Australian Government
Bureau of Meteorology

Severe Tropical Cyclone *Billy*

16 December 2008 - 5 January 2009

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23 June 2009, updated 16 July 2021

A. Summary

A tropical low formed in the Timor Sea northwest of Darwin on 15 December and moved to the southwest and then to the southeast on 17 December. The low moved into the Joseph Bonaparte Gulf on 18 December and intensified to cyclone intensity. The slow-moving system reached category two intensity before crossing the Kimberley coast near Wyndham early on 20 December as shown in Figure 1.

Billy passed over Oombulgurri community at category 2 strength causing tree damage and power outages before weakening over land. Heavy rainfall caused some flooding and road closures in the northeast Kimberley. Wyndham recorded 384 mm in the 48 hours to 9am on 21 December. *Billy* weakened below cyclone strength by the afternoon of 20 December and tracked overland to the west southwest.

Ex-TC Billy moved offshore to the south of Kuri Bay about 0900 WDT 22 December (note: WDT=WST+1h or UTC+9h). The system continued in a southwest direction passing close to Cape Leveque in the early hours of 23 December before finally moving out over open water after 0900 WDT 23 December. Once over water *Billy* re-intensified rapidly and reached category 2 by the afternoon of 23 December.

Billy continued to intensify quickly and reached category four intensity late on 24 December about 280 km north of Port Hedland. *Billy* then moved to the west northwest away from the Pilbara coast, weakening from late on 25 December due to increasing wind shear. *Billy* eventually weakened below cyclone intensity late on 28 December about 750 km north of Exmouth. The remains of Ex-TC *Billy* continued to move west until it moved out of the Perth area of responsibility on 6 January.

B. Meteorological Description

Intensity analysis

Scattered thunderstorm activity in the Timor Sea on 15-16 December gradually consolidated resulting in Dvorak T1 classification late on 16 December. Increasing curved banding in the deep convection in a generally favourable environment culminated in tropical cyclone intensity being estimated during 18 December, influenced by the 1418 WDT (0518 UTC) TRMM 85GHz microwave image that showed tight curvature in the deep convection, as shown in Figure 2.

Billy crossed the east Kimberley coast as a category 2 system before weakening quickly below cyclone strength. The system maintained a moderate circulation during

20 and 21 January as it crossed the Kimberley. Gales redeveloped offshore in western quadrants by 0900 WDT 22 December as the system moved offshore south of Kuri Bay. However, deep convection was not persistent and there was some difficulty in applying Dvorak techniques to obtain a Data T number. The intensity analyses relied heavily on the MET during 22 December.

The system stayed close to land with the centre passing over Cape Leveque during the early hours of 23 December. This interaction with the land hindered *Billy*'s re-development into a cyclone. Once the system moved west over open water during 23 December gales redeveloped in all quadrants and the system reached category 2 intensity by 1500 WDT 23 December. By 2030 WDT 23 December microwave imagery showed an eye with very deep convection wrapped halfway around the system.

Billy continued to move in a westerly direction and intensify, reaching mean wind peak intensity of 177 km/h (95 knots) at 0300 WDT 24 December (refer Figure 3). During 25 December the wind shear over the system increased and *Billy* began to weaken quickly in response. The system finally weakened below tropical cyclone strength at 0900 WDT 28 December. A well defined 35 km/h (20 knot) wind circulation persisted for many days after this and the remains of *Billy* finally moved west of 80^{o}E on 6 January 2009.

Motion

The southerly track in the circulation's early stages was influenced by the monsoon flow in the absence of a significant ridge to the south. However, once *Billy* crossed the Kimberley coast on 20 December a stronger mid-level ridge to the south steered the system to the west southwest. Despite breaks forming in the mid-level ridge at times, caused by mid-latitude troughs, the cyclone remained north of the ridge for its entire lifetime and always moved in a generally westerly direction.

Structure

Billy was a small system in its early stages having an average radius to gales of 30-50nm and a radius of maximum winds of about 10nm. Once it moved into the Indian Ocean it was a near average sized system with an average radius to gales of 80nm.

From the 25 December onwards it experienced moderate to strong shear and most convection became located on the western side of the system. Even once it had weakened to below cyclone intensity there were occasional bursts of deep convection persisting on the western side of the system.

C. Impact

Most of *Billy*'s impacts occurred when it crossed the northern Kimberley coast northwest of Wyndham. *Billy* passed over Oombulgurri community at category 2 strength causing tree damage and power outages before weakening over land. Heavy rainfall caused some flooding and road closures in the northeast Kimberley.

Moderate to strong winds and heavy rainfall were experienced by communities at Cockatoo Island, Koolan Island and along the Dampier Peninsular during 23 December but only minor tree damage was reported from One Arm Point.

D. Observations

Rainfall

Wyndham recorded 384 mm in the 48 hours to 0900 WDT 21 December.
Beagle Bay recorded 100 mm in the 24 hours to 0900 WDT 24 December.

Wind

Rowley Shoals recorded a period of gale force winds from 1130 WDT 24 December until 0510 WDT 25 December as *Billy* passed to the south of the site.

E. Forecast Performance

Model guidance consistently suggested that *Billy* would move to the west and parallel the Pilbara coastline. The forecast track always reflected this policy but Advices were issued for the Kimberley and Pilbara coast due to the close proximity of the system to the coast.

The first Advice was issued at 1900 WDT 20 December with a warning from Kulumburu to Cockatoo Island with a watch extending south to Broome. During 21 December the warning was extended south to Beagle Bay and the watch extended to Wallal.

On 22 December the warning area was contracted from Kulumburu to Mitchell Plateau but extended south to Bidyadanga and the watch extended to Port Hedland. Late Monday the area was again shifted west with a warning from Kuri Bay to Wallal and a watch from Wallal to Whim Creek.

During 23 and 24 December as the cyclone paralleled the Pilbara coastline the warning and watch areas were shifted gradually west until there was only a warning from Pardoo to Mardie remaining. Finally on 25 December as *Billy* moved west northwest away from the coastline all Advices were cancelled.

Table 1. Best track summary for TC *Billy.*

Note: Add 9 hours to convert to WDT. Refer to best track database for complete track details.

Year	Month	Day	Hour (UTC)	Position Latitude S	Position Longitude E	Position Accuracy nm	Max wind 10min knots	Max gust knots	Central Pressure hPa	Mn. Rad. of Gales nm	Rad. of storm force winds nm	Radius Max. Wind (RMW) nm
2008	12	16	00	10.6	127.7	25	15	45	1004			
2008	12	16	06	11.0	127.5	25	20	45	1000			
2008	12	16	12	11.3	127.3	25	20	45	1000			
2008	12	16	18	11.8	127.3	25	20	45	1000			
2008	12	17	00	12.3	127.3	25	20	50	1000			
2008	12	17	06	12.6	127.5	25	20	45	998			
2008	12	17	12	12.9	127.5	25	20	45	998			
2008	12	17	18	13.2	127.8	25	25	45	998			
2008	12	18	00	13.6	128.3	20	30	45	996			
2008	12	18	06	14.0	128.6	15	35	50	994	25		10
2008	12	18	12	14.4	128.8	15	40	55	993	30		12
2008	12	18	18	14.6	128.8	15	40	55	991	35		12
2008	12	19	00	14.5	128.7	15	45	65	988	35		12
2008	12	19	06	14.5	128.7	15	50	70	983	35	20	12
2008	12	19	12	14.6	128.6	15	50	70	983	35	20	12
2008	12	19	18	14.9	128.1	15	50	70	988	30	20	12
2008	12	20	00	14.9	127.9	10	35	50	993	25		15
2008	12	20	06	15.1	127.4	10	30	45	995			
2008	12	20	12	15.2	126.9	20	30	45	996			
2008	12	20	18	15.1	126.3	20	30	45	996			
2008	12	21	00	15.1	126.0	20	30	45	998			
2008	12	21	06	15.1	125.8	20	30	45	998			
2008	12	21	12	15.3	125.5	20	30	45	998			
2008	12	21	18	15.4	125.1	20	30	45	998			
2008	12	22	00	15.6	124.7	20	35*	50	996			
2008	12	22	06	15.9	124.0	20	35*	50	997			
2008	12	22	12	16.3	123.4	20	35*	50	996			
2008	12	22	18	16.6	122.8	10	35*	50	996			
2008	12	23	00	17.2	122.2	10	35*	50	995			
2008	12	23	06	17.6	121.2	10	50	70	986	57.5	30	
2008	12	23	12	17.8	120.8	10	50	70	985	62.5	30	
2008	12	23	18	17.9	120.3	10	60	85	978	75	30	
2008	12	24	00	17.8	119.9	10	65	90	976	75	30	20
2008	12	24	06	17.8	119.2	10	80	110	964	75	30	20
2008	12	24	12	17.8	118.6	10	90	125	955	75	30	20
2008	12	24	18	17.6	117.9	10	95	135	950	80	40	20
2008	12	25	00	17.5	117.2	10	90	125	955	80	40	20
2008	12	25	06	17.3	116.6	10	90	125	955	80	40	20
2008	12	25	12	16.9	116.0	20	90	125	955	80	40	20
2008	12	25	18	16.3	115.3	15	85	120	960	70	30	20
2008	12	26	00	16.1	114.8	10	80	110	964	82.5	32.5	20
2008	12	26	06	15.8	114.3	10	80	110	964	77.5	30	20
2008	12	26	12	15.6	113.9	10	70	100	970	50	30	20

2008	12	26	18	15.4	113.6	10	60	85	978	60	30	
2008	12	27	00	15.2	113.4	10	55	75	981	60	30	
2008	12	27	06	15.2	112.9	10	50	70	985	55	25	
2008	12	27	12	15.1	112.8	10	50	70	985	55	20	
2008	12	27	18	15.0	112.9	15	40	55	992	57.5		
2008	12	28	00	14.9	113.0	20	30	45	997			
2008	12	28	06	15.5	112.7	15	30	45	999			
2008	12	28	12	16.1	112.6	15	25	45	1001			
2008	12	28	18	16.4	112.0	20	25	45	1001			
2008	12	29	00	16.6	111.4	20	25	45	1001			
2008	12	29	06	16.7	110.6	20	25	45	1002			
2008	12	29	12	16.9	109.8	20	25	45	1002			
2008	12	29	18	16.9	108.7	20	25	45	1002			
2008	12	30	00	16.8	108.2	20	25	45	1001			
2008	12	30	06	16.8	107.7	15	25	45	1001			
2008	12	30	12	16.6	107.4	10	25	45	1001			
2008	12	30	18	16.5	106.7	10	20	45	1004			
2008	12	31	00	16.5	106.0	10	20	45	1005			
2008	12	31	06	15.9	105.2	10	20	45	1005			
2008	12	31	12	15.8	104.9	10	20	45	1005			
2008	12	31	18	15.4	103.2	10	15	45	1005			
2009	1	1	00	15.0	102.2	10	15	45	1005			
2009	1	1	06	14.9	101.4	10	15	45	1005			
2009	1	1	12	14.9	100.6	10	15	45	1005			
2009	1	1	18	14.6	99.3	10	15	45	1005			
2009	1	2	00	14.3	98.3	10	15	45	1005			
2009	1	2	06	13.9	97.1	10	15	45	1005			
2009	1	2	12	13.7	96.0	10	15	45	1006			
2009	1	2	18	13.5	94.6	10	15	45	1006			
2009	1	3	00	13.2	93.2	10	15	45	1006			
2009	1	3	06	13.0	92.0	10	15	45	1006			
2009	1	3	12	12.7	91.3	10	15	45	1005			
2009	1	3	18	12.6	90.2	15	15	45	1005			
2009	1	4	00	12.6	89.1	15	15	45	1005			
2009	1	4	06	12.5	88.0	15	15	45	1005			
2009	1	4	12	12.4	86.8	15	15	45	1005			
2009	1	4	18	12.4	85.8	15	15	45	1005			
2009	1	5	00	12.5	85.0	15	15	45	1005			
2009	1	5	06	13.2	83.1	15	15	45	1005			
2009	1	5	12	14.0	81.3	15	15	45	1005			
2009	1	5	18	14.7	79.4	15	15	45	1005			

* Not a cyclone as gale force winds did not extend more than half-way around the system at this time.

Table 2. Verification statistics: Track and Intensity.

Parameter	**0 hr**	**6 hr**	**12 hr**	**18 hr**	**24 hr**	**36 hr**	**48 hr**
Count	35	36	37	38	39	41	43
Distance (km)	15	31	47	60	76	97	108
Mean Wind (knots)	3	5	7	8	9	10	8

Figure 1. Track of Severe TC *Billy* 16 December 2008 – 4 January 2009.

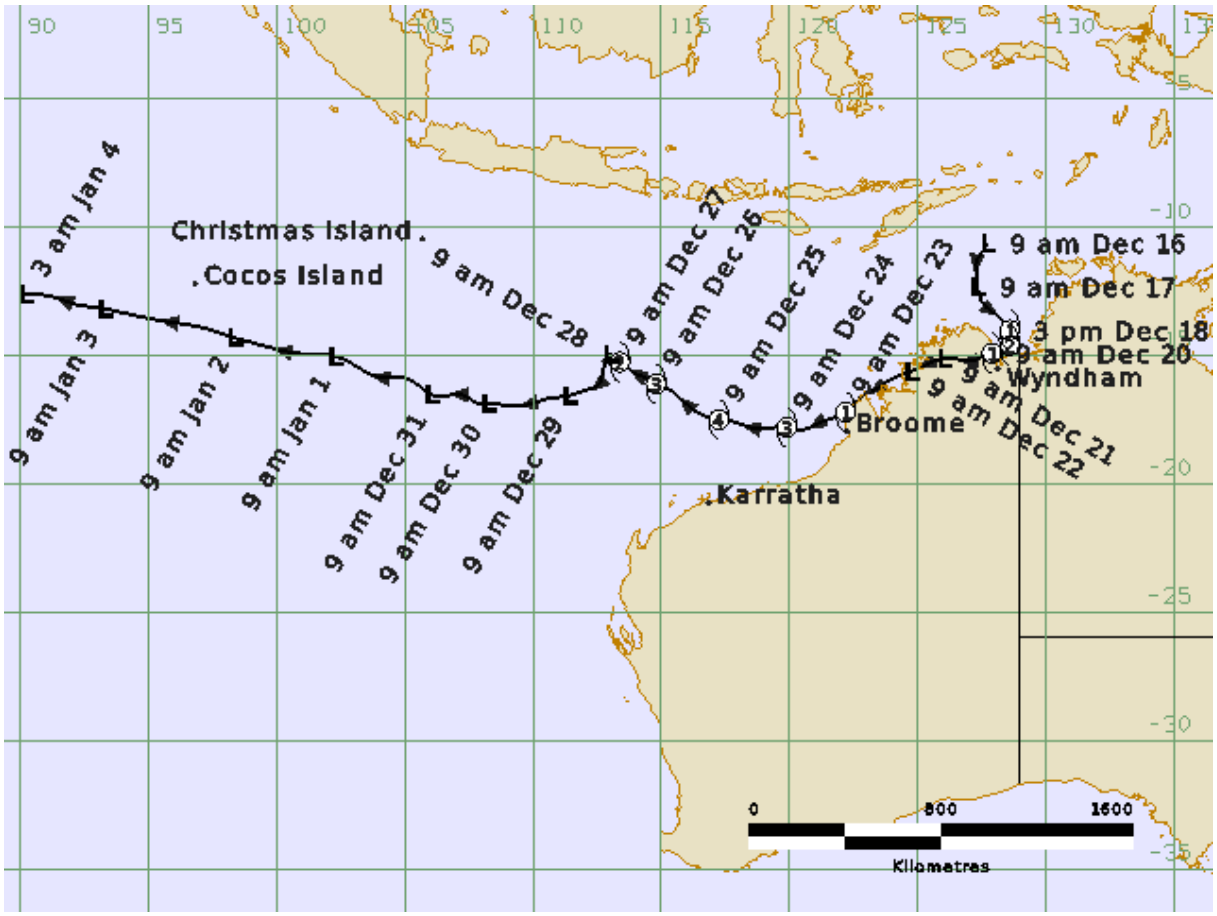

Figure 2. Microwave (TRMM 85 GHz) image at 1408 WDT 18 December 2008 (0518 UTC 18 December) when Billy reached tropical cyclone intensity.
(image courtesy of US NRL: http://www.nrlmry.navy.mil/)

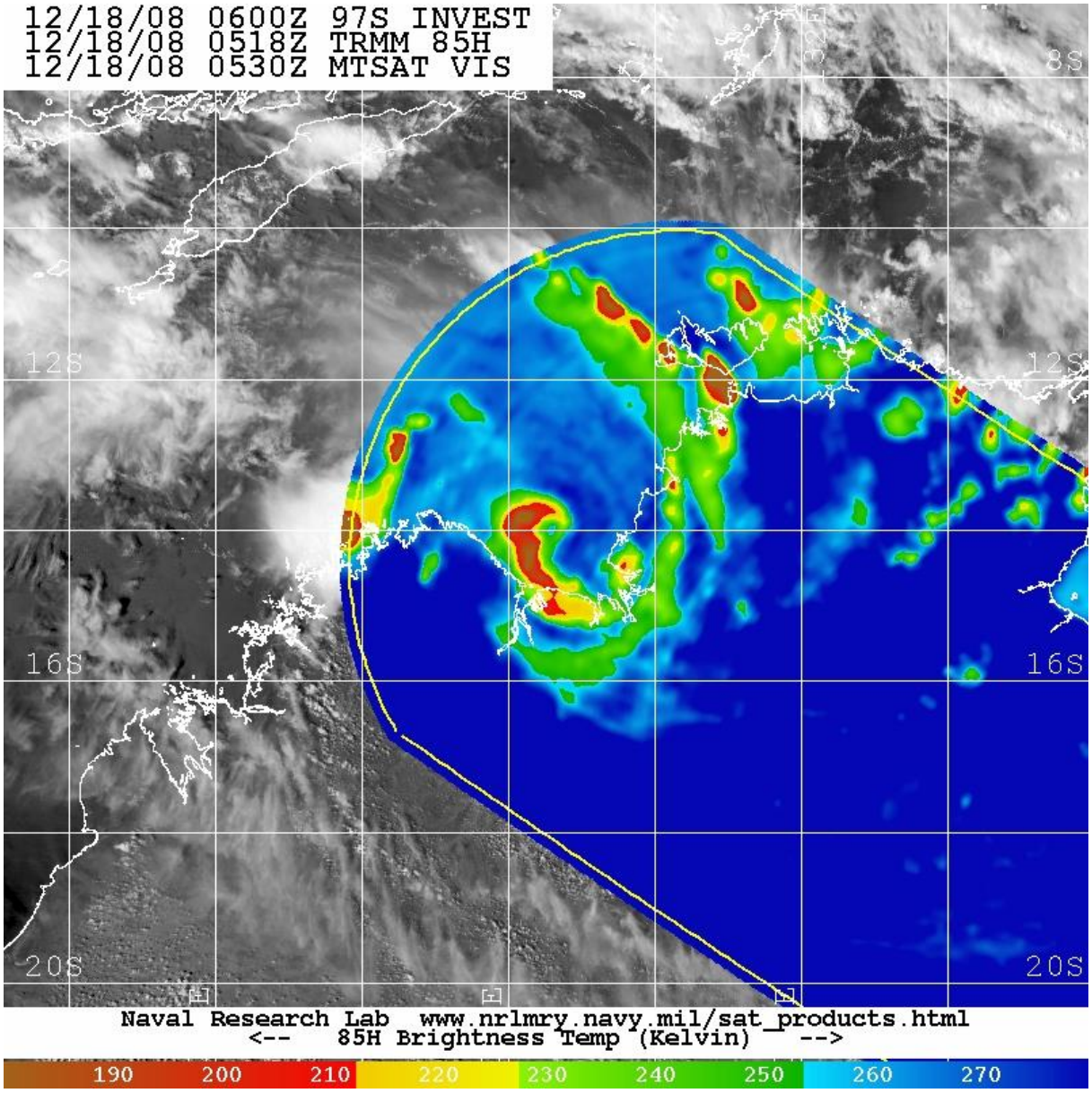

Figure 3. Microwave (AMSRE 89GHz) image at 0256 WDT 25 December 2008 (1756 UTC 24 December 2009) near peak intensity.
(image courtesy of US NRL: http://www.nrlmry.navy.mil/)