

# SEASCAPES

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## Cyclone Larry — Still Giving up its Secrets



When significant weather-related events occur they present enormous opportunity to test and validate a wide range of numerical tools and methodologies that underpin important risk studies of commercial and public interest. With the assistance of a variety of clients, SEA has been in the forefront of investigating the impacts of Tropical Cyclone *Larry* since it impacted the Innisfail region in March 2006. Previously reported in SEASCAPES has been work on assessing the damage to buildings and infrastructure resulting in the extensive insurance losses (research with Willis Re Australia) and also the debate over the actual intensity of Larry at landfall, which was downgraded by the Bureau of Meteorology

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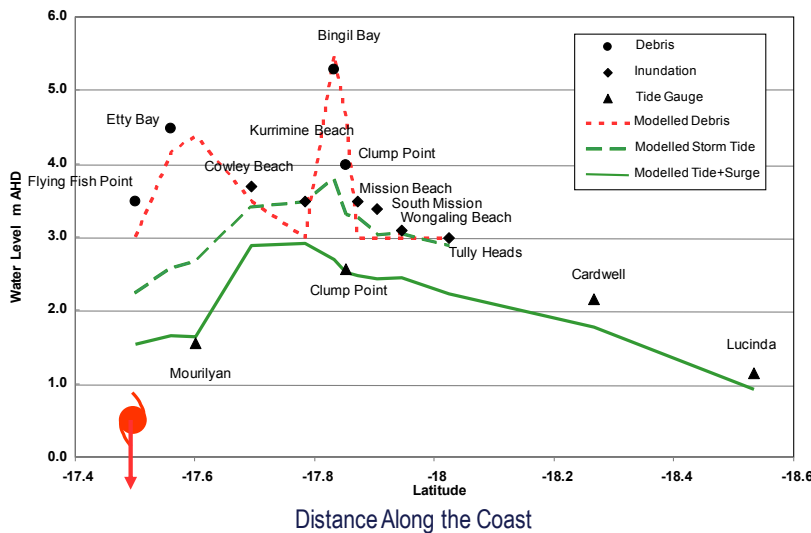
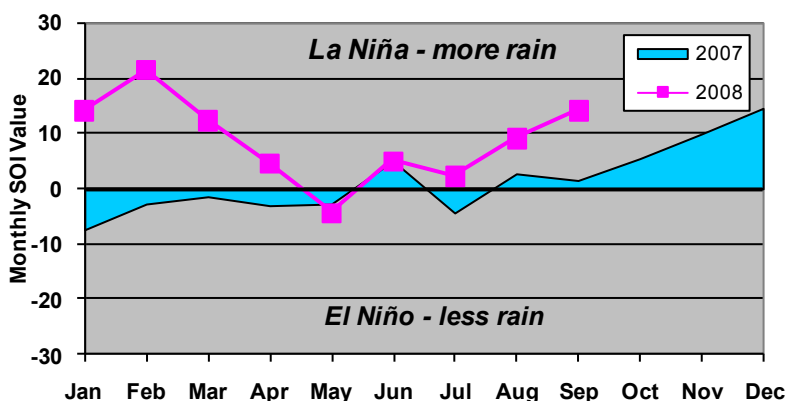


FIGURE: Summary results from the GHD-SEA Storm Tide Study for Cassowary Coast Regional Council.

The graph shows correspondence between official EPA-measured coastal water levels for a variety of sites and the GHD-SEA numerical modelling of the combined tide, storm surge, breaking wave setup and wave runup during Larry. Previously suspicious very high beach debris levels at some locations, thought to be due to potentially unusual wind structures within the storm, have been well explained by a detailed and expert analysis of surge and wave-related processes using conventional wind, surge and wave modelling assumptions.

## La Niña did not quite disappear ...

The present ENSO state (El Niño Southern Oscillation) is sending unusual and mixed messages at present. On the one hand, ocean equatorial temperatures are close to average, which is indicative of a continuing "neutral" condition. Meanwhile the SOI, which is simply ten times the ratio of the mean surface pressure between Darwin and Tahiti, continues at a high and potentially increasing level that is more typical of La Niña states. If the SOI maintains a generally positive value then, based on historical averages, there will be a higher than average likelihood of landfalling tropical cyclones next season on the east coast. [Data and comments based on Bureau of Meteorology sources.]



## SEASCAPES

SEASCAPES features the developing risk assessment capabilities of Systems Engineering Australia Pty Ltd (SEA).

Our services include coastal, ocean and offshore engineering, statistical analysis of tropical cyclone data, quantitative estimation of insurance losses, cyclone wind, wave and storm surge modelling, flood risk assessment and severe thunderstorm downbursts, hail and tornadoes. We do investigations, analysis, consulting, peer review and research.

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In 2007, partly as recognition of the success of the SEA-Willis technical partnership since 2004, SEA's Dr Bruce Harper was invited to join the newly formed global Willis Research Network (WRN).

The WRN is the world's largest partnership between academia and the insurance industry and is focused on research and outputs that bring practical assistance to the challenges of identifying, evaluating and sharing the costs of major risks. Willis has teamed up with sixteen leading institutions across a full range of disciplines: from atmospheric science and climate statistics, geography, hydrology and seismology, to the impacts of these hazards on the built environment via engineering, exposure analysis and geographical information systems. Dr Harper and SEA are part of the WRN that includes academics from the following institutions: Cambridge, Oxford, Reading, Bristol, Exeter, Durham, Imperial College London, City University London, Bologna, Pavia, Singapore, Kyoto, Princeton, Colorado and the US National Centre for Atmospheric Research.

The WRN held its first Global Clients Meeting in London in July this year.

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from a Category 5 to a Category 4 after reviewing all the available evidence.

In a recent storm tide risk study undertaken for Cassowary Coast Regional Council by GHD Pty Ltd in association with SEA, cyclone *Larry* has been used to validate the numerical model performance that underpins the risk study. GHD applied the Delft3D hydrodynamic modelling system to reproduce the tide and storm surge based on calibrated wind and pressure fields provided by SEA. Together with spectral wave modelling by SEA, a complete picture of the ocean response during *Larry* has emerged that explains its many complex features.

Water level surveys from beach debris and other evidence undertaken by the EPA had indicated some significantly higher levels than measured by the nearby storm tide gauge network at Mourilyan, Clump Point and Cardwell. These apparent inconsistencies extended northwards close to the actual landfall point and lead to conjecture by the Bureau of Meteorology that the complex deformations of the central core of *Larry* during landfall may have produced some unusually high winds over the adjacent coastal seas. Whilst this may also have contributed to the total outcomes, the results of the GHD-SEA modelling have shown that the computed levels are very consistent with the measured elevations. In particular, it has become apparent that the Great Barrier Reef provides a very complex backdrop to this event in terms of the way that the various reef passages and their alignment relative to the many bays and beaches have modulated the wave heights, periods and directions as the storm passed. Additionally, the nearshore beach slopes and back-beach dune elevations have further modified the potential for either breaking wave setup to occur or for wave runup to be dominant. When combined with the tide and the underlying storm surge, the measured water levels are very well explained by the GHD modelling.

## Conferences and Workshops:

SEA's Dr Bruce Harper continued his active local and international participation in several scientific meetings and workshops over the past 6 months:

- NOAA Hurricane Research Division, Miami, USA, October; Cyclone *Larry*—A Complex Storm in a Complex Environment.
- NOAA National Hurricane Center, Miami, USA, October; Recommendations for Wind Speed Averaging Conversions for Tropical Cyclones.
- ANZIIIF, 23rd Reinsurance Rendezvous, Sydney, Sept; Climate Change: Separating the Wheat from the Chaff.
- IPWEA Conference on Climate Change Response, Coffs Harbour, Aug; Managing Sea Level Rise and Climate Change.
- Willis Research Network, Global Clients Meeting, London, Jul; The Storm Footprint.

### Some of the SEA Clients:

#### Coastal and Ocean Hazards:

- Woodside Energy Ltd, WA
- EPA, QLD
- Dept Env and Climate Change, NSW
- Alcan
- GHD Pty Ltd
- Bureau of Meteorology
- Kvaerner E&C Australia
- McConnell Dowell

#### Multi-Hazard Studies:

- Dept Emergency Services, QLD
- Bureau of Meteorology / GA

#### Tropical Cyclone Risks:

- Willis Re
- RACQ Insurance
- CGU Insurance
- Suncorp Metway Insurance
- Powerlink Queensland
- Geoscience Australia
- CSIRO Atmospheric Research
- Risk Management Solutions

#### Severe Thunderstorm Risks:

- Suncorp Metway Insurance
- Macquarie University, NHRC
- Powerlink Queensland

#### Research:

- Risk Prediction Initiative, Bermuda.
- James Cook University CTS
- Willis Research Network

#### Guidelines:

- World Meteorological Organisation
- Engineers Australia

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making tools for your business.**