



Australian Government
Bureau of Meteorology

Severe Tropical Cyclone *Justin* 6 - 24 March 1997

Queensland Tropical Cyclone Warning Centre
Bureau of Meteorology

A. Summary

Severe Tropical Cyclone *Justin* was a large, long-lived Coral Sea cyclone that crossed the Queensland coast as a category two cyclone northwest of Cairns on 22 March.

Two lows that merged in a very active monsoon trough in the Coral Sea developed into Tropical Cyclone *Justin* on 7 March, reaching maximum intensity on 9 March as a very large system. *Justin* remained almost stationary and due to cooling SST's it was downgraded to a tropical low on 13 March. *Justin* then drifted north over warmer SST's and re-intensified to tropical cyclone strength on 14 March, reaching a peak intensity on 17 March before weakening and crossing the coast northwest of Cairns on 22 March.

The combined effects of heavy rain, large seas and gale to storm force winds caused widespread damage in the region between Cairns and Townsville and the loss of two lives. Earlier in *Justin*'s lifecycle 30 people were killed in Papua New Guinea and five people died when their yacht was destroyed. *Justin* was reportedly responsible for an estimated loss of \$150 million to the agricultural industry alone.

B. Meteorological Description

Intensity Analysis

The monsoon trough was characterised at 2300 UTC 3 March by a series of MSL low pressure centres below 1000 hPa extending from northeast Australia across the Coral Sea and by 2300 UTC 5 March one centre had developed in the Coral Sea. This low intensified and was named *Justin* at 1900 UTC 6 March. Surrounding pressure rises over southeast Australia and over the PNG Highlands helped produce gale force winds over a large area.

From 2300 UTC 7 March to 2300 UTC 9 March *Justin* moved only very slowly and reached peak intensity for this phase of its life at 1200 UTC 9 March. *Justin* continued to grow in size and by 2300 UTC 9 March gales extended from Cape Moreton (just NE of Brisbane) north to PNG waters. Between 2300 UTC 8 March and 2300 UTC 9 March large pressure rises over Indonesia contributed to increasing the pressure gradient over eastern PNG and this was the first period when widespread damage and loss of life occurred over PNG.

Between 1200 UTC 9 March and 1200 UTC 11 March the deep convection near the centre of *Justin* became greatly reduced in size while the SST at nearby Willis Island was falling below 26°C. By 1200 UTC 13 March *Justin* was moving northward away from Willis Island and over warmer water. Deep convection began increasing again near the centre of the cyclone and by 1200 UTC 15 March it was completely surrounding the centre for the first time. At 1200 UTC 18 March *Justin* was near peak intensity however it began to become embedded in strong easterly upper winds north of a strengthening subtropical ridge and in the following twenty-four hours *Justin* dramatically weakened. The convection began moving west of the centre around 2300 UTC 18 March when the cyclone came close to its old track and colder. At 1200 UTC 20 March *Justin* was approaching a warmer SST zone however by then there were 50 knot north-easterly winds at 200 hPa over the centre.

By 1200 UTC 21 March the 200 hPa winds had dramatically eased above *Justin* and convection rapidly developed to the north of the centre serving to intensify the cyclone. Despite being overland on the night of 22 March, deep convection around the cyclone developed and northerly gales lashed the Cairns area during Sunday 23 March. *Justin* was moving towards Townsville and closer to the upper north-westerly wind zone over Central Queensland. These winds were increasing in speed as an upper trough moved into Queensland. Gales then began to affect areas south to Townsville as *Justin* began a track towards the southeast.

Gales in the Townsville region reached a peak around 1600 UTC 23 March 1997 and then slowly eased as *Justin* began to weaken while moving beneath the strong upper winds. These winds were turning more westerly over the Townsville area by 2300 UTC 23 March 1997 as the upper trough moved seawards. This upper trough weakened sufficiently to have only a weak reflection at MSL which enabled ridging to develop at MSL south of *Justin*. To have remained a cyclone *Justin* would have had to move rapidly southeast ahead of the upper trough. However, the low level ridging to its south sheared it away from its convection.

Motion

Between 2300 UTC 8 March and 2300 UTC 9 March the 500 hPa heights increased in the ridge to the south of *Justin*. Westward movement towards the coast normally follows such a build up in the middle level ridge. The TAPS analysed winds indicated an increase in the south-easterly to north-easterly winds south of the cyclone. However there was an extensive band of westerly winds north of the centre which also increased. These 500 hPa westerlies strengthened as a 500 hPa ridge developed over Indonesia which set up a strong height contour gradient (similar to the pressure gradient at MSL) across PNG. Such strong westerlies are rare at 500 hPa north of tropical cyclones in the Australian region. Normally fluctuations in the depth and speed of the easterly wind zone south of east coast cyclones determine whether they move westwards (eastwards) towards (away from) the coast. The rotation of the earth contributes to a movement towards the west southwest reinforcing the steering by easterly winds. This latter effect is more pronounced in a large cyclone like *Justin*. However, *Justin* was a notable exception with a deeper than normal monsoon westerly wind zone to its north. Much stronger ridging at 500 hPa would have been required to steer it westwards.

By 1200 UTC 12 March *Justin* had begun moving northwards. Deep convection had been at a minimum near the centre over the previous twenty-four hours though it

began to grow in size as the cyclone started moving. The 500 hPa winds and the 850 hPa to 300 hPa deep mean layer winds provided the clearest explanation for this northward movement. Over the period from 2300 UTC 11 March 1997 to 2300 UTC 13 March 1997 the 500 hPa south-easterly to south-westerly winds on the western side of *Justin* increased in speed as 500 hPa heights rose over Queensland. At the same time 500 hPa winds with a northerly component east of *Justin* decreased in speed as a deep monsoon trough developed east of the cyclone. The deep layer mean winds indicated the development of a similar asymmetric wind pattern around *Justin* which was consistent with northwards movement. This intensifying monsoon trough at MSL produced an extraordinary area of near equatorial westerly gales extending more than 3000 km from north of New Guinea into the Pacific by 2300 UTC 13 March. *Justin* began a more easterly track at 2300 UTC 13 March when it moved to the north of the deep monsoon trough.

The movement of *Justin* became extremely erratic and difficult to forecast from 15 to 18 March 1997. The TAPS analysed 500 hPa winds in show fluctuations from day to day in the wind speeds in the quadrants surrounding *Justin*. Basically over the period a very strong 500 hPa subtropical ridge was starting to build over the continent south of *Justin*. However a slow-moving trough was passing directly south of the cyclone which was preventing the development of a sufficiently strong 500 hPa ridge south of *Justin* to cancel the effect of the vigorous monsoon westerlies.

From the 500 hPa ridge was slowly but surely building to the south of *Justin*. This ridge continued to strengthen and by 2300 UTC 19 March 1997 the cyclone was moving steadily towards the Queensland coast as the highest 500 hPa wind speeds surrounding *Justin* were in the easterly wind sector. At 2300 UTC 21 March 1997 a 500 hPa trough crossing Queensland weakened and moved off the east coast. The ridge to the south of *Justin* remained strong with the 500 hPa heights at Rockhampton remaining steady over the previous twenty-four hours. However, a new trough was entering southwest Queensland. There was some evidence that environmental westerly winds were extending northwards closer to the cyclone. The 500 hPa winds speeds at Mackay were decreasing as the intensifying tropical cyclone came closer to the station. An interpretation of this reduction in wind speed at the time was that the easterly wind component was being swamped by westerly environmental winds. By 2300 UTC 22 March 1997 the 500 hPa trough had amplified and *Justin* then overland near Cairns was clearly trapped in the westerly wind regime and was in the process of re-curving towards Townsville.

As discussed above there was evidence that *Justin* would re-curve near Cairns. The failure of the 500 hPa heights to fall at Rockhampton at 2300 UTC 21 March 1997 usually is an indication that the cyclone will be steered in a general westerly direction by the 500 hPa ridge for several hours. This indeed happened and re-curvature occurred over land.

C. Impact

Eleven people were killed when entire villages were flattened in Milne Bay and other maritime provinces in the far southeast of the country. It is feared that 30 lives were lost from the effects of *Justin* in PNG. This was also the period when the wreckage of the yacht Queen Charlotte was found 275 nautical miles southwest of Honiara, the capital of the Solomon Islands. A massive air and sea search failed to find the two

Australians and three New Zealanders aboard the vessel. Heavy rain with landslides also caused a great deal of damage in the Solomon Islands.

The large waves and high tides resulted in severe beach erosion and inundation along coast and offshore Islands between Townsville and Bundaberg. In the Cairns Region inundation at three beachfront communities resulted in damage estimated at \$430,000. The Islands around Hayman Island and the adjacent mainland suffered wind damage to trees and roofs and damage to retaining walls, marinas and yachts by the wild seas.

At sea the Large Tandem Thrust International Military exercise was badly disrupted with extensive damage to two landing craft. Troop ships were evacuated well out to the fringes of the Coral Sea away from *Justin* and many troops succumbed to sea sickness from the large waves. A Canadian couple were rescued from a 15 metre ferro concrete yacht by helicopter 1 hour 20 minutes out from Townsville. The rescuers reported waves at least 10 metres in height. In its passage through the eye of the cyclone, the Vessel *Oscostar* sustained \$600,000 damage.

Willis Island recorded more than a metre of rain from *Justin* as it slowly past the station. The wind, huge seas and horizontal rain from the cyclone caused a great deal of moderate damage to the station and to its equipment. The prolonged nature of the wind, rain and seas contributed to the damage. The maximum wind gust recorded was 67 knots.

Unfortunately two people were killed as *Justin* passed over the area. A lady was killed by a landslide at Paluma near Townsville. A boy was electrocuted by a fallen power line at Innisfail 70 km south southeast of Cairns.

The total horticultural and sugar cane damage bill is expected to reach \$150,000,000. The region between Townsville and Cairns lost 60% of their banana crop and a loss \$80,000,000 is expected. It is estimated the region lost 20 to 30% of its \$240,000,000 sugar cane crop and damage to paw paws is expected to be \$5,000,000. Macadamia nut producers lost half of their crop. In the Burdekin (near Townsville) flooding caused delays to vegetable planting. Capsicums and corn will require replanting. Damage to roads and bridges etc are expected to exceed \$20,000,000.

Cairns Region - From the track it can be seen *Justin* passed to the north of the city. Cairns harbour wall was badly damaged and 50 berths in the marina were destroyed. There was widespread tree damage which brought down power lines and caused massive blackouts. Large landslides covered roads leading up into the Atherton Tablelands west of the city. In the Tablelands fifteen homes were damaged by trees smashing through roofs. Wind caused \$1,000,000 loss to the Tableland's maize crop.

Townsville Region - Many trees were damaged by wind throughout Townsville with power lines down and blackouts and damage to cars and houses by trees. A plot of Macadamia trees were ripped apart at Toolakea. Damage to a park at Jourama Falls (85 km NW of Townsville) could reach \$130,000, \$30,000 to buildings by fallen trees and \$100,000 to washed out tracks. The Townsville wave recording station recorded a Hsig of 3.58 metres and a Hmax of 5.99 metres at 1700 UTC 23 March 1997.

D. Observations

Wind/Pressure

Green Island AWS (27 km ENE Cairns) recorded a wind gust of 128 km/h at 0430 EST and a minimum pressure of 995 hPa at 10:14 EST.

Cairns recorded a maximum wind gust of 93 km/h at 07:00 EST.

Rainfall

Very heavy rain was generated by *Justin* over the 48 hours to 2300 UTC 23 March 1997. The rainfall distribution in the 24 hours to 2300 UTC 22 March 1997 showed an area with falls greater than 100mm extending from the Cairns region down to the Townsville area. This is the typical rainfall distribution associated with tropical cyclones making landfall along the east coast of Queensland where the heaviest rain occurs south from the point of landfall. Over the next 24 hours *Justin* tracked overland down to Townsville and then back out to sea. The falls greater than 100 mm contracted southwards towards the Townsville region.

Storm surge

In early March prior to crossing, tides were very close to the highest astronomical tide (HAT) and the surge generated by the strong winds lifted the tide by up to 0.5m above the HAT on some parts of the coast. Mackay recorded a peak storm surge of 0.78m on 10 March.

Cairns recorded a peak storm surge of 0.66m about one hour before the low tide on 22 March.

Table 1. Best track summary for *Justin*, 6 - 23 March 1997

Note: Add 8 hours to convert to WST. Refer to best track database for complete track details.

Year	Month	Day	Hour (UTC)	Position Latitude S	Position Longitude E	Max wind 10min knots	Central Pressure hPa	Rad. of Gales nm
1997	03	6	1800	17.0	153.5	45	990	250
1997	03	7	0000	16.6	152.7	45	987	350
1997	03	7	0600	16.5	152.5	45	981	350
1997	03	7	1200	16.5	152.5	45	981	350
1997	03	7	1800	16.7	151.9	50	977	350
1997	03	8	0000	16.7	151.9	50	980	350
1997	03	8	0600	17.0	151.9	50	978	350
1997	03	8	1200	17.3	151.9	50	976	350
1997	03	8	1800	17.2	151.3	50	975	350
1997	03	9	0000	17.5	151.2	60	974	350
1997	03	9	0600	17.3	151.2	60	975	350
1997	03	9	1200	17.0	151.3	60	975	350
1997	03	9	1800	16.8	151.4	60	976	350
1997	03	10	0000	16.6	151.5	60	977	350
1997	03	10	0600	16.6	151.6	60	978	400
1997	03	10	1200	16.7	151.7	60	980	305
1997	03	10	1800	16.7	151.8	60	980	305
1997	03	11	0000	16.7	151.8	50	980	305
1997	03	11	0600	16.6	151.9	50	982	305

1997	03	11	1200	16.5	151.9	50	984	350
1997	03	11	1800	16.2	151.8	50	985	350
1997	03	12	0000	16.1	151.8	45	987	350
1997	03	12	0600	16.1	151.8	35	990	270
1997	03	12	1200	15.8	151.9	40	990	270
1997	03	12	1800	15.5	152.0	40	990	270
1997	03	13	0000	15.3	152.2	40	990	175
1997	03	13	0600	14.9	152.5	40	985	110
1997	03	13	1200	14.2	152.3	35	985	110
1997	03	13	1800	13.6	152.2	35	985	110
1997	03	14	0000	13.0	152.2	40	980	150
1997	03	14	0600	12.6	152.6	45	980	200
1997	03	14	1200	12.3	153.2	45	980	200
1997	03	14	1800	12.0	153.7	45	980	200
1997	03	15	0000	11.7	154.2	45	980	200
1997	03	15	0600	11.3	154.6	45	980	200
1997	03	15	1200	11.6	155.1	45	980	200
1997	03	15	1800	11.9	156.0	45	980	200
1997	03	16	0000	12.2	156.0	45	980	200
1997	03	16	0600	12.3	155.9	45	975	200
1997	03	16	1200	12.5	155.9	50	970	200
1997	03	16	1800	13.0	155.7	65	970	200
1997	03	17	0000	12.4	155.5	65	965	200
1997	03	17	0600	12.5	155.5	65	960	215
1997	03	17	1200	13.0	155.1	70	955	215
1997	03	17	1800	12.3	154.8	80	955	215
1997	03	18	0000	11.9	155.4	80	955	325
1997	03	18	0600	11.9	155.2	80	955	325
1997	03	18	1200	12.0	154.7	80	955	325
1997	03	18	1800	12.2	154.3	80	960	325
1997	03	19	0000	12.4	154.0	80	965	270
1997	03	19	0600	12.5	153.6	70	970	270
1997	03	19	1200	13.1	152.7	60	980	250
1997	03	19	1800	13.6	152.1	70	980	175
1997	03	20	0000	14.1	151.4	55	985	150
1997	03	20	0600	14.6	150.6	50	985	120
1997	03	20	1200	14.9	149.7	45	990	120
1997	03	20	1800	15.2	148.9	45	992	200
1997	03	21	0000	15.4	148.1	45	995	200
1997	03	21	0600	15.6	147.3	45	995	200
1997	03	21	1200	16.0	147.1	45	997	200
1997	03	21	1800	16.5	146.7	50	995	200
1997	03	22	0000	16.7	146.0	50	993	105
1997	03	22	0330	16.8	145.6	50	990	105
1997	03	22	0600	16.9	145.3	40	995	105
1997	03	22	1200	17.0	145.0	40	999	105
1997	03	22	1800	17.4	144.8	40	1000	105
1997	03	23	0000	17.6	144.9	40	1002	60
1997	03	23	0600	18.1	145.5	35	1000	20
1997	03	23	1200	18.6	145.9	45	999	105

1997	03	23	1800	19.0	146.7	45	999	105
1997	03	23	2300	19.2	147.3	40	1004	105

Figure 1. Track of Tropical Cyclone *Justin*, 6 – 23 March 1997.
All times in UTC.

