

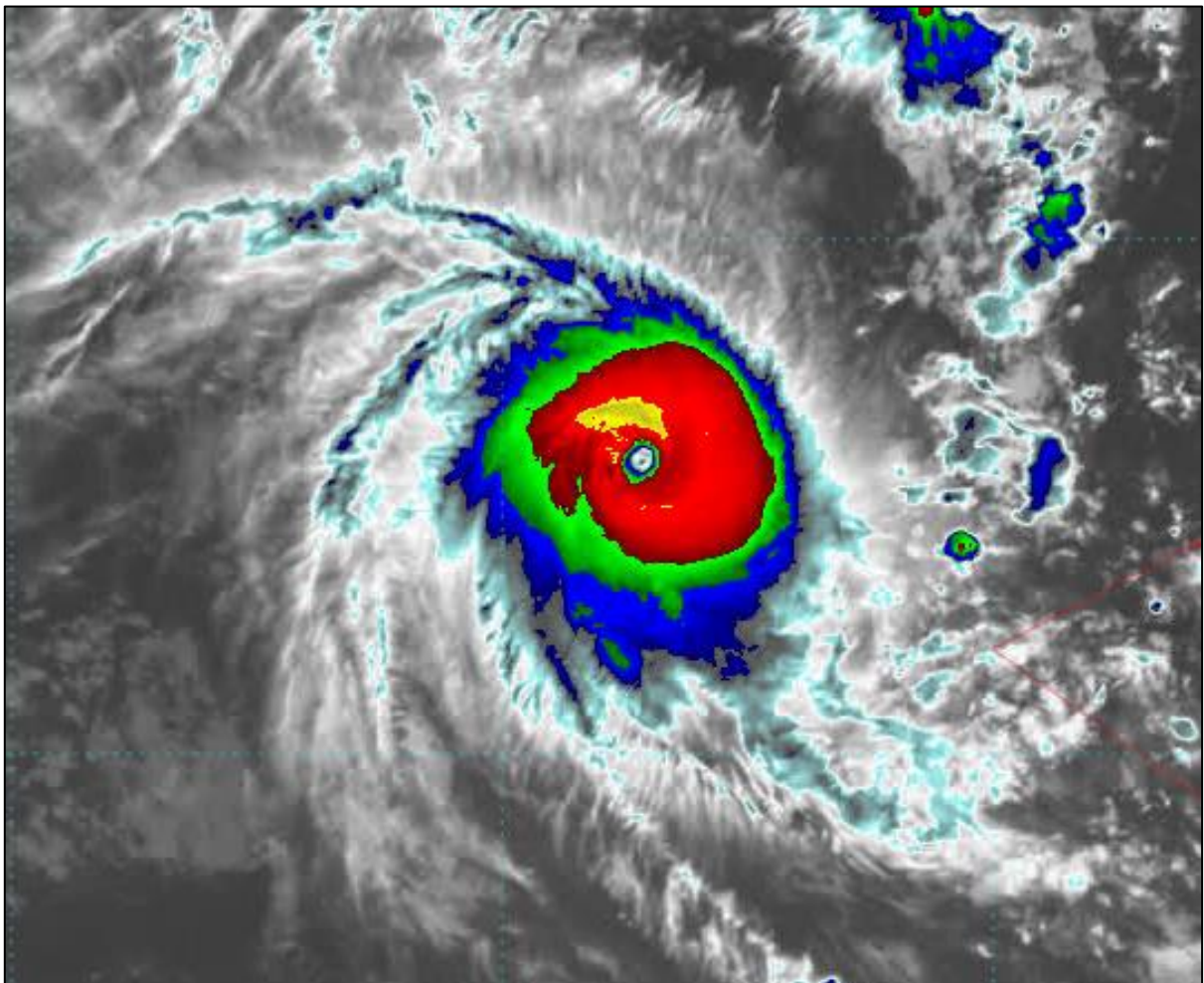
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Severe Tropical Cyclone Herman

28 March – 4 April 2023

Adam Conroy, Tropical Cyclone Environmental Prediction Services



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Revision history

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30/06/2023	1.0	Adam Conroy	Initial draft
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Cover image: EIR satellite image of Severe TC Herman at 0400UTC 31 March 2023

Table of contents

1. Summary4

2. Meteorological description7

3. Impact.....16

4. Observations.....17

5. Forecast performance18

1. Summary

Severe Tropical Cyclone Herman was a small intense system that both rapidly intensified and rapidly weakened well off the northwest Australian coast.

A weak tropical low developed to the north of Cocos Islands on 28 March and tracked to the southeast over open waters. The low rapidly developed and was named Tropical Cyclone Herman on 29 March. The small circulation continued to develop and rapidly intensified from a category 2 system on the morning of 30 March to a category 5 system just 24 hours later on 31 March.

After peaking on 31 March, Herman then encountered less favourable conditions on 1 April as dry air was ingested into the circulation. Weakening was almost as dramatic as the development, taking just 36 hours to go from a category 5 system to below tropical cyclone intensity on 2 April. By this stage the system had turned to the west eventually dissipating over open waters of the Indian Ocean.

There were no impacts from this cyclone.

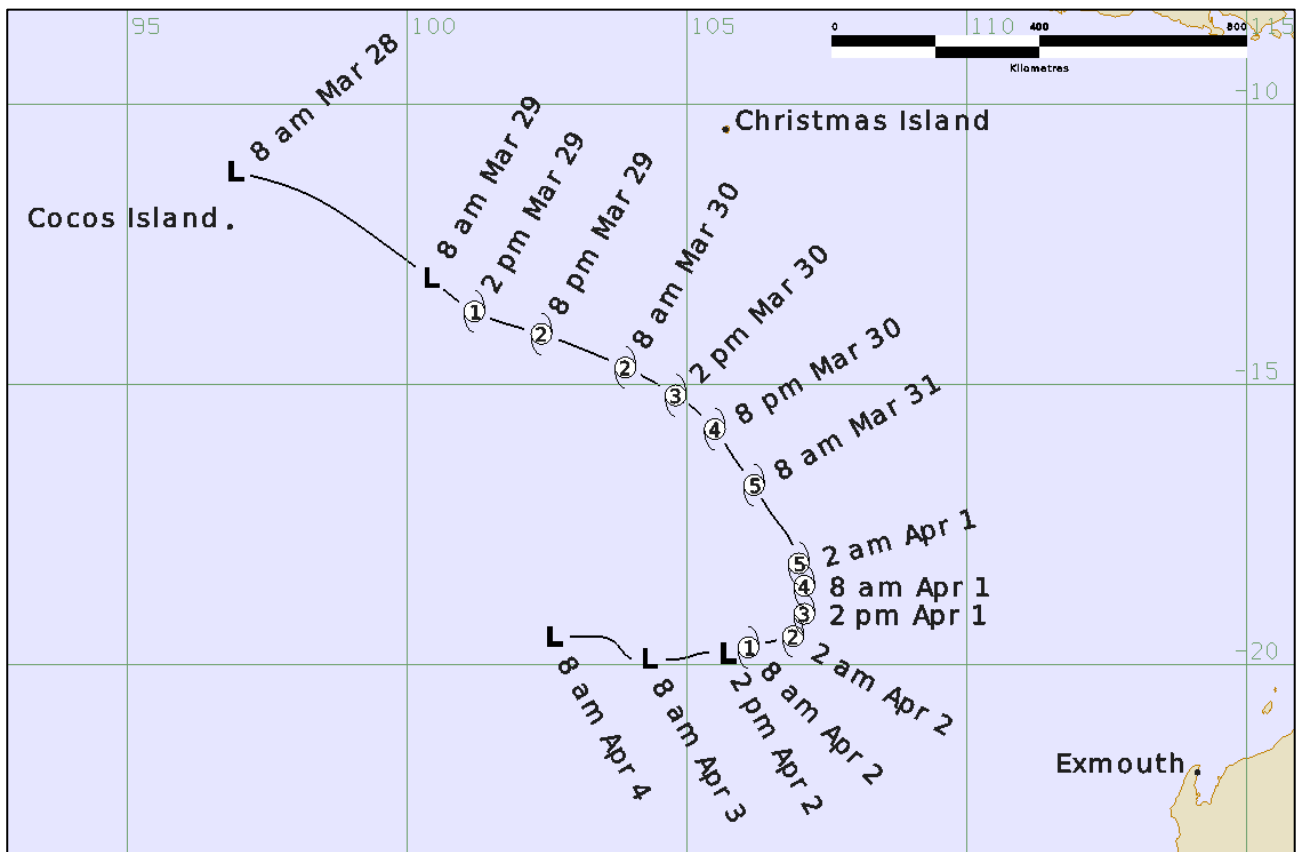


Figure 1a. Best track of Severe Tropical Cyclone Herman (times in AWST, UTC +8).



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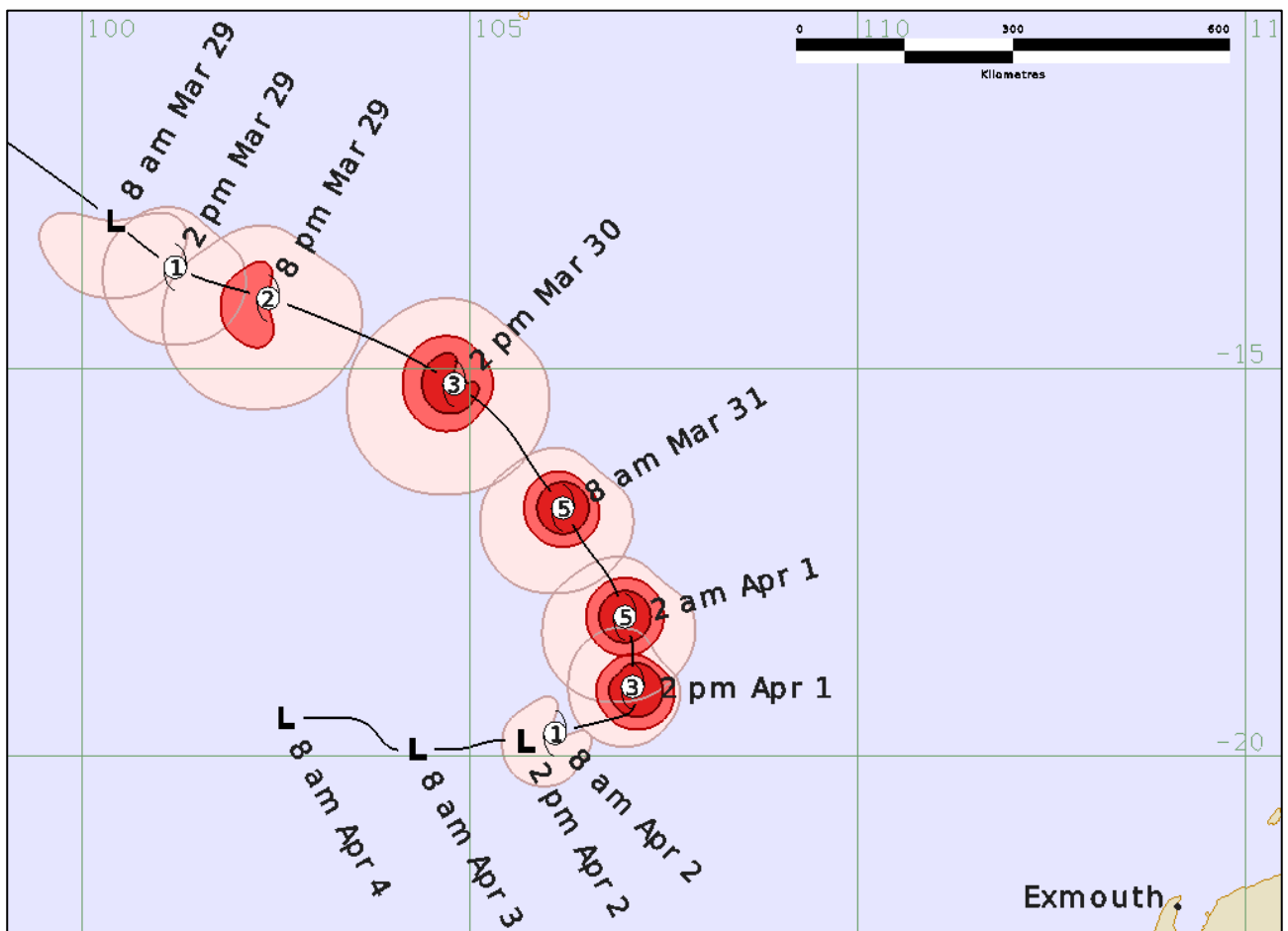


Figure 1b. Best track of Severe Tropical Cyclone Herman showing wind radii at selected times (gale - pink, storm - red and hurricane force – dark red) (times in AWST, UTC +8).

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Table 1. Best track summary for Severe Tropical Cyclone Herman, 28 March – 4 April 2023.

UTC=AWST-8h. * Not at tropical cyclone intensity as gales less than halfway around centre.

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
2023	3	28	0000	11.2	96.9	20	20	45	1005	0/0/0/0	0/0/0/0	-
2023	3	28	0600	11.6	98.2	30	25	45	1004	0/0/0/0	0/0/0/0	-
2023	3	28	1200	12.0	98.9	30	30	45	1002	0/0/0/0	0/0/0/0	-
2023	3	28	1800	12.5	99.6	30	30	45	1002	0/0/0/0	0/0/0/0	-
2023	3	29	0000	13.1	100.4	20	35*	50	999	0/60/60/0	0/0/0/0	-
2023	3	29	0600	13.7	101.2	20	40	55	996	40/60/60/50	0/0/0/0	20
2023	3	29	1200	14.1	102.4	15	50	70	991	50/80/90/60	0/0/40/30	25
2023	3	29	1800	14.4	103.2	15	55	75	986	50/90/90/60	0/30/40/40	25
2023	3	30	0000	14.7	103.9	15	60	85	983	50/90/90/70	30/30/40/40	18
2023	3	30	0600	15.2	104.8	20	75	105	972	60/80/90/70	30/30/40/40	12
2023	3	30	1200	15.8	105.5	10	90	125	956	50/80/80/70	30/30/45/40	10
2023	3	30	1800	16.4	105.9	10	105	145	940	45/70/70/60	25/30/30/30	8
2023	3	31	0000	16.8	106.2	10	115	160	930	40/60/70/50	25/30/30/30	7
2023	3	31	0600	17.3	106.5	10	115	160	930	40/60/70/50	30/30/30/30	7
2023	3	31	1200	17.7	106.8	10	115	160	930	40/60/70/50	30/30/30/30	7
2023	3	31	1800	18.2	107.0	10	110	155	935	40/60/70/50	30/30/30/30	8
2023	4	1	0000	18.6	107.1	15	100	140	944	40/50/70/60	25/30/30/30	10
2023	4	1	0600	19.1	107.1	15	85	120	960	30/40/50/50	25/35/30/25	10
2023	4	1	1200	19.4	107.1	20	75	105	968	30/40/35/30	25/25/15/20	10
2023	4	1	1800	19.5	106.9	20	55	75	984	30/40/35/30	15/15/0/0	12
2023	4	2	0000	19.7	106.1	15	40	55	996	0/30/45/30	0/0/0/0	20
2023	4	2	0600	19.8	105.7	10	35*	50	998	0/0/50/30	0/0/0/0	-
2023	4	2	1200	19.8	105.3	15	30	45	1002	0/0/0/0	0/0/0/0	-
2023	4	2	1800	19.9	104.9	15	25	45	1004	0/0/0/0	0/0/0/0	-
2023	4	3	0000	19.9	104.3	15	25	45	1004	0/0/0/0	0/0/0/0	-
2023	4	3	0600	19.9	104.0	10	25	45	1005	0/0/0/0	0/0/0/0	-
2023	4	3	1200	19.6	103.7	15	25	45	1005	0/0/0/0	0/0/0/0	-
2023	4	3	1800	19.5	103.2	20	25	45	1006	0/0/0/0	0/0/0/0	-
2023	4	4	0000	19.5	102.6	20	20	45	1007	0/0/0/0	0/0/0/0	-



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2. Meteorological description

2.1 Intensity analysis

A comparison of the intensity estimates is shown in Figure 2. This shows both the remarkable periods of intensification and weakening that occurred with Severe Tropical Cyclone Herman.

A weak low formed near Cocos Islands on 28 March. Environmental conditions were favourable for development, and the low quickly consolidated and improved in structure over the following 24 hours.

Gales developed in the southern semicircle of the system by 0000 UTC 29 March, and an ASCAT-C pass at 0304 UTC 29 March (Figure 3) showed that the gales had extended around the remainder of the system centre. Tropical Cyclone Herman was then declared at 0600 UTC 29 March.

The environment remained conducive to further development during the following 48 hours. As Tropical Cyclone Herman was a small system, it intensified rapidly in response to these conditions. The intensity increased to 60 knots by 0000 UTC 30 March, and at this time an eye was apparent in the low levels on microwave imagery (Figure 4). Severe tropical cyclone intensity (Category 3) was estimated to be reached at 0600 UTC 30 March, only 24 hours after the system was declared a tropical cyclone.

Severe Tropical Cyclone Herman was estimated to reach an intensity of 90 knots at 1200 UTC 30 March, based on an RCM-1 SAR pass at 1129 UTC (Figure 5).

A maximum intensity of 115 knots was estimated to have been reached from 0000 UTC to 1200 UTC on 31 March. Figure 6 shows an infrared image of Severe Tropical Cyclone Herman during this period, with a small and well-defined eye. The small size of the system was evident in scatterometry passes such as that shown in Figure 7.

After this period, Severe Tropical Cyclone Herman encountered an increase in vertical wind shear (changing wind speed and direction with height), which caused weakening to commence. The rate of weakening accelerated after 0000 UTC 1 April, as dry air was ingested into the centre of the cyclone, with the intensity dropping from 100 knots to 40 knots in the 24-hour period to 0000 UTC 2 April. Soon after, gales became confined to the western semicircle of the system (Figure 8), and at 0600 UTC 2 April it was downgraded to below tropical cyclone strength.

The remnant low then weakened further on 3-4 April as the circulation tracked to the west northwest.

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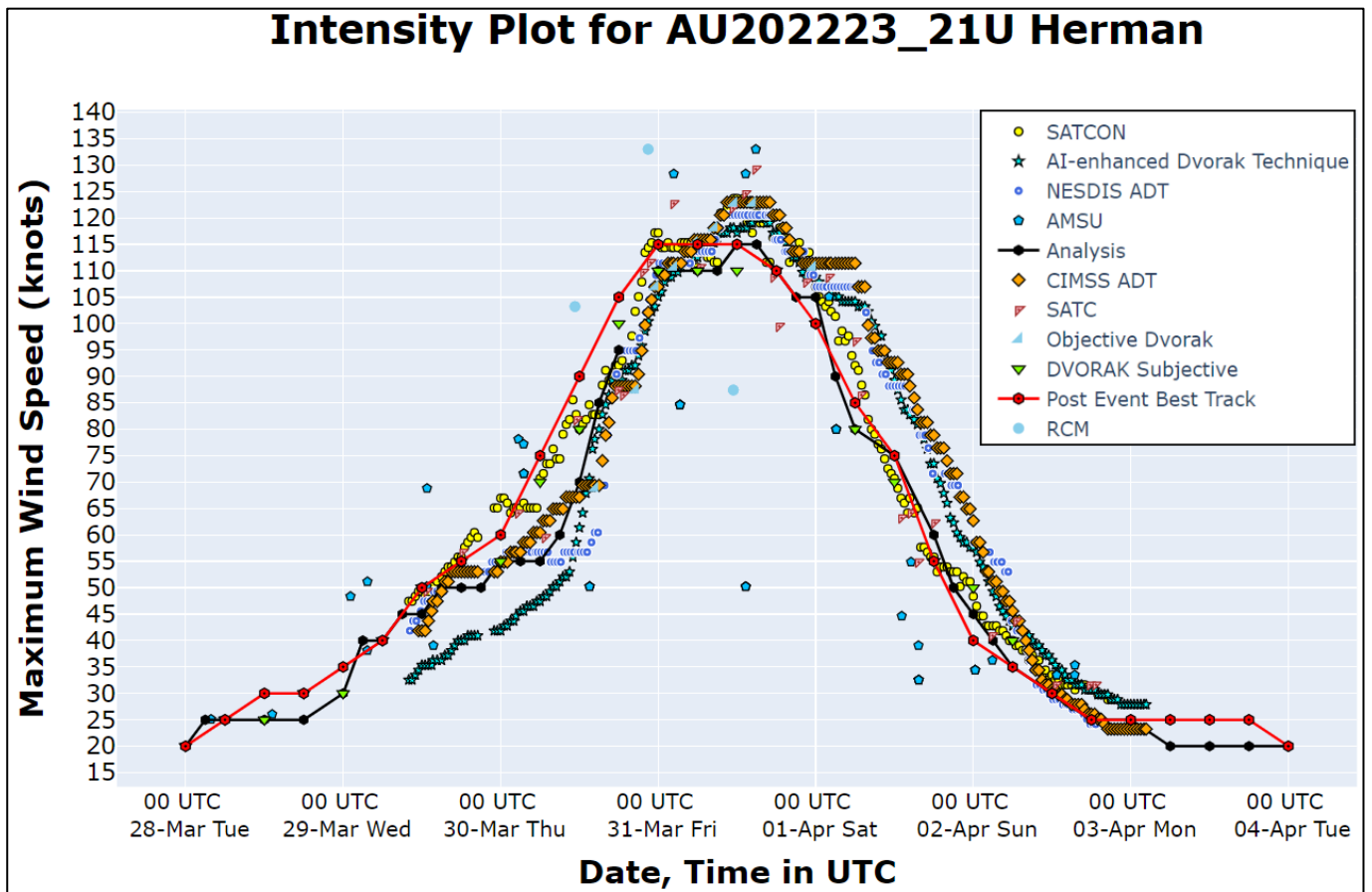


Figure 2. Intensity comparison plot showing the best track intensity (red) against the operational track intensity (black), subjective Dvorak (green triangles) and objective estimates (refer to appendix for list of abbreviations).

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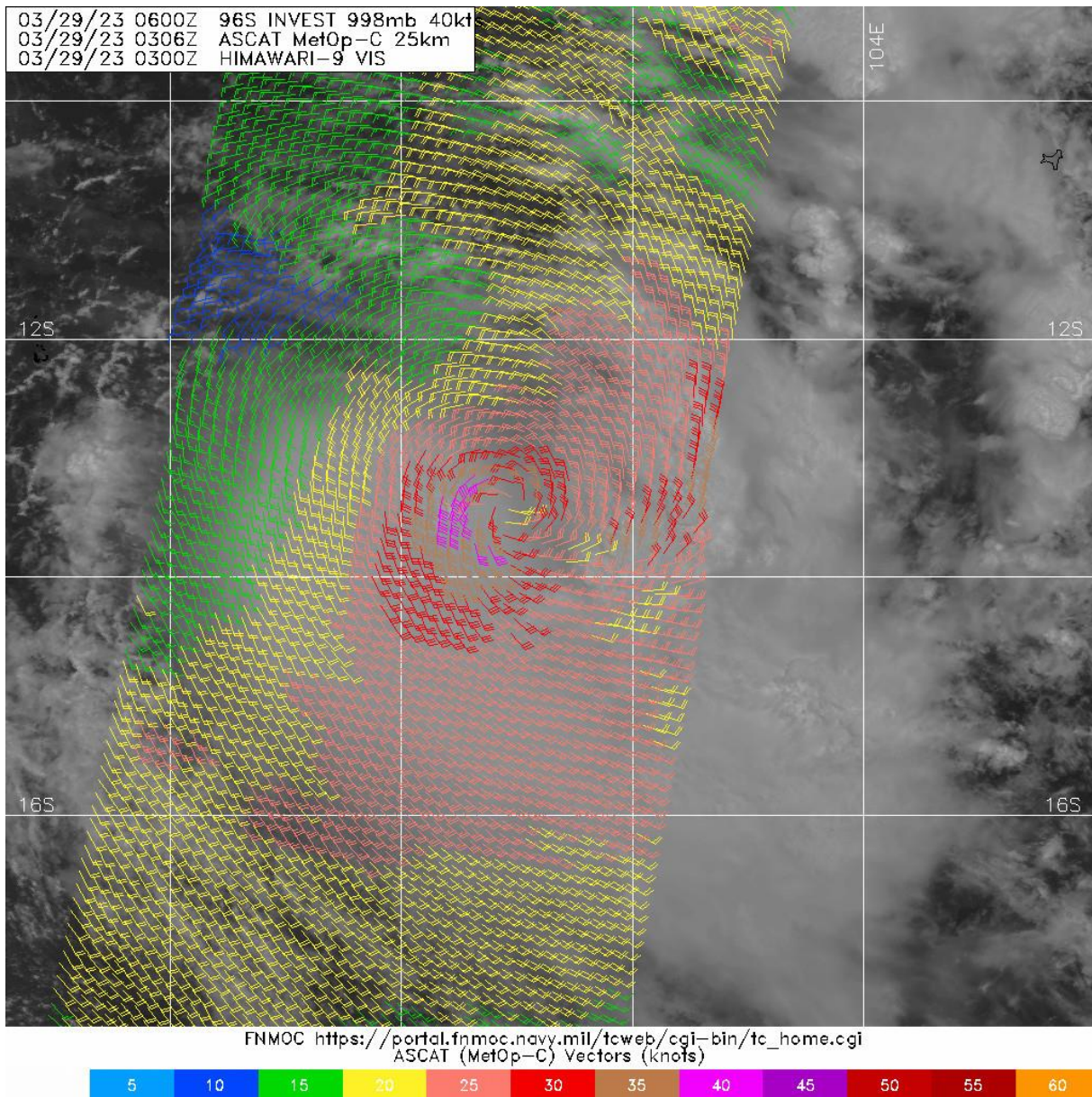


Figure 3. ASCAT-C pass at 0306 UTC 29 March showing gales more than half way around the system centre. Image courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

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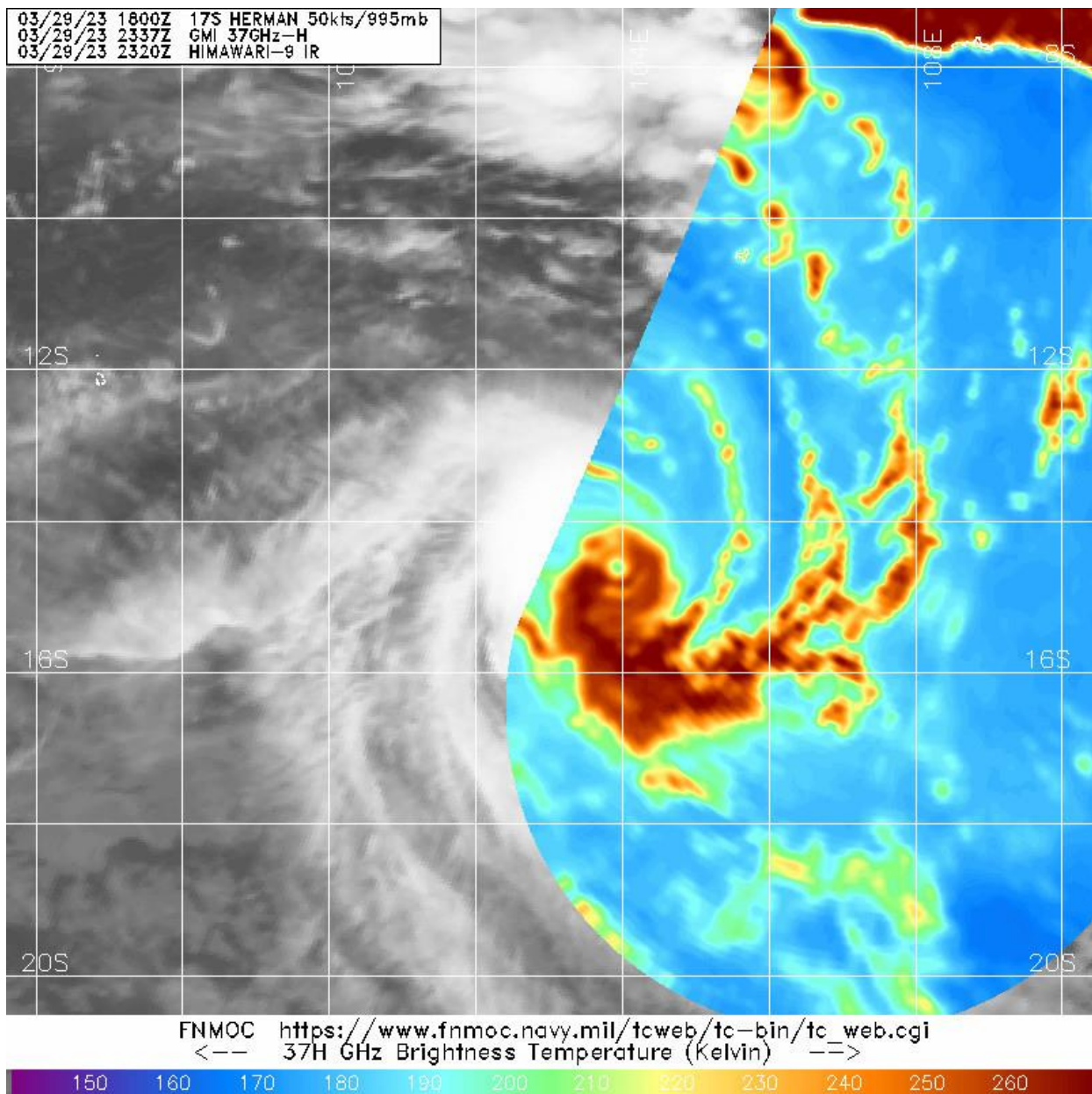


Figure 4. 37 GHz microwave image from the GMI sensor at 2337 UTC 29 March showing significant improvement to the low-level circulation, with a small eye appearing. Image courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

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SH17 HERMAN at 2023-03-30 11:19:54, NRL-Monterey

RCM-1 SAR-SPD windspeed at 2023-03-30 11:19:54

HIMAWARI-9 AHI Infrared-Gray at 2023-03-30 11:00:00

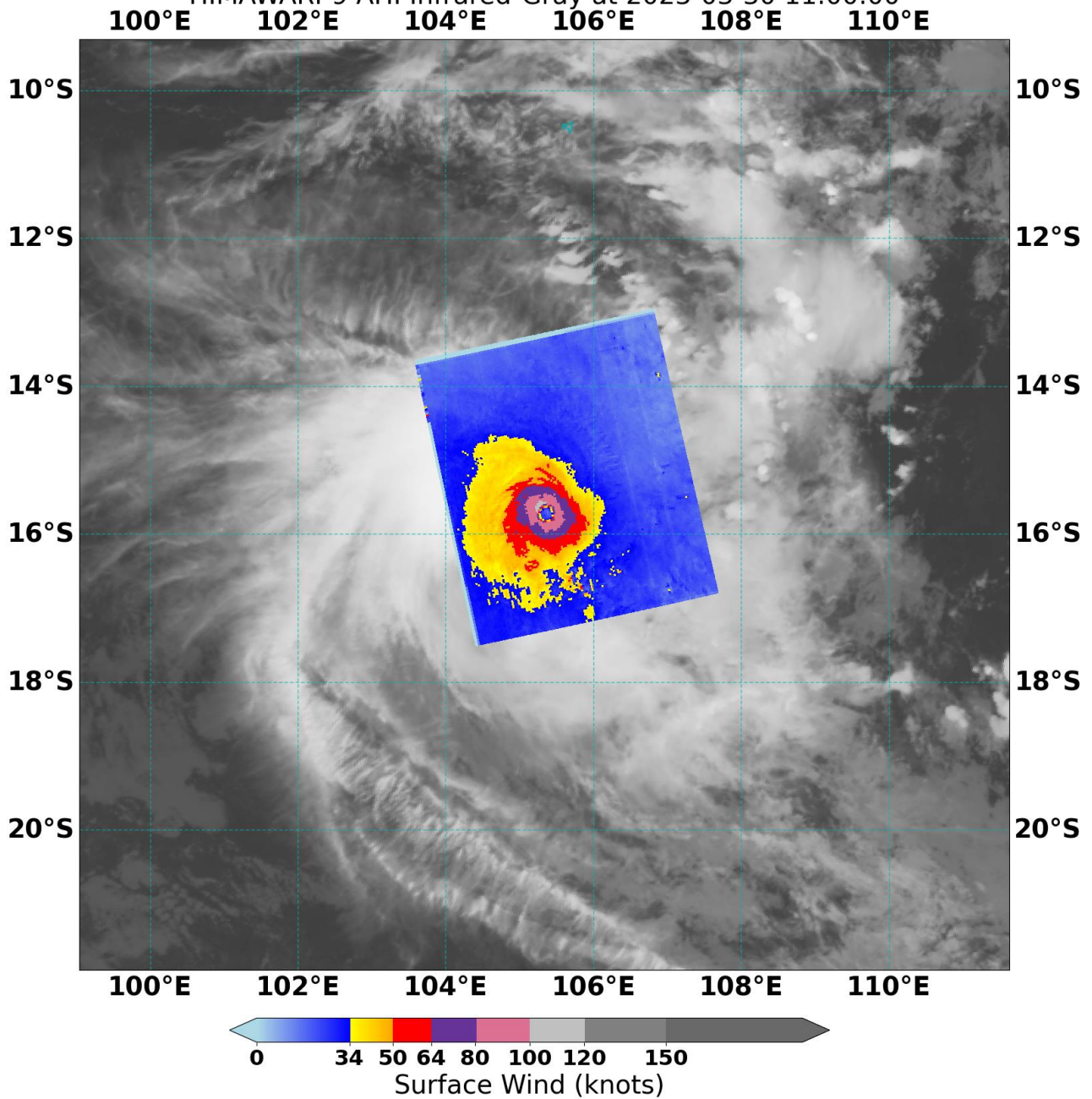


Figure 5. SAR wind speed image at 1119 UTC from an RCM-1 pass at the time Severe Tropical Cyclone Herman was estimated to reach category 4 intensity. Image courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

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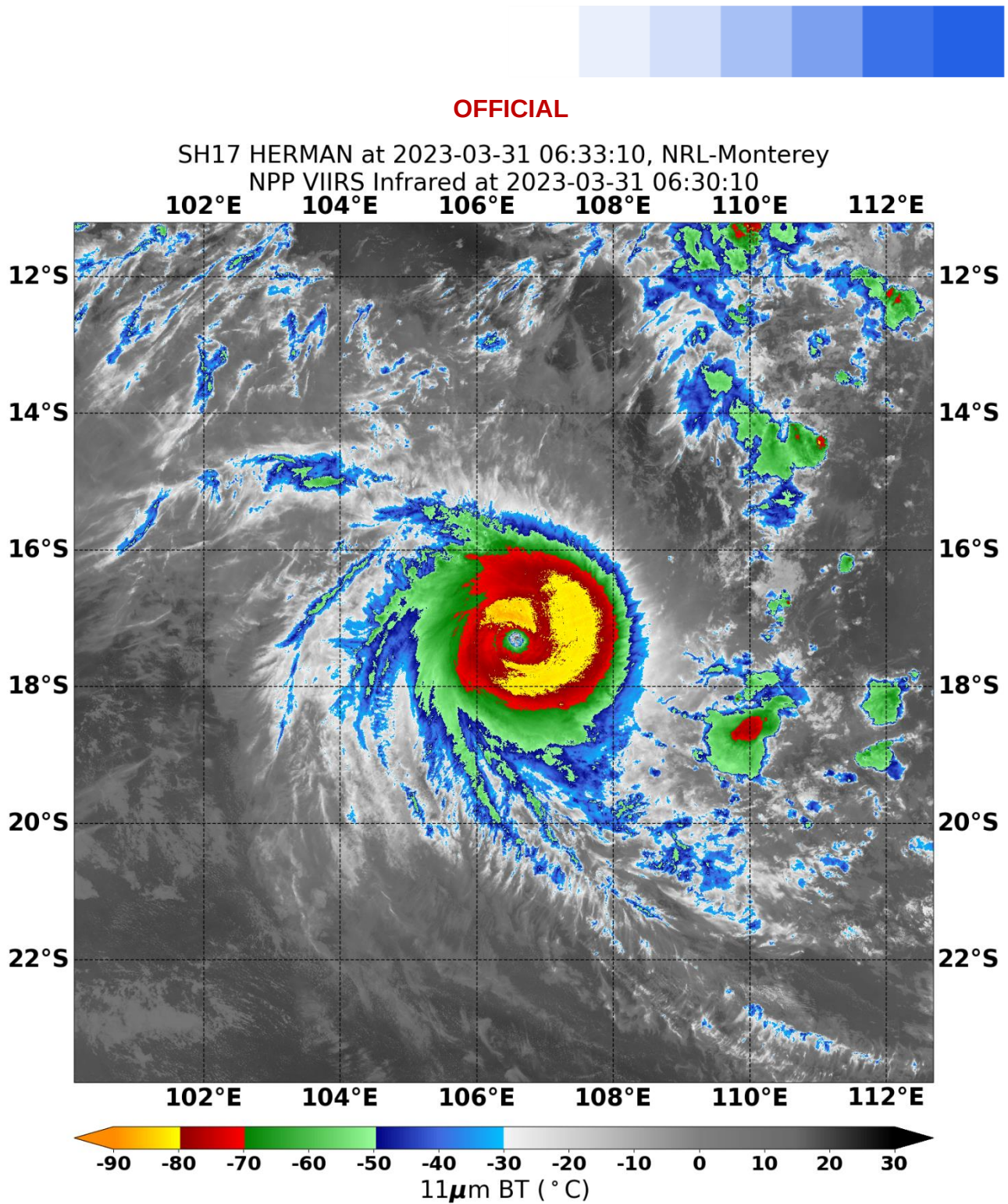


Figure 6. VIIRS infrared image from the NPP sensor at 0630 UTC 31 March, when Severe Tropical Cyclone Herman was estimated to be at maximum intensity. Image courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>



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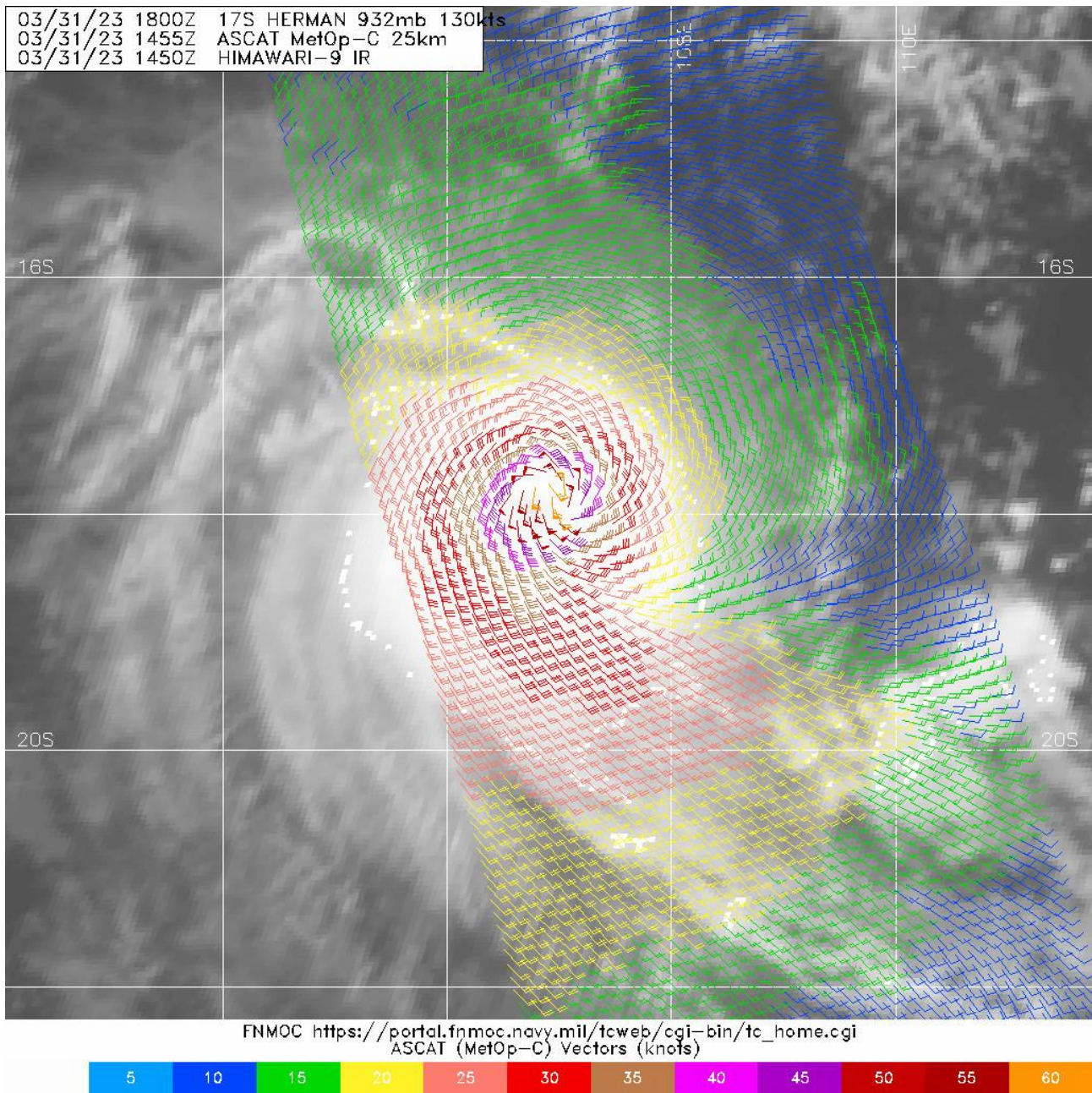


Figure 7. ASCAT-C image at 1455 UTC 31 March, when intensity was estimated to be 110-115 knots. This image shows the small size of Severe Tropical Cyclone Herman. Image courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

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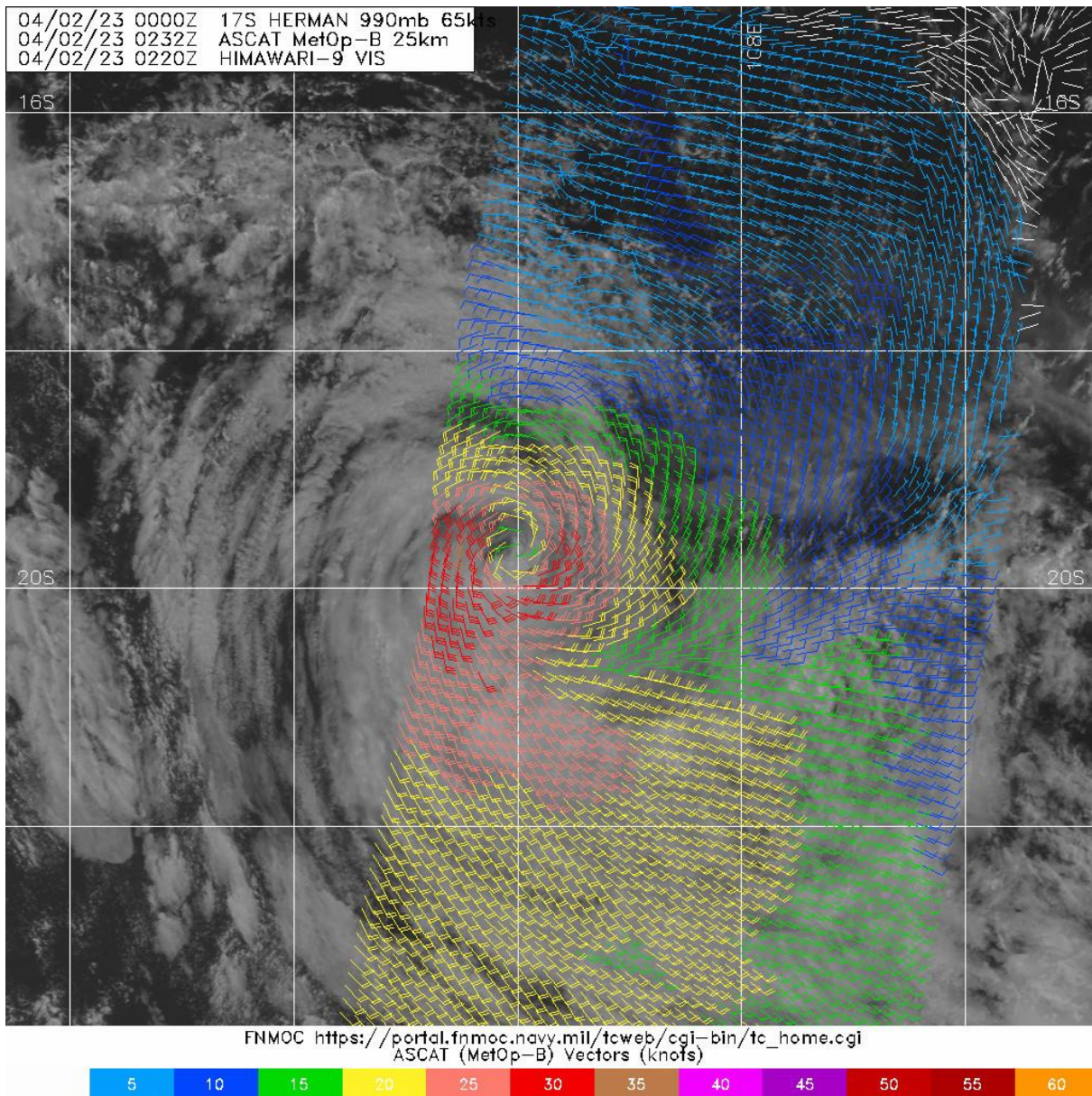


Figure 8. ASCAT-B pass at 0232 UTC 2 April showing that the system had weakened below tropical cyclone intensity, with only a small area of gales in the western semicircle. Image courtesy NRL: <https://www.nrlmry.navy.mil/TC.html>

2.1 Structure

Herman was a small system. The radius to gales varied from about 40 to 70 nautical miles (nm) (90 to 130 km). This was observed in the range of scatterometry and SAR passes such as the ASCAT-C at 1455 UTC 31 March in Figure 7.

The radius to maximum winds (RMW) was small being just 7 nm (13 km) at peak intensity as observed in a SAR pass at 1127 UTC 31 March.

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2.2 Motion

The system was initially steered towards the southeast due to the combined influence of a mid-level trough to the south and a mid-level ridge to the east. During 31 March, the mid-level trough weakened and moved east, and by 1 April Severe Tropical Cyclone Herman was being steered towards the south as the mid-level ridge started to extend towards the southeast of the system.

Once weakening occurred, the shallower remnants were steered towards the west by a 700 hPa ridge located to the south of the system.



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3. Impact

There were no known impacts associated with Severe Tropical Cyclone Herman.

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4. Observations

There were no surface observations.

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5. Forecast performance

Tropical Cyclone forecast products were issued from 01 UTC March until 07 UTC 2 April.

The accuracy figures for Severe Tropical Cyclone Herman are shown in Table 2 and in Figures 9a and 9b.

The forecasts issued during the developing stages identified intensification, but not at the extremely rapid rate that occurred. This resulted in large forecast intensity errors in the first 48 to 72 hours. However, the rapid weakening rate was well forecast. This resulted in much lower forecast intensity errors for 96 hours and 120 hours, as these forecasts only covered the time after the system had weakened.

The forecast motion was for Severe Tropical Cyclone Herman to move towards the southeast followed by a turn towards the west after weakening. However, the as the system intensified more than was forecast, there was a corresponding delay in weakening and the subsequent westwards turn. As a result, there were larger position errors in the longer-term forecasts.

Forecast hour	0	6	12	18	24	36	48	72	96	120
Position										
Absolute error (km)	18	28	40	53	72	114	145	237	370	473
Intensity										
Absolute error (kn)	7.1	11.8	18.2	23.2	27.9	34.4	33.5	19.6	6.1	1.0
Sample Size	17	17	17	17	17	17	17	13	9	5

Table 2. Verification statistics for Severe Tropical Cyclone Herman.

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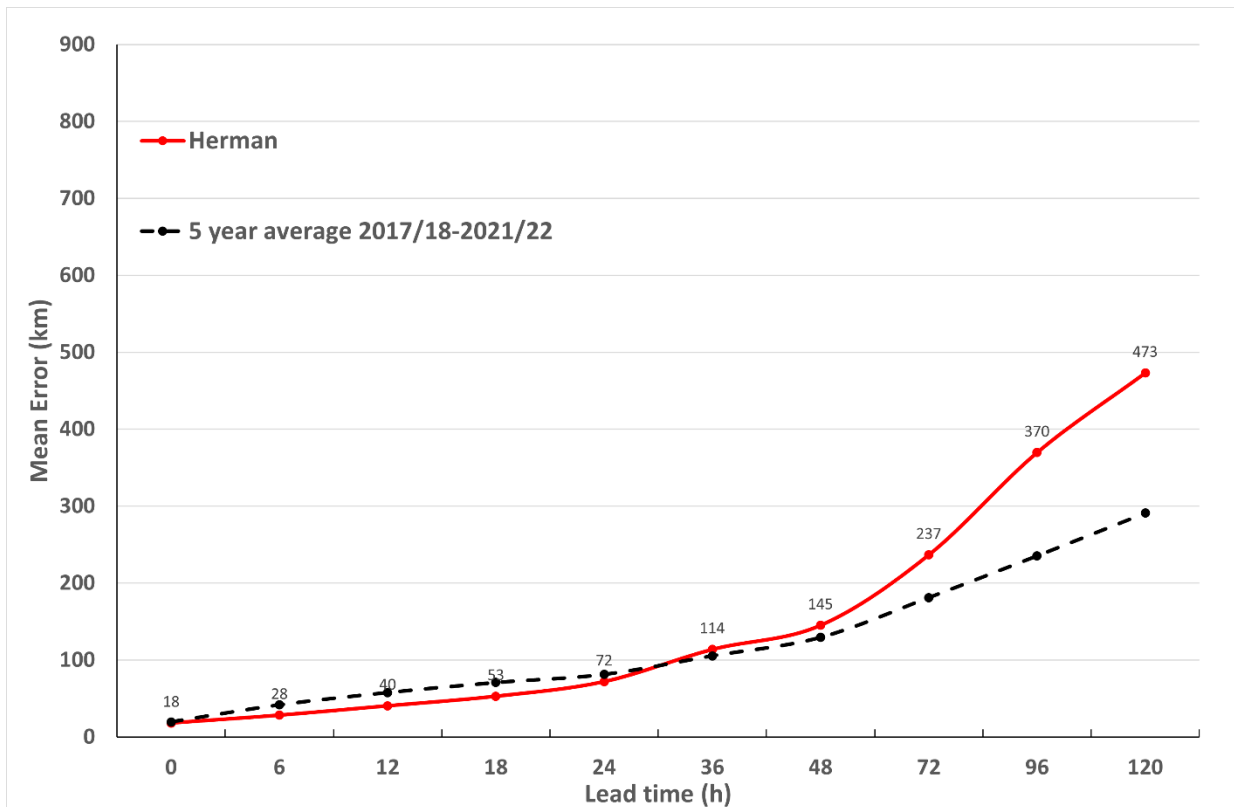


Figure 9 a. Position accuracy figures for Severe Tropical Cyclone Herman.

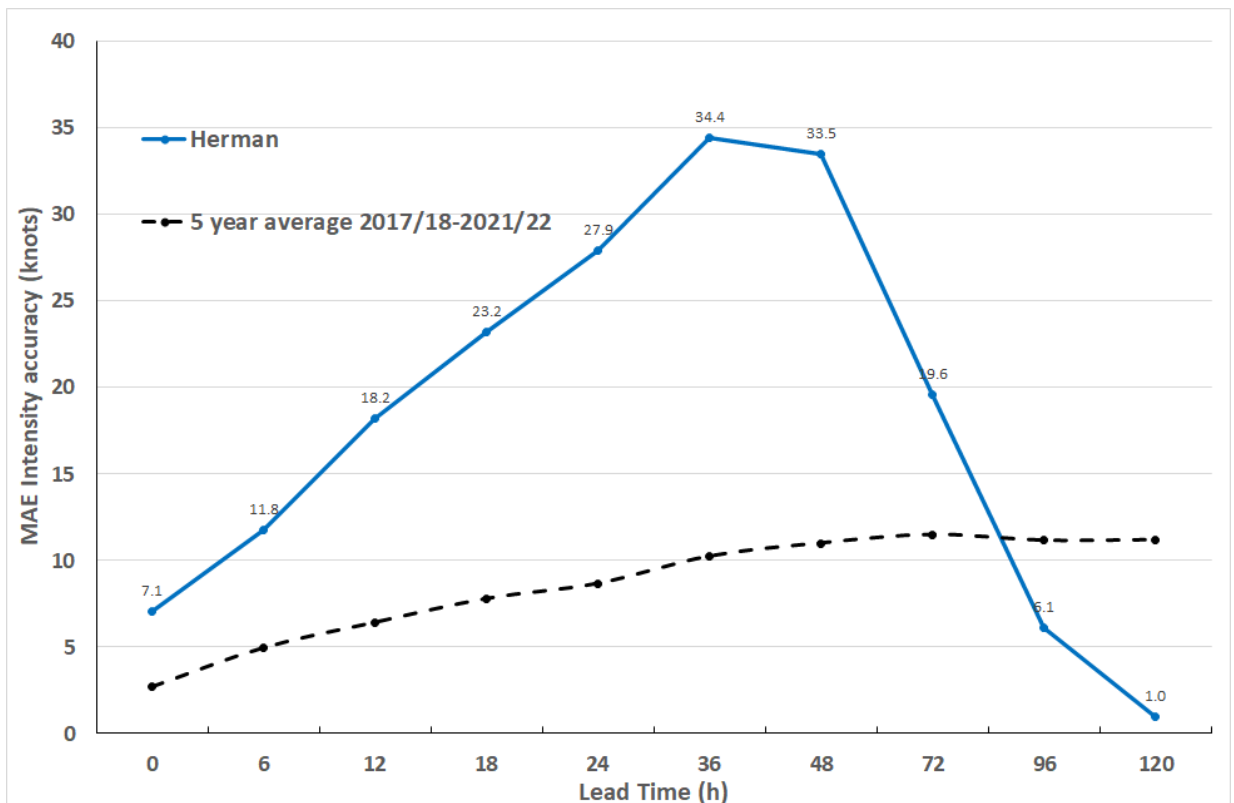


Figure 9 b. Intensity accuracy figures for Severe Tropical Cyclone Herman.

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1. Appendix: List of abbreviations

Abbreviation	Term
ADT	Advanced Dvorak Technique
ACST	Australian Central Standard Time
AEST	Australian Eastern Standard Time
AMSR2	Advanced Microwave Scanning Radiometer
AMSU	Advanced Microwave Sounding Unit
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
FNMOCC	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
km/h	kilometres per hour
kn	knot
LLCC	LLCC



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MET	Model Expected T-number
METOP	Meteorological Operational Satellite
MJO	Madden-Julian Oscillation
mm	millimetres
MSLP	mean sea level pressure
NESDIS	National Environmental Satellite, Data, and Information Service
nm	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NRL	Navy Research Lab (USA)
PAT	Pattern T-number
RCM	RadarSat Constellation Mission – Synthetic Aperture Radar
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
VIIRS	Visible Infrared Imaging Radiometer Suite