Australian Government
Bureau of Meteorology

Tropical Cyclone *Joshua*

14 – 17 January 2021

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April 2022

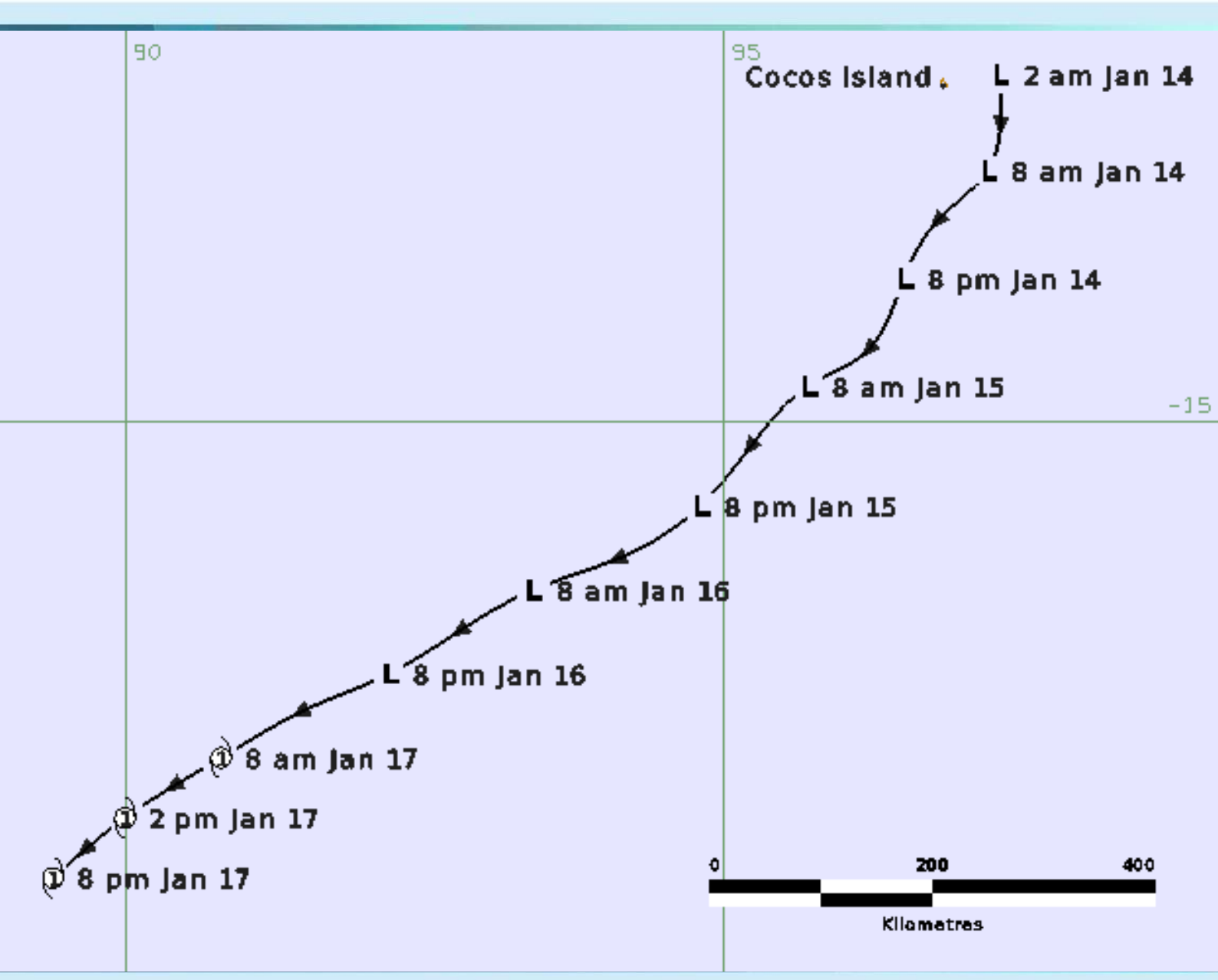

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Table of Contents

1 Summary 1

FIGURE 1. Best track of Tropical Cyclone *Joshua* 14 – 17 January 2021, showing extent of gales (times in UTC, AWST – 8h). 1

2 Meteorological Description 2

2.1 Intensity analysis 2
2.2 Structure 2
2.3 Motion 2

FIGURE 2. SSMIS 91GHZ at 0007 UTC 17 January, at the time tropical cyclone intensity is estimated. 3

FIGURE 3. OSCAT scatterometry pass at 0204 UTC 17 January, confirming gales (yellow) near the centre (marked with X). 4

FIGURE 4. Plot of objective and subjective intensity estimates for *Joshua*. 5

3 Impact 6

4 Observations 7

TABLE 1. Best track summary for Tropical Cyclone *Joshua 14-17 January 2021.* 8

5 Forecast Performance 9

FIGURE 5a. Track accuracy figures for Severe Tropical Cyclone *Joshua.* 10

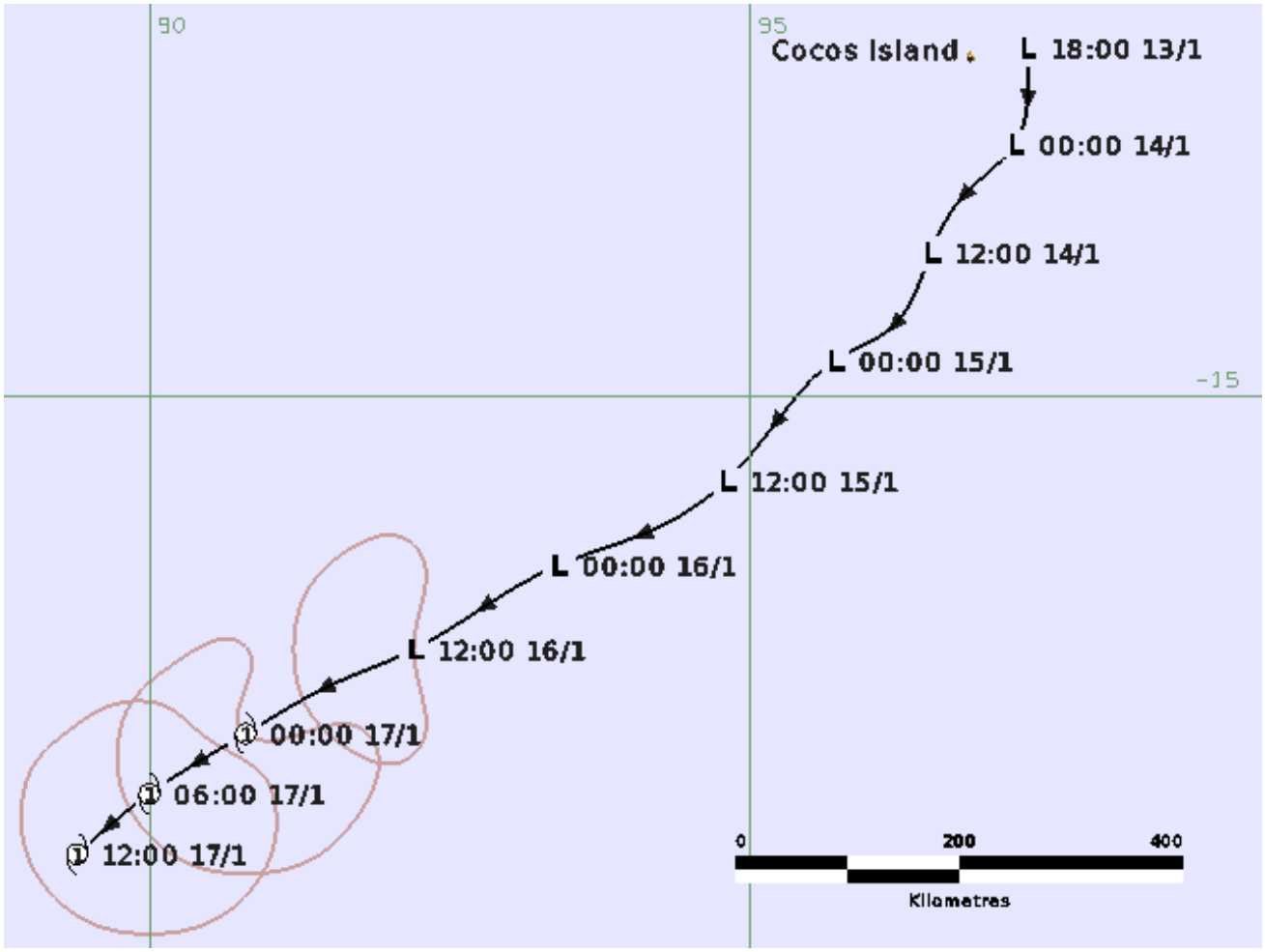
FIGURE 5 b. Intensity accuracy figures for Tropical Cyclone *Joshua.* 11

1 Summary

Tropical Cyclone *Joshua* was a small weak Indian Ocean tropical cyclone that reached tropical cyclone intensity on the day it passed west of 90°E outside the Australian region of responsibility.

Cocos Islands reported heavy rainfall in the early stages of *Joshua*, recording 106.2mm in the 24 hours to 9am on 14 January and 68.2 mm on 13 January.

FIGURE 1. Best track of Tropical Cyclone *Joshua* 14 – 17 January 2021, showing extent of gales (times in UTC, AWST – 8h).



2 Meteorological Description

2.1 Intensity analysis

A low formed in the monsoon trough on 13 January just east of Cocos Islands. Advanced Scatterometer (ASCAT) passes (ASCAT-A at 1427 Universal Time Coordinated (UTC) and ASCAT-C at 1455 UTC 13 January) depicted a defined circulation. Deep convection persisted to the southwest of the centre consistent with the moderate to strong northeasterly vertical wind shear. This pattern persisted during 14 and 15 January.

Gales were observed southwest of the centre on ASCAT-A pass at 1553 UTC 15 January but not on the subsequent pass at 0230UTC 16 January. Gales are estimated to occur from 0600 UTC 16 January with improved in the curvature of deep convection north of the centre corresponding with decreasing vertical wind shear. Advanced Microwave Scanning Radiometer 2 (AMSR2) radiometer pass at 0623 UTC 16 January showed gales in the northwestern semi-circle only. Operationally *Joshua* was named at 1200 UTC 16 January consistent with subjective Dvorak estimates (Current Intensity (CI) = 3.0) and objective Advanced Dvorak Technique (ADT) and SATellite CONsensus (SATCON) guidance (Figure 4). However, upon reanalysis gales are not estimated to extend more than halfway around the centre at this time. Deep convection weakened abruptly after 1000 UTC and a Soil Moisture Active Passive (SMAP) radiometer pass at 1217 UTC only showed gales south of the centre.

Deep convection improved markedly on the morning of 17 January to a well-defined curved band pattern as shown in the Special Sensor Microwave Imager/Sounder (SSMIS) microwave image (Figure 2). Tropical cyclone intensity was estimated at 0000 UTC 17 January. The Oceansat-2 Scatterometer (OSCAT) scatterometer pass at 0204 UTC 17 January confirmed gales occurring near the centre (Figure 3). The 10-minute mean wind peak intensity is estimated at 0600 UTC 17 January at 40 knots (kn) (75 kilometres per hour (km/h)) as *Joshua* moved out of the Australian region. Objective techniques (ADT and SATCON) indicated higher intensities during 16 January, the CIMSS ADT technique peaking at 49 kn at 1200 UTC 16 January.

2.2 Structure

Under the influence of ongoing moderate to strong northeasterly vertical wind shear, the deep convection and strongest winds occurred southwest of the centre. Gales first appeared in the southwest quadrant overnight on 15-16 January but not on the subsequent pass. The shear eased during 16 January and convection and gales extended to the north of the centre for a period before easing overnight. Gales are estimated to surround the centre by 0600 UTC 17 January. *Joshua* was a small system having gales extend to a maximum of 70 nm (130 km) to the south and approximately 50 nm (93 km) to the north, and a radius to maximum winds of 15-20 nm (28-37 km/h).

2.3 Motion

The system had a consistent southwesterly track from its formation until it moved out of the Australian region at about 15 km/h under the influence of a mid-level ridge to the south.

FIGURE 2. SSMIS 91GHZ at 0007 UTC 17 January, at the time tropical cyclone intensity is estimated.

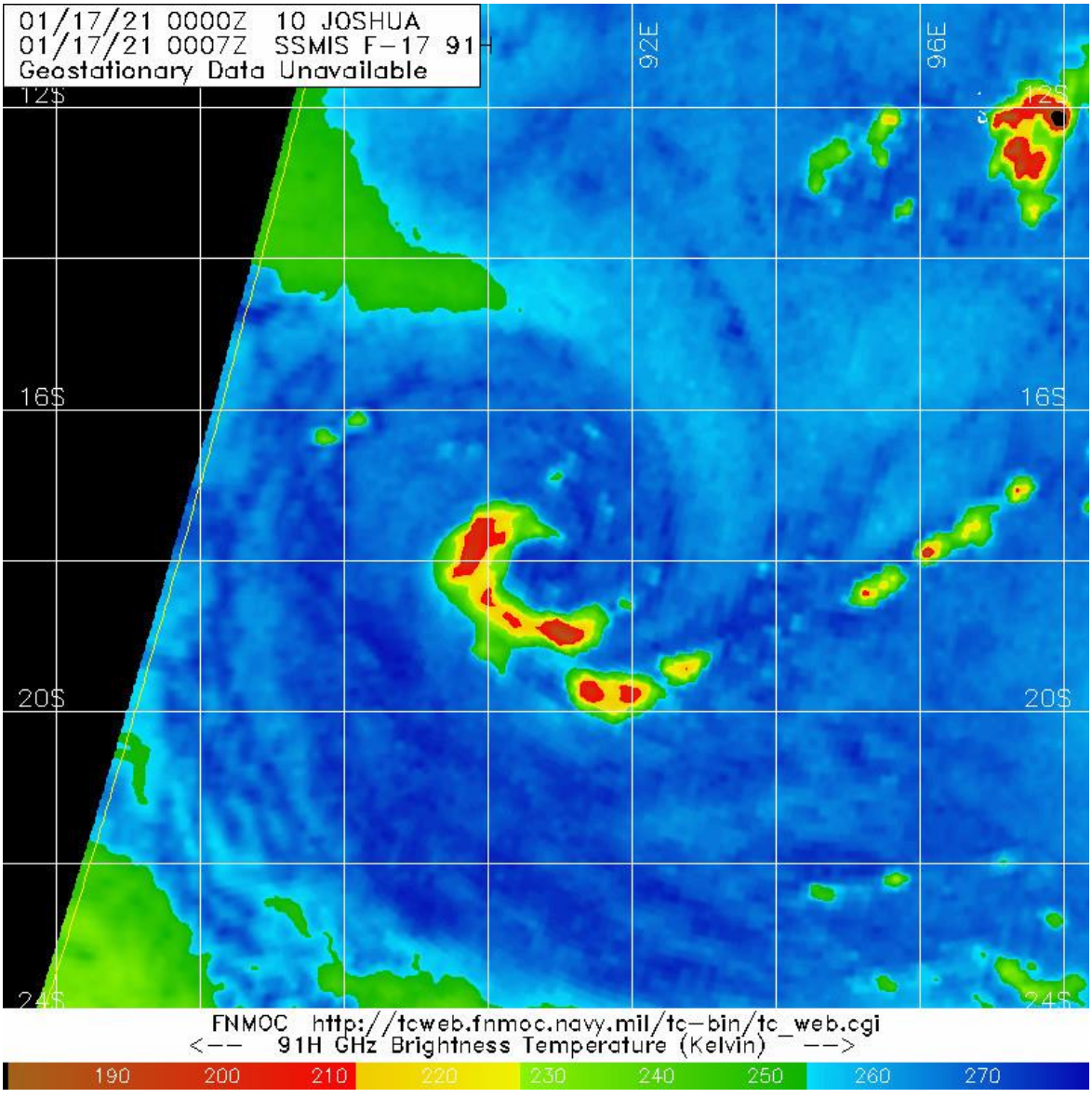


FIGURE 3. OSCAT scatterometry pass at 0204 UTC 17 January, confirming gales (yellow) near the centre (marked with X).

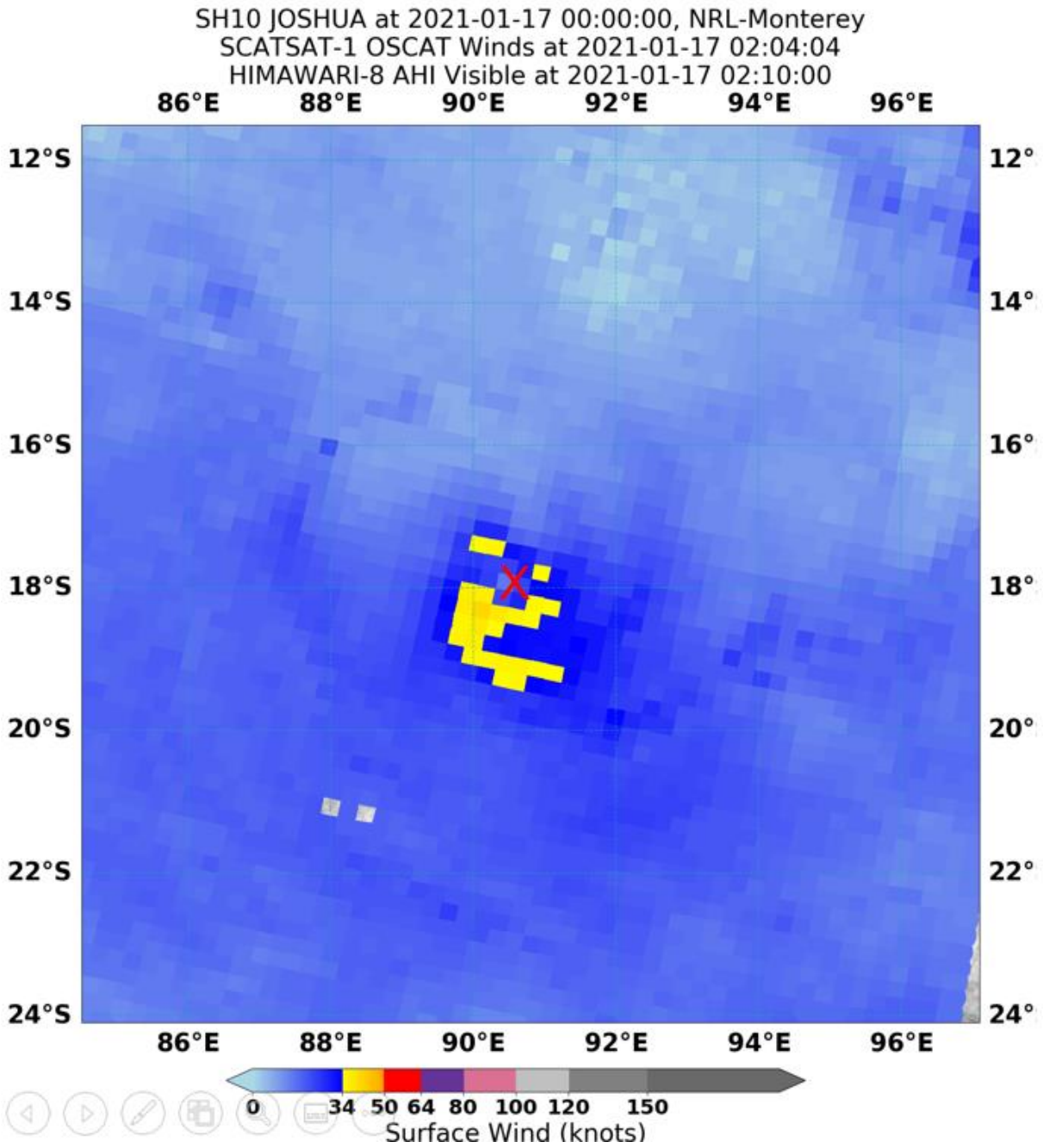
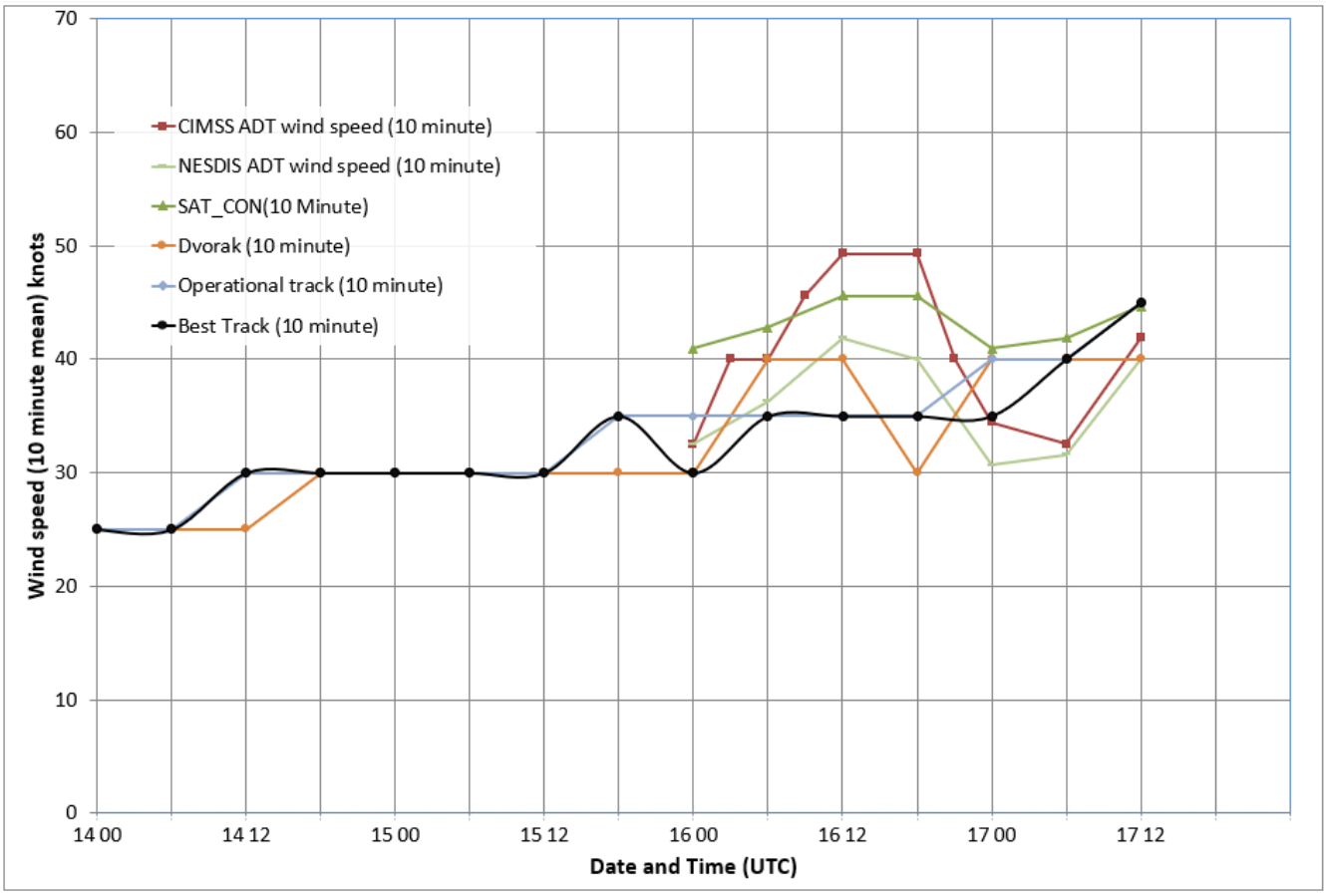


FIGURE 4. Plot of objective and subjective intensity estimates for *Joshua*.



3 Impact

There were no known impacts from this cyclone.

4 Observations

Cocos Islands reported heavy rainfall in the early stages of *Joshua*, recording 106.2mm in the 24 hours to 9am on 14 January and 68.2 mm on 13 January.

TABLE 1. Best track summary for Tropical Cyclone *Joshua 14-17 January 2021.*

Refer to the Australian Tropical Cyclone database for complete listing of parameters and track.
Note: UTC is AWST - 8 hours.
*not at tropical cyclone intensity as gales not extending more 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 n mi
2021	01	13	18	12.1	97.3	20	25	45	1002			
2021	01	14	00	12.9	97.2	15	25	45	1001	-	-	-
2021	01	14	06	13.3	96.8	15	25	45	1001	-	-	-
2021	01	14	12	13.8	96.5	20	30	45	999	-	-	-
2021	01	14	18	14.4	96.2	20	30	45	998	-	-	-
2021	01	15	00	14.7	95.7	20	30	45	998	-	-	-
2021	01	15	06	15.1	95.3	20	30	45	998	-	-	-
2021	12	15	12	15.7	94.8	20	30	45	998	-	-	-
2021	12	15	18	16.1	94.2	20	35	50	997	0/0/60/0	-	-
2021	01	16	00	16.4	93.4	20	30	45	996	-	-	-
2021	01	16	06	16.8	92.7	20	35*	50	994	0/0/60/60	-	-
2021	01	16	12	17.1	92.2	20	35*	50	994	0/0/60/60	-	-
2021	01	16	18	17.4	91.5	20	35*	50	994	0/70/70/0	-	-
2021	01	17	00	17.8	90.8	20	35	50	994	0/70/70/50	-	20
2021	01	17	06	18.3	90.0	15	40	55	992	40/70/70/50	-	20
2021	01	17	12	18.8	89.4	15	45	65	990	50/70/70/50	-	15

5 Forecast Performance

Accuracy figures were based on official forecast tracks issued from 1800 UTC 14 January to 0600 UTC 17 January. The table below and Figure 5 show that the forecast track was similar to the five-year average at all time steps and the intensity accuracy was considerably better than the five-year average at all time steps.

Table 2. Accuracy statistics obtained by comparing the forecast positions against the best track positions for *Joshua.*

	00	**06**	**12**	**18**	**24**	**36**	**48**	**72**	**96**	**120**
Position Absolute error (km)	22	35	48	71	96	141	171	-	-	-
Intensity Absolute error (kn)	1.8	2.3	3.0	3.9	4.4	5.0	7.5	-	-	-
Sample Size	11	11	10	9	8	6	4*			

*Sample size considered insufficient for meaningful conclusions and not shown in graphs.

FIGURE 5a. Track accuracy figures for Severe Tropical Cyclone *Joshua.*

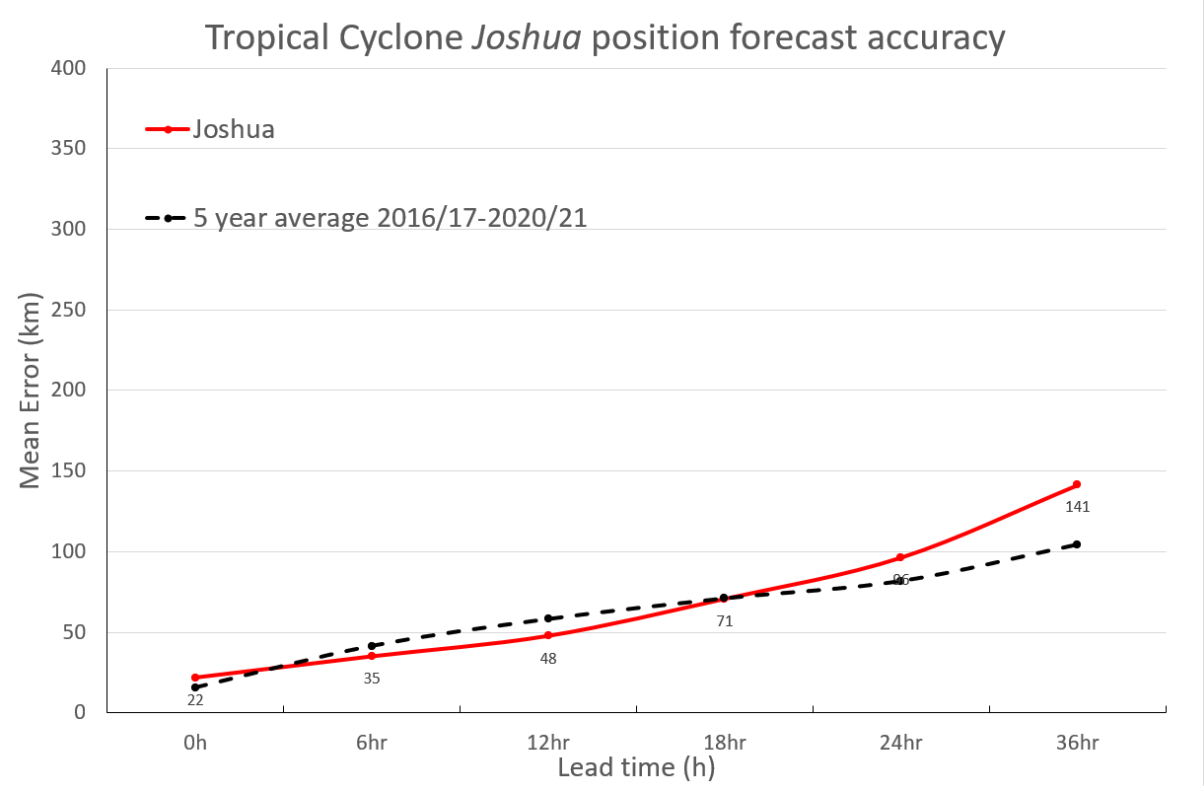


FIGURE 5 b. Intensity accuracy figures for Tropical Cyclone *Joshua.*