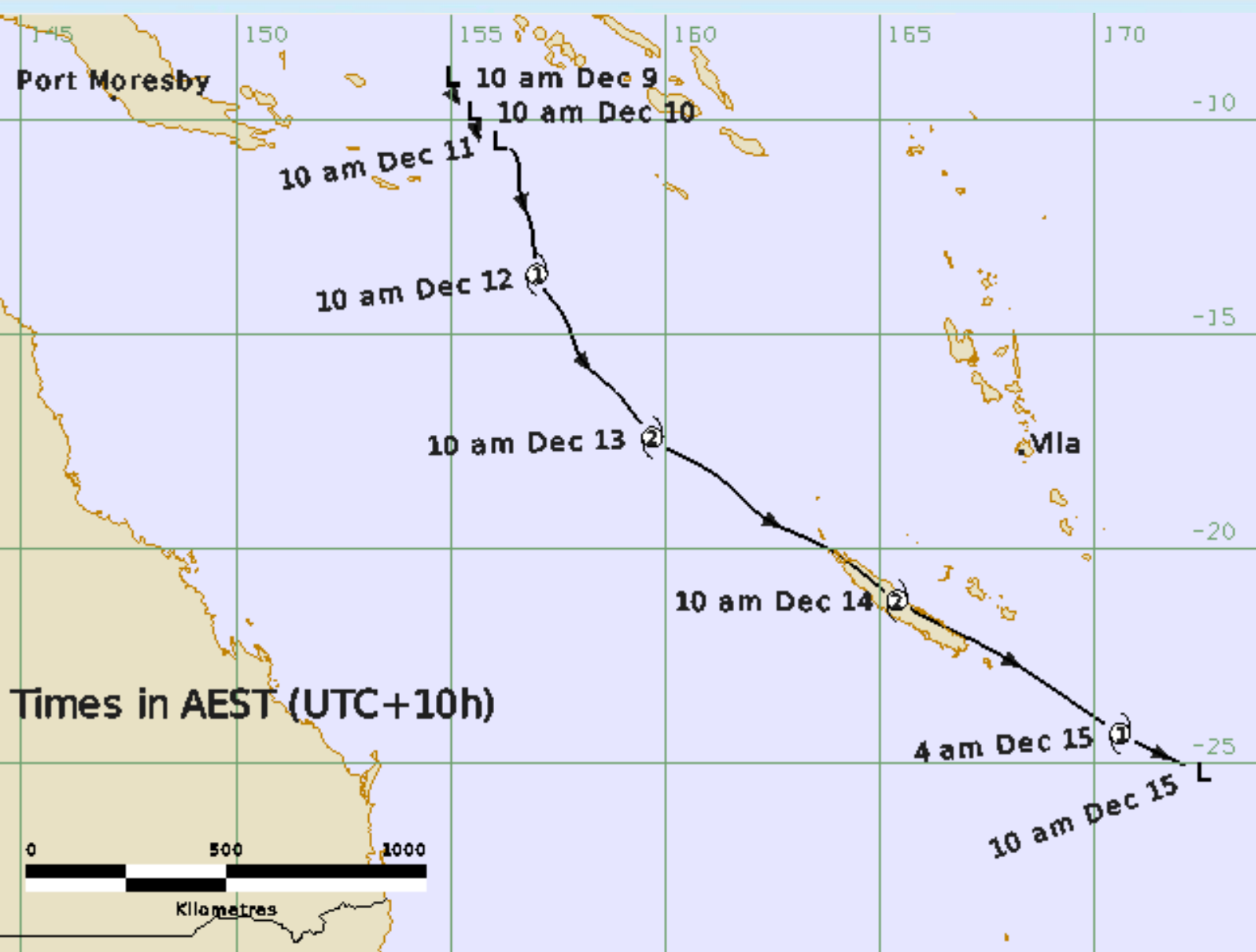




Tropical Cyclone *Ruby*

09 – 15 December 2021

Matthew Boterhoven, Craig Earl-Spurr, Lauren Pattie, Nadine Birch, Severe Weather Environmental Prediction Services, 27 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

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1 Summary

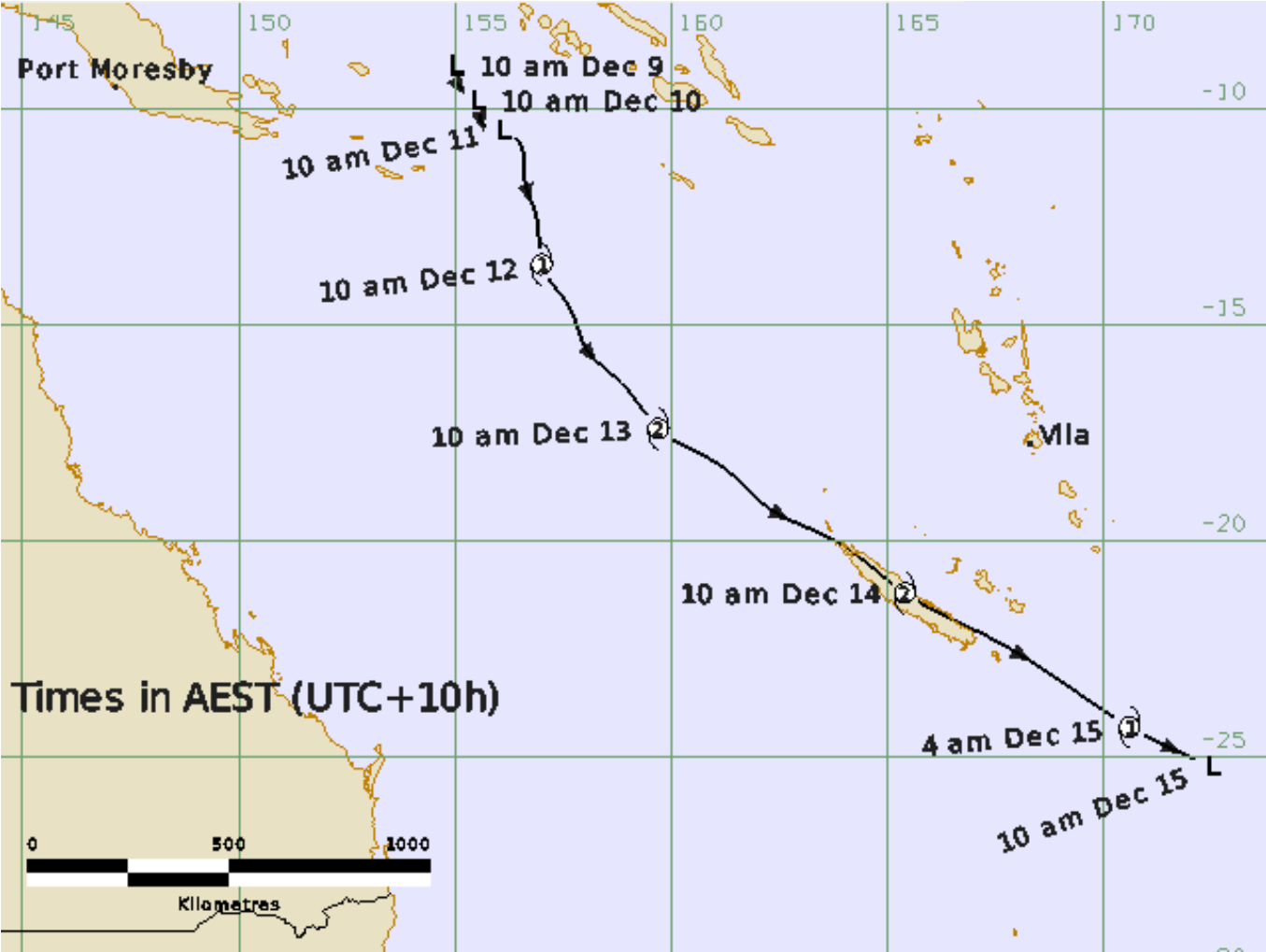
A tropical low formed in the Solomon Sea on 9 December and travelled very slowly to the southeast over the next few days. The tropical low gradually developed, reaching category 1 tropical cyclone strength on the morning of 12 December. Later that night *Ruby* intensified into a category 2 tropical cyclone, increasing in speed as it continued its motion towards the southeast. Around midday EST on 13 December *Ruby* moved out of the Australian region (160°E). Tropical Cyclone *Ruby* maintained its intensity, at category 2, as it travelled directly over New Caledonia on 14 December. Wind gusts of 137 km/h were recorded at Touho and at Thio¹.

Tropical Cyclone *Ruby* occurred a significant distance from the Australian mainland and was short-lived as a tropical cyclone in the Australian area of responsibility.

Tropical Cyclone *Ruby* was the second tropical cyclone in the Australian region for the 2021/22 season.

¹ Observations courtesy of Météo France

FIGURE 1 Best track of Tropical Cyclone *Ruby* 9 - 15 December 2022 (times in AEST, UTC+10 hours).



2 Meteorological Description

2.1 Intensity analysis

An initial low developed in the Solomon Sea on 9 December and began moving slowly towards the southeast. Deep convection, associated with the low, became more organised overnight into 10 December and the system began strengthening later that day.

Gales briefly developed in the eastern quadrants around 0000 UTC 11 December, evident in an Advanced Scatterometer Metop C (ASCAT-C) pass at 2329 UTC 10 December but eased again in Advanced Microwave Scanning Radiometer 2 (AMSR2) pass at 0258 UTC 11 December.

Tropical Cyclone *Ruby* formed at 0000 UTC 12 December, when it was over the northern Coral Sea, with an intensity of 40 knots (75 kilometres per hour), based on improved satellite imagery and Dvorak estimate. *Ruby* continued to intensify during 12 December. A 1046 UTC 12 December ASCAT-B image (Figure 2) showed *Ruby* reaching 50 kn (95 km/h) or Category 2 intensity, prior to obtaining a peak intensity of 60 kn (110 km/h) at 0000 UTC 13 December.

As the influence of the trough passing to the south of *Ruby* increased, westerly vertical wind shear began to inhibit further intensification, with Dvorak intensity trend changing to a weakening trend from 0600 UTC 13 December. As *Ruby* passed over New Caledonia on 14 December, 74 kn (137 km/h) gusts was recorded at Touho and at Thio², consistent with a 10-minute mean wind of 55 kn (100km/h). Other gusts, recorded by Météo France as *Ruby* moved over New Caledonia, ranged from 49 to 87 kn (90 to 162 km/hr)³, and were consistent with a category 2 intensity.

With increasing vertical wind shear, deep convection near the centre of *Ruby* quickly reduced overnight into 15 December. This provided clear evidence that *Ruby* was transitioning into a subtropical system, though a 2117 UTC 14 December an ASCAT-B pass showed *Ruby* maintaining an intensity of 45 kn (85km/h) as it transitioned.

The intensity plot in Figure 5 indicates the post-event estimated intensity is generally consistent with operational estimates, though generally lower than objective aids. The Advanced Dvorak Technique (ADT) provided estimates significantly higher during 12 and 13 December as *Ruby* reached its peak intensity.

² Observations courtesy of Météo France.

³ Observations courtesy of Météo France. Significant observations listed in: Brice Bacquet and Jean-Alexis Gallien-Lamarche (14 December 2021) *Ruby a quitté le Caillou, les alertes ont été levées à 8 heures*, *The Caledonian News, the Journal of New Caledonia*, accessed 28 June 2022. <https://www.lnc.nc/article-direct/faits-divers/nouvelle-caledonie/ruby-a-quitte-le-caillou-les-alertes-ont-ete-levees-a-8-heures>

2.2 Structure

Ruby was a small circulation during much of its lifetime. When first reaching Category 1 intensity, *Ruby* had a symmetric wind field with radius of gales of 40 nautical miles (75 kilometres). Aided by some weak monsoonal inflow, the radius of gales extended out to 50 nm (90 km) in the northeast quadrant as the circulation moved through the northern Coral Sea. When first reaching Category 2 intensity, the radius of storm force winds was 20 nm (35 km) and once again was symmetric.

As *Ruby* began accelerating towards the southeast, its structure became much more asymmetric. Assisted by the forward motion, storm force winds became restricted to only the northeast quadrant and eventually extended out to 45 nm (80 km) and the radius of gales also increased to 90 nm (170 km).

After passing New Caledonia on 14 December, *Ruby* began transitioning into a subtropical cyclone. While the low-level circulation remained well organised the radius of gales began to decrease again.

2.3 Motion

Ruby initially tracked slowly to the southeast as weak tropical low from the Solomon Sea into the northern Coral Sea. While intensifying during 11 December, *Ruby* adopted a more southward track under the influence of a mid-level high pressure system to the east. *Ruby* was then captured by a mid-latitude trough to the south and accelerated towards the southeast once more, passing over New Caledonia during 14 December.

FIGURE 2. ASCAT-B wind speed analysis image at 1046 UTC 12 December 2021.

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

SH03 RUBY at 2021-12-12 12:00:00, NRL-Monterey

METOP-B ASCATUHR Winds at 2021-12-12 10:46:30

HIMAWARI-8 AHI Infrared at 2021-12-12 10:50:00

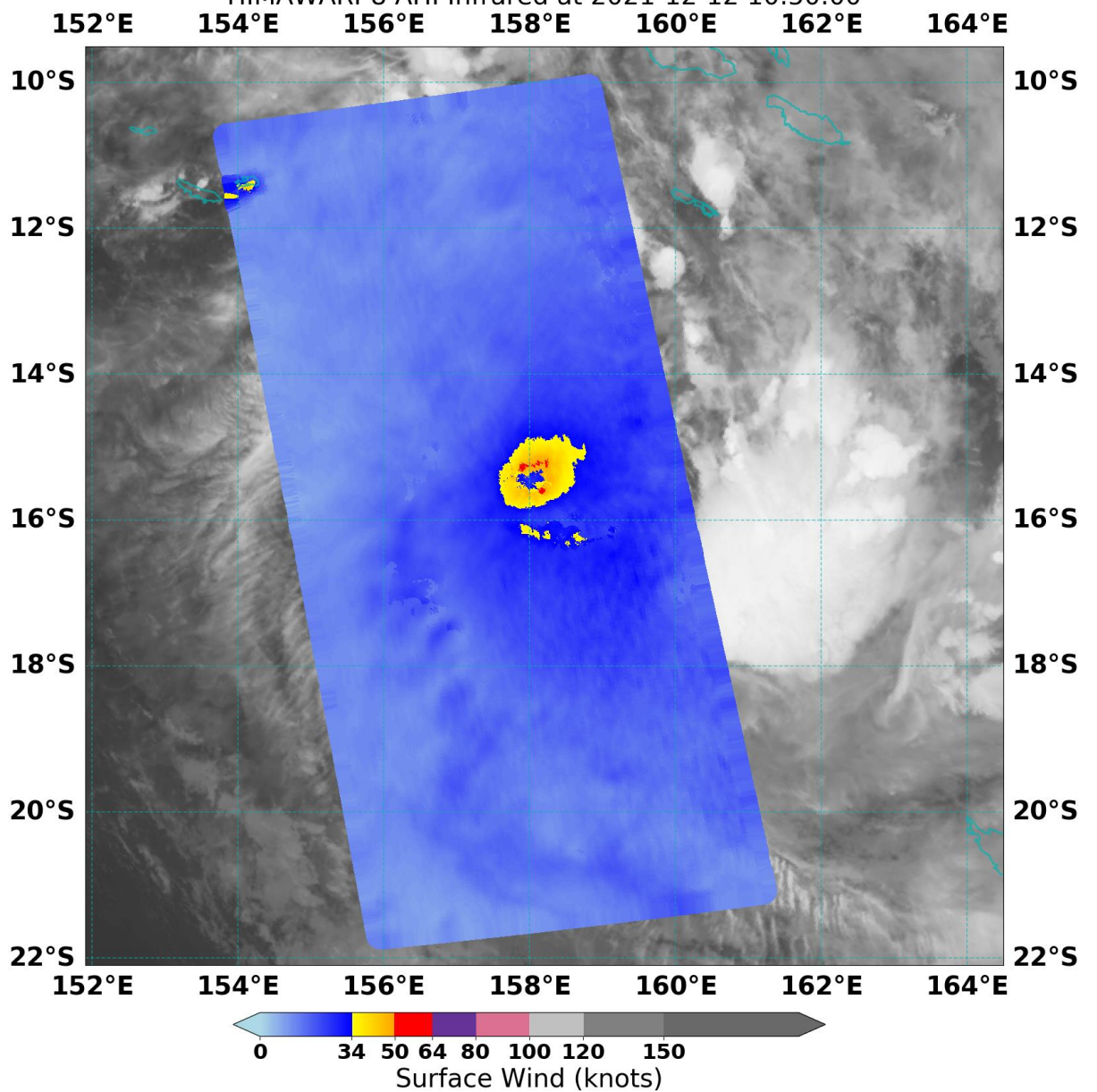


FIGURE 3. GCOM 89 GHz microwave image at 1431 UTC 12 December 2021

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

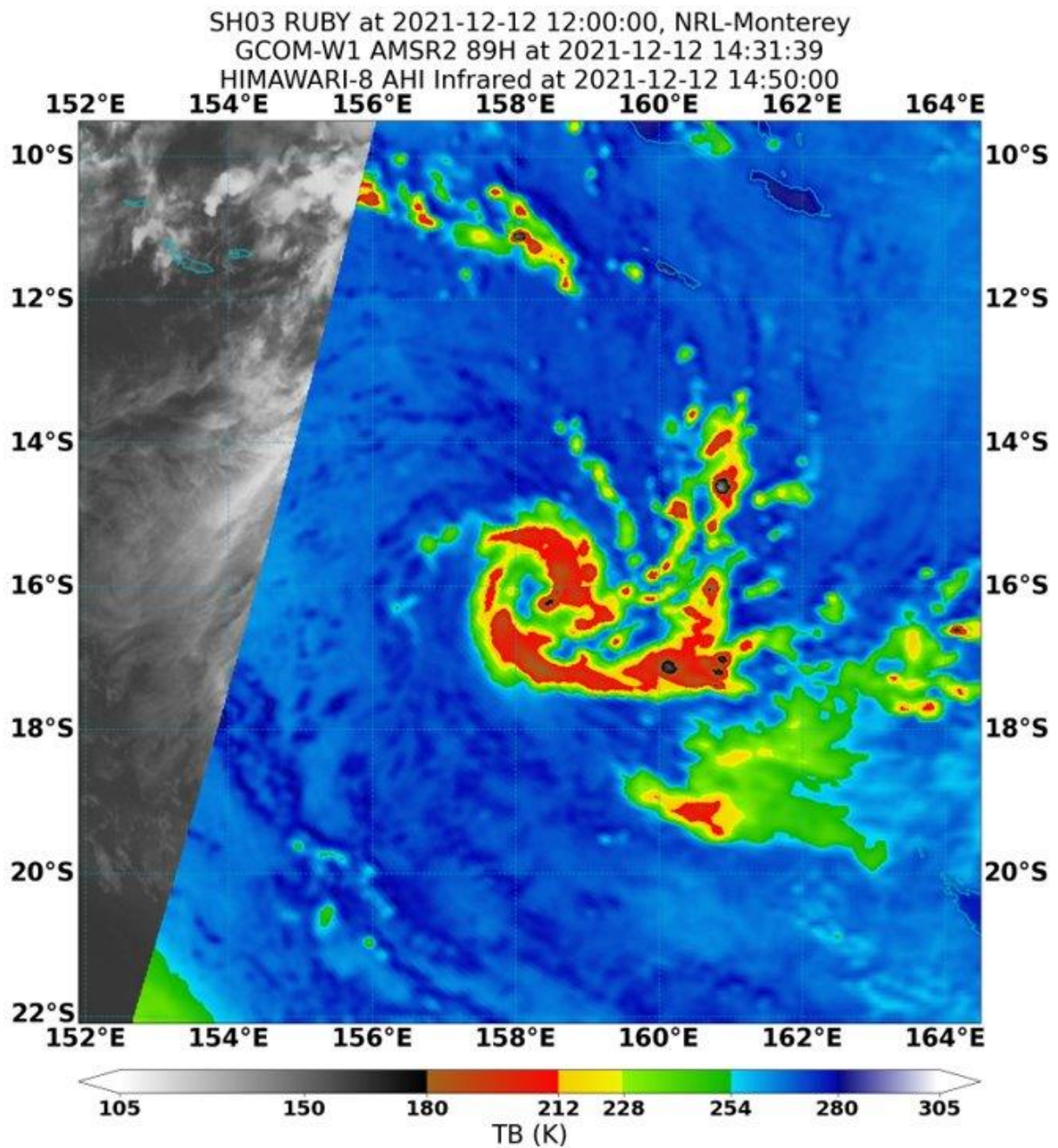


FIGURE 4. Calédonie Radar image 0430 UTC 14 December 2021.

Image courtesy Meteo France (Nouvelle Calédonie): <https://www.meteo.nc/>

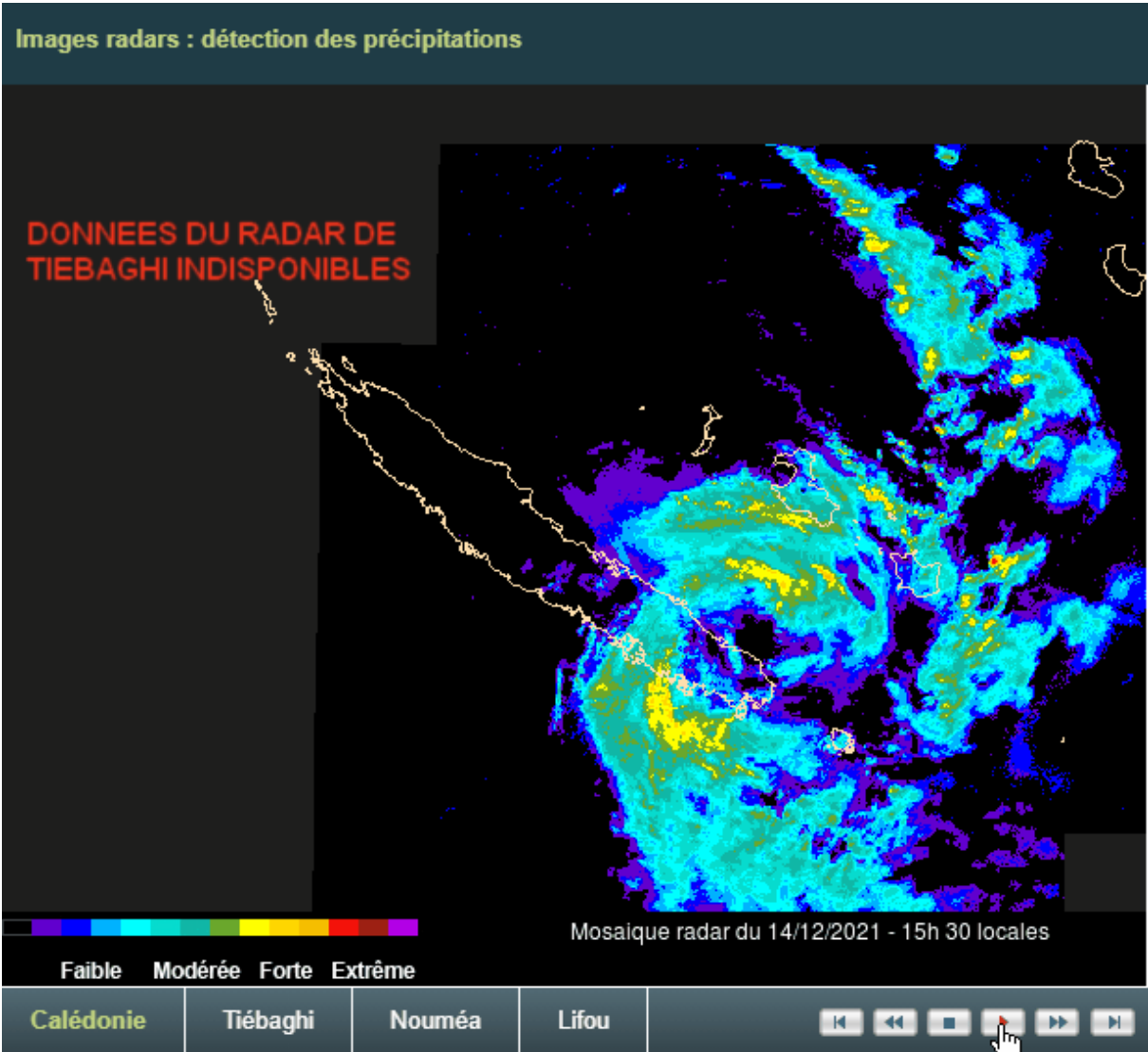
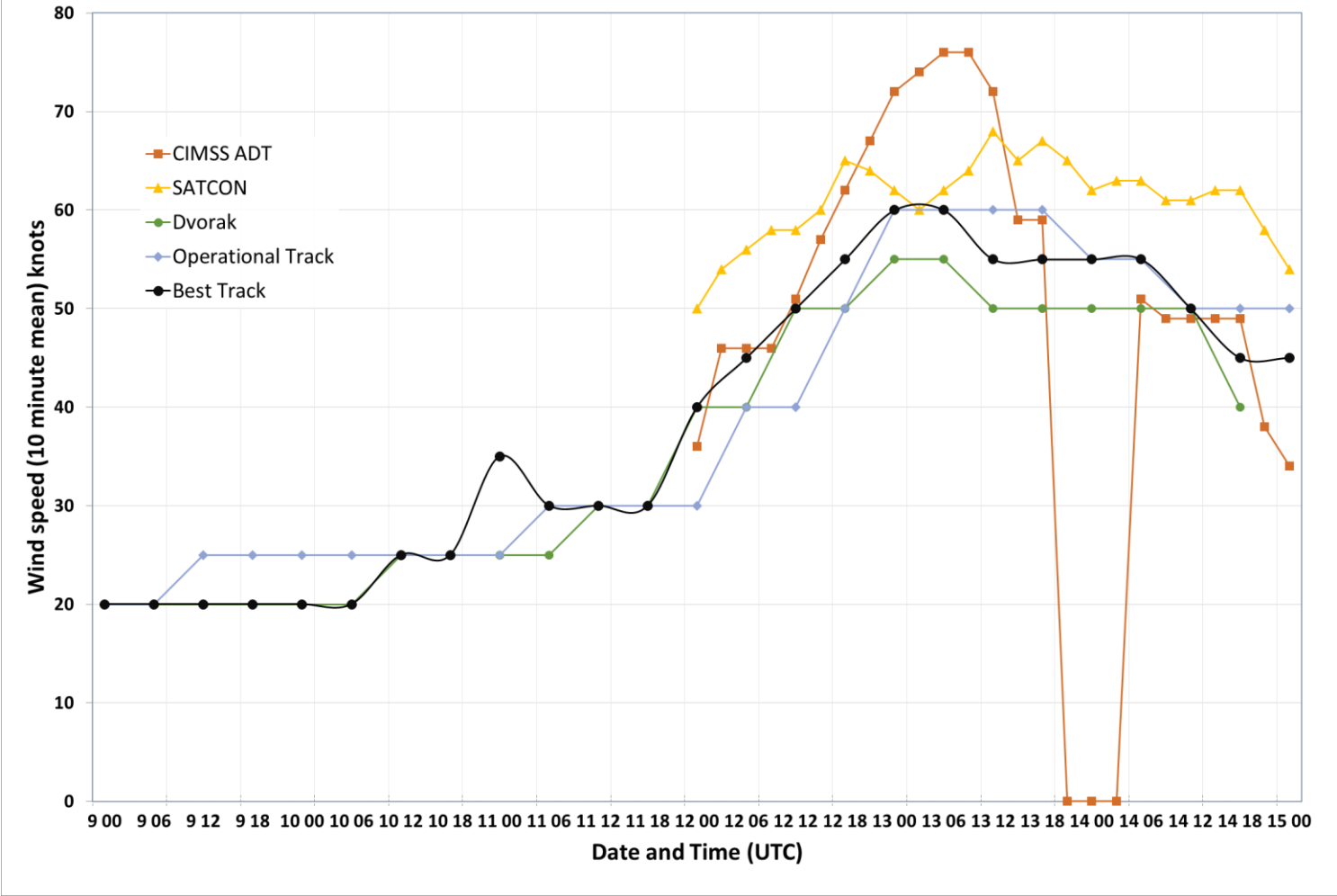


FIGURE 5. Plot of objective and subjective intensity estimates for *Ruby*.



3 Impact

No impacts were reported for the Australian region.

Ruby impacted transportation and electricity services in New Caledonia. Evacuations also occurred as *Ruby* moved over New Caledonia.⁴⁵

⁴ Brice Bacquet and Jean-Alexis Gallien-Lamarche (14 December 2021)

⁵ Caroline Moureaux (13 December 2021) La Nouvelle-Calédonie se prépare à l'arrivée de la dépression Ruby, *france.tv*, accessed 28 June 2022.

<https://la1ere.francetvinfo.fr/nouvellecaledonie/la-nouvelle-caledonie-se-prepare-a-l-arrivee-de-la-depression-ruby-1179301.html>

4 Observations

No significant observations were recorded in the Australian region.

Gusts of 90-162km/hr were observed as *Ruby* moved over New Caledonia. Additionally, significant rainfall was recorded during the 48hrs of *Ruby's* passage with Grande Terre broadly recording 100-200mm, and some locations in New Caledonia 200-400mm.⁶

⁶ Observations curtesy of Météo France. Significant observations listed in: Brice Bacquet and Jean-Alexis Gallien-Lamarche (14 December 2021)

TABLE 1. Best track summary for Tropical Cyclone *Ruby* 9-15 December 2021.

Refer to the Australian Tropical Cyclone database for complete listing of parameters and. Note: UTC is AEST - 10 hours. * not at tropical cyclone intensity. **sub-tropical system from 00 UTC 15 December.

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	12	9	0000	9.0	155.0	45	20	45	1007	0/0/0/0	0/0/0/0	-
2021	12	9	0600	9.5	155.1	45	20	45	1007	0/0/0/0	0/0/0/0	-
2021	12	9	1200	9.6	155.2	60	20	45	1006	0/0/0/0	0/0/0/0	-
2021	12	9	1800	9.7	155.3	60	20	45	1006	0/0/0/0	0/0/0/0	-
2021	12	10	0000	9.8	155.5	60	20	45	1006	0/0/0/0	0/0/0/0	-
2021	12	10	0600	10.1	155.6	45	20	45	1003	0/0/0/0	0/0/0/0	-
2021	12	10	1200	10.3	155.6	30	25	45	1002	0/0/0/0	0/0/0/0	-
2021	12	10	1800	10.4	155.7	25	25	45	1000	0/0/0/0	0/0/0/0	-
2021	12	11	0000	10.5	156.1	20	35*	50	998	0/40/0/0	0/0/0/0	-
2021	12	11	0600	10.8	156.5	35	30	45	999	0/0/0/0	0/0/0/0	-
2021	12	11	1200	11.6	156.6	45	30	45	1001	0/0/0/0	0/0/0/0	-
2021	12	11	1800	12.6	156.9	30	30	45	1000	0/0/0/0	0/0/0/0	-
2021	12	12	0000	13.6	157.0	20	40	55	994	40/40/40/40	0/0/0/0	20
2021	12	12	0600	14.7	157.7	20	45	65	990	50/40/30/40	0/0/0/0	15
2021	12	12	1200	15.5	158.0	20	50	70	988	50/50/30/30	20/20/20/0	10
2021	12	12	1800	16.4	158.9	20	55	75	983	50/40/40/40	20/20/20/20	10
2021	12	13	0000	17.4	159.7	30	60	85	980	50/40/40/40	20/20/20/20	10
2021	12	13	0600	18.3	161.2	20	60	85	977	50/40/50/30	20/20/20/20	10
2021	12	13	1200	19.2	162.2	15	55	75	981	50/30/50/30	20/0/0/0	10
2021	12	13	1800	20.0	163.8	20	55	75	980	60/50/50/30	20/0/0/0	15
2021	12	14	0000	21.2	165.4	35	55	75	982	75/60/50/30	20/0/0/0	20
2021	12	14	0600	22.2	167.3	20	55	75	981	90/70/50/50	45/0/0/0	25
2021	12	14	1200	23.3	169.1	15	50	70	987	90/70/50/50	45/0/0/0	25
2021	12	14	1800	24.3	170.6	15	45	65	987	70/60/60/60	0/0/0/0	25
2021	12	15	0000	25.2	172.5	20	45**	65	987	70/50/50/50	0/0/0/0	25

5 Forecast Performance

Official tropical cyclone forecasts were issued from 10-13 December. Ocean wind warnings commenced at 0644 UTC 10 December for the Coral Sea and ceased by 0138 UTC 13 December when *Ruby* moved east of (160E), the Australian region of responsibility. The tropical cyclone information bulletins commenced 0136 UTC 10 December and ceased at 0139 UTC 13 December.

The accuracy figures for Tropical Cyclone *Ruby* below and in Figure 6 show that both the forecast position and intensity errors versus the five-year average out to 96 hour forecast range. The intensity forecast errors were above the five-year average for the 0-24 hour forecast range but were similar or better than the five-year average for the 36-96 hour forecast range.

The intensity errors over the 0-24 forecast range were a consequence of the official forecast tracks issued between 0000 UTC 11 December and 0000 UTC 12 December underestimating the development of *Ruby* between 0600 UTC 12 December and 0600 UTC 13 December. The official forecast tracks during this period were derived from inconsistent intensity forecasts from the model guidance.

The track position errors were similar or better than the five-average in the first 72 hours of the forecast, however the position error increased from the 96 hour forecast range. The positional error increased at the 96 hour forecast due to *Ruby* accelerating to the southeast under the influence of an approaching upper trough to the southwest.

	0	6	12	18	24	36	48	72	96	120
Position										
Absolute error (km)	34	48	58	63	66	82	124	171	327	-
Intensity										
Absolute error (kn)	3.8	5.0	5.8	7.1	7.9	7.5	7.1	3.8	2.5	-
Sample Size	12	12	12	12	12	12	12	8	4	-

FIGURE 6 a. Position accuracy figures for Tropical Cyclone *Ruby*.

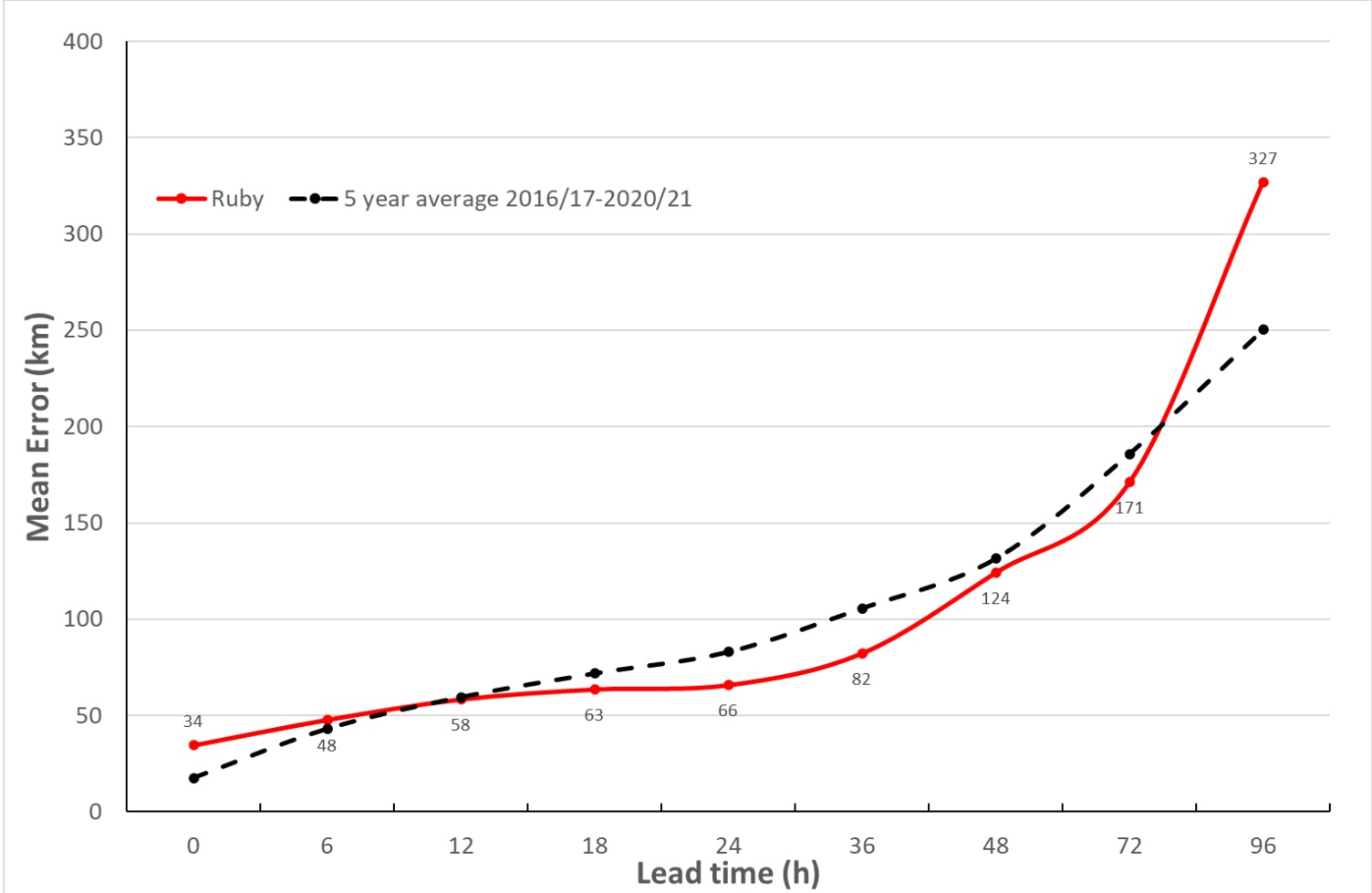


FIGURE 6 b. Intensity accuracy figures for Tropical Cyclone *Ruby*.

