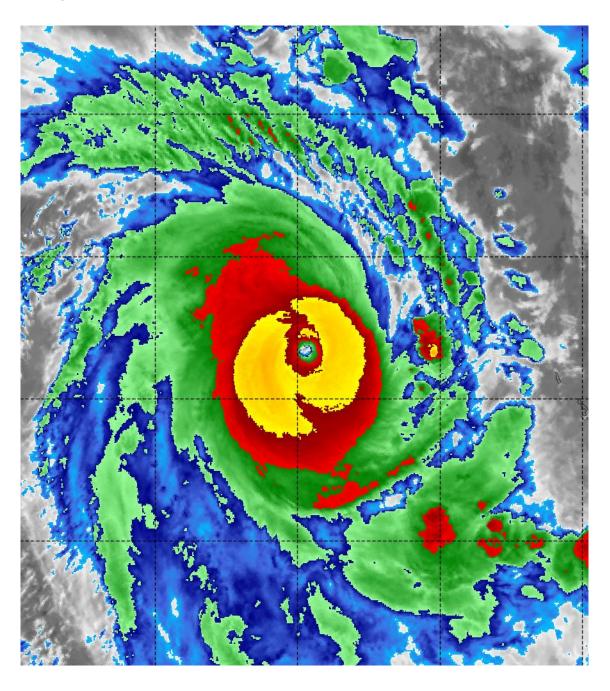


# Severe Tropical Cyclone Niran

27 February - 6 March 2021

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# **Table of Contents**

1. Summary	
2. Meteorological Description	
2.1 Intensity Analysis	5 11
3. Impact	12
4. Observations	13
4.1 Wind	13
5. Forecast Performance	15
Table 1. Best track summary for Severe Tropical Cyclone Niran	18

# 1. Summary

Despite never crossing the Australian coast, Severe Tropical Cyclone Niran caused extensive impacts along the Cassowary Coast of Queensland prior to moving eastwards across the Coral Sea and intensifying into a category 5 tropical cyclone as it passed close to New Caledonia.

A low pressure system first developed off the north Queensland coast on 27 February. Initially, the low moved slowly towards the Cairns coast, but then it began moving northwards from 1 March. The system was named on 2 March as it became slow moving approximately 260 km off the north Queensland coast.

Niran remained slow moving for the next two days while gradually intensifying to a category 3 system. It began accelerating towards the southeast on 4 March, passing to the north of Willis Island in the afternoon. Niran continued to intensify as it moved south-eastwards, becoming a category 5 cyclone on 6 March, just before it crossed the Eastern Region boundary [160 degrees East].

Throughout its entire lifetime, Niran was never expected to make landfall. However, during its initial stages of development on 1 March, gales were experienced on the north Queensland coast due to the tightening pressure gradient. There were reports of minor structural damages, mainly due to falling trees, but the main impact was to the banana plantations along the Cassowary Coast, between Cains and Lucinda. Some growers around Innisfail, particularly at Boogan and Wangan reported total loss of their crop.

The winds along the coast were accompanied by heavy rainfall leading to localised flash flooding and flooding of low-lying areas. A Flood watch had been current for coastal catchments between Cooktown and Rollingstone. The winds and heavy rainfall eased on the coast as the tropical low moved northwards and slightly off the coast on 2 March.

Gales continued over the coastal and offshore waters between Cooktown and Lucinda as tropical cyclone Niran remained slow-moving and intensified over the next two days, 2 to 4 March. Gales and large waves were reported over Willis Island as a category 3 tropical cyclone Niran passed within 110 km north of the island on 4 March.

Niran intensified into a category 5 cyclone as it moved very close to New Caledonia around midnight on 6 March with destructive winds and heavy rainfall causing extensive damage to the power grid and vegetation. Later that day, the cyclone passed 400 km north of Norfolk Island, generating large swells and hazardous surf conditions on the island.

Figure 1 a. Best Track of Niran 27 February - 6 March 2021 (times in AEST, UTC +10).

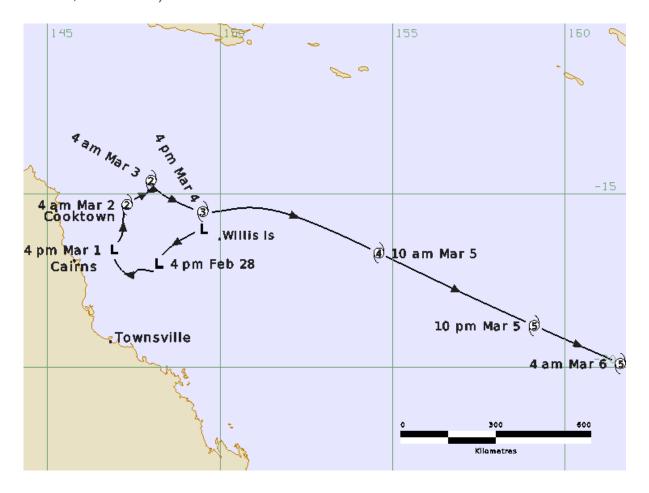
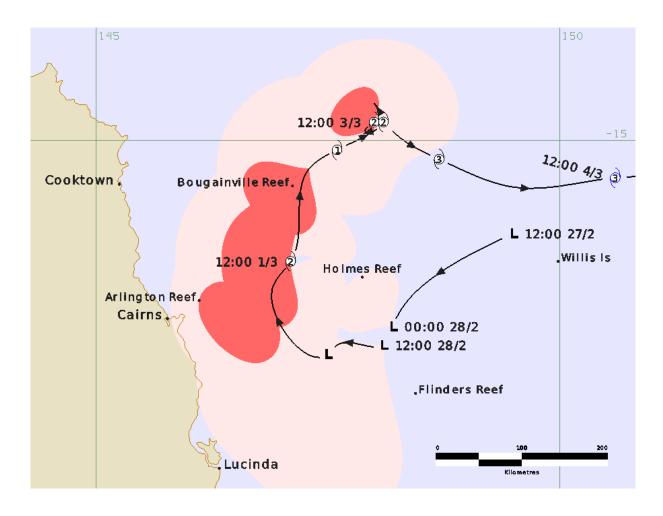


Figure 1 b. Detailed best track showing six-hourly gale and storm force wind swathe between 0000 UTC February 28 and 0600 UTC March 3.



# 2. Meteorological Description

### 2.1 Intensity Analysis

Figure 2 is a plot of intensity changes during the lifetime of Niran. A low developed in an area of active thunderstorm activity on 26 February and an initial Dvorak Data T-number (DT) of 1.0 was assigned at 1800 Universal Time Coordinated (UTC, AEST = UTC +10 hours).

The organisation of the low-level circulation was relatively poor during the following 24 hours but began to improve on 28 February. A strong pressure gradient formed between the centre of the circulation and the Queensland coast which resulted in stronger winds developing in the western quadrants. From 0727 28 February, Holmes Reef Automatic Weather Station (AWS) began recording gale force winds. Several other AWS recorded winds more than gale force during 28 February and 1 March with the strongest recorded 10-minute mean winds being 50 knots (kn. 95 kilometres per hour (km/h)) at 0850 UTC 1 March at Arlington Reef.

Numerous satellite wind analysis showed that these winds of gale force or stronger were confined to the western quadrants. While the proximity to the coast of the stronger winds made the results susceptible to land contamination, the absence of gales in the eastern quadrants was consistent with the low-level centre circulation (LLCC) being exposed due to easterly vertical wind shear, as well as AWS observations.

In post-analysis Tropical Cyclone Niran was upgraded from a tropical low to a category 2 tropical cyclone 1200 UTC 1 March, six hours earlier than when it was named operationally. The unusual progression from a tropical low straight to a category 2 tropical cyclone was due to synoptically aided storm force winds having developed in the western quadrants prior to gales extending into either of the eastern quadrants and therefore less than halfway around the centre. The intensity of 50 kn was based primarily on AWS observations and was significantly higher than other intensity estimations technique.

An Advanced Microwave Scanning Radiometer 2 (AMSR2) pass at 1423 UTC 1 March was the first clear evidence of gales extending into the northeast quadrant and therefore more than halfway round the centre (refer Figure 3). An Advanced Scatterometer (ASCAT) pass at 2353 UTC 1 March (refer Figure 4) showed gale force winds now extending into all four quadrants and improved deep convection over the LLCC. The synoptic forcing that had contributed to storm force winds developing also eased and, in the absence of continuing observations of storm force winds, the intensity estimate was made more consistent with objective aids and dropped to 45 kn (85km/h) making Niran drop in intensity to category 1. However, AMSR2 and Soil Moisture and Ocean Salinity (SMOS) radiometer passes at 0410 UTC and 0749 UTC respectively on 2 March showed storm force winds had redeveloped and Niran was once again a category 2 system.

From 0600 UTC 2 March through to the time that Niran crossed 160 E and moved out of the Australian region, there was a steady strengthening of the circulation. A Special Sensor Microwave Imager (SSMIS) 91 GHz microwave image at 1808 UTC 3 March showed an eye forming in the deep convection (refer Figure 5). Niran became a category 3 Severe tropical cyclone which was also confirmed by a Soil Moisture Active Passive (SMAP) radiometer pass at 2012 UTC 3 March showing hurricane force winds of 65 kn (120 km/h).

As Niran continued intensifying, a ragged eye briefly formed around 0600 UTC 4 March before a Dvorak Embedded Centre pattern developed. A more distinct eye began to develop around 0000 UTC 5 March as Niran reached 95 kn (175km/h) and category 4 based on a

Dvorak analysis of FT5.5. By 0600 UTC Niran was displaying a clear eye pattern (refer Figure 6). Niran than reached a peak intensity of 110 kn (205 km/h) at 1200 UTC 5 March before moving out of the Australian region.

Figure 2 Plot of objective and subjective intensity estimates for Niran.

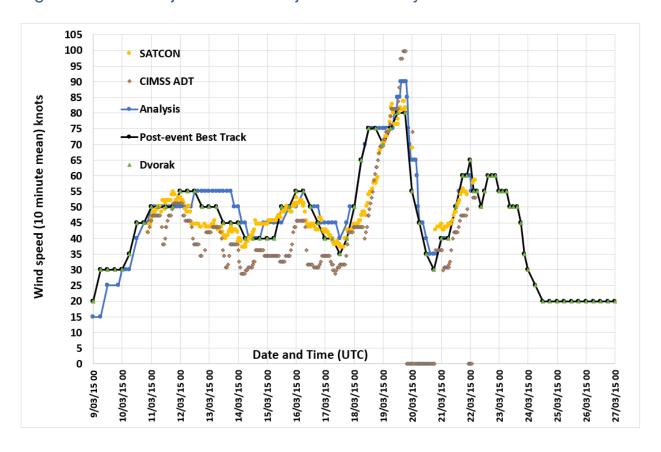


Figure 3. Advanced Microwave Scanning Radiometer 2 (AMSR2) pass at 1423 UTC 1 March showing gales extending more than halfway around the LLCC.

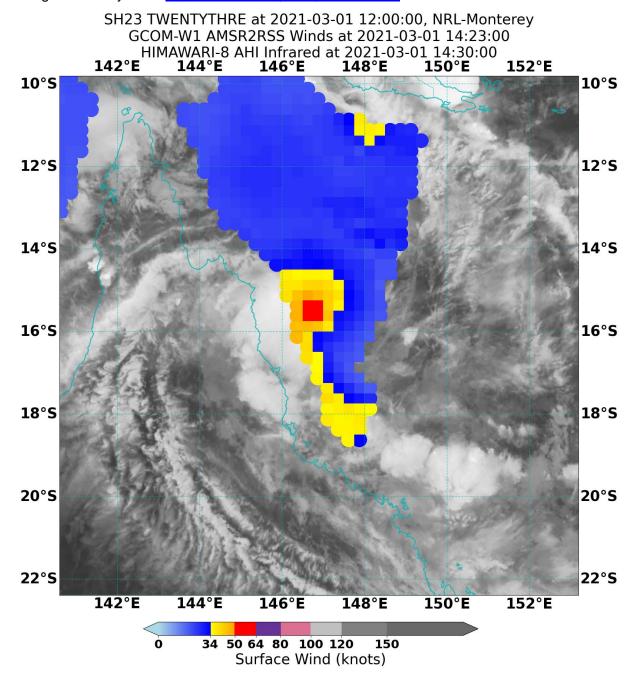


Figure 4. Advanced Scatterometer (ASCAT-B) image 2353 UTC 1 March.

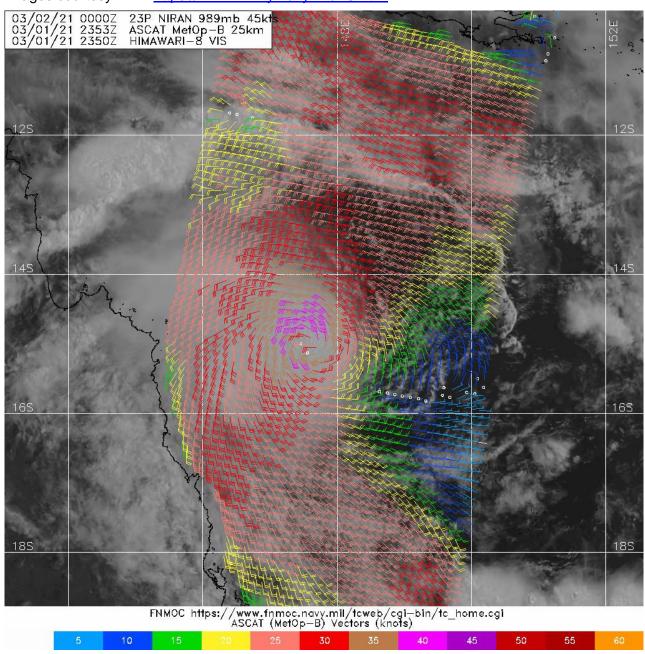


Figure 5. SSMIS 91 GHz microwave image at 1808 UTC 3 March.

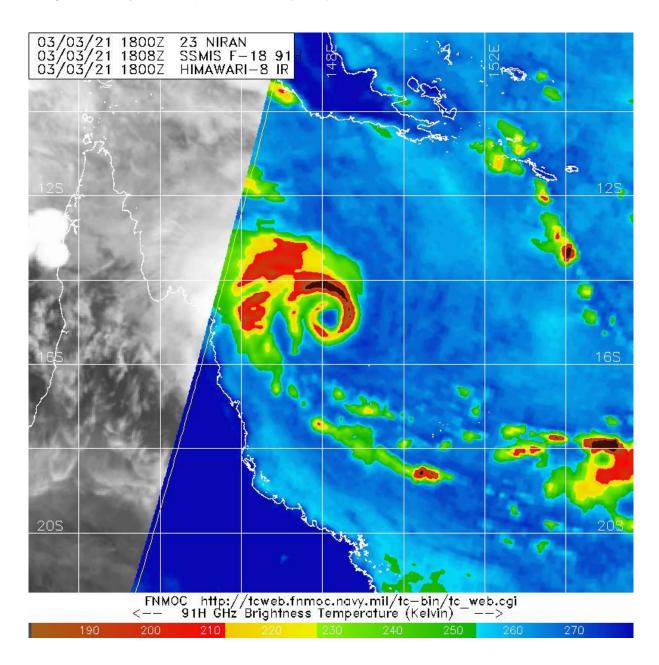
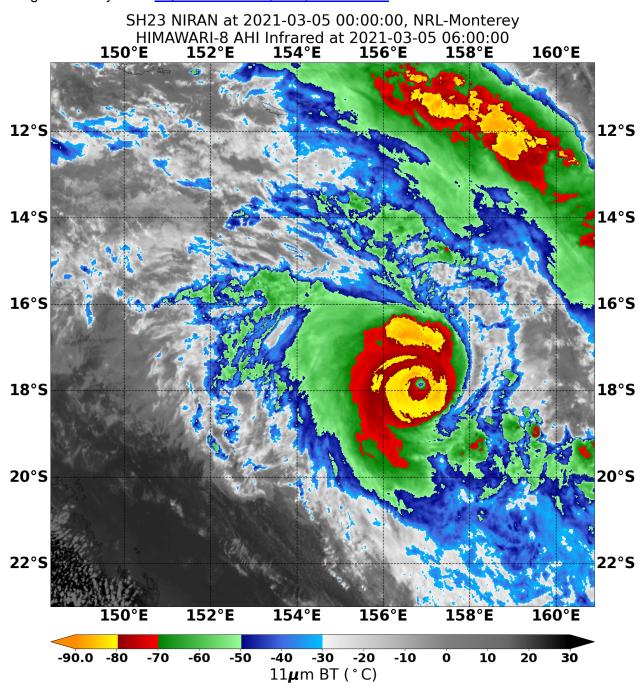


Figure 6. Enhanced Infrared image from Himawari-8 satellite at 0600 UTC 5 March.



#### 2.2 Structure

During the early stages of development, Niran experienced easterly vertical wind shear, this led to the initial development of gales extending as far as 120 nautical miles (nm, 220 kilometres (km)) in the southwest quadrant at 1200 UTC 28 February. Gales extended through the northwest quadrant as well, however there remained an absence of gales in the eastern quadrants. During March 1, the radius of gales contracted to 75 nm (140 km) though storm force winds developed to 45 nm (85 km) in the western quadrants.

As the easterly vertical wind shear started to decrease, gales extended into the northeast quadrant at 1200 UTC 1 March, leading to the unusual occurrence of Niran first meeting the definition of a tropical cyclone at category 2 intensity. With the low-level structure improving and gales extending the entire way around the centre at 0000 UTC 2 March, Niran briefly weakened into a category 1 tropical cyclone before re-intensifying. At this stage the radius of gales was 60 nm (110 km), reducing to 30 nm (55 km) in the southeast quadrant. This reduced radius in the southeast quadrant remained a relatively consistent feature of Niran.

As Niran started re-intensifying the radius to gales began increasing, reaching 90 nm (165 km) in all but the southeast quadrant at 1800 UTC 3 March. At the same time the radius of storm force winds was 30 nm (55 km) and hurricane force winds had developed to a radius of 20 nm (35 km) in the northwest quadrant.

From 0000 UTC 4 March the wind field in the northern quadrants expanded, aided by a strengthening monsoon flow and increased forward speed of the system. Prior to moving out of the region after 1200 UTC 5 March, the maximum extent of the wind field on the northern side of the system were 150 nm (280 km) for gales, 75 nm (140 km) for storm force winds and 60 nm (110 km) for hurricane force winds.

Niran maintained a relatively consistent radius of maximum winds of 10 to 15 nm (20 to 30 km) and the radius of the eye during the later stages varied between 5 and 8 nm (10 to 15 km).

#### 2.3 Motion

Niran moved southeast and then southwest during 27 and 28 February. From 0000 UTC it then began a steady track back to the north as the stronger low-level southerly winds on the western side of the sheared system pushed it along. Once the easterly vertical wind shear eased after 1 March, the strengthening system became slow moving, maintaining a steady position approximately 150 nm (280 km) off the coast from Cape Flattery from 0600 UTC 2 March until 1800 UTC 3 March.

During 4 March a strengthening monsoon flow to the north started to steer Niran quickly east to southeast at approximately 20 kn (35 km/h) until it moved out of the Australian region after 1200 UTC 5 March.

# 3. Impact

Throughout its entire lifetime, Tropical Cyclone Niran was never expected to make landfall or have a direct impact on the mainland. However, during its initial stages of development on 1 March, gales were experienced on the north Queensland coast due to the tightening pressure gradient. There were reports of minor structural damages, mainly due to falling trees, but the main impact was to the banana plantations along the Cassowary Coast, between Cains and Lucinda. Some growers around Innisfail, particularly at Boogan and Wangan reported total loss of their crop.

The winds along the coast were accompanied by heavy rainfall leading to localised flash flooding and flooding of low-lying areas. A Flood watch had been current for coastal catchments between Cooktown and Rollingstone. The winds and heavy rainfall eased on the coast as the tropical low moved northwards and slightly off the coast on 2 March.

Gales continued over the coastal and offshore waters between Cooktown and Lucinda as Tropical Cyclone Niran remained slow-moving and intensified over the next two days, 2 to 4 March. Gales and large waves were reported over the Willis Island as a category 3 cyclone moved close to 110 km north of the island on 4 March.

An intense category 5 cyclone moved very close to New Caledonia around midnight on 6 March with destructive winds and heavy rainfall causing extensive damage to the power grid and vegetation. Several ships reportedly ran aground, though with no major damage.

Later that day, Niran passed 400 km north of Norfolk Island, generating large swells and hazardous surf conditions.

### 4. Observations

#### 4.1 Wind

Selected observations are detailed below.

<u>Arlington Reef</u> recorded gale force winds from 0059 UTC 1 March to 0030 UTC 2 March, 0725 UTC to 1901 UTC 2 March 0145 UTC to 0634 UTC March 3 including storm force winds from 0453 UTC to 0856 UTC 1 March. The maximum 10-minute mean wind recorded was 50 knots (90 km/h) at 0849 UTC 1 March and the maximum 3-second wind gust recorded was 67 knots (124 km/h) at 1649 UTC 1 March.

Bougainville Reef recorded gale force winds from 0824 UTC 1 March to 0552 UTC 2 March and 1159 UTC 2 March to 0850 UTC 4 March including storm force winds from 1322 UTC to 1358 UTC 1 March and 1925 UTC to 2151 UTC 1 March. The maximum 10-minute mean wind recorded was 49 knots (90 km/h) at 2109 UTC 1 March and the maximum 3-second wind gust recorded was 62 knots (115 km/h) at 1321 UTC 1 March.

<u>Holmes Reef</u> recorded gale force winds from 0727 UTC to 0819 UTC 28 February, 1536 UTC to 1613 UTC 28 February, 1110 UTC to 1315 UTC 2 March and 2249 UTC 3 March to 0942 UTC 4 March. The maximum 10-minute mean wind recorded was 40 knots (75 km/h) at 0529 UTC 4 March and the maximum 3-second wind gust recorded was 49 knots (90 km/h) at 0617 UTC 4 March.

<u>Willis Island</u> recorded gale force winds from 0446 UTC to 1350 UTC 4 March. The maximum 10-minute mean wind recorded was 42 knots (78 km/h) at 0515 UTC and the maximum 3-second wind gust was 50 knots (90 km/h) at 0506 UTC.

<u>Lucinda Point</u> recorded gale force winds from 1327 UTC to 1411 UTC 28 February and 2231 UTC 28 February to 0238 UTC 1 March . The maximum 10-minute mean wind recorded was 40 knots (75 km/h) at 0015 UTC and the maximum 3-second wind gust was 50 knots (90 km/h) at 0016 UTC.

#### 4.2 Pressure

**Bougainville Reef** recorded a minimum mean sea level (MSL) pressure of 983.9 Hectopascals (hPa) from 1718 UTC to 1721 UTC 1 March.

Willis Island recorded a minimum MSL pressure of 990.5 hPa from 0655 UTC to 0657 UTC 4 March.

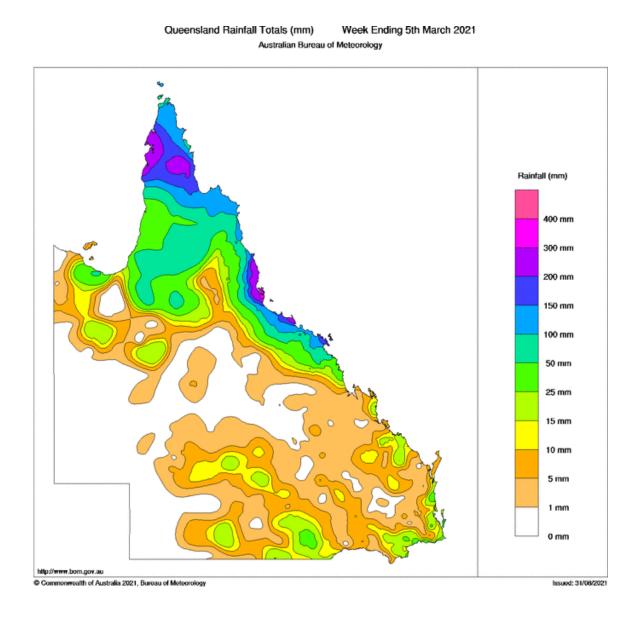
<u>Arlington Reef</u> recorded a minimum MSL pressure of 992.7 hPa at 0451 UTC 1 March.

Holmes Reef recorded a minimum MSL pressure of 994.7 hPa at 0313 UTC 4 March.

### 4.3 Rainfall

The highest 24-hour rainfall totals to 9am during the time Niran was located near the Queensland coast are 300.3 millimetres (mm) on at Bellenden Ker Top Station, 216 mm at Cowley Beach and 212.4 mm at Bingil Bay on 2 March and 219.4 mm at Alva Beach on 1 March. Refer Figure 8 for a plot of the weekly rainfall totals to 5 March.

Figure 8. Rainfall total analysis for the 7 days to 9 am AEST 5 March.



### 5. Forecast Performance

Official tropical cyclone forecasts were issued from 0100 UTC 28 February until 1300 UTC 5 March when Niran moved outside the Australian area of responsibility. A tropical cyclone watch was issued from 0100 UTC 28 February for the north Queensland coast for the possibility of gales even though a coastal crossing was not expected. Tropical cyclone advices continued until 2100 UTC 4 March when there was greater confidence that Niran was moving away from the coast.

The accuracy statistics obtained by comparing the forecast positions and intensity against the best track positions are shown in the table below and in Figures 9a (position) and 9b (intensity). Figure 9a shows that the position accuracy was close the five-year mean for shorter lead times but increased after 48-hour lead time. During the early stages of formation forecasts at the extended range moved the track further to the south than the actual track. Intensity forecasts were skillful in forecasting a severe tropical cyclone, even during the early stages of formation. For example the first official forecast issued at 0000 UTC 28 February forecast a severe tropical cyclone at +102h lead time at 0600 UTC 4 March, just 9 hours after the actual time. However, intensity forecasts were lower than the actual most intense phase of Niran's cycle. This reflected in the overall accuracy being a little worse than the 5-year historical skill in Figure 9b..

Note: Values for the 120-hour lead time are not plotted as the sample size is just four and insufficient to draw meaningful conclusions.

	0	6	12	18	24	36	48	72	96	120
Position Absolute error (km)	21	42	63	82	97	122	140	226	322	580
Intensity Absolute error (kn)	3.5	4.1	5.8	6.7	6.8	9.3	9.5	12.1	22.5	28.8
Sample Size	23	23	22	21	20	18	16	12	8	4

Figure 9 a. Position accuracy statistics for Severe Tropical Cyclone Niran.

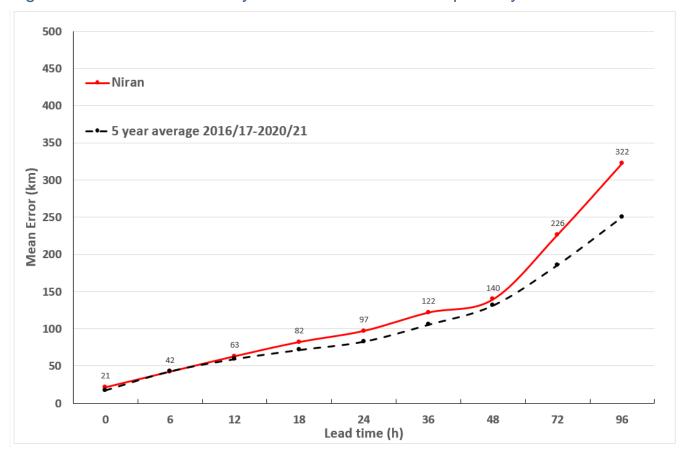


Figure 9 b. Intensity accuracy statistics for Severe Tropical Cyclone Niran.

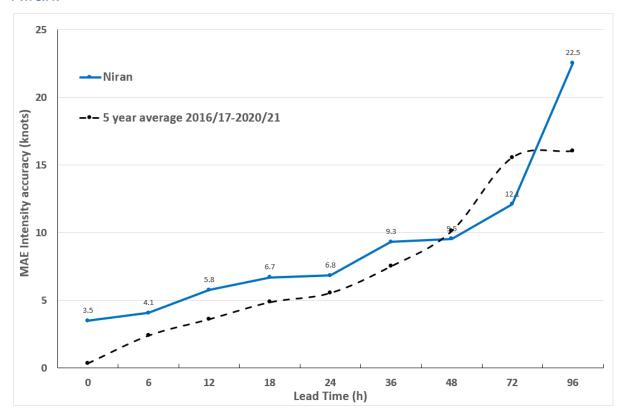


Table 1. Best track summary for Severe Tropical Cyclone Niran.

Refer to the Australian Tropical Cyclone database for complete listing of parameters. UTC=AEST-10 h.

Year	Month	Day	Hour UTC	Pos. Lat S	Pos. Long. E	Pos. Acc. nm	Max Wind 10 min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/ SW/NW)	Rad. of storm (NE/SE/ SW/NW)	RMW nm
2021	2	26	18	-14.4	148.9	60	20	45	1002			
2021	2	27	0	-15.2	149.4	45	25	45	1002			
2021	2	27	6	-15.7	149.9	20	25	45	1001			
2021	2	27	12	-16	149.5	60	25	45	1001			
2021	2	27	18	-16.5	148.6	60	30	45	999			
2021	2	28	0	-17	148.2	20	30	45	998			
2021	2	28	6	-17	148.2	20	35	50	993	-/-/-40		
2021	2	28	12	-17.2	148.1	20	35	50	994	-/-/120/-		
2021	2	28	18	-17.2	147.6	30	35	50	995	-/-/100/60		
2021	3	1	0	-17.3	147.5	20	40	55	991	-/-/90/60		
2021	3	1	6	-16.6	146.9	20	50	70	987	-/-/70/60	-/50/-/-	
2021	3	1	12	-16.3	147.1	60	50	70	985	-/-/75/75	-/45/45/-	
2021	3	1	18	-15.3	147.3	30	50	70	986	60/-/60/60	-/45/-/-	15
2021	3	2	0	-15.1	147.6	20	45	65	988	60/30/45/50		15
2021	3	2	6	-14.9	148	30	50	70	985	60/30/60/60	-/-/-30	15
2021	3	2	12	-14.8	148.1	45	50	70	984	60/30/75/75	-/-/-40	10
2021	3	2	18	-14.6	148	30	55	75	980	60/30/90/90	-/-/-45	10
2021	3	3	0	-14.8	148.1	30	55	75	981	75/30/90/90	45/-/-/40	10
2021	3	3	6	-14.9	147.9	30	55	75	980	90/45/90/90	30/-/30/30	10
2021	3	3	12	-14.8	148	20	60	75	976	105/45/90/90	30/20/30/30	10
2021	3	3	18	-14.9	148.2	20	65	90	973	90/60/90/90	30/20/30/30	10
2021	3	4	0	-15.2	148.7	20	70	100	970	105/75/105/90	45/30/30/30	15
2021	3	4	6	-15.5	149.5	10	80	110	963	120/90/90/120	60/45/30/60	15
2021	3	4	12	-15.4	150.6	30	85	120	960	120/75/75/120	75/30/30/75	15
2021	3	4	18	-15.8	152.6	20	85	120	963	120/60/75/105	60/30/30/60	15
2021	3	5	0	-16.7	154.6	10	95	135	954	105/75/90/90	60/45/45/60	10
2021	3	5	6	-17.8	156.9	10	105	145	944	120/90/90/90	75/45/45/60	10
2021	3	5	12	-18.8	159.1	10	110	155	936	150/90/90/90	75/45/45/60	10
2021	3	5	18	-19.9	161.6	20	110	155	937	120/75/90/90	60/30/45/60	10