CASE STUDY: Tropical Cyclone Steve, February 2000

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Tropical cyclone Steve crossed the coast at the Cairns Northern Beaches around 7pm Sunday 27 February 2000. It was named at 7am that morning while near the Holmes Reef, which is located 230km east-northeast of Cairns. Cairns Airport reported the cyclones lowest MSL pressure 991 hPa at 6.39pm Sunday (not in the eye) and the maximum wind gust was 77 knots at 6.45pm and 6.50pm Sunday. The maximum 10 min average wind was 120/56 knots at 6.51 pm. At Green Island the lowest MSL pressure was 984.6 at 5.53pm Sunday and at the maximum gust there was 85 knots around 6.30pm. The highest significant wave at the Cairns wave recording Station was 2.75m around 8pm Sunday and the maximum wave height was 5m at midnight. The maximum storm surge at Cairns (1 metre) was at 7.30pm Sunday. The rain increased in the Barron River Catchment around the time of landfall. Emerald Crest recorded 256mm in the 12 hours to 6.25am Monday 28 February 2000. This resulted in major flooding at Mareeba in the early hours of Monday and in Cairns during Monday. At Mareeba 90 people were evacuated including 20 by helicopter evacuation from rooftops. A railway bridge was washed away. The flood level reached 12.4m at Mareeba (a record) at 4.37am Monday morning. Many buildings in Cairns suffered severe water damage including the Cairns Hospital. Powerlines were down throughout the district with more than 40,000 without power. A 17-year-old youth drowned in a flooded stream south of Cairns the day after the cyclone made landfall. Many buildings in Cairns suffered roof damage including the Cairns Yacht club, which lost a large section of the roof. Kuranda Township on the Atherton Tableland west of Cairns suffered high wind damage with hundreds of trees uprooted. Twelve houses were extensively damaged when large trees fell on them. Fallen trees and landslides caused the closure of the two highways to the Atherton Tablelands. The Gillies Highway was closed for a week. Crop damage from rain and wind was severe and the sugar cane damage has been quoted at AU$20 million.

Mean Sea Level

Steve was also a rapidly developing system (see Figure 1), which reached tropical cyclone intensity at 2100UTC on 26 February 2000 and crossed the coast at Cairns just below category 3 intensity at 0900UTC on 27 February, while moving towards the west at 10 knots. Note the small size of the system at landfall.

Rainfall

The track in Figure 2 with 24hour rainfall totals shows how *Steve* moved over the 18 hours between 0300UTC (1pm local time) and 2100UTC (7am local). Walkamin and Mareeba recorded 285mm and 218mm respectively from *Steve* and this contributed to a record local flood at Mareeba, which experienced its highest flood since records began in1921. The highest one hourly registration was 72mm in the hour to 1850UTC on 27 February 2000 at Bolton Road (18km northeast of Mareeba).

The flood producing rainfall in the Barron River catchment did not commence until late Sunday night after the crossing of Cyclone *Steve*. Cairns recorded 251mm in the 24 hours to 9am Saturday while, in other parts of the Barron, falls ranged from 65mm in the upper reaches to 120mm in the lower reaches.

In the 24 hours to 9am Monday 28 February, rainfalls ranged from 111mm at Atherton to 305mm at Copperlode Dam. Highest rainfall totals were recorded in that part of the catchment from Copperlode to
Mareeba. **The most intense recorded one hourly rainfalls were:** 38mm at Mareeba ending 11:50pm Sunday 27 February; 51 mm at Emerald Crest ending 00:35am Monday 28 February; 72mm at Bolton Rd (near Koah) ending 04:50am Monday 28 February.

Flooding

Cyclone *Steve* caused the Barron River at Mareeba to reach its highest flood since records began in1921. Major flooding also occurred in the lower Barron River around the Delta area at the same time.

On Sunday 27 February at Mareeba, the river rose very quickly from 4.2 metres at 9.30pm Sunday to a peak of 12.4 metres at 4.30am Monday. (This level is the highest recorded since records began in 1921; 1.3 metres above the previous highest record in March 1977). The Barron River at Myola peaked at 10.9 metres at 7.15am Monday. A peak of 8.3 metres was recorded at Kamerunga at 8am Monday. This was about 0.35 metres less than the February 1999 peak. Major flooding occurred in the Tully River from 25th February and continued into March.

Explosive intensification period - 85 gHz data

Tropical cyclone forecasters and researchers around the globe have been able to download 85 GHz microwave satellite data from Microwave data obtained from the US Navy Naval Research Laboratory site: - http://www.nrlmry.navy.mil/tc_pages/tc_home.html

Data at microwave frequencies from polar-orbiting satellites are more directly related to precipitation than are those from visible and infrared channels. The rapid increase in intensity of Steve over the period 26-28 February 2000 is studied using 85 GHz imagery in Figure 3. In this imagery the green areas highlight rain, while the yellow region shows heavier rain and the red through to black show convective thunderstorm activity. This shows the change in convective structure over the rapid intensification phase. At 0851UTC on 26 February 2000 (left panel) the centre of the low at MSL was located at the south-western edge of the deep convection which was only weakly organised. By 2240UTC on 26 February 2000 (top right panel) an eye was forming around the low level centre, which was becoming surrounded by a ring of convective cloud (red areas). The image at 1719UTC on 27 February 2000 (lower left frame) shows a cyclone signature with thunderstorms and rain surrounding dry ‘eye’ region despite being overland.

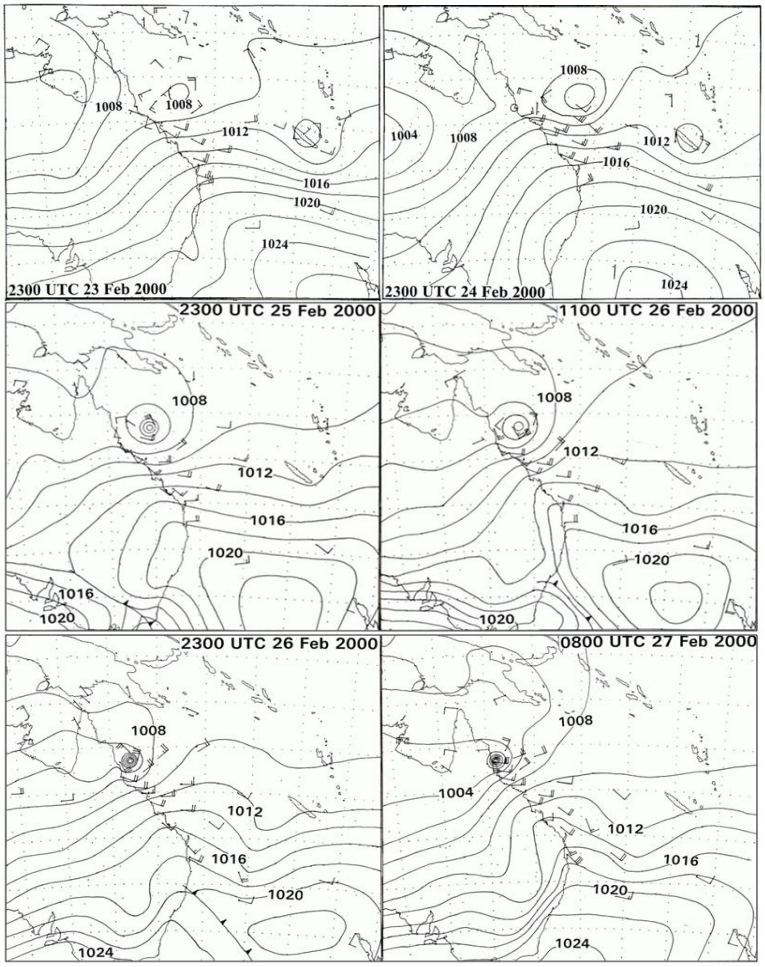

Figure 1 Mean Sea Level Analyses showing the cyclogenesis and intensification of Tropical Cyclone *Steve.*

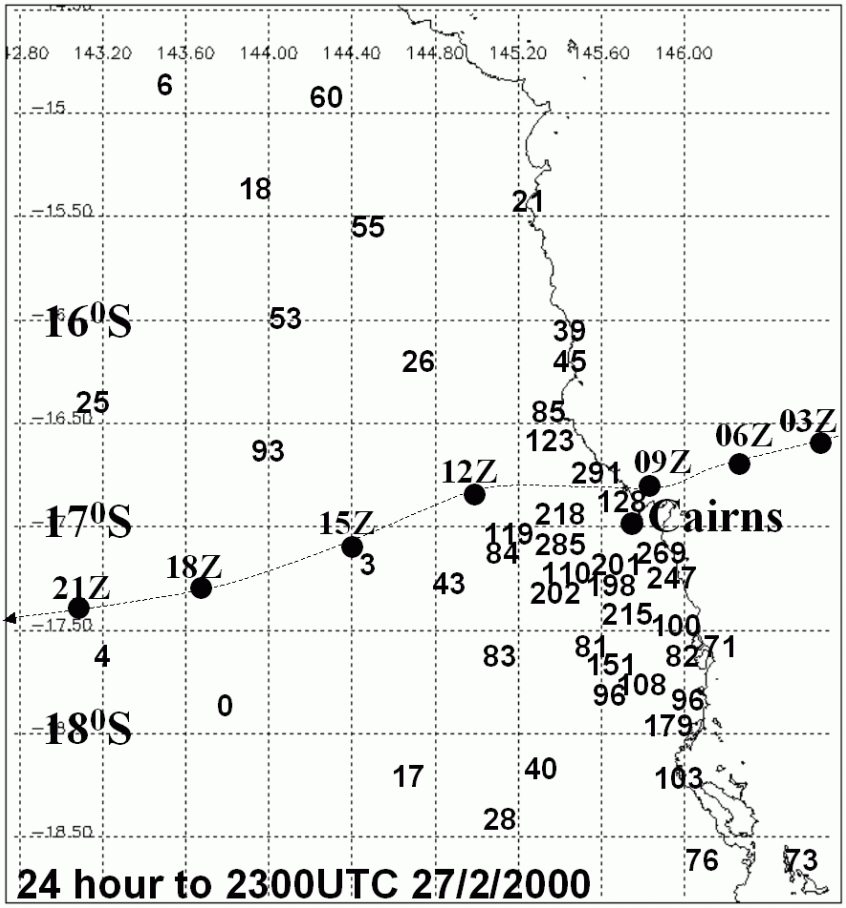

Figure 2 24 hour rainfall (mm) to 2300UTC on 27 February 2000 (9am 28 February local time) with the track of tropical cyclone *Steve* from 0300UTC on 27 February 2000 to 2100UTC on 27 February 200.

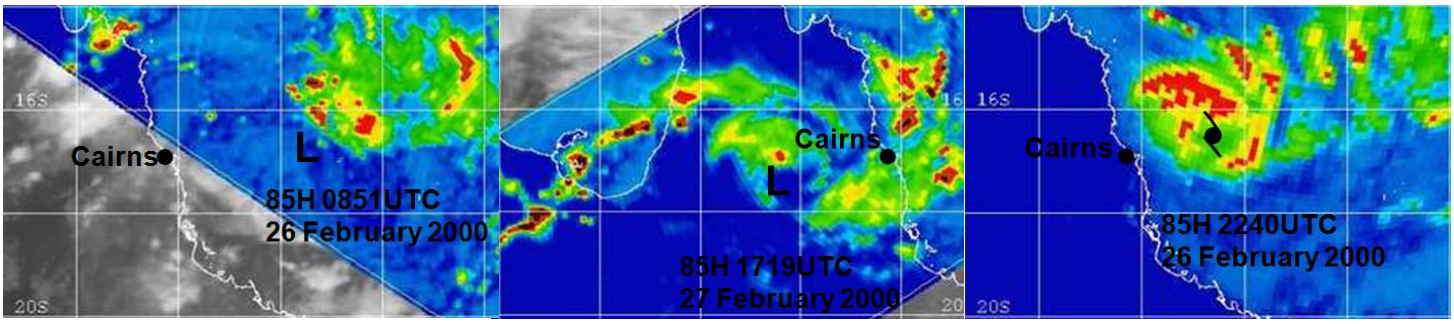

Figure 3 The rapid intensification and landfall of tropical cyclone *Steve* as seen from 85GHz microwave imagery. The green areas highlight rain while the yellow heavier rain and the red through to black show convective thunderstorm activity.