



Australian Government
Bureau of Meteorology

Severe Tropical Cyclone *Magda*

18 - 23 January 2010

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A. Summary

A tropical low formed close to the Indonesian Island of Roti (southwest of Timor) on 18 January and drifted slowly to the south southwest reaching cyclone intensity on 20 January. Tropical Cyclone *Magda* developed rapidly during the overnight period reaching category three intensity on the morning of 21 January close to Browse Island. *Magda* weakened for a period during the day but regained intensity the following night again reaching category three intensity as it crossed the Kimberley coast at Kuri Bay, about 210 km north northeast of Derby, at about 5 am WST 22 January. *Magda* weakened below cyclone intensity late that day as it moved inland passing east of Derby.

Some mostly minor damage to infrastructure occurred at Kuri Bay as *Magda* passed by. Vegetation near the coast was considerably defoliated. Fortunately facilities at Koolan Island and Cockatoo Island only experienced the western peripheral gales and no damage was reported.

Note: Operationally *Magda* was rated as a category two cyclone but was upgraded to category three intensity upon post-analysis.

B. Meteorological Description

Intensity analysis

Convection developed in low level west northwesterly winds south of Timor on 15-17 January. This coincided with a tropical low (04U) being in the region, near 15S 105E on 17 January and moving to the west. Convection decreased in this area on the morning of 18 January, but redeveloped further to the east near Roti Island just south of Timor later on 18 January. Initial Dvorak classification is estimated at 18/1200 UTC. The Windsat 37GHz microwave pass at 18/2148 UTC shows a well developed low level circulation.

Two Ascet passes on 19 January suggested 30 knot winds near the circulation centre, although Dvorak estimates would suggest lower wind speeds. Development was favoured at this time by low to moderate NE wind shear and increasing poleward upper level outflow ahead of a short wave upper trough near the WA west coast.

Although the analysed wind shear is only light, convection was predominantly on the western and southern sides of the low. While convection persisted during the diurnal minimum during the day on 19 January, a curved band did not wrap more than 0.4 about the centre.

Tropical cyclone intensity is estimated at 0600 UTC 20 January when visible imagery (see Fig. 2) indicated the centre was under the deep convection, despite the convection being relatively confined to near the centre. The Dvorak analysis is a little ambiguous at this stage: the curved band wrap being less than 0.6 would suggest below TC intensity and it is arguable whether a shear pattern can be used given how the system has developed. A bias towards MET/PAT can suggest a FT=3.0 and this is supported by subsequent imagery. The Windsat 37GHz 20/1005 UTC image showed a small but well-defined circulation with convection on the western side. The 20/1118 UTC SSMIS 85 GHz image shows better definition of the convection near the centre indicative of an emerging partial eye signature. The comparable IR image does not show this banding and it is difficult to get more than 0.4 wrap using curved band pattern.

While the shear appears to have remained at ~15 knots during the overnight period, the circulation appears to have been able to withstand this to enable convection to extend across the circulation. Combined with strong upper level poleward outflow, the small inner circulation intensified as shown by the progression of microwave images culminating with a strong microwave eye signature on the 20/2230 UTC SSMIS 91GHz image shown in Figure 3.

Conventional Dvorak estimates increase at the maximum 0.5 Tno per 6 hours from 3.0 at 12 UTC to 4.0 at 21/00 UTC (1.0+ degree wrap with white band =4.0 or eye LG surround B/W eye adjustment 5.0 - 1.0 =4.0). This would suggest a peak intensity of 55-60 knots. However AMSU intensity estimates reach one minute values of 72 knots (CIMSS) and 81 knots (CIRA) at 20/2222 UTC equivalent to ~65-70 knot 10-minute winds. Noting the increased accuracy of the CIMSS AMSU estimate the actual intensity estimate at 21/00 UTC is 65 knots equivalent to a Dvorak T4.5. Subjectively, the strong SSMIS eye signature at 2230 UTC would warrant the system being at category three intensity.

Magda than passed just to the west of Browse Island at 21/03-04 UTC. Unfortunately only intermittent hourly observations were received. Nearby observations suggested the central pressure was likely to have been in the 975-980 hPa range which is consistent with a maximum wind of 65 knots.

Following the intensity peak at 21/00UTC the influence of the ongoing moderate NE shear became more apparent on imagery and by 12 UTC the low level circulation centre (LLCC) was close to the edge of deep convection. The small inner core weakened accordingly with convection being eroded on the eastern side of the system. Deep convection with very cold tops persisted on the western side and the LLCC remained well-defined. The estimated intensity fell to 50 knots by 21/12UTC based on persisting DT=3.5 estimates (based on shear pattern) and also to AMSU estimates of 40-50 knots.

However, once again overnight convection improved and an eye re-emerged on microwave imagery as shown in Fig. 4 as *Magda* reached the remote northwest Kimberley coast at Kuri Bay.

Both CIMSS and CIRA AMSU intensity estimates reached 76 knots at 21/1730 prior to landfall. The Dvorak DT estimates reached 5.0 based on embedded centre (EC)

pattern although the FT/CI were estimated at 4.5 given the high bias of the EC pattern. Although the CIMSS shear analysis persists with ~15 knots of NE shear the circulation was obviously able to withstand this to redevelop an eye with very strong convection.

According to reports, the centre passed over Kuri Bay at 5am (21/21 UTC). A Paspaley Pearls vessel anchored in Samson Inlet estimated winds at 80-90 knots. The vessel had been through *Laurence* the previous month when instrumentation recorded 80 knots and the Ship's captain reported that winds were stronger during *Magda*. There was also some infrastructure damage to facilities at Kuri Bay. While the quality of these observations are unknown, they would suggest winds of at least category three intensity. This is consistent with the extent of defoliation in the area (see Fig. 5). Peak intensity is estimated at 70 knots at 21/21 UTC.

Magda tracked over land south of Kuri Bay but remained very close to the coast. A weak eye emerged on IR imagery suggesting DT=5.0 although FT/CI was held at 4.5 consistent with MET. While it is difficult to assess the impact of land on the maximum wind, the western eye wall remained over water through the morning period. While the maximum intensity is reduced lower than the normal Dvorak over-water values, the intensity was kept to 60 knots at 22/03 UTC.

However after this time *Magda*'s circulation weakened as it moved completely over land. A report from Kimberley Downs (east of Derby) suggested the eye passed over at about 8 pm WST (12 UTC) with winds less than gale force, and as a result operationally the cyclone was downgraded to tropical low status. At this time deep convection was evident in western quadrants and the inland decay model would suggest gales were still likely at 12UTC although *Magda* being smaller is likely to spin down faster than normal. The Broome radar (eg Broome at 6pm (10UTC)) indicated the convection on the western side resembled a squall line rather than a band associated with the circulation. The 12 UTC maximum intensity is estimated at 30 knots with gusts to 50 knots to allow for the severity of thunderstorms. Operationally a severe weather warning was issued to alert for damaging wind gusts despite *Magda* being downgraded to tropical low intensity at this time.

Motion

Initially the low drifted to the south under a light steering pattern. A mid-level ridge well to the south over central Australia, and the two other tropical circulations AU0910_04U in the Indian Ocean and AU0910_05U (pre Neville) off the north Qld coast were features affecting the mid-level steering flow. On 20 January an approaching upper trough began to steer *Magda* to the south southeast at about 7 knots. *Magda* slowed to about 5 knots and took a more southerly track on 22 January at landfall, as the trough well to the south relaxed.

Structure

Magda retained 'midget' status throughout its lifetime. The radius of maximum winds was estimated to be about 10nm decreasing to about 7-8 nm at peak intensities. The radius of gales were estimated to be less than 60nm.

C. Impact

Some mostly minor damage to infrastructure occurred at Kuri Bay as *Magda* passed by. Vegetation near the coast sustained considerable defoliation. Fortunately facilities

at Koolan Island and Cockatoo Island only experienced the western peripheral gales and no damage was reported.

D. Observations

While *Magda* passed quite close to Browse Is Automatic Weather Station (AWS), only sporadic observations were received. At 21/03UTC Browse Island recorded 52 knots easing to 38 knots at 04UTC.

Rainfall

Cumulative rainfall exceeded 100 mm over the northwest Kimberley including Derby, the Dampier Peninsula and Kuri Bay regions. The highest daily fall included 142 mm at Camballin; 138 mm at Curtin while Kuri Bay had a three-day total of 185 mm, most of which would have fell as *Magda* passed close by.

E. Forecast Performance

The first mention on the 3-Day TC Outlook was on 18 January (Low-Mod-Mod). The outlook on 19 January first indicated Mod-High-High but was then upgraded to High-High-High at 5:16 pm. Given that TC intensity was reached on 20 January, at D-3 there was no mention of the low, at D-2 the likelihood was Mod and at D-1 the (updated) likelihood was High. In this case the models failed to adequately resolve the circulation for the outlooks at D-3 and earlier.

A shipping warning was first issued at 5 pm WST 19 January for areas within 60nm of the centre. This was 21 hours prior to when the low reached cyclone intensity.

A watch was first issued for areas between Wyndham and Cockatoo Island at 9am 20 January when the low was 510 km north northwest of Cockatoo Island. The watch was upgraded to a warning for areas between Kalumburu to Cockatoo Is at 9 pm 20 January. The low was then named *Magda* operationally at midnight. At 9 am 21 January, the warning was extended southwest to Beagle Bay and the watch to Broome, and FESA placed communities between Kalumburu and Cape Leveque to Blue alert. The FESA alert for communities between Kuri Bay and Cape Leveque (not Derby) was upgraded to Yellow at 6 pm 21 January and then Kuri Bay was put on Red alert at midnight.

During 22 January the areas under warning/watch were contracted as *Magda* moved inland and weakened. Red alert at Kuri Bay was lifted at noon, and the Yellow alert at other communities was lifted at 3 pm WST. Derby remained in Blue Alert until the cyclone was downgraded at 9 pm 22 January. At that time a severe weather warning was issued which was continued until 3:20 pm WST 23 January.

Table 1. Best track summary for *Magda*, January 2010.

Refer to the Australian Tropical Cyclone database for complete listing of parameters.

Year	Month	Day	Hour (UTC)	Position Latitude S	Position Longitude E	Position Accuracy nm	Max wind 10min knots	Max gust knots	Central Pressure hPa	Rad. of Gales nm	Rad. of storm force winds	Radius Max. Wind (RMW)
2010	1	18	12	10.9	123.0	30	20	45	1004			
2010	1	18	18	11.2	122.9	30	25	45	1002			
2010	1	19	00	11.3	122.9	25	30	45	1000			
2010	1	19	06	11.5	122.5	25	30	45	1000			
2010	1	19	12	11.8	122.5	25	30	45	1000			
2010	1	19	18	11.9	122.4	25	30	45	1000			
2010	1	20	00	12.1	122.3	25	35	50	996			20
2010	1	20	06	12.4	122.2	25	40	55	995	40		15
2010	1	20	12	12.7	122.3	20	45	65	992	45		10
2010	1	20	18	13.1	122.5	20	55	75	985	50	15	10
2010	1	21	00	13.6	123.2	20	65	85	978	50	20	8
2010	1	21	06	14.3	123.5	20	60	85	982	45	20	8
2010	1	21	12	14.6	124.1	15	50	70	988	45	20	10
2010	1	21	18	15.2	124.4	15	65	90	980	45	20	108
2010	1	21	21	15.6	124.5	15	70	100	975	40	20	107
2010	1	22	00	15.9	124.5	15	65	90	980	35	15	108
2010	1	22	03	16.3	124.4	15	60	85	982	35	15	8
2010	1	22	06	16.7	124.4	15	50	70	986	30		10
2010	1	22	09	17.2	124.4	15	40	55	992	20		10
2010	1	22	12	17.4	124.4	15	30	50	996			
2010	1	22	18	17.9	124.2	20	25	45	998			
2010	1	23	00	18.2	124.0	15	25	45	1002			
2010	1	23	06	18.4	123.8	15	20	40	1000			
2010	1	23	12	19.0	123.6	15	20	40	1002			
2010	1	23	18	19.6	123.3	20	20	40	1002			
2010	1	24	00	19.9	122.9	15	15	40	1004			
2010	1	24	06	20.1	122.4	15	15	40	1002			

Figure 1. Track of Severe Tropical Cyclone *Magda*, 19-23 January 2010. Times in WST (subtract 8 hours to convert to UTC).

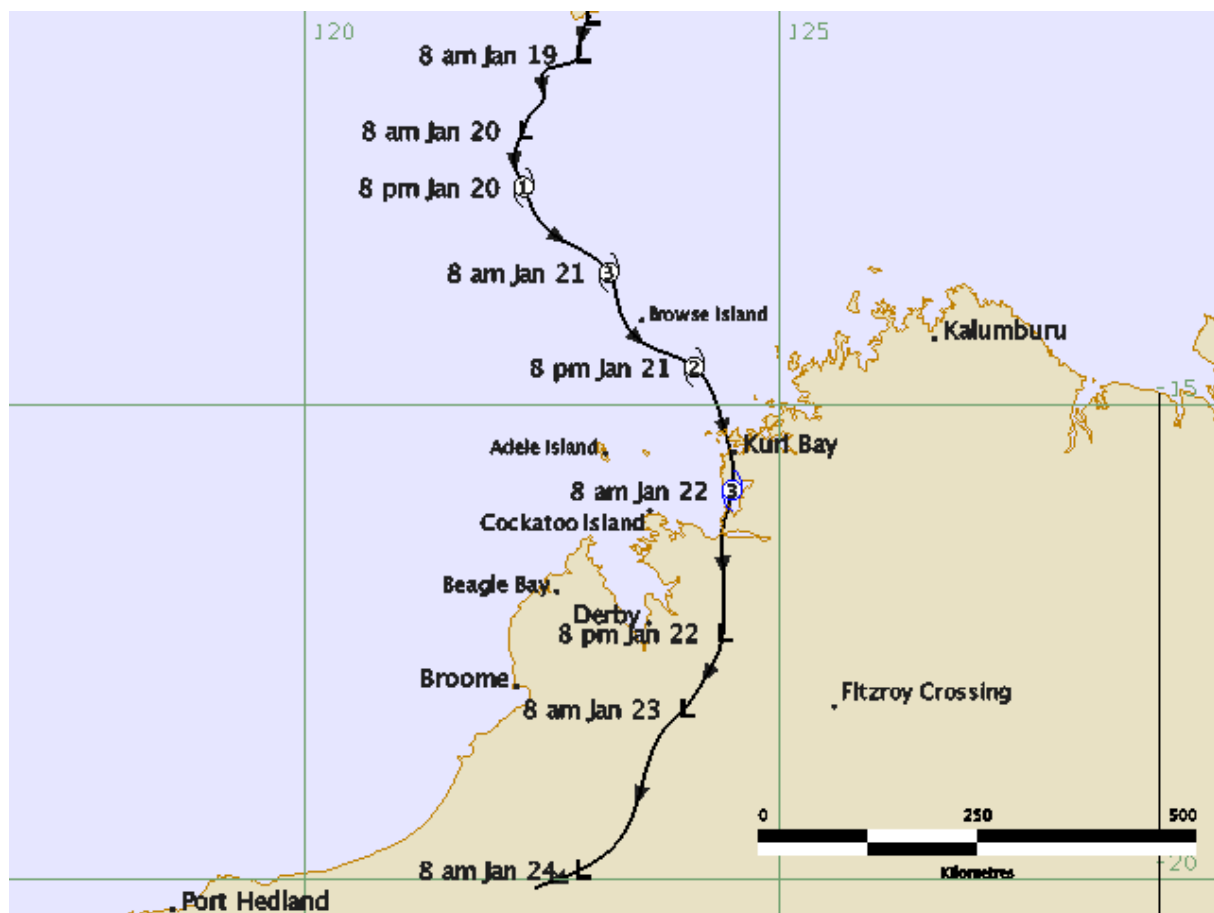


Figure 2. Initial cyclone intensity: visible image at 0630 UTC 20 January showing the centre underneath deep convection. (image courtesy of US NRL: <http://www.nrlmry.navy.mil/>)

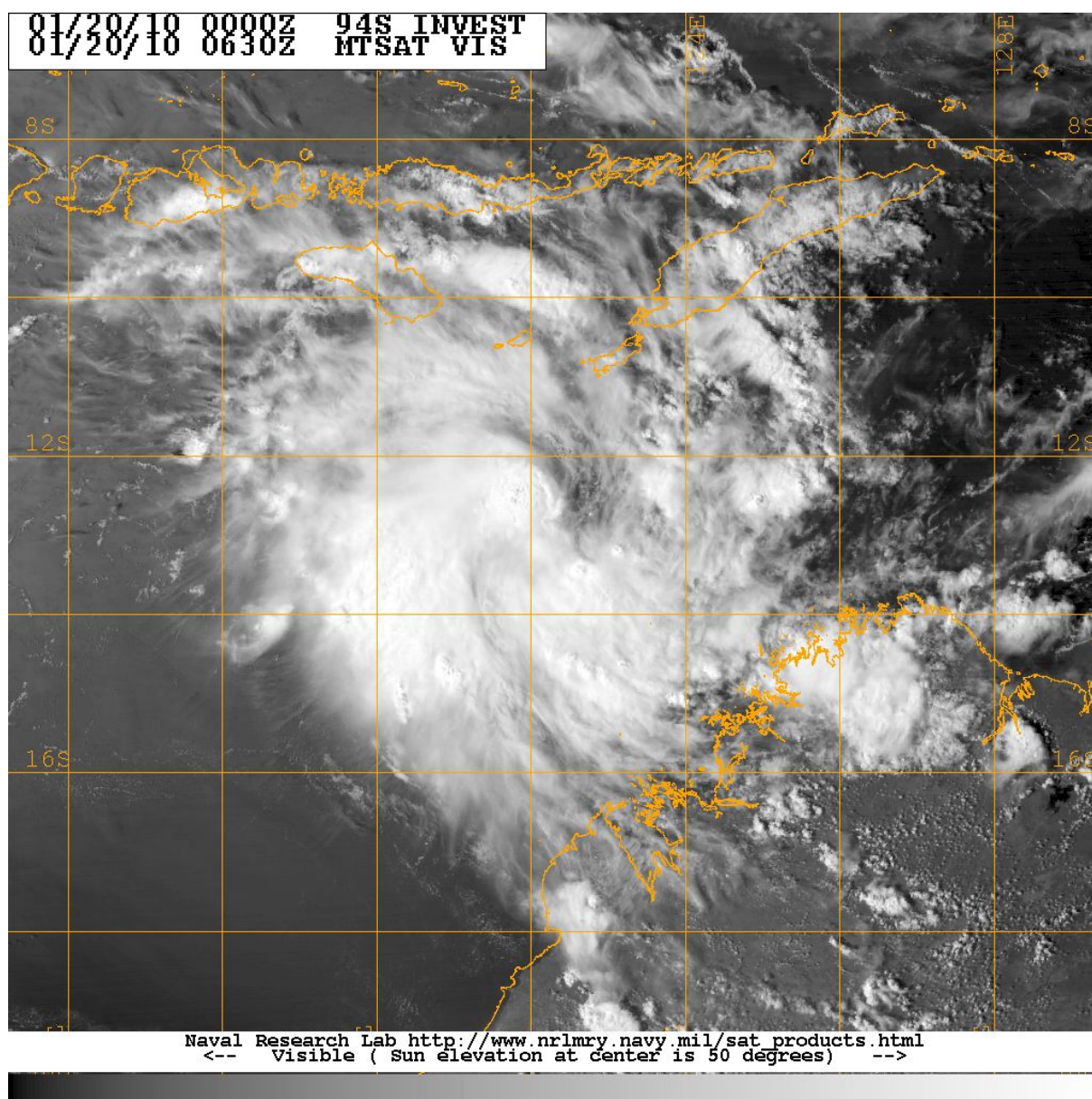


Figure 3. Microwave (SSMIS 91GHz) image at 2229 UTC 20 January.

(image courtesy of US NRL: <http://www.nrlmry.navy.mil/>)

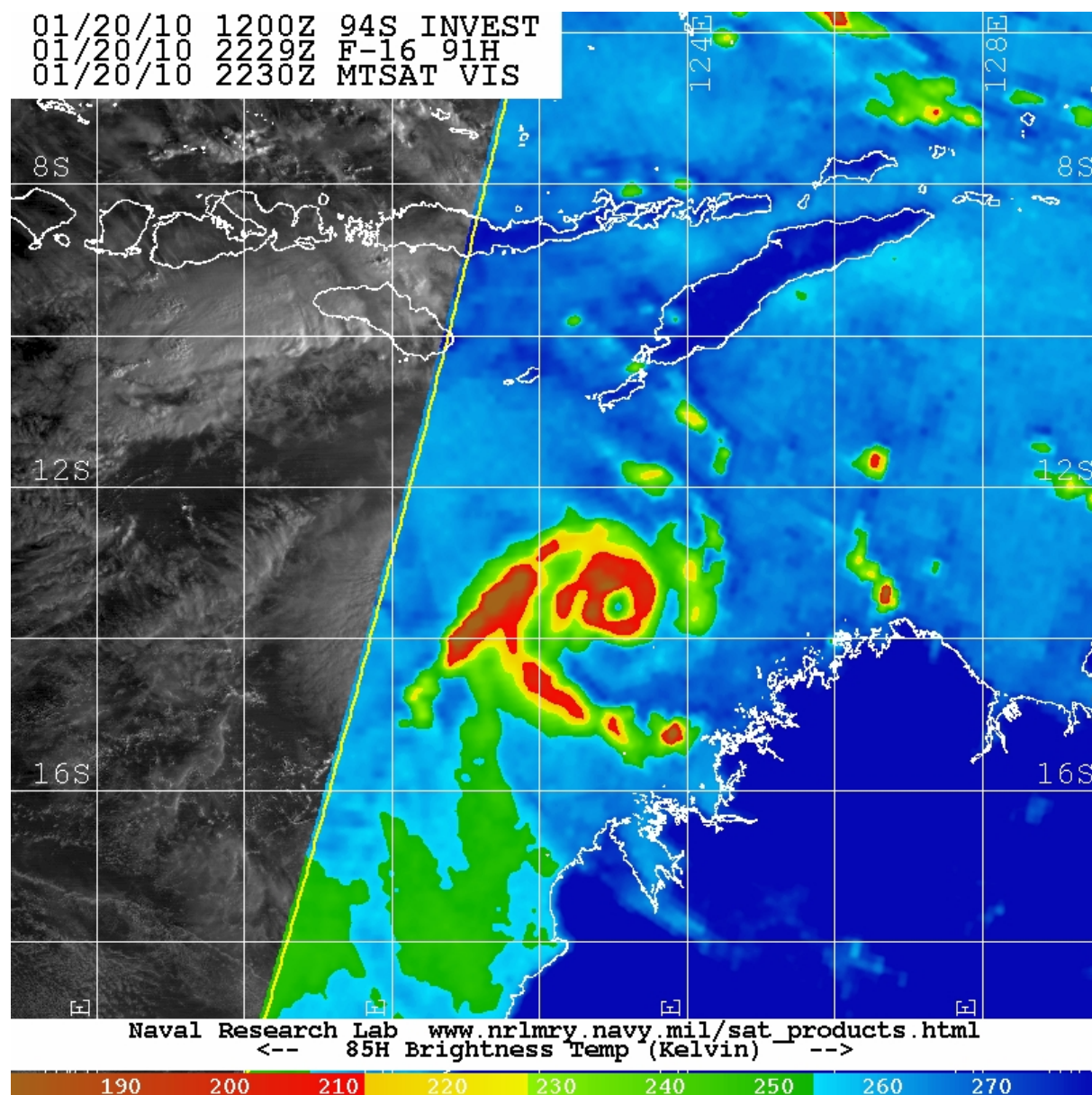


Figure 4. Microwave (SSMIS 91GHz) image at 2118 UTC 21 January showing the eye just after landfall near Kuri Bay.

(image courtesy of US NRL: <http://www.nrlmry.navy.mil/>)

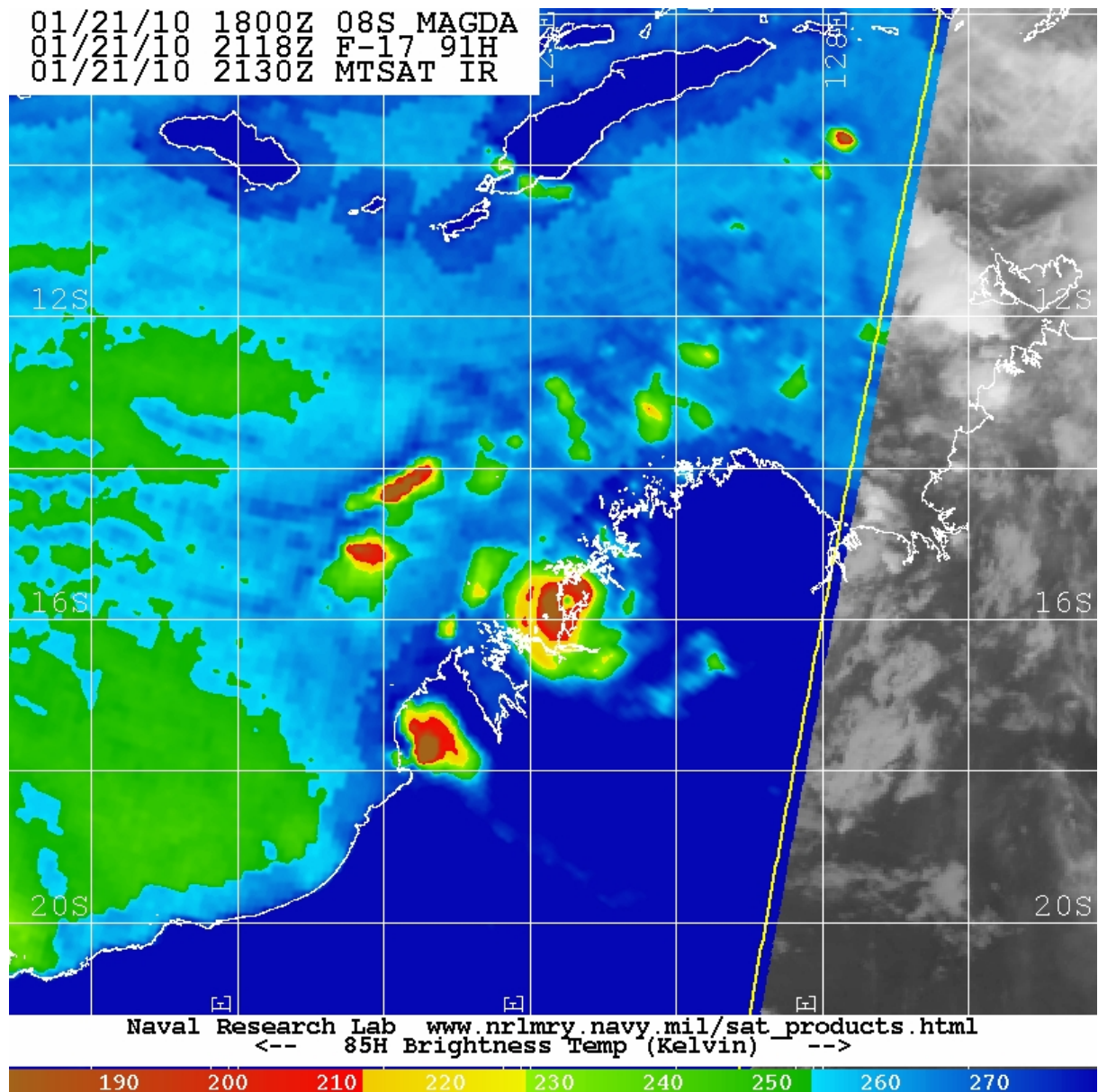


Figure 5. Photo at Kuri Bay showing defoliation of the vegetation. Image courtesy of Paspaley Pearls.

