



CASE STUDY: Tropical Cyclone Rona, 1999

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Rona made landfall just to the north of Cow Bay, which is near the Daintree River Mouth. The main wind damage extended from Newell Beach to Cape Tribulation, with the major damage between Cape Kimberley and Cape Tribulation. Some trees in the Cape Tribulation area that survived the legendry 1934 cyclone fell during Rona. The maximum wind speeds were recorded by the Low Isle automatic weather station with 10minute average winds of 71 knots and a maximum wind gust of 85 knots. The lowest pressure of 983.0 hPa (not in the eye) was recorded at Low Isle. A 1metre storm surge was recorded at Port Douglas (at low tide) and a 1.4m surge was recorded at the mouth of the Mossman River. These sites were south of the maximum wind zone where the largest storm surge would be expected. Major flooding occurred between Cairns and Townsville. Despite the confined wind fetch inside the Barrier Reef, Rona generated some large waves as indicated from wave recording stations run by the Beach Protection Authority. At the Low Isle station the peak significant wave height (the average of the one-third highest waves in a 26.6 minute period) exceeded 3.5m and the maximum wave height exceeded 6.3m. The Cairns station recorded significant wave heights to 2.49m and a peak height of 4.65m. These were record heights (since recordings commenced in 1975) for Cairns. Tropical cyclone Steve in 2000 exceeded these wave heights at Cairns. At Dunk Island the corresponding readings were 3.06m and 5.69m. There was major damage to crops and infrastructure in the Douglas Shire and major damage to crops between Townsville and Cairns.

Mean Sea Level Analyses

At 10 am Eastern Standard Time (EST) 9 February 1999 (top left Figure 1) the monsoon trough was denoted by the areas enclosed by the 1004 hPa isobars over Northern Australia and the Coral Sea. The pressure gradient and winds along the Queensland coast immediately south of the monsoon trough were weak as a small low causing severe weather in southeast Queensland had an intense pressure gradient and gales and flooding rain to its south. This prevented the trade winds extending up to the monsoon trough. The severe weather low, which claimed 7 lives over southeast Queensland, was beginning to weaken and 24 hours later (top right panel Figure 1) it had dissipated and the trades rapidly extended up to the monsoon trough.

Over the same 24 hour period, pressures rose over New Guinea, resulting in a strong pressure gradient between New Guinea and a developing low just off the North Queensland coast. Notice that the pressure fell across the monsoon trough in the Coral Sea with two discrete lows forming.

At 10am on 11 February 1999 (lower panel Figure 1), tropical cyclone *Rona* had developed close to the North Queensland Coast. The ridge along the coast south of the cyclone continued to strengthen over the preceding 24 hours while the high pressures were maintained over New Guinea.

Tropical Cyclone Rona then rapidly intensified and moved towards the coast (Figure 2).

Rapid intensification and rainfall intensity

Tropical cyclone Rona developed very rapidly into a tropical cyclone and was named at 1800UTC 10 February 1999 and reached Australian category 3 intensity 15 hours later. It crossed the coast north of Cairns around 1300UTC 11 February 1999 while moving towards the west at around 11 knots.



Heavy rain began in the Cairns region around 2300UTC 10 February 1999 or about 14 hours before landfall and continued up the 1700UTC (3am local) after landfall. At 1800UTC (4am local) the heaviest rain eased in coastal areas of North Queensland as the cyclone slowed down and turned back towards the east.

Associated with the heavy rainfall (Figure 3) was major flooding in the Tully, Barron, Johnstone and Herbert Rivers and in the Barron River delta on the northern side of Cairns, where the highest floods were recorded since January 1979. Intense one-hour rainfalls in the Barren River Catchment include 66mm in the one-hour to 1310UTC 11 February 1999 at Copperlode Dam just to the southwest of Cairns and 57mm in the one-hour to 1515UTC 11 February 1999 at Bolton Road (18km northeast of Mareeba).

How the Dvorak analyses can lag rapid developers

Rona was a very rapidly developing system, which was named at 2300UTC 10 February 1999 and reached category 3 intensity 12 hours later. In Figure 4 is the Dvorak enhanced infrared image at landfall showing no eye but a large cold convective anvil over the centre. The burst in convection began about 4 hours earlier. On radar an inner eye formed at landfall inside a pre-existing large open eye. As the inner eye formed hurricane force winds were reported from the Low Isle AWS (see Figure 4).

Large storm surge Cow Bay

From debris levels measured near the landfall point at Cow Bay by Professor Jon Nott (James Cook University Cairns), there is evidence of a 2.9 to 3.4m surge with waves. The debris levels found were 2.5 to 3m above Australian Height Datum (AHD) and the highest astronomical tide there was 1.78m AHD. As shown above there were large measured waves further south at Low Isle. The waves were thought to come from the southeast where from Figure 5 there is a long southeast fetch inside the reef and south-easterly gales or stronger were blowing over this body of water between 0900UTC and 1100UTC on 11 February 1999.

Flooding

Tully River: Heavy rainfall on the 11th caused rapid stream rises and major flooding downstream to Euramo with a peak of 9.1 metres on the 13 February.

Barron River: Following heavy rainfall on the 11th, rapid rises occurred in rivers and streams from Mareeba to the Barron delta. Major flooding developed from Mareeba to Bilwon and in the Barron River delta on the northern side of Cairns, the highest since January 1979.

Johnstone River: Heavy rainfall on the 11th led to major flooding developing in the North Johnstone River and South Johnstone River downstream to Innisfail. An initial peak was reached at Innisfail on the 12th, with additional rain causing another lower peak on the 13th. The peak of 12th was the highest since February 1986.

Herbert River: Heavy rainfall in the middle of the catchment on the 12th caused rapid stream rises down to Ingham, with major flooding between Gleneagle and Halifax.

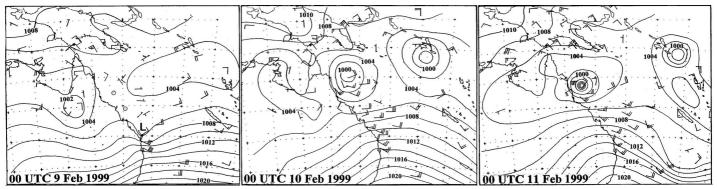


Figure 1 Mean sea level pressure analyses with wind observations from 0000UTC 9 February 1999 (top left), 0000UTC 10 February 1999 (top right), and 0000UTC 11 February 1999 (bottom left).



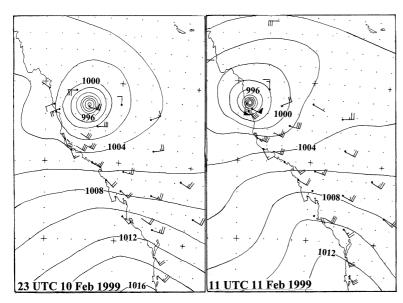
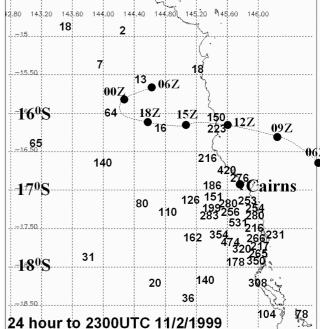


Figure 3 24 hour rainfall (mm) for 2300UTC 11 February 1999 with the track of tropical cyclone *Rona* from 0600UTC 11 February to 0600UTC 12 February.

Figure 2 Regional mean sea level pressure analyses with wind observations for 2300UTC 10 February 1999 (left) and 1100UTC 11 February 1999 (centre).



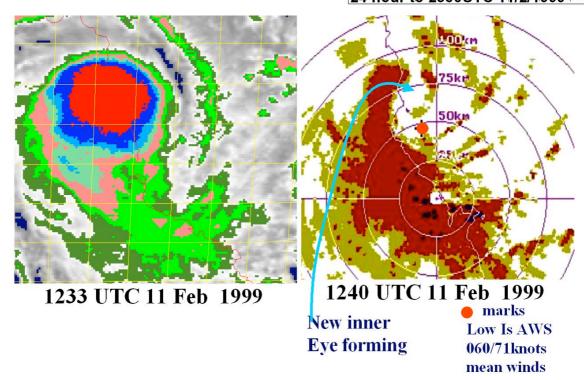


Figure 4 Infrared satellite image (left) and radar image (right) close to the time tropical cyclone *Rona* made landfall.



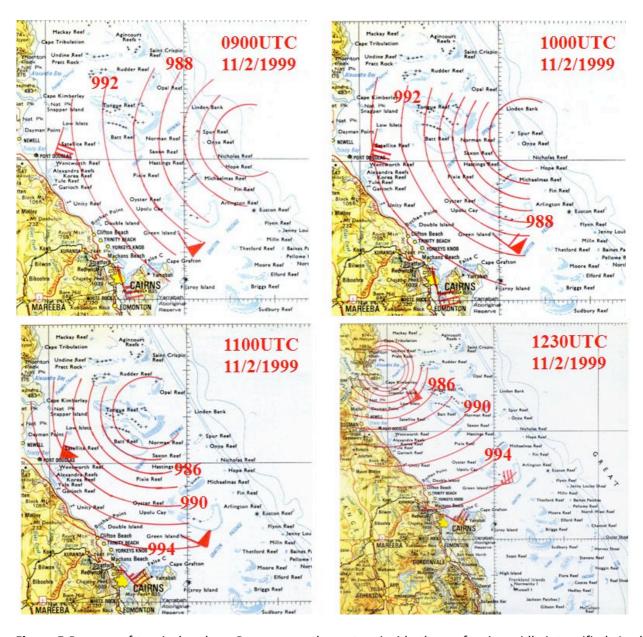


Figure 5 Passage of tropical cyclone *Rona* across the waters inside the reef as it rapidly intensified. Analyses derived from radar fixes and observations from Cairns Airport, Green Island and Low Isle.