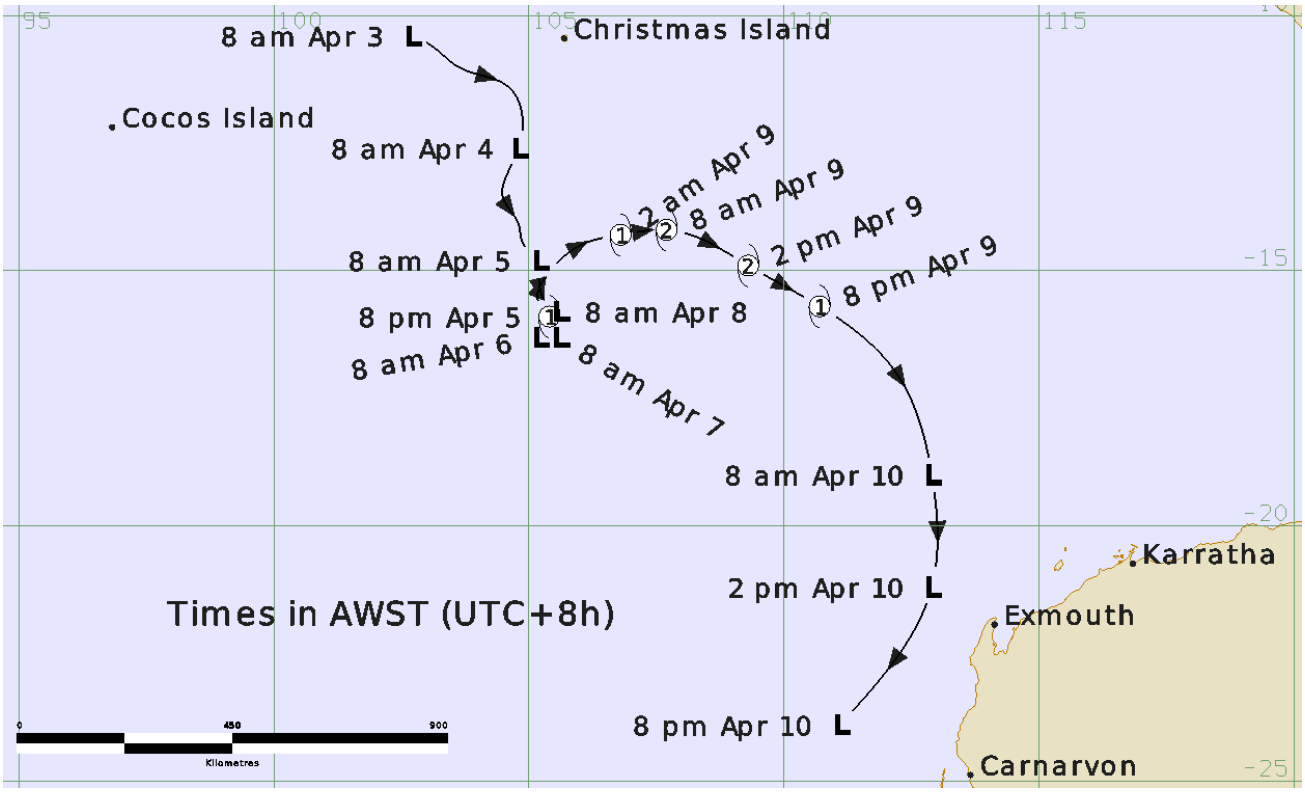
The Bureau of Meteorology

Tropical Cyclone Odette

3 -10 April 2021

Adam Conroy, Tropical Cyclone Environmental Prediction Services



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Cover image: Track of Tropical Cyclone Odette

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1. Summary

Tropical Cyclone Odette reached tropical cyclone intensity for two short periods over the Indian Ocean to the north-west of the Western Australian mainland, and whilst it threatened the far western parts of the Pilbara, it did not have any significant impacts on the Western Australian mainland.

A tropical low formed within the monsoon trough well to the west of Christmas Island on 3 April and began tracking south-east. On 4 April it continued to develop and started to move towards the south. Gales (ten-minute mean winds of 34 kn or greater) developed on the eastern side of the low, however the system remained classified as a tropical low as the gales failed to extend more than halfway around the centre. Later on 4 April, the gales moved around into the southern semicircle of the low, but remained less than half way around the centre.

On 5 April environmental conditions became more conducive to development. In post analysis it has been determined that gales extended around the entirety of the system at 1200 UTC and 1800 UTC on 5 April. Although it was not operationally named during this time, it has now been classified as a tropical cyclone for this short period.

Gales once again become confined to the southern semicircle of the system at 0000 UTC 6 April, and it then remained slow moving for the next 48 hours. On 8 April, the system started to move north-east as Tropical Cyclone Seroja approached from the east and began to interact as per the Fujiwhara effect (see http://media.bom.gov.au/social/blog/2571/when-cyclones-collide-the-fujiwhara-effect/). At the same time conditions again became conducive for development, and it redeveloped into a tropical cyclone at 1800 UTC 8 April (operationally, the system was named Tropical Cyclone Odette at 0000 UTC 9 April). In part due to the rapid eastward motion during its interaction with Tropical Cyclone Seroja enhancing the winds on the northern side of the system, Odette reached category 2 intensity (with ten-minute mean winds of 50 kn) at 0000 UTC 9 April. As the low transitioned to the south-east and then south conditions rapidly deteriorated and Tropical Cyclone Odette weakened. Due to the fast southward movement on 10 April, gale force winds were still observed to the east of the low as it passed well to the west of the Northwest Cape.

Heavy rainfall was observed at Christmas Island in the overnight period from 3 April into 4 April whilst the tropical low was in the vicinity, with 115.6 millimetres recorded to 9 am 4 April. Although Tropical Cyclone Odette did not result in any damage, it was a notable system due to its Fujiwara interaction with Severe Tropical Cyclone Seroja, which is a rarely observed phenomenon for Australian tropical systems.

Tropical Cyclone Odette was the 8th tropical cyclone in the Australian region for the 2020/2021 season.

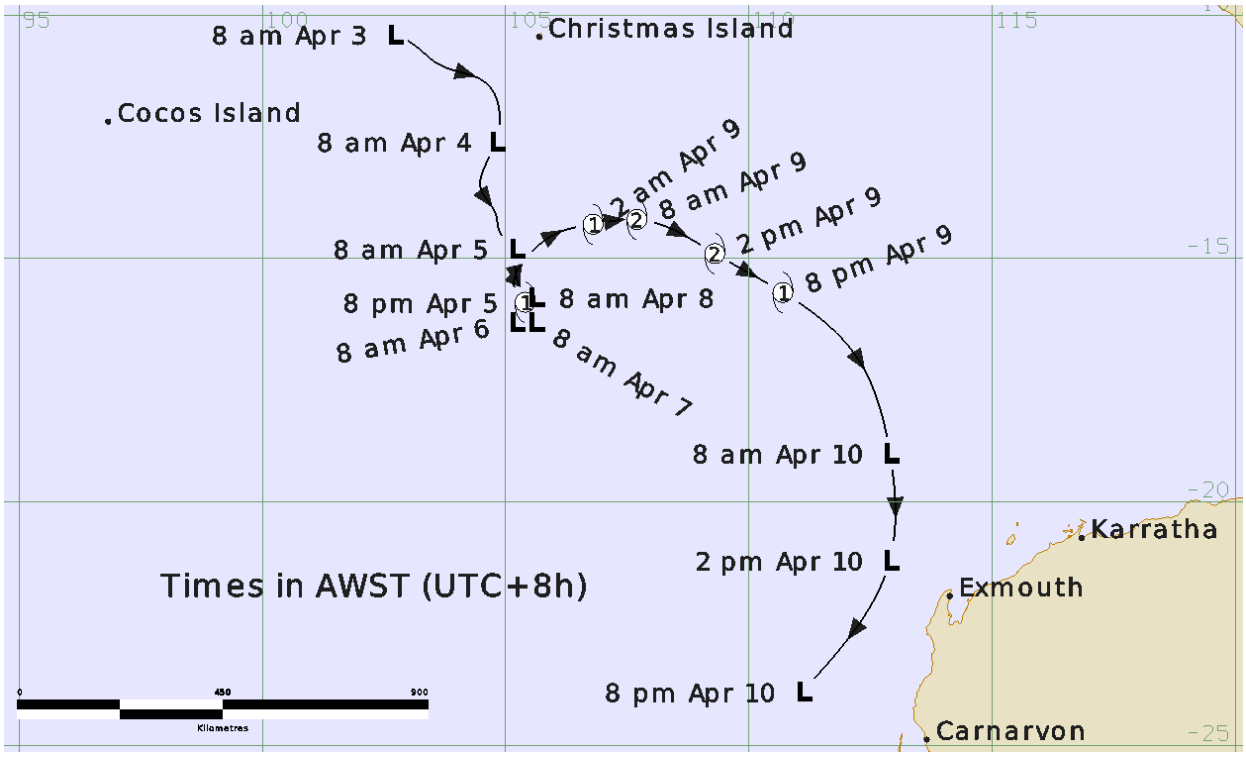

Figure 1 a. Best track of Tropical Cyclone Odette, 3–10 April 2021 (times in AWST, UTC+8).

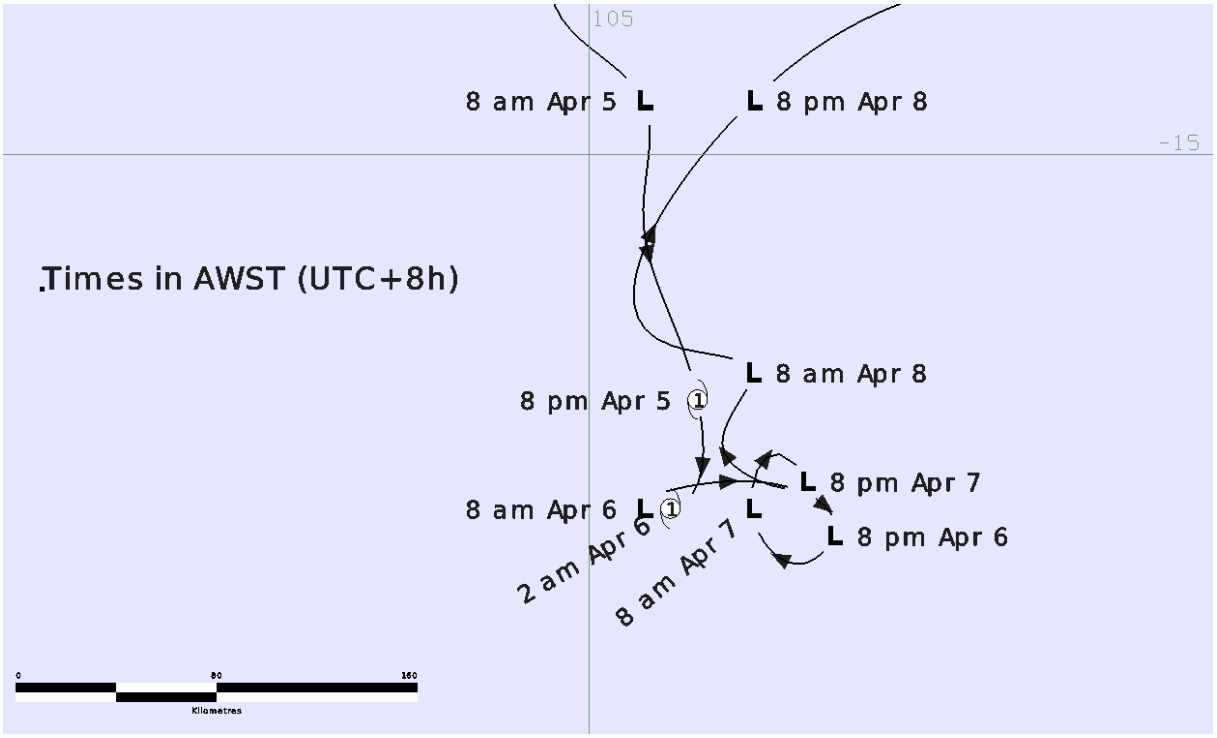

Figure 1 b. Higher detail best track of Tropical Cyclone Odette for the period 5–8 April 2021 (times in AWST, UTC+8).

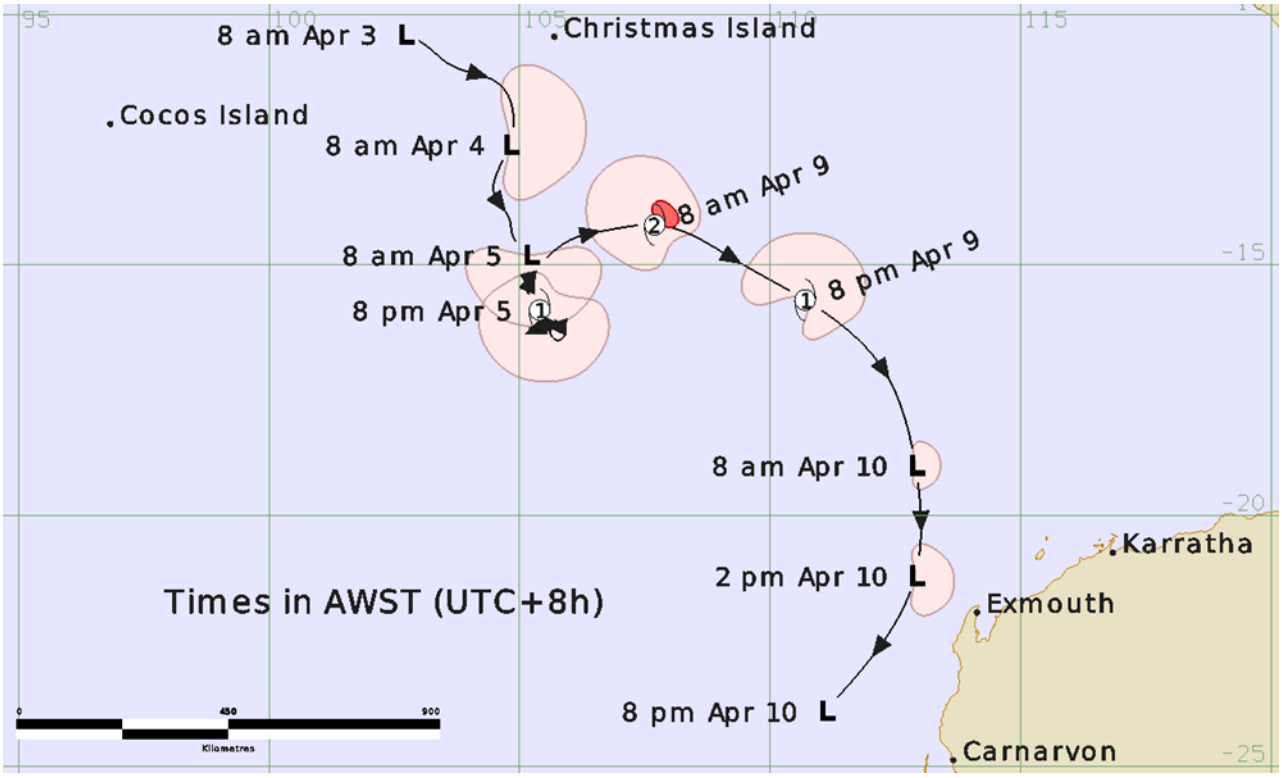

Figure 1 c. Best track of Tropical Cyclone Odette with gale and storm force wind radii at selected times, 3–10 April 2021 (times in AWST, UTC+8).

Table 1. Best track summary for Tropical Cyclone Odette 3-10 April 2021

Refer to the Australian Tropical Cyclone database for complete listing of parameters. 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 nm
2021	4	3	0000	10.4	102.7	40	15	35	1005	0/0/0/0	0/0/0/0	-
2021	4	3	0600	10.6	103.1	40	20	40	1005	0/0/0/0	0/0/0/0	-
2021	4	3	1200	11.0	103.6	60	20	40	1004	0/0/0/0	0/0/0/0	-
2021	4	3	1800	11.4	104.6	45	30	45	1003	0/0/0/0	0/0/0/0	-
2021	4	4	0000	12.6	104.8	45	35*	50	1001	100/70/0/0	0/0/0/0	-
2021	4	4	0600	13.6	104.5	20	35*	50	1000	90/90/0/0	0/0/0/0	-
2021	4	4	1200	14.1	104.8	30	35*	50	997	0/90/60/0	0/0/0/0	-
2021	4	4	1800	14.5	104.9	30	35*	50	996	0/90/80/0	0/0/0/0	-
2021	4	5	0000	14.8	105.2	30	35*	50	996	0/90/80/0	0/0/0/0	-
2021	4	5	0600	15.2	105.2	30	40*	55	994	0/90/90/0	0/0/0/0	-
2021	4	5	1200	15.9	105.4	20	40	55	994	0/90/80/50	0/0/0/0	40
2021	4	5	1800	16.3	105.3	20	40	55	994	0/90/80/50	0/0/0/0	40
2021	4	6	0000	16.3	105.2	30	40	55	995	0/90/80/40	0/0/0/0	30
2021	4	6	0600	16.2	105.6	20	35	50	995	0/60/80/40	0/0/0/0	30
2021	4	6	1200	16.4	105.9	30	35*	50	995	0/60/80/0	0/0/0/0	-
2021	4	6	1800	16.5	105.8	20	35*	50	995	0/60/100/0	0/0/0/0	-
2021	4	7	0000	16.3	105.6	20	35*	50	995	0/0/100/0	0/0/0/0	-
2021	4	7	0600	16.1	105.7	20	35*	50	995	0/0/100/0	0/0/0/0	-
2021	4	7	1200	16.2	105.8	20	40*	55	993	0/0/100/0	0/0/0/0	-
2021	4	7	1800	16.1	105.5	20	40*	55	993	0/0/100/0	0/0/0/0	-
2021	4	8	0000	15.8	105.6	20	35*	50	993	0/0/100/0	0/0/0/0	-
2021	4	8	0600	15.7	105.3	20	35*	50	994	0/0/70/0	0/0/0/0	-
2021	4	8	1200	14.8	105.6	30	40*	55	992	0/0/50/0	0/0/0/0	-
2021	4	8	1800	14.3	106.8	20	45	65	990	50/0/50/80	0/0/0/0	20
2021	4	9	0000	14.2	107.7	20	50	70	986	60/30/60/90	30/0/0/0	20
2021	4	9	0600	14.9	109.3	15	50	70	986	80/50/60/80	30/0/0/30	30
2021	4	9	1200	15.7	110.7	20	40	55	998	80/50/0/80	0/0/0/0	30
2021	4	9	1800	17.0	112.2	15	40	55	990	60/30/0/60	0/0/0/0	20
2021	4	10	0000	19.0	112.9	15	35*	50	992	30/30/0/0	0/0/0/0	-
2021	4	10	0600	21.2	112.9	30	35*	50	996	40/50/0/0	0/0/0/0	-
2021	4	10	1200	23.9	111.1	60	30	45	998	0/0/0/0	0/0/0/0	-

2. Meteorological description

2.1. Intensity analysis

Despite being classified as a tropical cyclone (requiring gales to extend more than halfway around the centre) for less than 48 hours in total, the system maintained an intensity of at least 35 knots for the entire period from 0000 UTC 4 April until 0600 UTC 10 April. This is shown in the intensity comparison plot in Figure 2.

The initial intensification was driven by synoptic influences. A monsoon surge enhanced winds on the eastern side, reaching 35 knots (10-minute mean) at 0000 UTC 4 April as shown on the Advanced Scatterometer (ASCAT-C) image in Figure 3. Gales then persisted on the southern side for a number of days, aided by the synoptic squeeze between the system and a high-pressure ridge to the south as shown on ASCAT images in Figures 4, 5, and 7. Convection developed over the centre on 5 April, and on post-analysis it has been determined that the system reached tropical cyclone intensity (with gales more than halfway around the system centre) for a 12-hour period from 1200 UTC 5 April until 0000 UTC 6 April, also indicated in Figures 5 and 6.

Sector gales remained on the southern side of the system (Figure 7) until it began interacting with Tropical Cyclone Seroja. As the system moved to the north-east, convection developed over the centre, and at 1800 UTC 8 April it regained tropical cyclone intensity as gales extend back around the northern side. The enhanced infra-red image at 0000 UTC 8 April in Figure 8 shows the centre under an extensive region of very cold cloud.

The rapid eastwards motion of Odette on 9 April enhanced the winds on the northern side, reaching a peak intensity of 50 kn at 0000 UTC 9 April as shown on the ASCAT-B image at 0149 UTC 9 April in Figure 9. At the same time this rapid motion saw an increase in shear over the system, which caused the convection to become displaced to the west of the centre. At 0000 UTC 10 April, gales became confined to the eastern side of the centre as shown on the ASCAT-B image at 0129 UTC 10 April in Figure 10, and the system was downgraded to below tropical cyclone intensity. It then dissipated at 1200 UTC 10 April as shown on ASCAT-A at 1243 UTC 10 April in Figure 11.

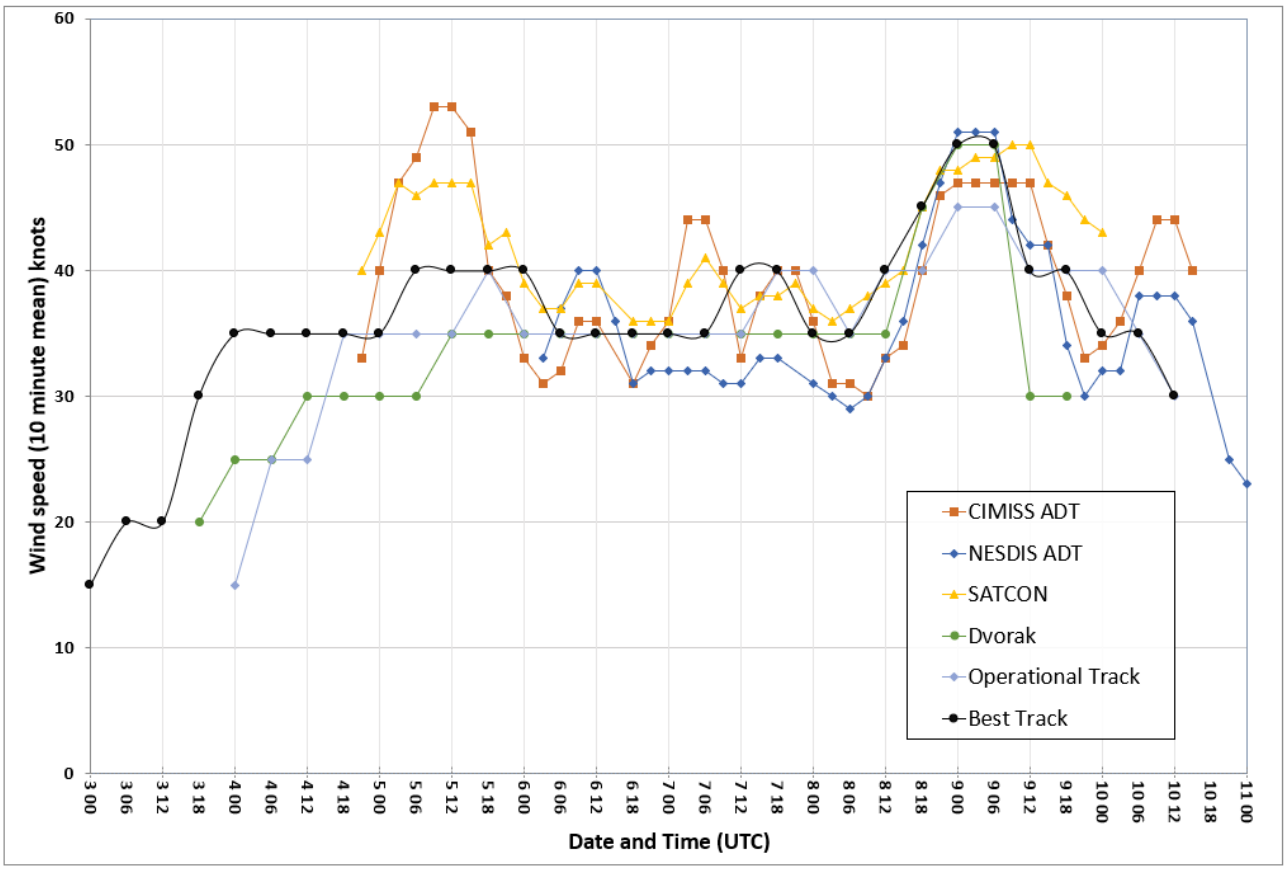

Figure 2. Plot of objective and subjective intensity estimates for Tropical Cyclone Odette.

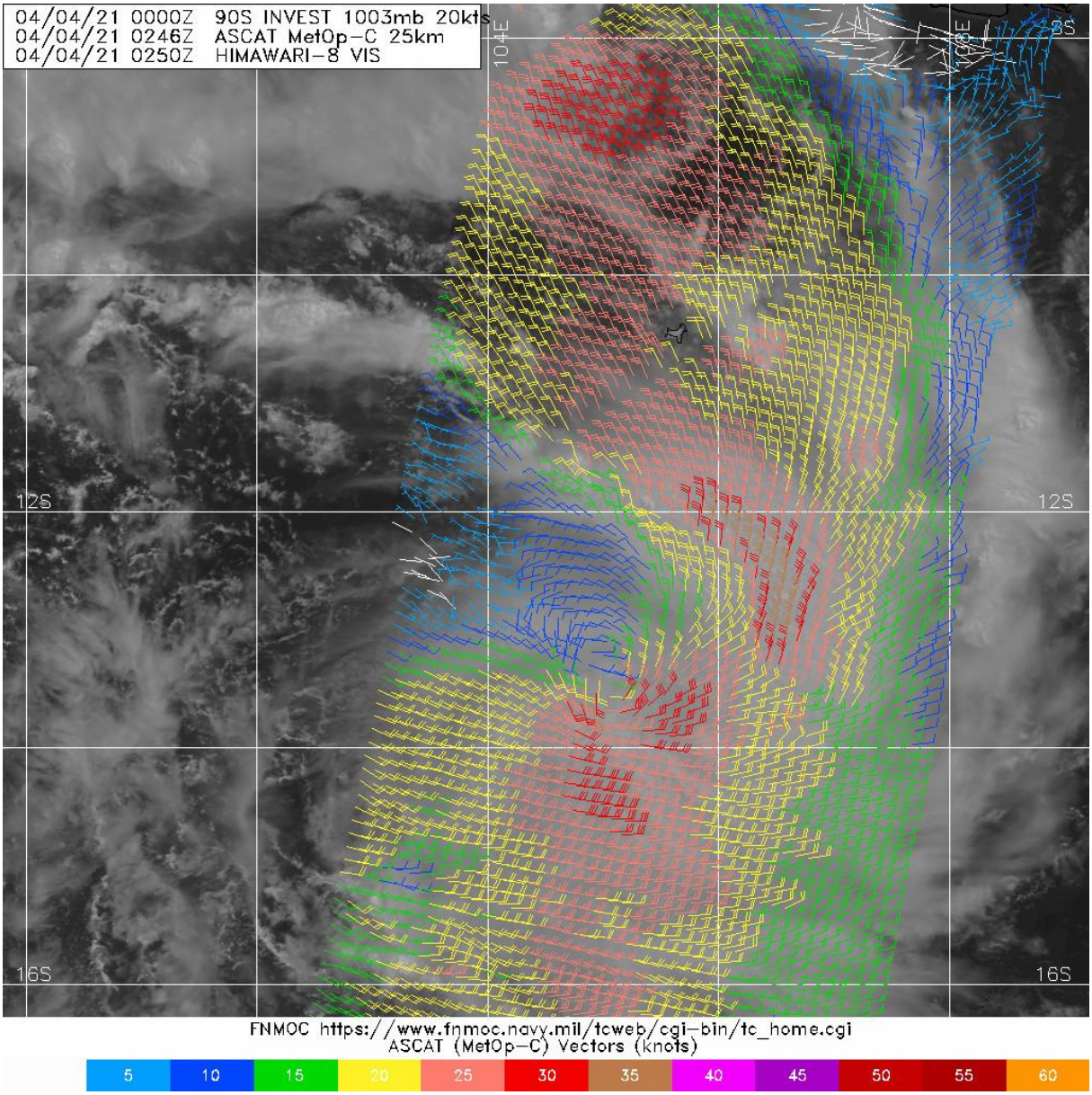

Figure 3. ASCAT-C at 0246 UTC 4 April, showing a band of 30-35 knot winds (one-minute mean) in convection to the east of the centre.

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

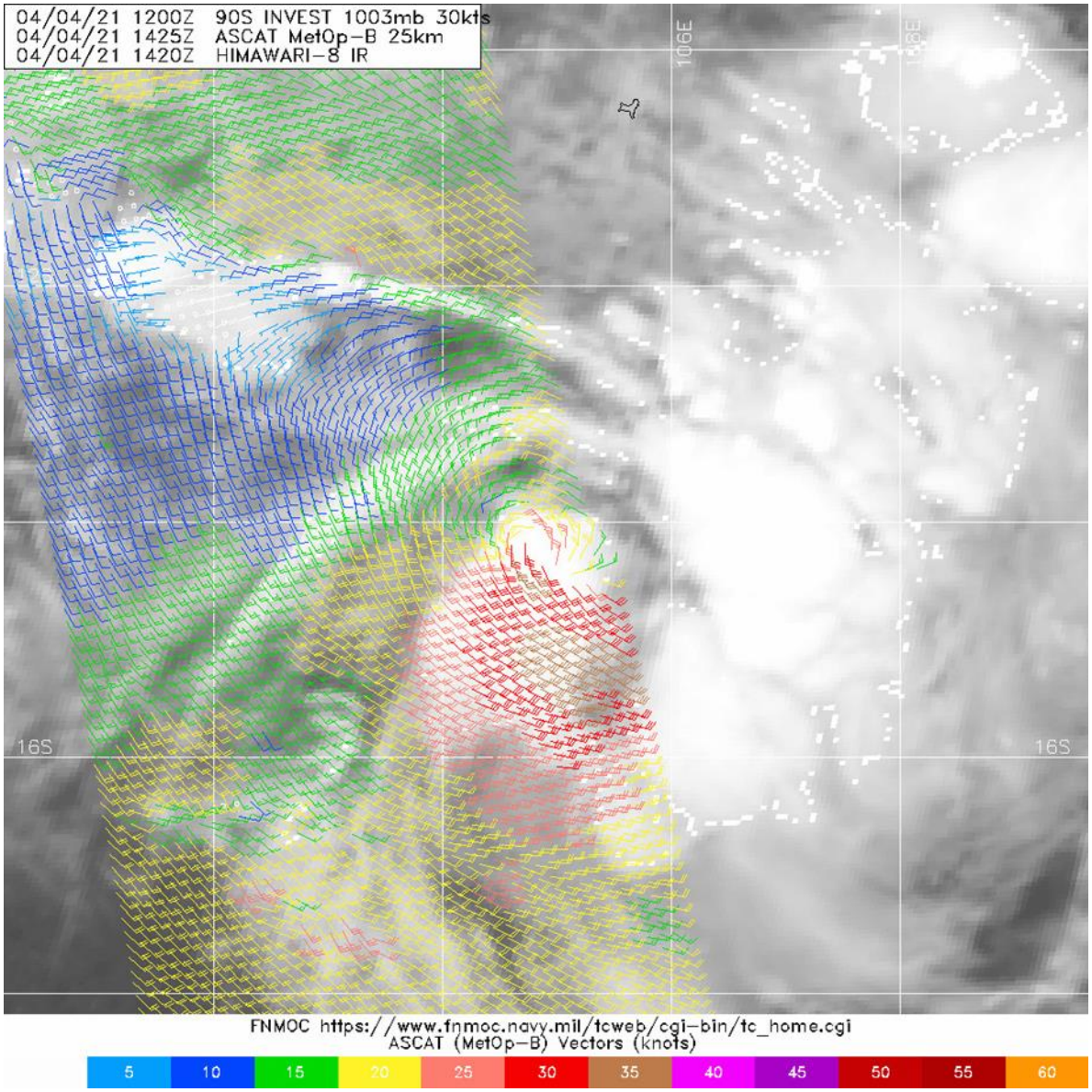

Figure 4. ASCAT-B at 1425 UTC 4 April, showing 35 knot winds in the southern semicircle.

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

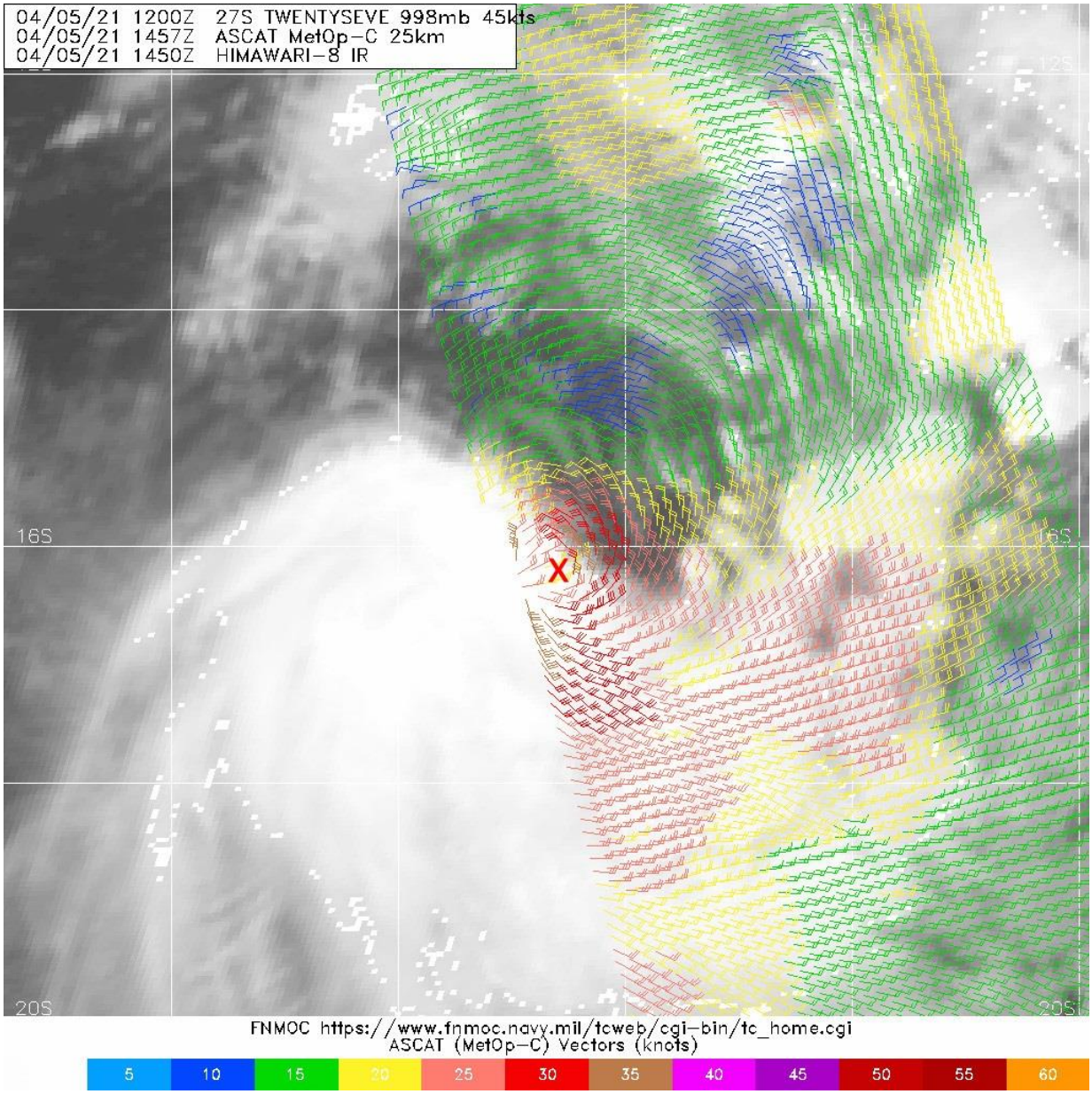

Figure 5. ASCAT-C at 1457 UTC 5 April, showing gales around the system centre.

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

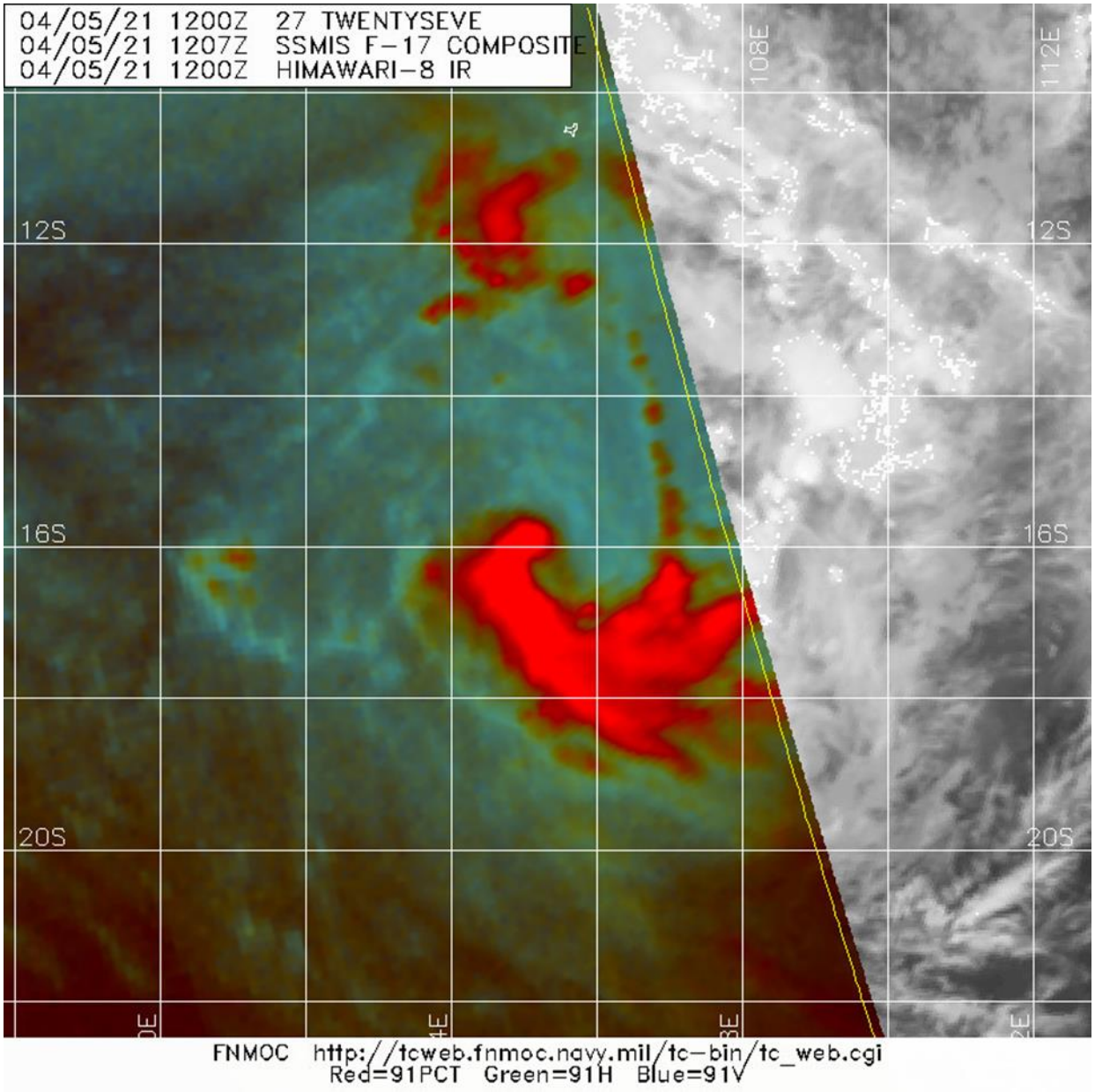

Figure 6. SSMIS F17 91GHz microwave pass at 1207 UTC 5 April, when tropical cyclone intensity is first estimated to be reached (note: system was not operationally assigned tropical cyclone intensity at this stage).

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

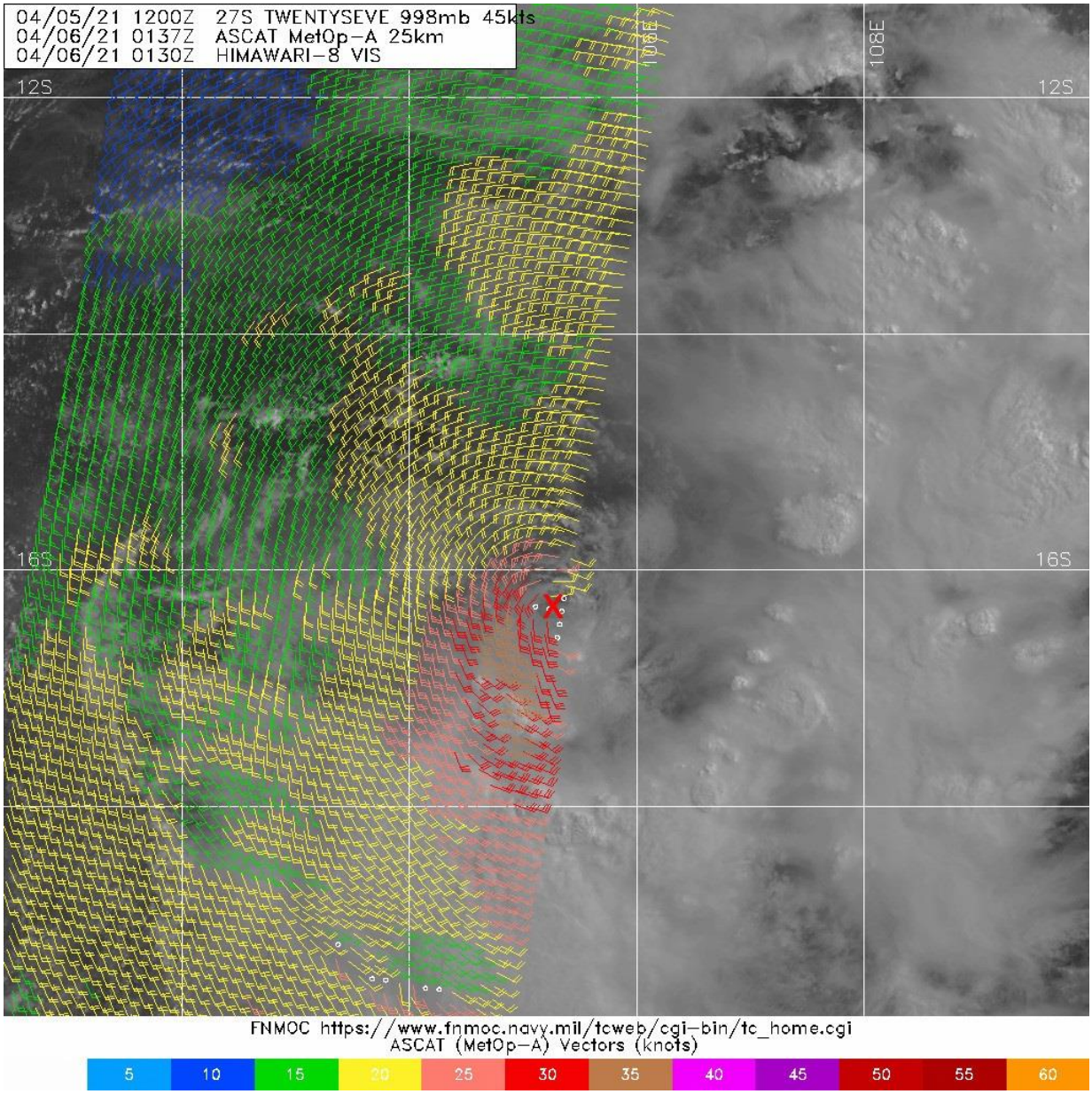

Figure 7. ASCAT-A at 0137 UTC 6 April, showing gales no longer occurring on the northern side of the system, along with an exposed low-level centre in visible imagery.

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

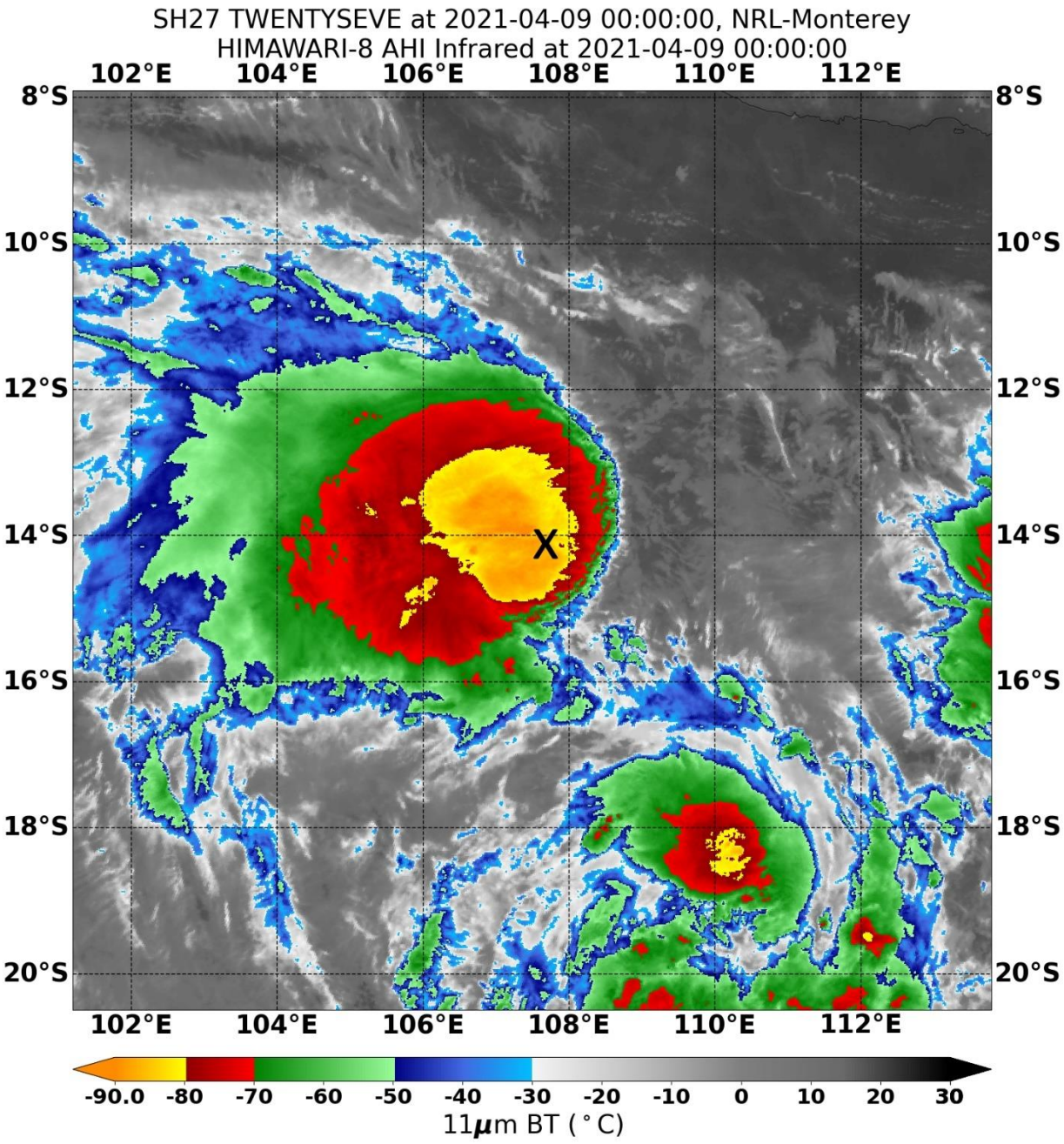

Figure 8. Infrared satellite image at 0000 UTC 9 April, when Tropical Cyclone Odette was at peak intensity of 50 kn.

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

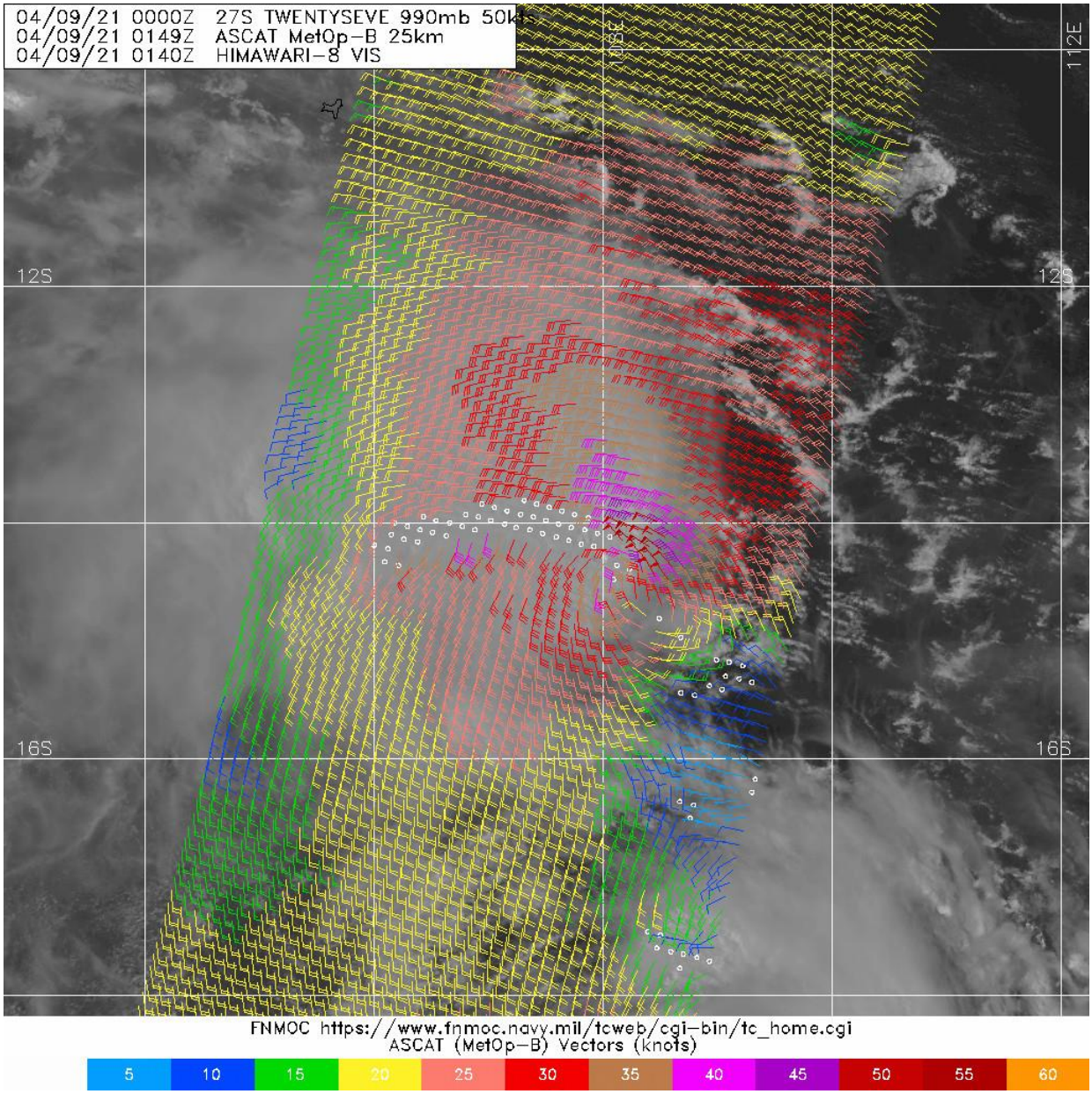

Figure 9. ASCAT-B at 0149 UTC 9 April, showing winds up to 55 knots.

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

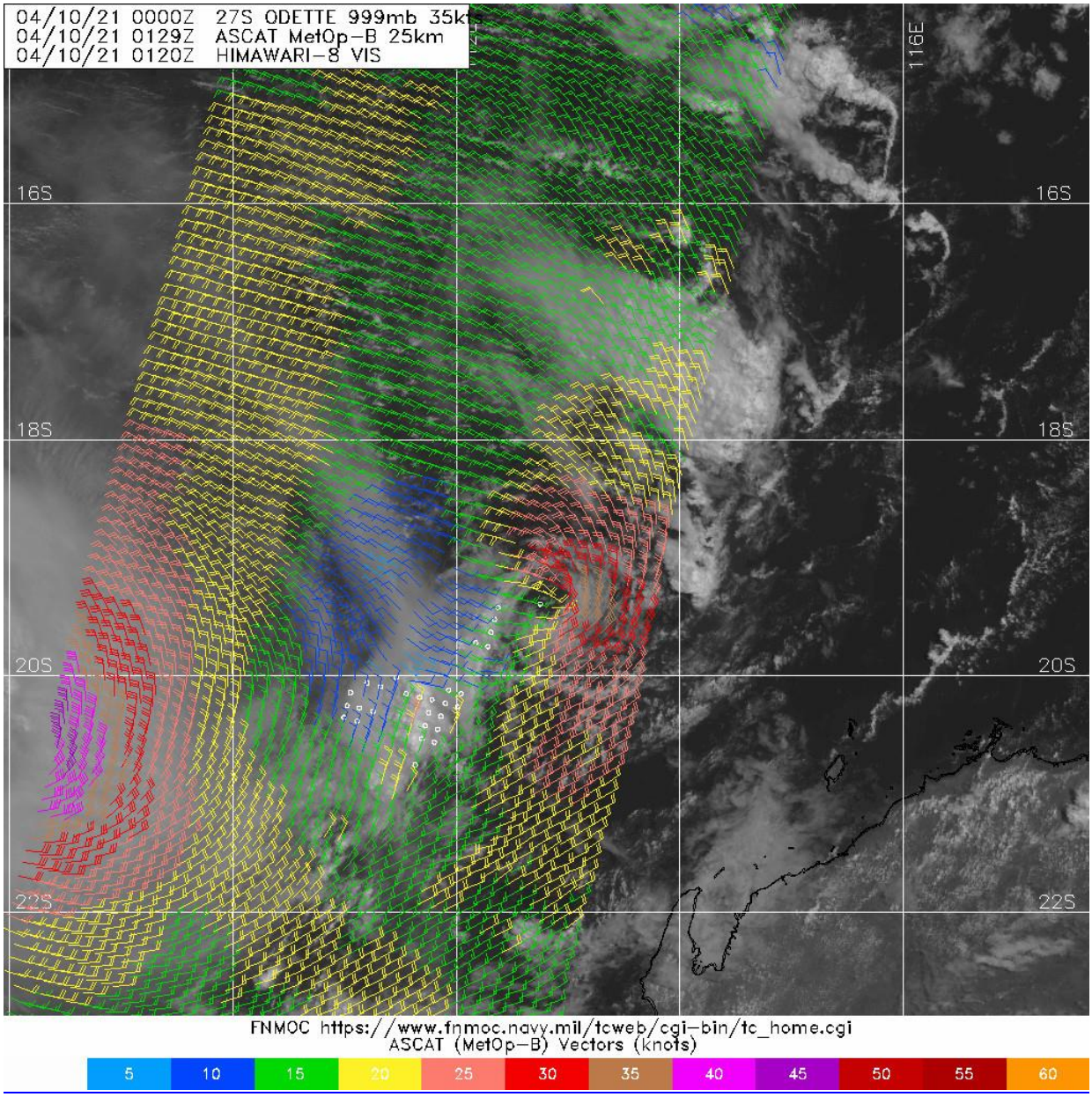

Figure 10. ASCAT-B at 0129 UTC 10 April, showing ex-Tropical Cyclone Odette with 35 knot winds still observed in the eastern semicircle. Tropical Cyclone Seroja can be seen further to the west.

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

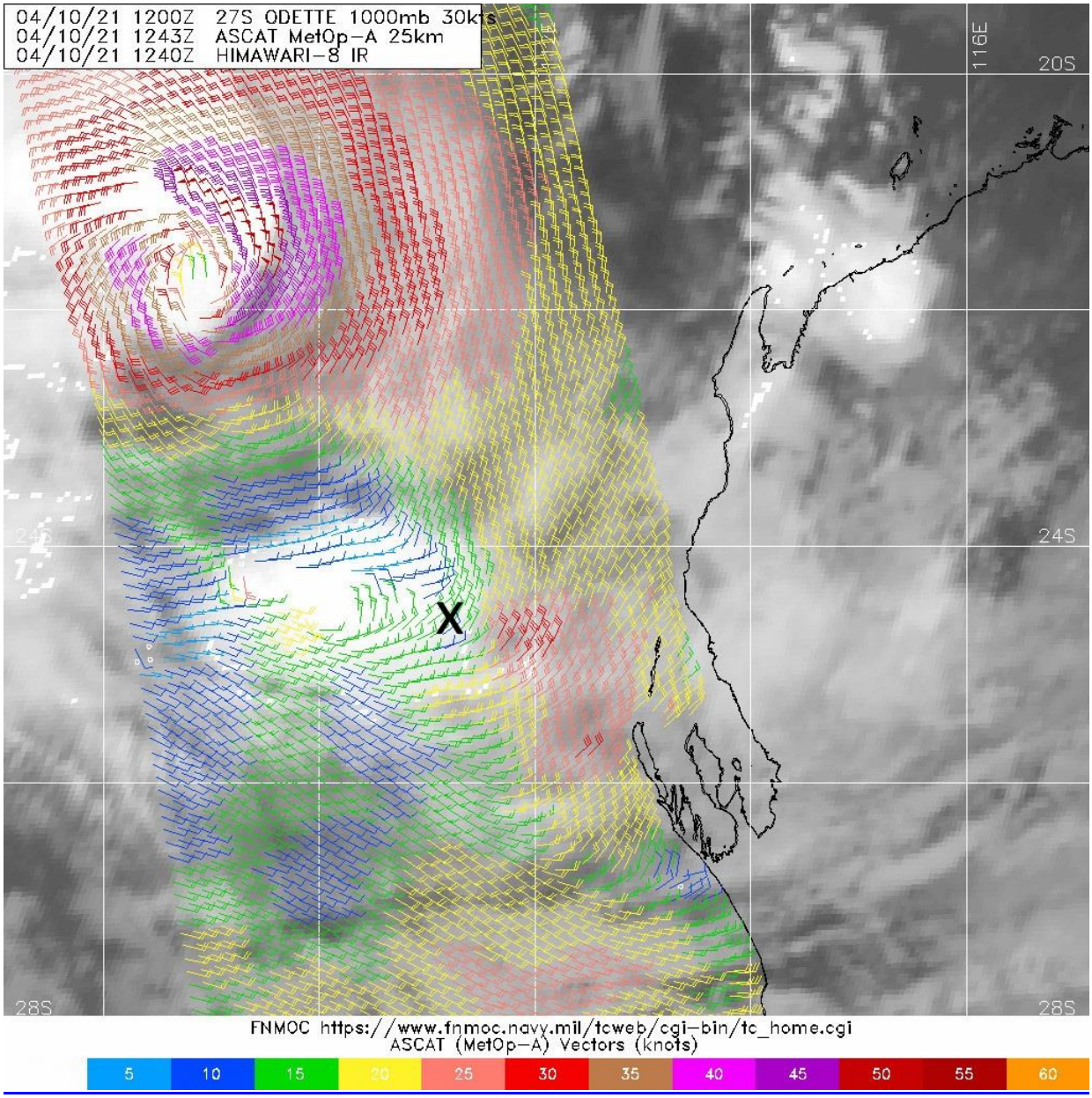

Figure 11. ASCAT-A at 1243 UTC 10 April, showing the remnants of ex-Tropical Cyclone Odette (centre marked by x) dissipating to the south-east of Tropical Cyclone Seroja.
Image courtesy NRL: https://www.nrlmry.navy.mil/TC.html

2.2. Structure

Tropical Cyclone Odette maintained an asymmetric structure for most of its lifetime. Gales initially formed to the east of the system, as shown in Figure 3 due to enhancement from the monsoonal flow. These gales then moved to the southern side, shown in Figure 4 as the system interacted with a high- pressure ridge to the south. For a period on 5 April, gales extended to the northern side of the centre, as shown in Figure 5. However as northerly shear increased, the gales again become confined to the southern semicircle as shown in Figure 6.

When the system interacted with Tropical Cyclone Seroja and accelerated towards the north-east and then south-east, gales once again extended to the north of the centre. The rapid motion saw a small band of storm force winds develop on the northern side, shown in Figure 9. When the system started weakening under the influence of strong easterly shear on 10 April, the gales became confined to the eastern semicircle, shown on the ASCAT image in Figure 10 due to the rapid southerly motion. The system then dissipated later on 10 April shown on the ASCAT image in Figure 11.

2.3. Motion

After formation, the system was initially steered towards the south-east under the influence of a north-westerly monsoonal flow. On 4 April, a mid-level ridge to the south-east of the system produced a more northerly steering flow over the system, causing it to move towards the south. During 5 April, the steering flow became light as the system was cradled between mid-level ridges to the south-east and north-west, and mid-level trough to the west. This resulted in slow and slightly erratic motion over the following three days.

On April 8, Tropical Cyclone Seroja was approaching from the east, moving in a south-westerly direction under the influence of the mid-level ridge over northern Australia. Seroja interacted with Odette via a Fujiwara interaction, with the two systems rotating around each other in a clockwise direction. Odette moved rapidly towards the north-east and then south-east during 8-9 April, before moving south of April 10 and ultimately dissipating.

3. Impact

Tropical Cyclone Odette remained over the Indian Ocean and had no significant impacts to the Western Australian mainland. Heavy rainfall affected Christmas Island as the developing system passed to the west, with 115.6 mm of rainfall recorded in the 24 hours to 0100 UTC 4 April.

4. Observations

4.1. Rainfall

Christmas Island recorded 115.6 mm of rainfall in the 24 hours to 0100 UTC 4 April.

5. Forecast performance

Official tropical cyclone forecasts were issued from 6-10 April. Prior to this, Ocean Wind Warnings were issued by the Bureau of Meteorology National Operations Centre, due to the expectation that gales would remain to the southern semicircle, and the system would not develop into a tropical cyclone.

No tropical cyclone watches or warnings were issued for this system due to its forecast weakening before approaching the WA mainland. However, Severe Weather Warnings for damaging winds were issued from 9 April for the risk of a period of gales as the remnants of Odette passed close to the north-west of WA. A cancellation was issued on the evening of 10 April as the system dissipated.

The accuracy figures are shown in table 2 below and in Figure 12. Note that there is no verification beyond 96 hours, as the first official forecast was issued less than 120 hours before the system dissipated. Also note that the sample size for 96 hours is too small to be considered reliable. We can see that the forecast position accuracy was close to the five-year average until 48 hours, then worse beyond that. This was due to longer term uncertainty in how the system would interact with Tropical Cyclone Seroja. The intensity forecasts had a reasonably constant error for the first 72 hours, which can be attributed to the intensity remaining in the 35 to 45 kn range for an extended period of the system's life.

Table 2. Verification statistics for Tropical Cyclone Odette.

Forecast hour	**00**	**06**	**12**	**18**	**24**	**36**	**48**	**72**	**96**
Position Absolute error (km)	26	49	60	62	69	100	139	376	*629*
Intensity Absolute error (kn)	1.8	3.3	3.5	3.8	3.7	4.2	3.6	5.7	*1.7*
Sample Size	19	18	17	16	15	13	11	7	*3*

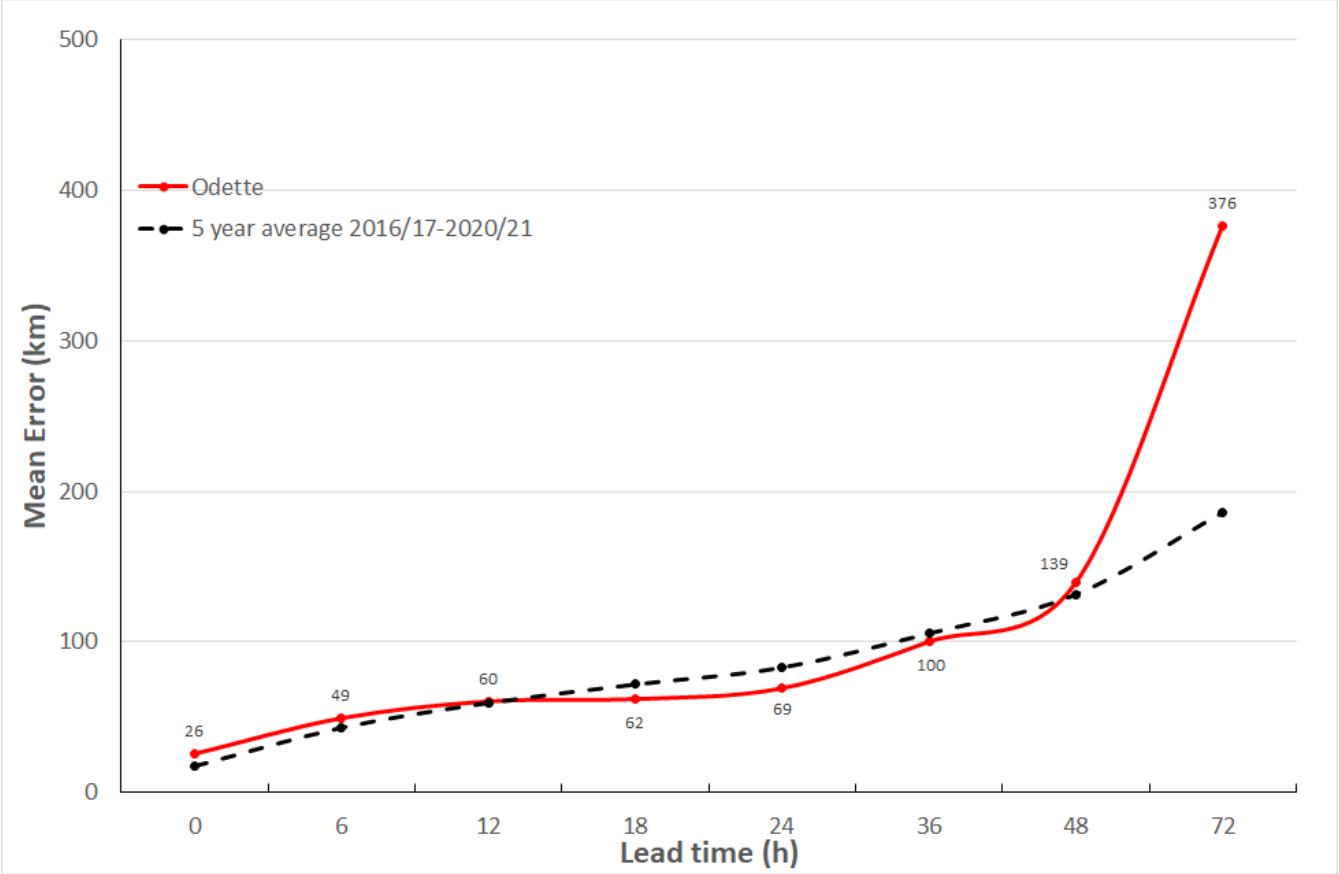

Figure 12 a. Position accuracy figures for Tropical Cyclone Odette.

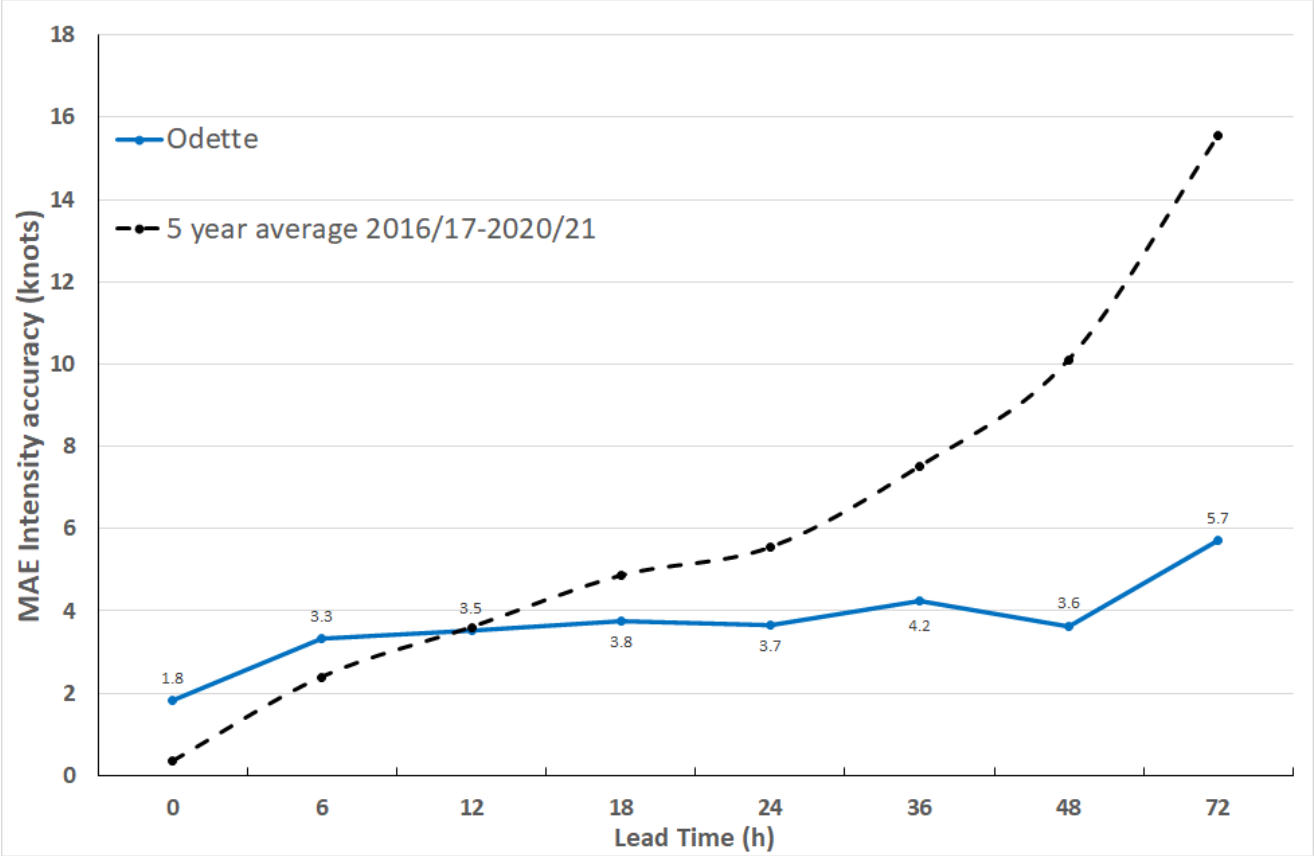

Figure 12 b. Intensity accuracy figures for Tropical Cyclone Odette.

6. 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
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
km/h	kilometres per hour
kn	knot
LLCC	LLCC
MET	Model Expected T-number

METOP	Meteorological Operational Satellite
MJO	Madden-Julian Oscillation
mm	millimetres
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