Cyclone Larry Fieldwork (RAMP)

Introduction

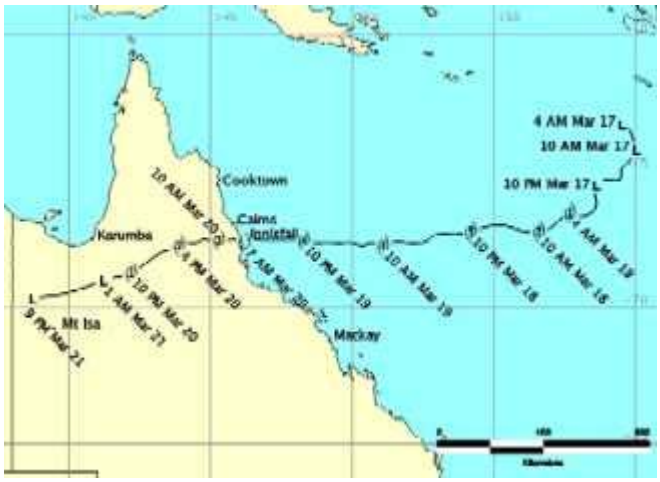

Figure 1 (right): *Tropical Cyclone Larry track. Click to enlarge.*

Severe Tropical Cyclone Larry crossed the far north Queensland coast near Etty Bay around 7 a.m. on 20 March, 2006. It then tracked west-northwest and passed directly over the town of Innisfail (*Figure 1*). Within 48 hours, teams from Geoscience Australia were on the ground to begin a program of assessing building and crop damage. This continued for 3 weeks. The initial analysis of data collected is presented below.

At landfall, the eye of Tropical Cyclone Larry extended about 20 to 25 kilometres from Mirriwinni in the north to Mourilyan Harbour in the south. A vessel sheltering in the South Johnstone River to the east of Innisfail recorded winds gusting to 225 km/h while gusts as high as 294 km/h were recorded near the peaks of the Bellenden Ker mountain range (1450 metres) and 187 km/h at the Ravenshoe wind farm (about 75 kilometres from the coast) as the cyclone moved inland.

The fast-moving tropical depression travelled westward, weakening throughout the day. By 10 p.m. it had passed to the south of Croydon in Queensland's Gulf country where it continued to bring heavy rain and severe flooding.

Cyclone description

Tropical Cyclone Larry was classified as a 'midget' cyclone because of the limited range of its destructive winds. Furthermore, coastal communities were not exposed to cyclonic winds and airborne debris for long periods as the cyclone moved relatively quickly at landfall. Low tides at the time also ensured there was no significant storm surge.

Since the 1870s, 22 cyclones have impacted the Innisfail region causing damage from severe wind, storm surge, estuarine flooding or a combination of these hazards (Callaghan, 2004). Tropical Cyclone Larry impacted the coast at both high lateral speed and at low tide, causing only wind-related damage. From analysis of impacts to simple structures (such as road signs), preliminary estimates of maximum wind gust speeds at a height of 10 metres are in the order of 55-65 m/s (~200-235 km/h) compared to 50-55 m/s (~180-200 km/h) reached in Tropical Cyclone Winifred, which hit the region in February 1986 (Reardon et al, 1986). Further analysis of the data will be required before final wind speeds are determined.

Impact to critical infrastructure

Electricity transmission was cut to the north and southwest of Innisfail. Severe damage to pole-mounted electrical distribution and communications networks was widespread. Power disruption affected other essential utilities such as the hospital, water supply and water treatment works. These needed emergency generators. Road and rail access to the region was disrupted for several days by flooding.

Impact on buildings

Severe winds caused by Tropical Cyclone Larry resulted in significant damage on buildings. All townships in the Innisfail region were severely affected.

Figure 2 (left): *Kurrimine Beach GIS example. Click to enlarge.*

The assessed damage index, which expresses the repair cost as a proportion of the value of rebuilding damaged residential structures (*Table 1*), was calculated for buildings within a number of Innisfail suburbs and nearby townships. *Figure 2* gives an example of the spatial analysis conducted for the community of Kurrimine Beach (30 kilometres south-southeast of Innisfail). *Figure 3* displays the results as a population percentage (e.g. 25% indicates a damage level equal to 25% of the value of the structures in the local population).

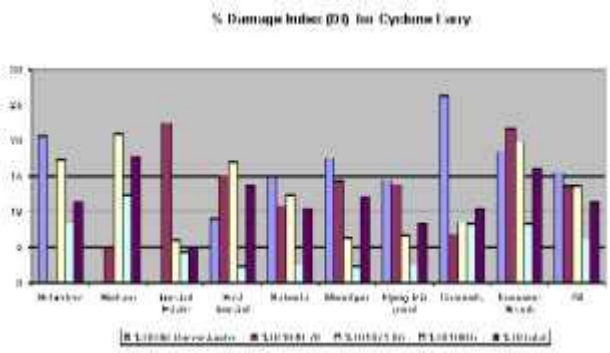

Figure 3 (right): *Damage index (DI) for Cyclone Larry. Click to enlarge.*

Among residential properties, older homes (pre-1986) tended to suffer the greatest wind damage due to their vulnerable locations (e.g. on ridge tops), building regulations requiring limited cyclone-resistance measures at the time of construction, and their lower resilience through aging processes (corrosion, rot, insect attack).

Structures built after Tropical Cyclone Winifred withstood Tropical Cyclone Larry better. This may be due to the revised building standards introduced for domestic construction in the early 1980s and a better understanding of prevention methods following an analysis of the damage inflicted in 1986 by Winifred.

Damage to newer homes tended to be comparatively minor and was mostly limited to garage doors, roof tiles, fascias and guttering.

In addition to engineering considerations, the impact of local winds on structures was significantly influenced by geographical terrain, structure height, shielding by upwind structures, and topographical factors. Topographical acceleration of local winds was a very significant factor - severe damage was often confined to exposed ridge tops.

Impact on primary industry

From Tully in the south to sections of the tablelands in the north and as far west as Herberton, wind-related damage to crops was extensive. Banana plantations within a 40 to 50 kilometre radius of the cyclone path were destroyed. Sugarcane crops, which were well advanced for the mid-year harvest, were damaged. The Babinda sugar mill suffered damage to its gas bin and cooling tower. The Mourilyan mill suffered some structural damage, particularly to a boiler chimney stack. The mill at South Johnstone suffered superficial damage. Mill operators indicated that the 2006 cane crush would go ahead, despite widespread damage to crops and industry infrastructure.

Geoscience Australia's response

Geoscience Australia's post-disaster response was multifaceted, beginning with the provision of 2500 maps of the affected area for Department of Defence emergency-response personnel following the initial impact. Our teams were subsequently dispatched to the area, with the first team departing within 48 hours. One of the responsibilities was to collaborate with James Cook University, TimberEd Services and the Australian Building Codes Board to assess structural damage to residential and commercial buildings and infrastructure. Teams recorded building and property information such as construction type, building materials, number of floors, and damage sustained. High resolution satellite imagery was used to complete buildings property information, such as roof size, and to locate the structures on land parcels.

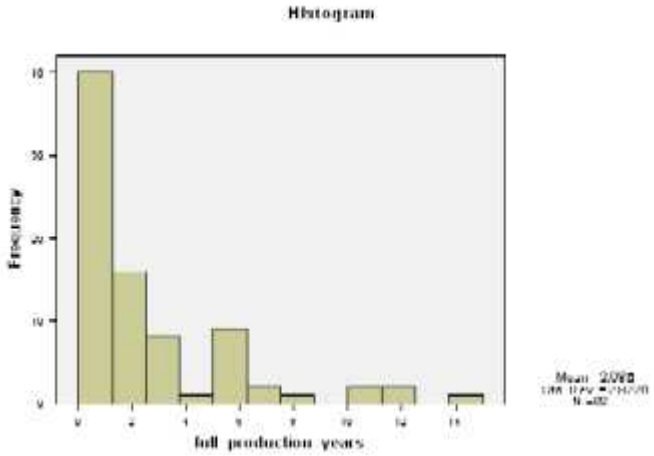

Figure 4 (left): *Predicted crop regrowth following Cyclone Larry. Click to enlarge.*

As part of the Operation Recovery-Industry Action Group (OR IAG), Geoscience Australia collaborated with the Queensland Department of Primary Industries and Fisheries (DPIF) to provide regional and farm-level assessments of economic impact for the Cyclone Larry Recovery Taskforce. An initial assessment of the economic impact from the cyclone to Far North Queensland was conducted in collaboration with Monash University, Queensland Treasury's Office of Economic and Statistical Research, and the DPIF (Milne, 2006). The assessment incorporated productivity losses sustained by the primary industry sector in addition to government assistance for individuals, households and businesses. Teams from Geoscience Australia and DPIF interviewed 85 primary producers about their immediate needs and plans for recovery (*Figure 4*) and recorded the extent of crop damage.

How will the collected data be used?

The collected structural damage information will be useful in a number of ways. It will contribute to a better understanding of extreme cyclonic wind gusts and provide engineers with highly detailed data on the vulnerability of houses and other structures to severe wind. When combined with information from similar events and other sources, the data collected will provide a clearer picture of severe-wind risk for Australian communities. This information will help Australian communities in preparing for future cyclone events and reduce their potential impact.

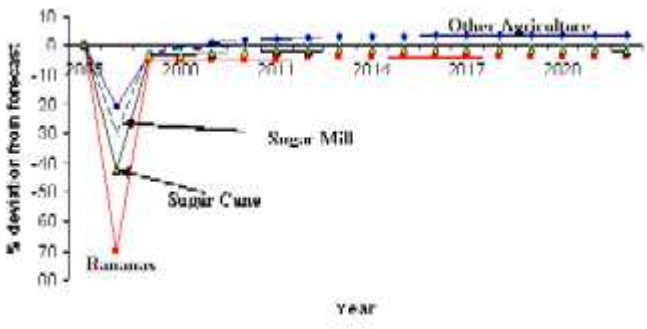

Figure 5 (right): *Impact of Cyclone Larry on industries. Click to enlarge.*

In addition to the findings of the primary producer survey, which were provided to the Cyclone Larry Recovery Taskforce, Geoscience Australia used field survey data to assess the extent of damage to agricultural areas and validate post disaster remote sensing imagery (Thankappan, 2006). The data collected with the assistance of DPIF has provided empirical farm level data on the recovery needs and plans of primary

producers, and identification of factors that may influence primary producers' ability to recover in the short and longer term. This will be used to develop practical recovery strategies for affected sectors and to produce a comprehensive assessment of the impact of Tropical Cyclone Larry (*Figure 5*).

The work undertaken by Geoscience Australia and DPIF has lead to greater State and Federal Government collaboration in post-disaster data collection. This will aid policy makers at both the State and Federal level make better, informed decisions to assist Australian communities' in recovering from future natural hazard events.

Results and additional information

Preliminary results from the Tropical Cyclone Larry post-impact surveys, including a review of the meteorology, can be found in the report from the Cyclone Larry Forum held two weeks after the event (Cyclone Larry Forum Report, 2006). The Bureau of Meteorology have prepared a meteorological report detailing the maximum wind zones associated with Cyclone Larry (Callaghan and Otto, 2006). The Cyclone Testing Station at James Cook University have issued a report detailing the damage to buildings from Cyclone Larry (Boughton et al., 2006). A whole of-government report on Larry's impact (due December 2006) is being coordinated by the Bureau of Meteorology for the Queensland Tropical Cyclone Coordination Committee. Geoscience Australia will be posting updates of our analysis of the impact on this website.

References

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Thankappan M. (2006), *Crop damage assessment using a GIS and remote sensing approach. Report for the Operation Recovery-Industry Action Group*.

Equipment used by GA fieldwork teams to collect pre and post-hazard information. Image courtesy Geoscience Australia.

Collecting data and information on the impact of Cyclone Larry to residential buildings, Innisfail. Image courtesy Geoscience Australia.

GA fieldwork team collecting data in Innisfail following Cyclone Larry. Image courtesy Geoscience Australia.

GA fieldwork team surveying streets to determine residential building with damage following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Downloading information onto a field laptop. Image courtesy Geoscience Australia.

Surveying sign damage following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Calculating the wind speed of Cyclone Larry by measuring the damage to steel posts. Image courtesy Geoscience Australia.

Severely damaged residential building following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Destroyed residential building following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Damaged to a new residential building following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Power pole damage to a residential building following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Tree damage to residential buildings following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Damage to a veranda post following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Roof damage to a residential house following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Internal damage to a residential house following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Rusted nails used in the construction of a residential house, Innisfail. Image courtesy Geoscience Australia.

Flimsy nails used in the construction of a residential house, Innisfail. Image courtesy Geoscience Australia.

Commercial building damage following Cyclone Larry to "Centrepoint", Innisfail. Image courtesy Geoscience Australia.

Commercial building damage following Cyclone Larry to "KFC", Innisfail. Image courtesy Geoscience Australia.

Industrial building damage to roller doors following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Destroyed industrial building following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Destroyed industrial building following Cyclone Larry at an airfield near Innisfail. Image courtesy Geoscience Australia.

GA team member surveying damage to an industrial building following Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Banana crops damaged by Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Sugar cane damaged by Cyclone Larry, Tablelands. Image courtesy Geoscience Australia.

Helicopter replacing and restoring power to Innisfail. Image courtesy Geoscience Australia.

Surveying paw paw crops damaged by Cyclone Larry, Tablelands. Image courtesy Geoscience Australia.

Antenna damaged by Cyclone Larry, Innisfail. Image courtesy Geoscience Australia.

Paw paw crops damaged by Cyclone Larry, Tablelands. Image courtesy Geoscience Australia.

Close up of the helicopter used to move the tower and restore power to Innisfail. Image courtesy Geoscience Australia.

Damage to power supply in Innisfail following Cyclone Larry. Image courtesy Geoscience Australia.

Damage to a power pole in Innisfail following Cyclone Larry. Image courtesy Geoscience Australia.

Wooden stake embedded into a tree due to the high and powerful winds caused by Cyclone Larry. Image courtesy Geoscience Australia.

Tree damage in Innisfail as a result of Cyclone Larry. Image courtesy Geoscience Australia.