FACT SHEET Storm event – January 2008

Summary

The largest wave ever measured at the EPA's Weipa wave monitoring station (since it was installed in December 1978) was recorded on 6 January 2008. At the time the Bureau of Meteorology had issued Top Priority Tropical Cyclone Warnings for coastal and island communities from Thursday Island to the Queensland and Northern Territory border.

- 993hPa low (ex-tropical cyclone Helen) located 315km West of Weipa (figure 1).
- Second-highest significant wave (Hsig) recorded at Weipa wave monitoring station (see table 1).
- Highest maximum wave of 7.1m recorded at Weipa wave monitoring station (see table 2).
- Peak wave periods (Tpeak) in excess of 12 seconds.
- Moderate erosion damage to beaches reported but very minor damage to local infrastructure.

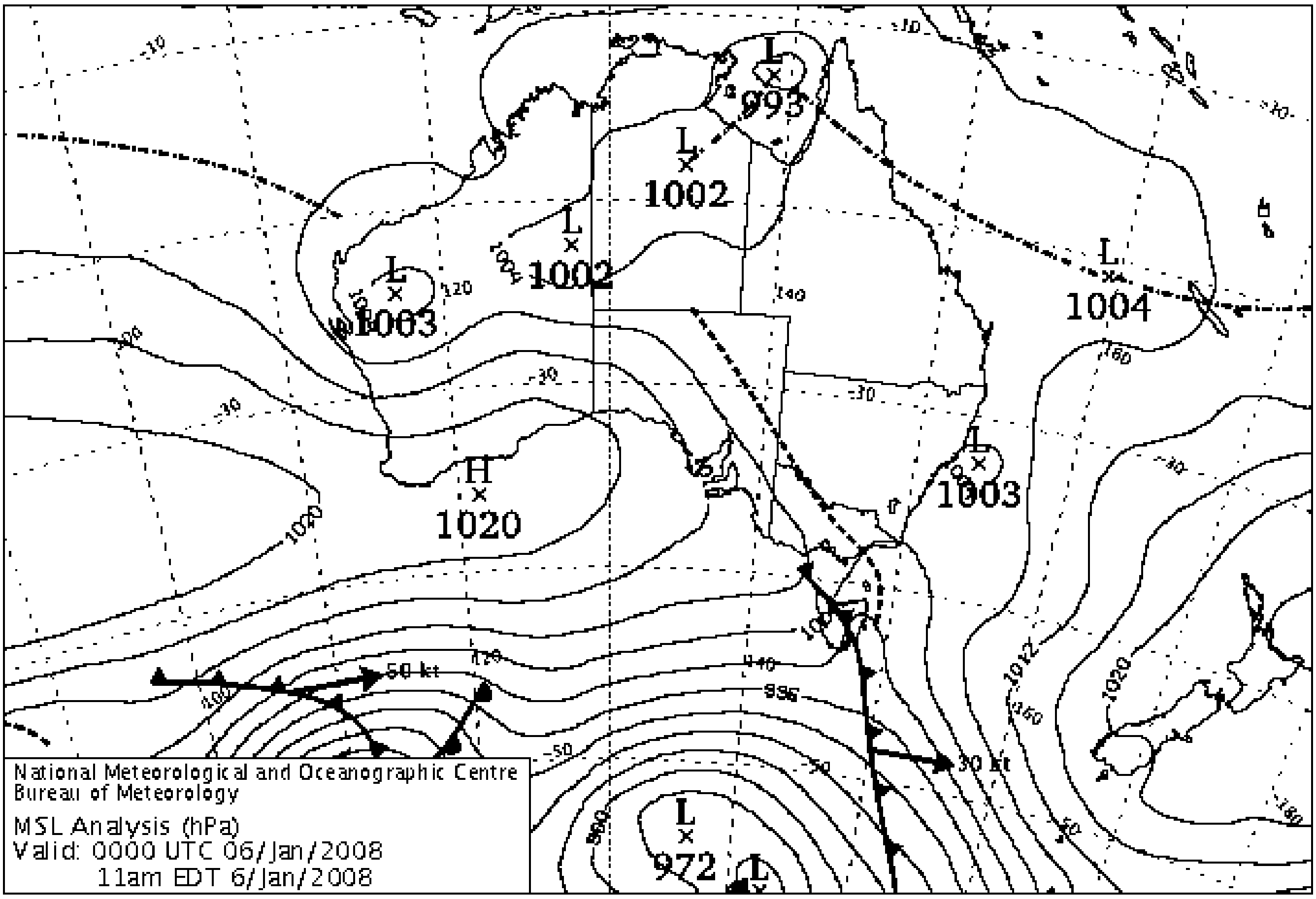

Figure 1 - Low, 6 January 2008
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Wave recording

The EPA operates a network of wave monitoring stations along the Queensland coastline including Gold Coast, Brisbane, Moreton Bay, Tweed Heads, Mooloolaba, Caloundra, Emu Park, Hay Point, Mackay, Townsville, Cairns and Weipa. Figure 2 shows the wave monitoring and storm tide stations in north Queensland including the Gulf or Carpentaria.

Table 1 – Top 5 recorded significant wave heights at Weipa*

Hsig (m)	Time / Date	Rank
4.7	10/01/1992 0826	1
4.1	06/01/2008 1700	2
3.8	09/03/1996 2100	3
3.4	08/03/1997 1800	4
3.1	12/03/2003 1530	5

* *See glossary*

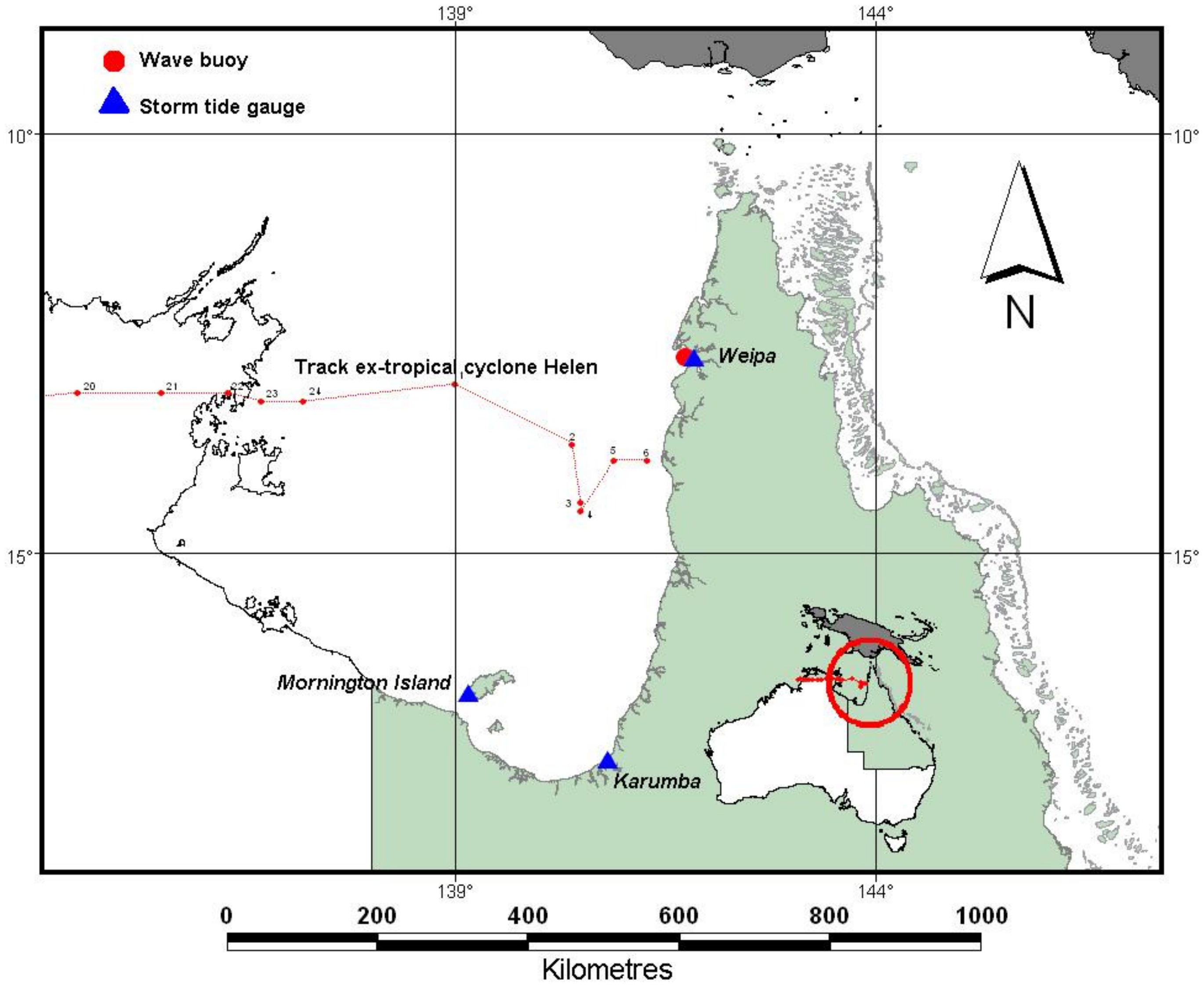

Figure 2 – Wave and tide sites, and track of ex-tropical cyclone Helen

Table 2 shows the maximum individual wave heights (Hmax) recorded at these stations during the event.

*Table 2 – Top 5 Maximum recorded individual wave heights at Weipa**

Hmax	Time / Date	Rank
7.1	06/01/2008 1630	1
6.7	09/03/1996 2000	2
6.2	08/01/1992 0827	3
5.6	06/02/2007 1530	4
5.1	22/01/1998 1300	5

* *See glossary*

A plot of wave heights and periods from the Weipa wave monitoring station is shown in figure 3. The peak maximum individual wave height (7.1m Hmax) during this event is the largest ever recorded by the EPA at this site since recordings commenced there in December 1978. The wave was measured by a 0.7m non-directional Datawell Waverider buoy moored in 5.2m of water (LAT) at latitude 12° 40.48' South and longitude 141° 45.73 'East.

Given the depth of water at the wave-buoy site, the long wave periods (Tpeaks in excess of 10 seconds), and the large heights of individual waves, it is highly likely that some waves would have been breaking at the site (and before reaching the site). Consequently, actual wave heights near the site may have been larger than those recorded.

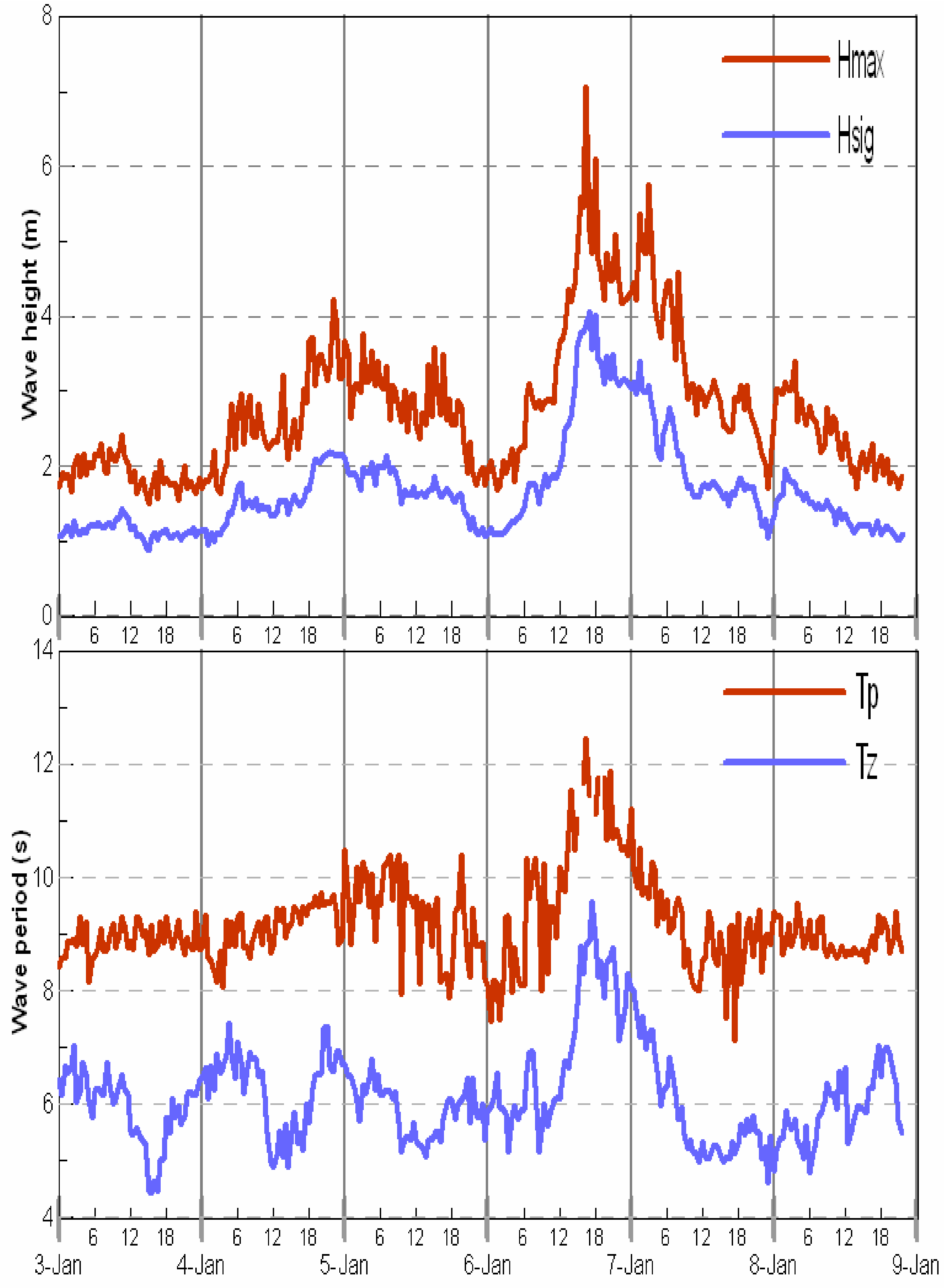

Figure 3 - Weipa wave data 3–9 January 2008

Tide recording

The EPA operates a storm tide system (comprising 23 tide gauges along the Queensland coastline). This allows real-time access to tide data via the public telephone network during events to monitor the effects of coastal flooding from tidal surge. For this event, tide data was obtained from the Weipa, Karumba, and Mornington Island gauges (see table 3 and figure 4).

Table 3 – Recorded surge heights

Site	Date & time	Surge (m)	Exceeded HAT
Weipa	06/01/2008 2250	1.37	Yes
Karumba	06/01/2008 1400	1.00	No
Mornington Island	06/01/2008 1730	0.92	Yes

The peak storm tide of 3.99m occurred at Weipa at 1400 on 6 January 2008 (at about the time of the predicted high tide of 2.92m), and exceeded HAT by 0.6m. Meanwhile, the peak surge of 1.37m occurred nine hours later, at 2250 on 6 January (at about the predicted low tide of 0.99m). Had this peak surge occurred coincident with the earlier predicted high tide, the actual storm tide thus created would have been 4.29m, exceeding HAT by 0.91m and possibly resulting in flooding of low lying areas.

Similarly, the peak storm tide of 4.62m occurred at Karumba at 1750 on 6 January 2008 (about an hour before the time of the predicted high tide), but did not exceeded HAT. The peak surge of 1.0m had been recorded almost four hours earlier, at 1400 (at about the middle of the rising tide). Had this peak surge occurred at 1900 (when the high tide of 4.16m was predicted to occur), the resulting storm tide would have been about 0.3m above HAT, and this may have resulted in flooding around Karumba.

The peak storm tide of 3.93m occurred at Mornington Island at 1840 on 6 January 2008 (about one hour and thirty minutes before the predicted high tide of 3.24m), and exceed HAT by 0.35m. The peak surge of 0.92m had already occurred at 1730. Had this peak surge occurred coincident with the predicted high tide, the peak storm tide created would have been a further 0.23m higher, and would have resulted in substantial flooding of local low-lying areas.

These examples show how important the time of occurrence of a storm surge is (in relation to the state of the tide) in determining the amount of flooding that may occur. This coincidence is, in turn, directly related to the time of coast-crossing of the tropical cyclone or severe storm event (see Glossary for more information).

Figure 4 –Storm tide overtopping low-lying coastal area at Weipa
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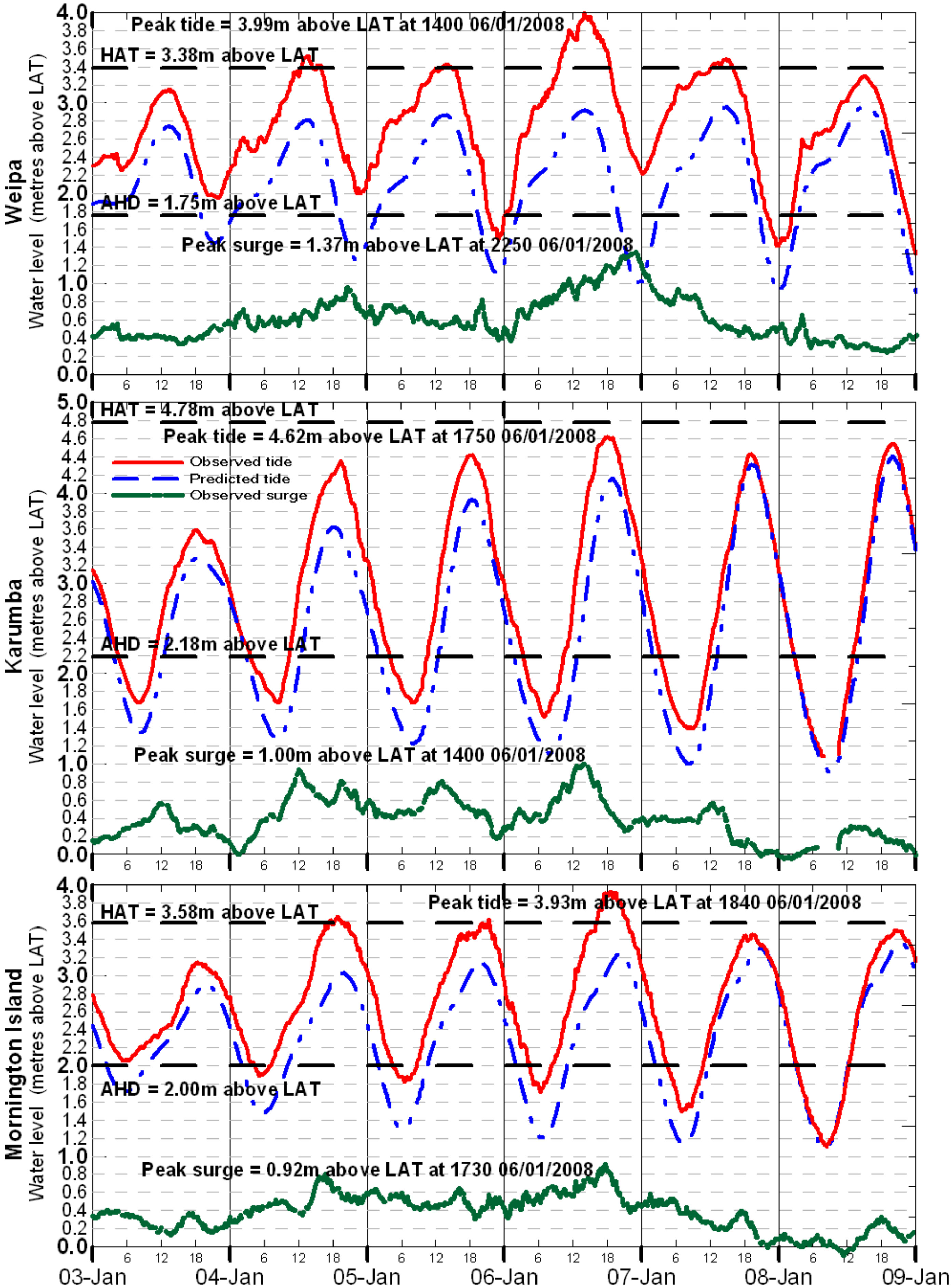

Figure 5 –Tide levels (in metres) 3–9 January 2008

EPA Web Sites
During the event, the following EPA wave and tide web sites were updated at regular intervals
www.epa.qld.gov.au/waves
www.epa.qld.gov.au/tides

Glossary

Hsig	The significant wave height (in metres), defined as the average of the highest one third of the zero up-crossing wave heights in a 26.6-minute wave record. This wave height closely approximates the value a person would observe by eye. Significant wave heights are the values reported by the Bureau of Meteorology in their forecasts.
Hmax	The maximum zero up-crossing wave height (in metres) in a 26.6-minute record.
Tz	The average of the zero up-crossing wave periods (in seconds) in a wave record.
Tp	Wave period at the peak spectral energy (in seconds). This is an indication of the wave period of those waves that are producing the most energy in a wave record. Depending on the value of Tp, waves could either be caused by local wind fields (sea) or have come from distant storms and have moved away from their source of generation (swell).
HAT	HIGHEST ASTRONOMICAL TIDE is the highest water level which can be predicted to occur at a particular site under average weather conditions. This level won't be reached every year.
AHD	AUSTRALIAN HEIGHT DATUM is the reference level used by the Bureau of Meteorology in Storm Tide Warnings. AHD is very close to the average level of the sea over a long period (preferably 18.6 years), or the level of the sea in the absence of tides.
Storm tide	The total water level obtained by adding the STORM SURGE and WAVE SETUP to the height of the ASTRONOMICAL TIDE.
Storm surge	A storm surge is an increase (or decrease) in water level associated with some significant meteorological event, e.g. persistent strong winds and change in atmospheric pressure, or tropical cyclone. Its typical effect is to raise the level of the tide above the predicted level. In some situations, e.g. when winds blow offshore, the actual tide level can be lower than that predicted. The storm surge height depends on a range of factors including (a) intensity and size of the tropical cyclone or storm event – the stronger the winds the higher the surge, (b) shape of the seafloor – the more gentle the slope the greater the surge, and (c) speed and angle of approach of the cyclone or storm event to the coast. The surge can be worsened by funnelling effects of bays and estuaries - and river and local flooding caused by torrential rain. In Queensland, most large surges are caused by tropical cyclones.
Wave setup	The increase in mean water level above the SWL towards the shoreline caused by wave action in the surf zone. The amount of rise of the mean water level depends on wave height and beach slope such that setup increases with increasing wave height and increasing beach steepness. It can be very important during storm events as it results in a further increase in water level above the tide and surge levels.
Astronomical tide	Or more simply, the tide, is the periodic rise and fall of water along the coast because of gravitational attraction on the water by the moon and sun. When the moon, sun and earth are in line their combined attraction is strongest and the tide range is greater (spring tides). When the moon and sun are at right angles to each other (in relation to the earth) the effect of the attraction is somewhat reduced and the tide range is smaller (neap tides).
Predicted tide	The tide expected to occur under average meteorological conditions. Tide predictions are typically based on previous actual tide readings gathered over a long period (usually one year or more). However, the sun, moon and earth are not in the same relative position from year to year. Accordingly, the gravitational forces that generate the tides, and the tides themselves, are not the same each year.