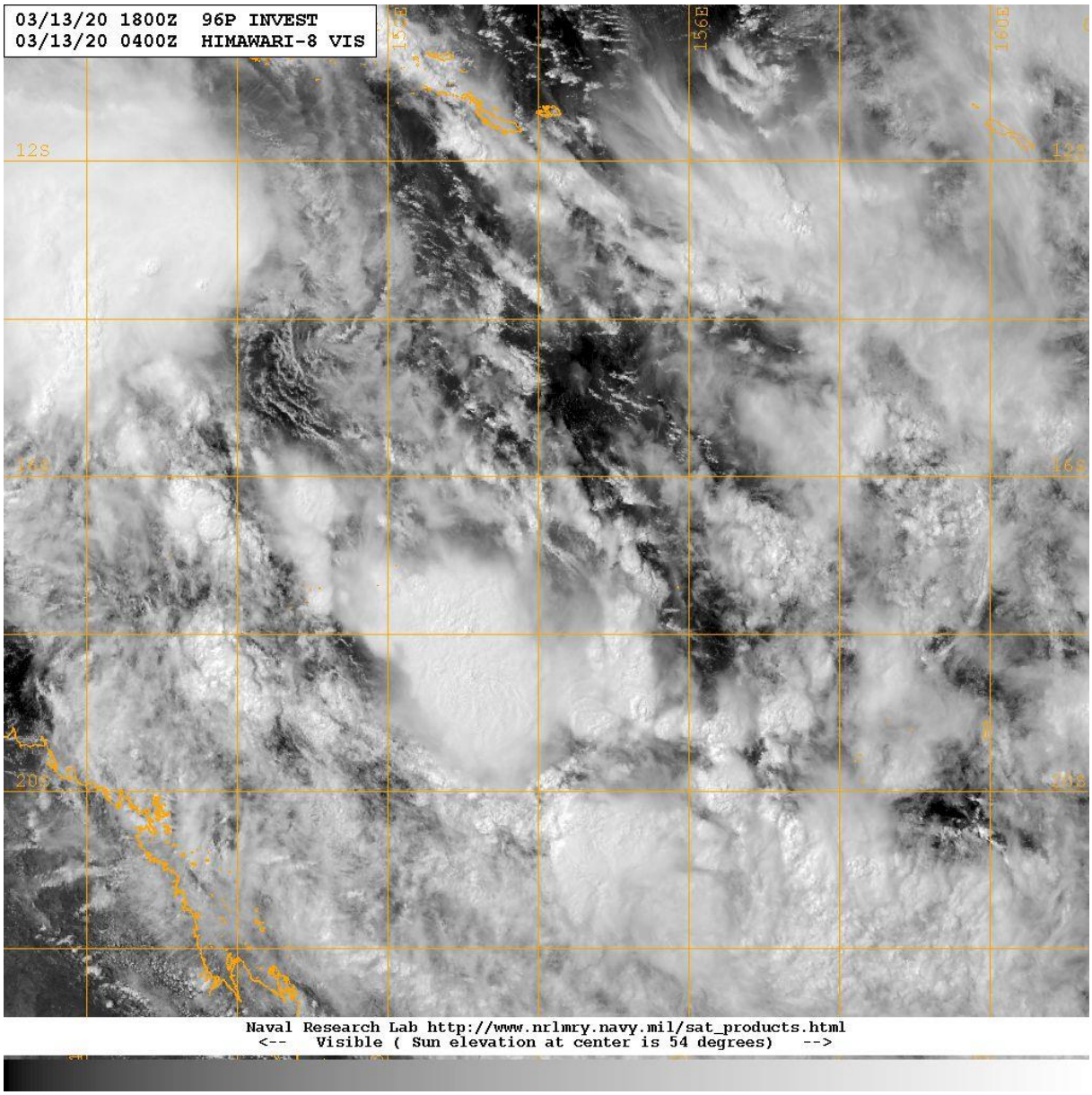


FIGURE 4. SSMI-S 91GHz microwave image at 1649 UTC 14 March 2020 close to when tropical cyclone intensity was attained.

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

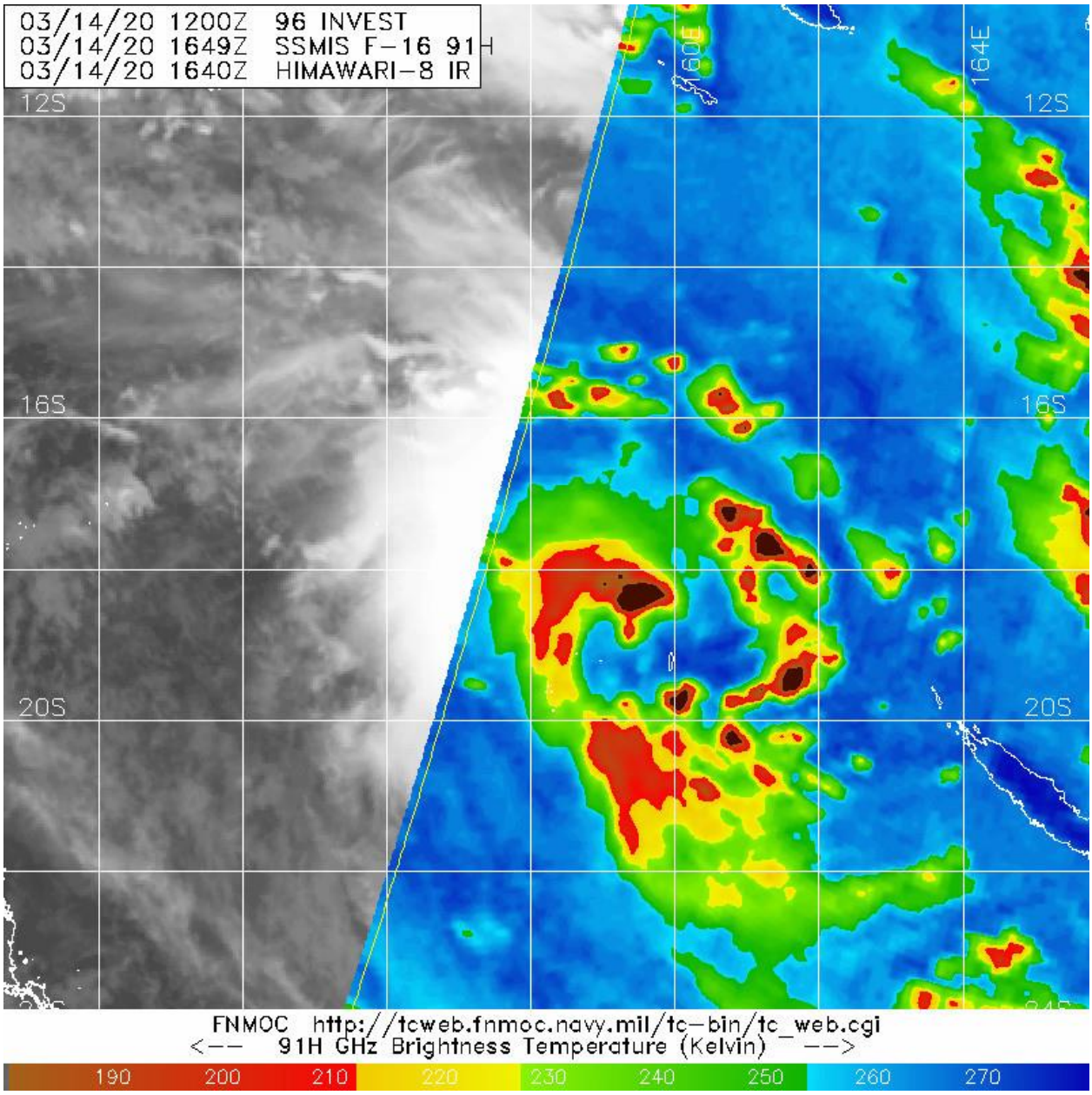


FIGURE 5. Advanced Scatterometer ASCAT-A pass at 2222 UTC 14 March 2020.

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

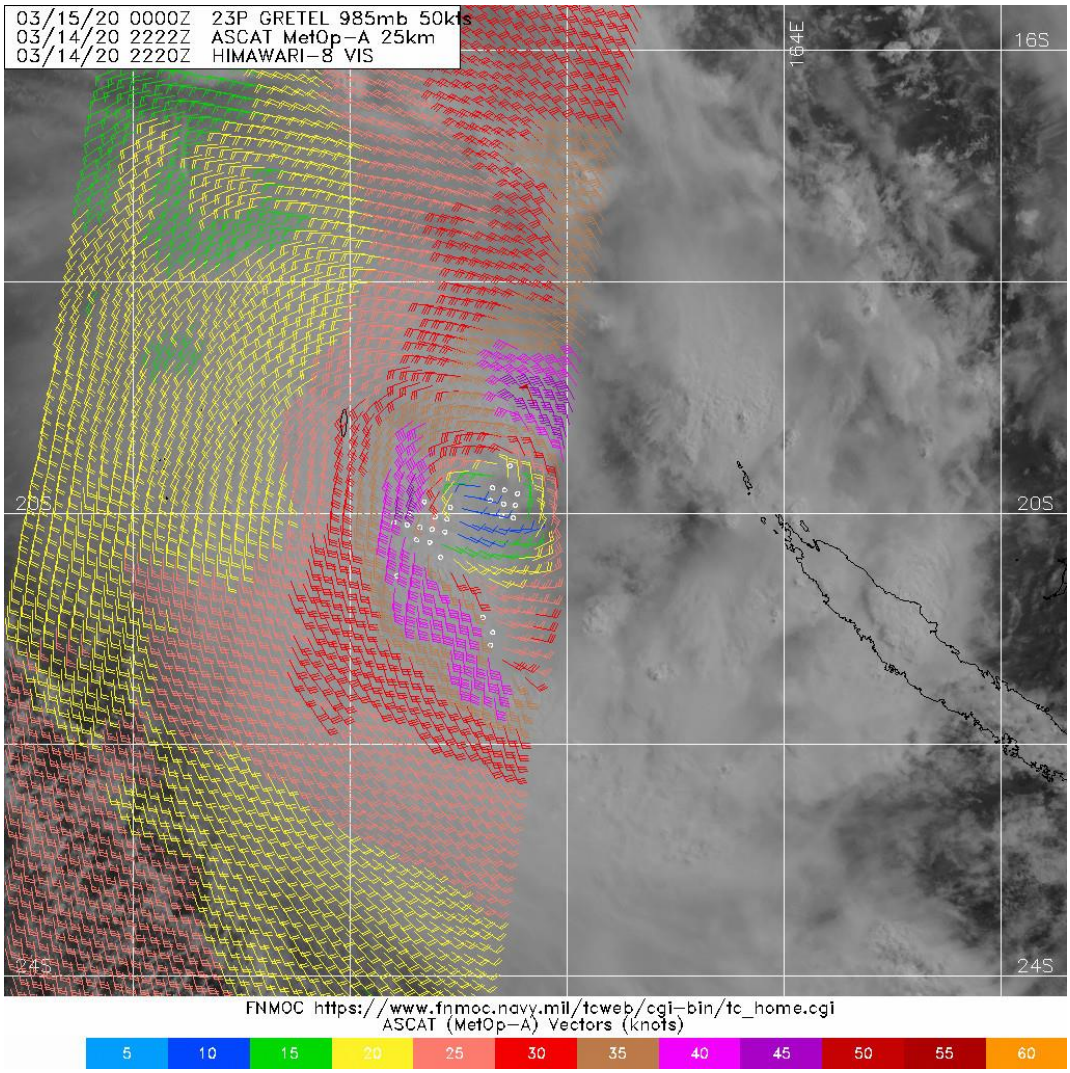
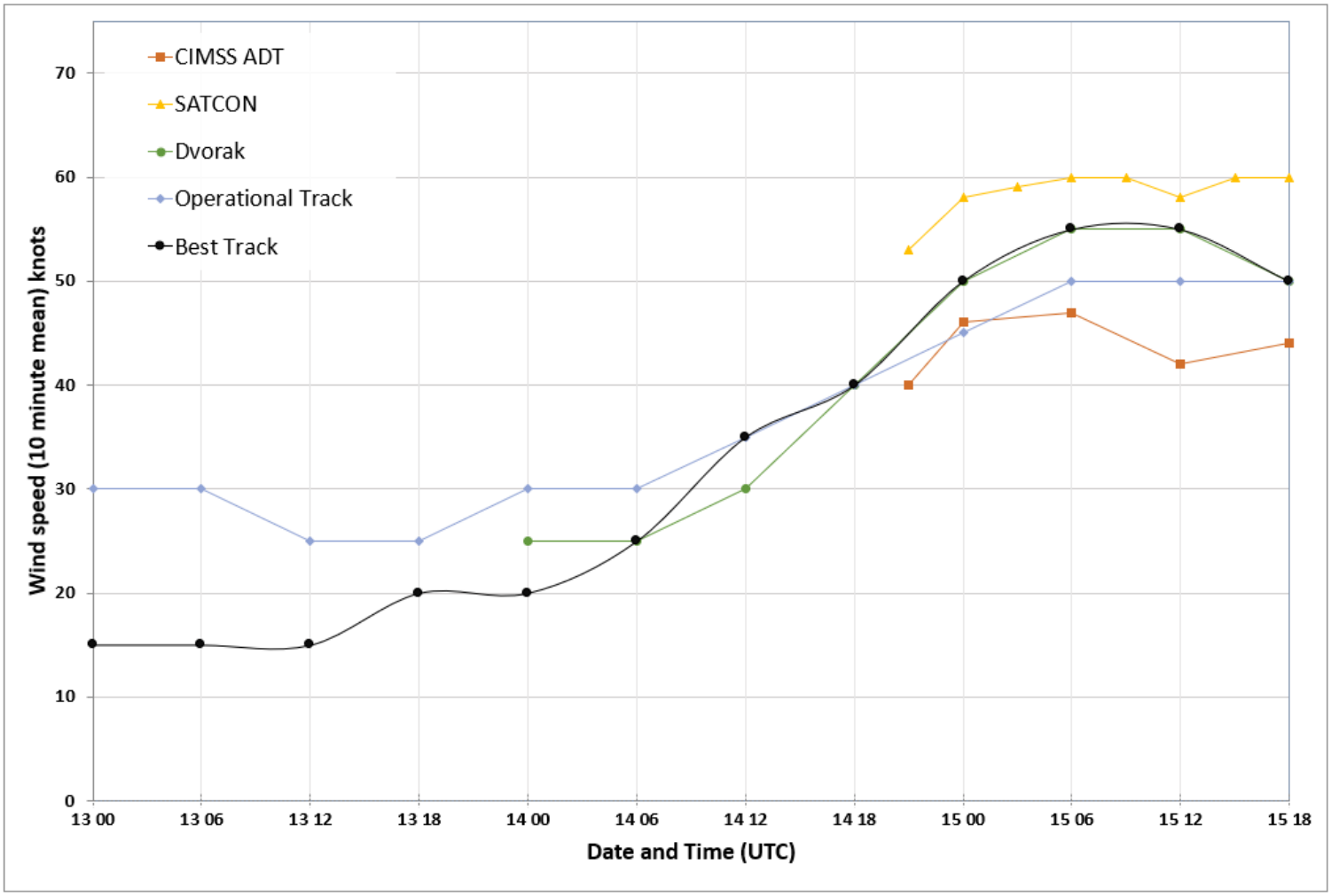


FIGURE 6. Plot of objective and subjective intensity estimates for Tropical Cyclone Gretel.



3. Impact

There were no significant impacts on the Australian community.

4. Observations

There were no significant observations recorded during this event.

5. Forecast Performance

Official Tropical Cyclone Forecast Track Maps were issued from 11-16 March 2020. Ocean Wind Warnings for a tropical cyclone in the Coral Sea commenced at 0107 UTC 14 March and continued until 0056 UTC 15 March. Tropical Cyclone Information Bulletins commenced at 0815 UTC 11 March and continued until Norfolk Island Tropical Cyclone Advices were issued between 0056 UTC 14 March and 0328 UTC 16 March. The Tropical Cyclone Watch phase commenced for Norfolk Island at 0056 UTC 14 March before entering the Warning phase at 0054 UTC 15 March.

The accuracy figures for Tropical Cyclone Gretel can be seen below and in Figures 7a and 7b. The intensity forecast errors were between 8 to 12 knots over the first 24 hours in the forecast range and then increased to around 20 knots in the 36-72 hours forecast range. The forecast intensity errors were greater than the five-year average throughout the forecast range. These figures were influenced by the slower than expected development of the system during the early stages of the event.

The track position errors were greater than the five-year average throughout the forecast range. Post event analysis showed that Gretel tracked well north of the Official Forecast Track, particularly during the early stages of the event prior to forming into a tropical cyclone. During the early stages of the event the low-pressure system that went on to become Gretel was quite broad in nature and there was a considerable amount of model variation in where any dominant central feature would develop. The general model consensus favoured a consolidation of a dominant central feature to occur further south than what transpired in the end.

The accuracy statistics obtained by comparing the forecast positions and the intensities against the best track for Gretel are:

	00	**06**	**12**	**18**	**24**	**36**	**48**	**72**	**96**	**120**
Position Absolute error (km)	96	155	165	183	224	238	221	275	272	-
Intensity Absolute Error (kn)	8.1	9.7	9.1	9.6	12.3	19.0	20.8	21.0	25.0	-
Sample Size	8	8	8	8	8	8	8	5	1	-

FIGURE 7a. Position accuracy figures for Tropical Cyclone Gretel.

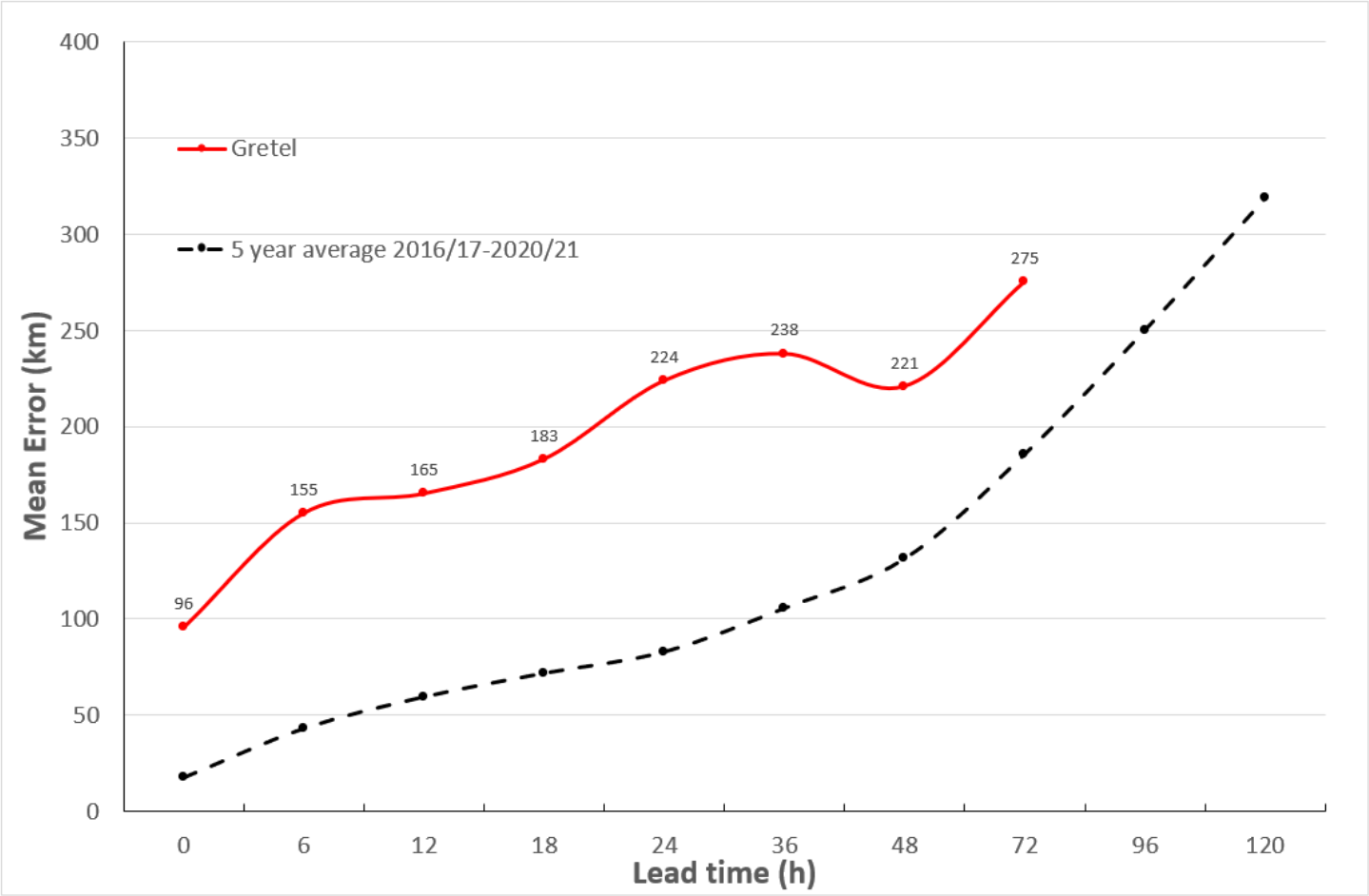


FIGURE 7b. Intensity accuracy figures for Tropical Cyclone Gretel

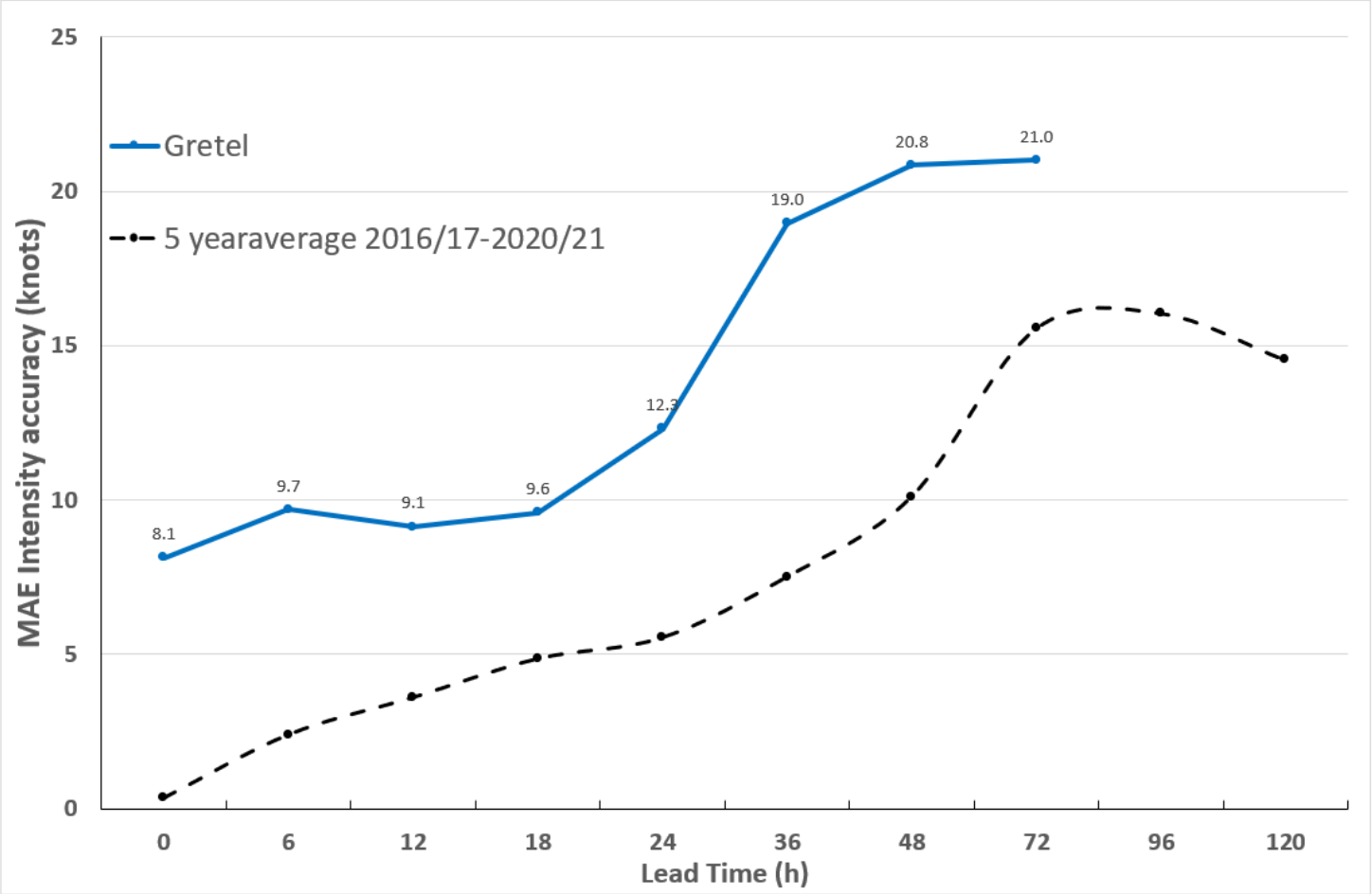


TABLE 1. Best track summary for Tropical Cyclone Gretel

Refer to the Australian Tropical Cyclone database for complete listing of parameters. Note: AEST is UTC +10 hours. Values east of 160 degrees E from 0000 UTC 15 March are from Fiji Meteorological Service.

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 nm
2020	3	13	0000	14.1	149.1	90	15	35	1000	0/0/0/0	0/0/0/0	-
2020	3	13	0600	14.9	151.7	30	15	35	999	0/0/0/0	0/0/0/0	-
2020	3	13	1200	16.0	153.0	45	15	35	999	0/0/0/0	0/0/0/0	-
2020	3	13	1800	16.4	153.7	60	20	45	999	0/0/0/0	0/0/0/0	-
2020	3	14	0000	16.8	154.7	45	20	45	998	0/0/0/0	0/0/0/0	-
2020	3	14	0600	17.0	156.6	30	25	45	997	0/0/0/0	0/0/0/0	-
2020	3	14	1200	18.0	158.4	30	35	45	996	180/0/0/0	0/0/0/0	-
2020	3	14	1800	19.0	160.0	30	40	55	993	120/90/90/70	0/0/0/0	40
2020	3	15	0000	20.1	161.4	45	50	70	985	120/120/75/90	50/50/50/40	40
2020	3	15	0600	21.6	163.5	45	55	80	980	130/100/75/95	65/60/55/35	40
2020	3	15	1200	23.2	165.5	45	55	80	980	130/100/70/90	50/60/55/50	45
2020	3	15	1800	25.3	168.5	30	50	70	985	120/100/70/90	55/60/50/50	45

List of abbreviations

ADT	Advanced Dvorak Technique
ACST	Australian Central Standard Time
AEST	Australian Eastern Standard Time
AMSR2	Advanced Microwave Scanning Radiometer
ASCAT	Advanced Scatterometer
ATMS	Advanced Technology Microwave Sounder
AWS	Automatic Weather Station
AWST	Australian Western Standard Time
C	Celsius
CI	Current intensity
CIMSS	Cooperative Institute for Meteorological Satellite Studies (USA)
CIRA	Cooperative Institute for Research in the Atmosphere (USA)
EIR	Enhanced InfraRed
ERC	Eyewall Replacement Cycle
FNMOC	Fleet Numerical Meteorology and Oceanography Centre (USA)
FT	Final T-number
GCOM	Global Change Observation Mission
GHz	Gigahertz
GMI	Global Precipitation Measurement Microwave Imager
h	hour
hPa	hectopascal
HSCAT	Hai Yang 2 Scatterometer (HY-2B, HY-2C)
km	kilometres
kn	knot
LLCC	Low Level Cloud Centre
MET	Model Expected T-number
METOP	Meteorological Operational Satellite
MJO	Madden-Julian Oscillation
MSLP	Mean Sea Level Pressure
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NRL	Navy Research Lab (USA)
PAT	Pattern T-number
RH	Relative Humidity
RMW	Radius of maximum winds
RSMC	Regional Specialised Meteorological Centre
SAR	Synthetic Aperture Radar
SATCON	Satellite Consensus
SMAP	Soil Moisture Active Passive
SMOS	Soil Moisture and Ocean Salinity
SSMIS	Special Sensor Microwave Imager/Sounder
TC	Tropical Cyclone
TCWC	Tropical Cyclone Warning Centre
UTC	Universal Time Co-ordinated