DEVELOPING BETTER PREDICTIONS AND FORECASTS FOR EXTREME WATER LEVELS AROUND AUSTRALIA

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THE OCCURRENCE OF EXTREME WATER LEVELS CAN LEAD TO LOSS OF LIFE AND DAMAGE TO COASTAL INFRASTRUCTURE. TO BETTER PREPARE, COASTAL ENGINEERS, EMERGENCY MANAGERS AND PLANNERS REQUIRE ACCURATE ESTIMATES OF EXTREME WATER LEVELS

BACKGROUND

- Extreme water levels result from the **combination** of different physical processes including **tides, storm surges, tsunamis, seasonal and inter-annual mean sea level variations**.
- These signals may be forced by both local and remote forcing, with processes active over a temporal range from **hours to decades**.
- This work will **improve the accuracy** of predictions of extreme water levels by investigating the effects of several key processes that are often ignored.

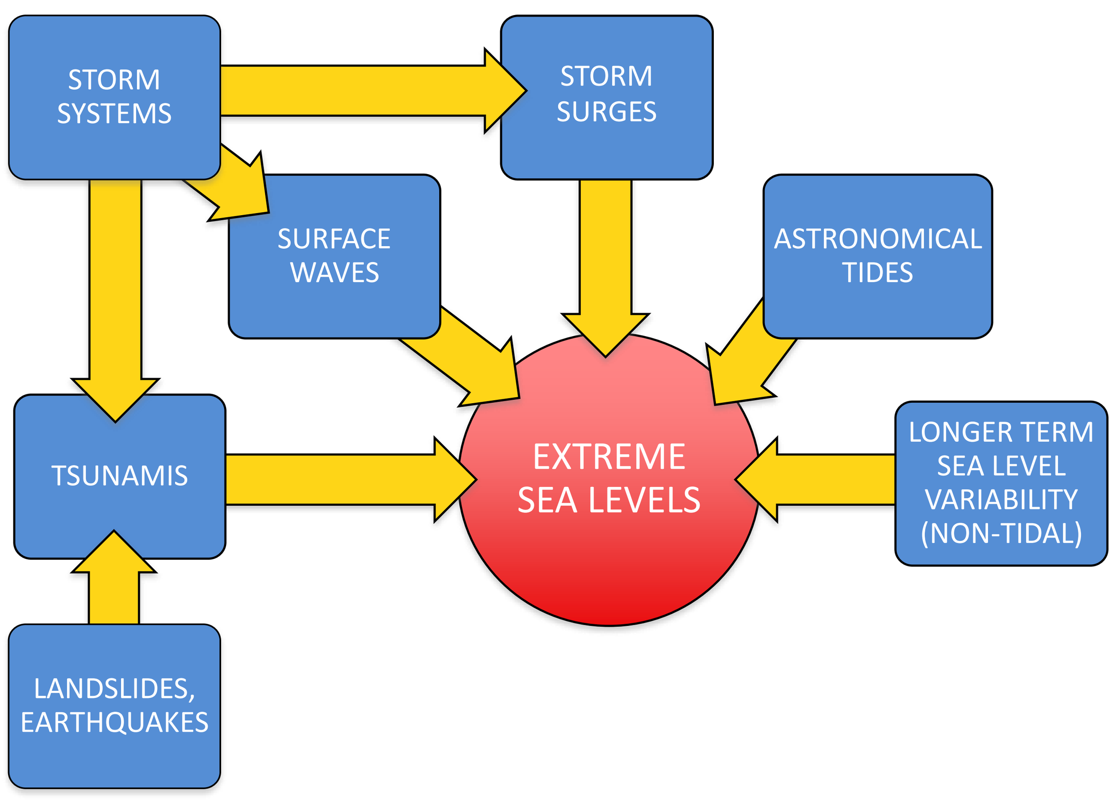

Figure 1. Illustration of the various physical processes that contribute to create extreme water levels.

OBJECTIVES

Develop better predictions and forecasts for extreme water levels arising from:

- Tides.
- Storm surges
- Surface gravity waves
- Continental shelf waves
- Tsunamis (meteorological)

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Wave Setup

Wave setup is the increase in mean water level due to the presence of waves and in some cases it can exceed that of the storm surge.

This project will define the magnitude of the wave setup component at various locations around Australia to estimate its importance to total water levels.

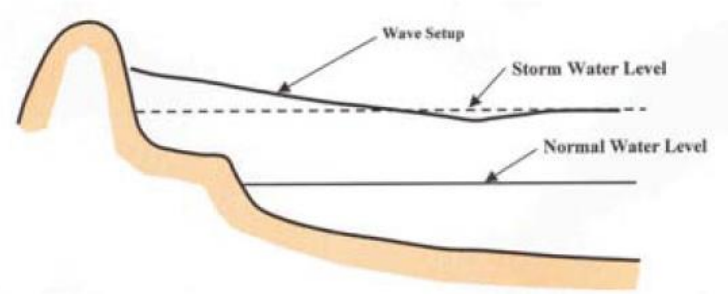

Figure 2. Illustration of the wave setup component of surge at a coast.

Continental Shelf Waves

When weather systems cross a coast the mass of water accumulated in the storm surge can be released as a continental shelf wave that travels anti-clockwise around the Australian coast.

For example, waves generated off Broome in the Kimberley can be identified off Tasmania, 2-3 days later!

An improved hydrodynamic model will include the effects of continental shelf waves.

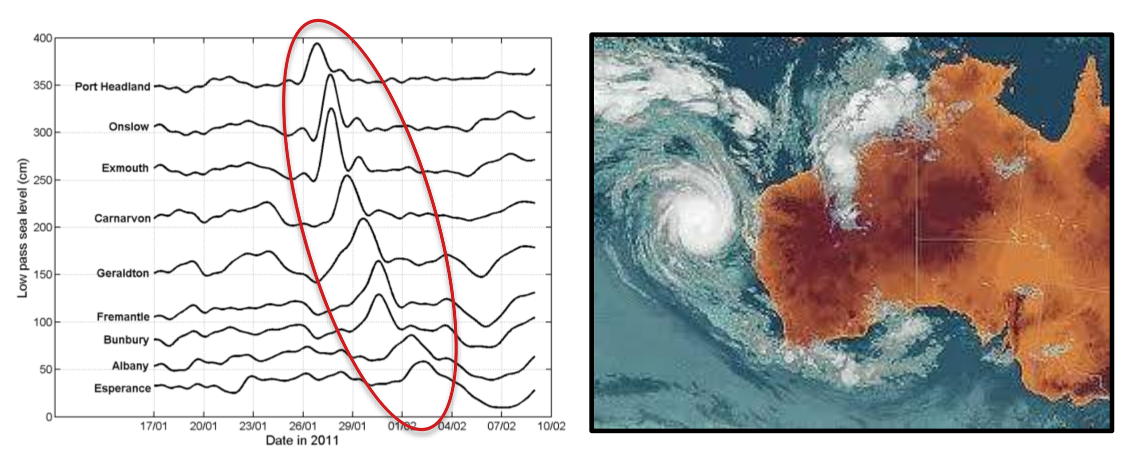

Figure 3. Filtered tide gauge records (left) showing a continental shelf wave traveling down the WA coast that was created by a tropical cyclone

Meteorological Tsunamis

Large-amplitude sea level oscillations similar to those generated by seismic activity can also be created by meteorological disturbances.

In Western Australia these "meteo-tsunamis" can exceed 0.7m and impact hundreds of kilometers of coastline (Pattiaratchi & Wijeratne, 2013).

We aim to identify the occurrence and define the magnitude of the hazard from meteo-tsunamis at other regions around Australia.

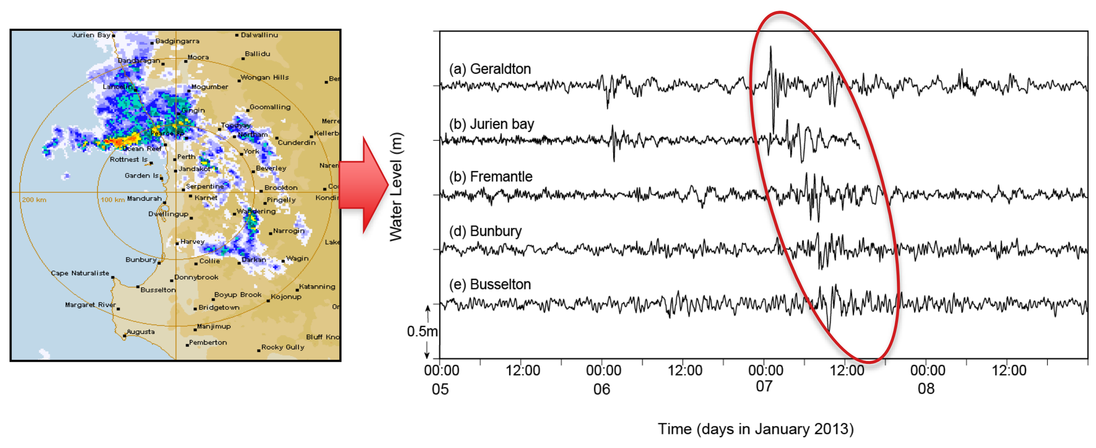

Figure 4. Perth Doppler radar image (left) showing a thunderstorm that produced a meteo-tsunami in January 2013 visible in the tide gauge records (right) along the WA coastline. The tsunami propagated from north to south and had a maximum height of 0.72 m. In WA this event exceeded the magnitude of the seismic tsunami created by the earthquake in Indonesia 2004 (0.60 m max)!

Transition from tropical to extratropical cyclones

Tropical cyclones moving into higher latitudes can interact with other weather systems and evolve into **intense, larger, fast-moving systems.**

These systems can produce destructive winds, storm surges, large waves, intense rainfall, and hazardous bushfire conditions

We are working to develop parameterisations that will improve our ability to include these systems in numerical models used to predict water levels.

References

Pattiaratchi, C., Wijeratne, E.M.S., 2014. **Observations of meteorological tsunamis along the south-west Australian coast**. Nat Hazards, 1-23.

'This project provides a comprehensive benchmark that will underpin the ability to manage the impacts of extreme water levels on coastal regions at local, regional and national scales.' Martine Woolf, lead end-user from Geoscience Australia

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