bushfire&natural HAZARDSCRC

DEVELOP BETTER PREDICTIONS AND FORECASTS FOR EXTREME WATER LEVELS AROUND AUSTRALIA

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An Australian Government Initiative

CRC AUSTRALIA

THE UNIVERSITY OF WESTERN AUSTRALIA

Project Team

Researchers

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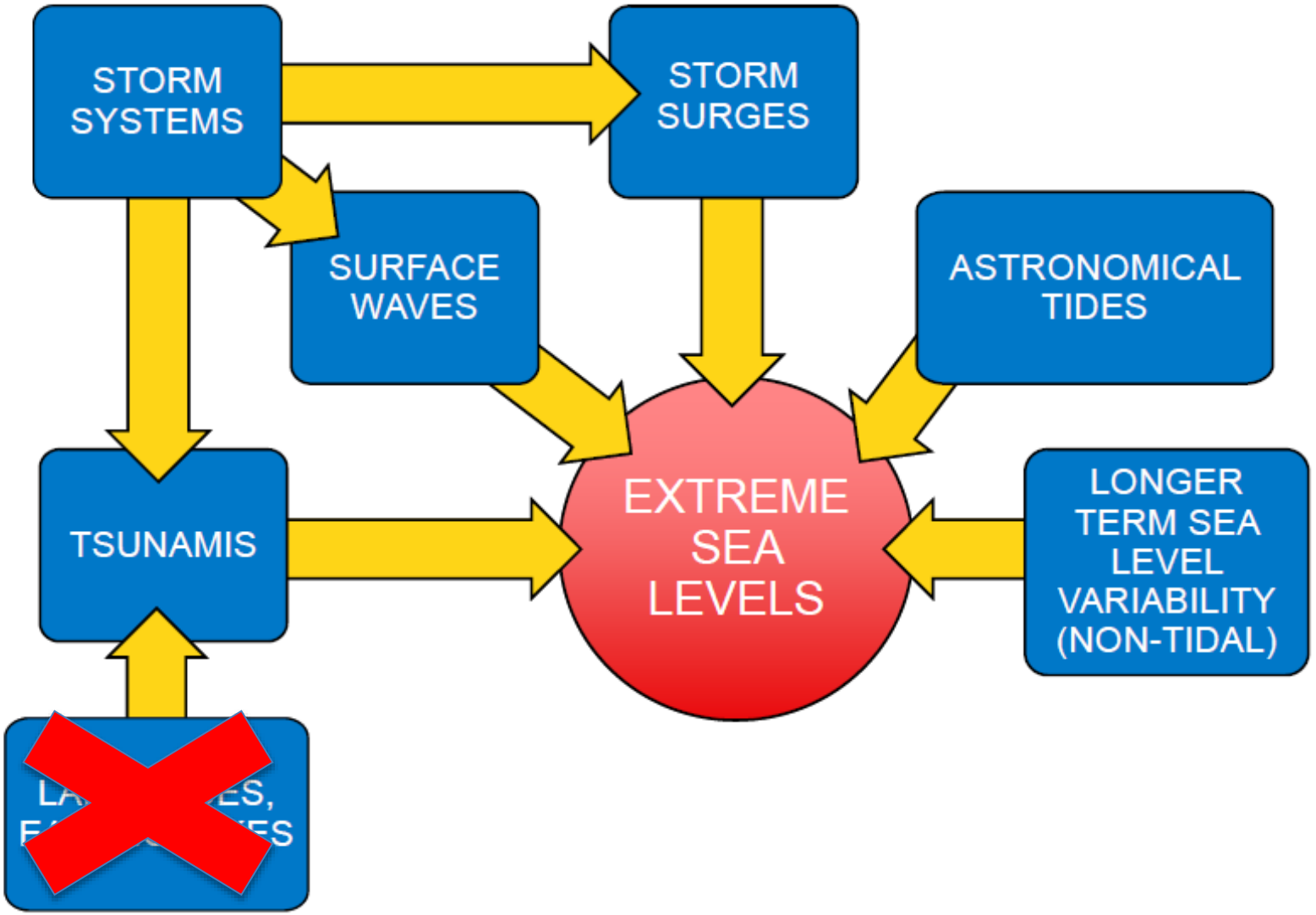
- Yasha Hetzel (UWA)
- Ivica Janeković (UWA)

Endusers

- R. Schwartz (Queensland)
- James Guy (SA)
- Heather Stuart & David Hanslow (NSW)

Extreme Sea levels



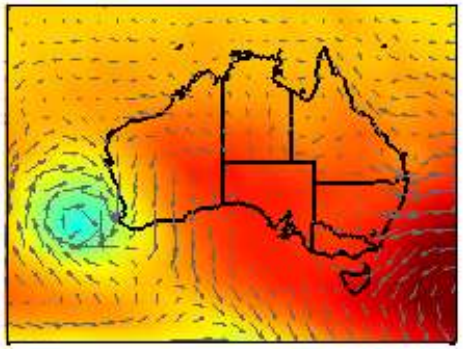
OBJECTIVES

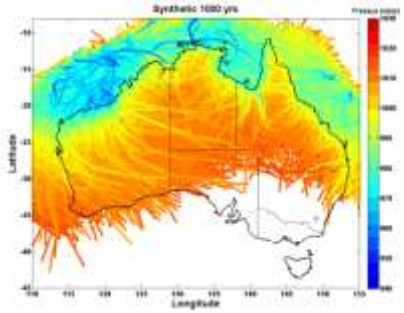
Develop better predictions and forecasts for extreme water levels arising from:

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

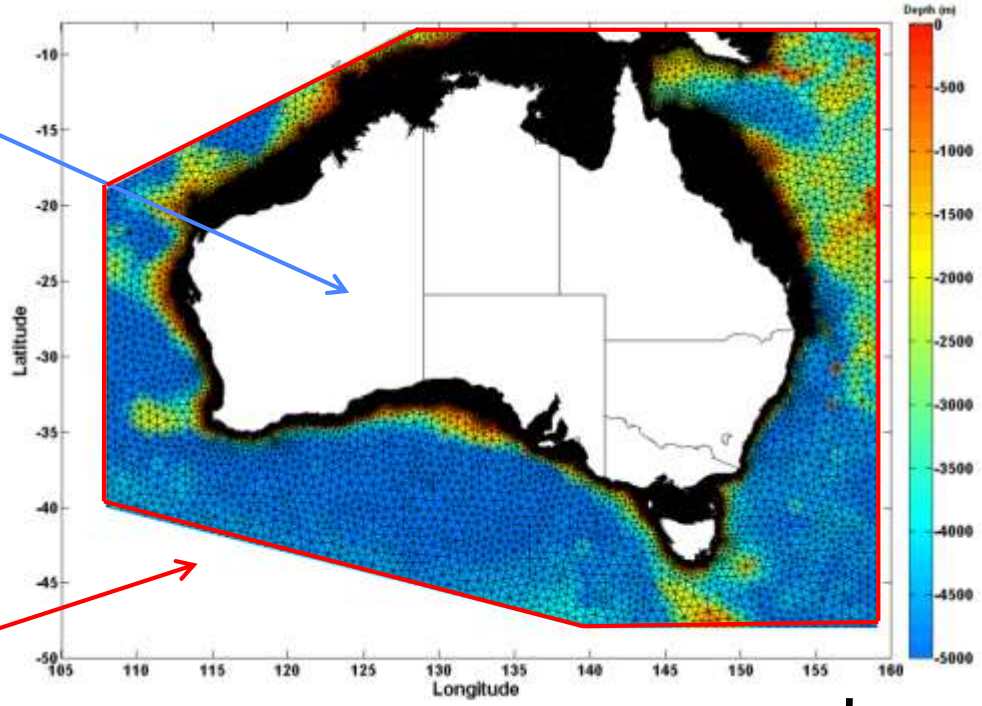
Sea level hindcasts

NCEP: 1949-2014

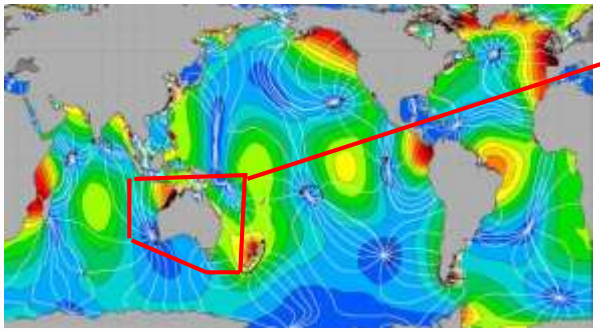




Tropical Cyclones



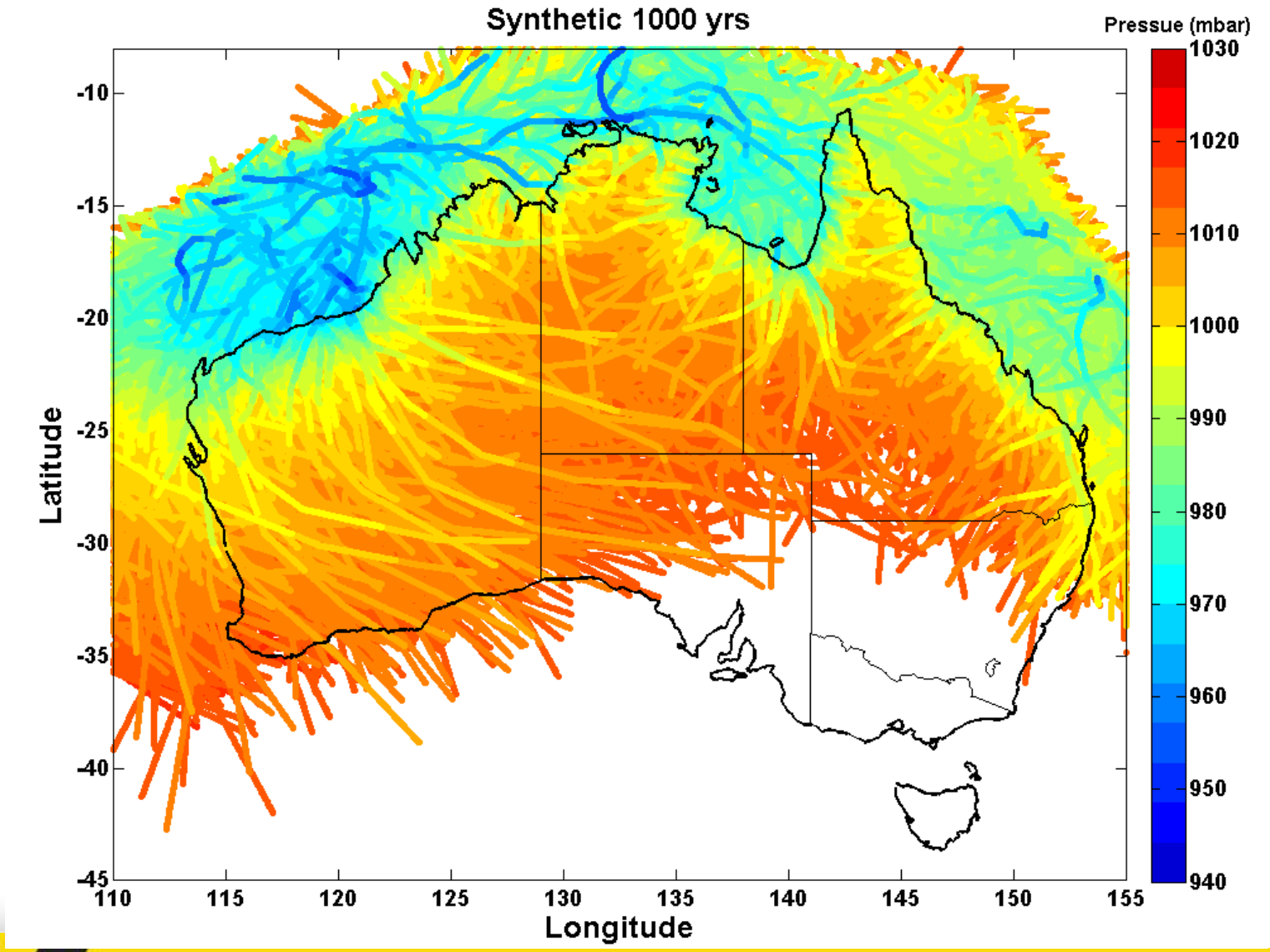
Global tidal model



~75,000 simulations equivalent to 10,000 years

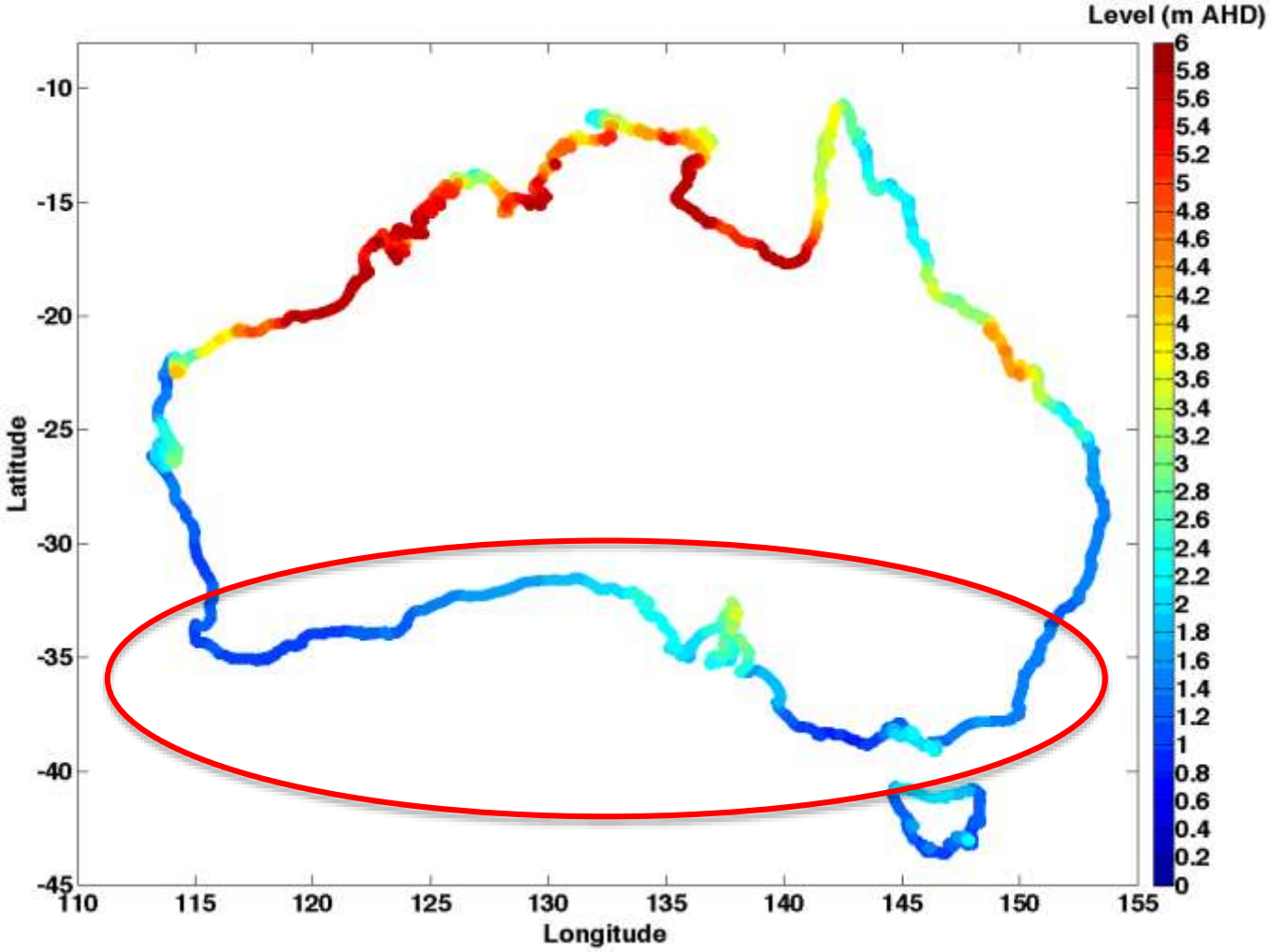
Total Sea level (~60 year time series)

Tropical storms – 10,000 year climatology



Tide/surge Numerical model: Australia

1:1000ARI: total water level (tropical + extra-tropical)



Missing Processes

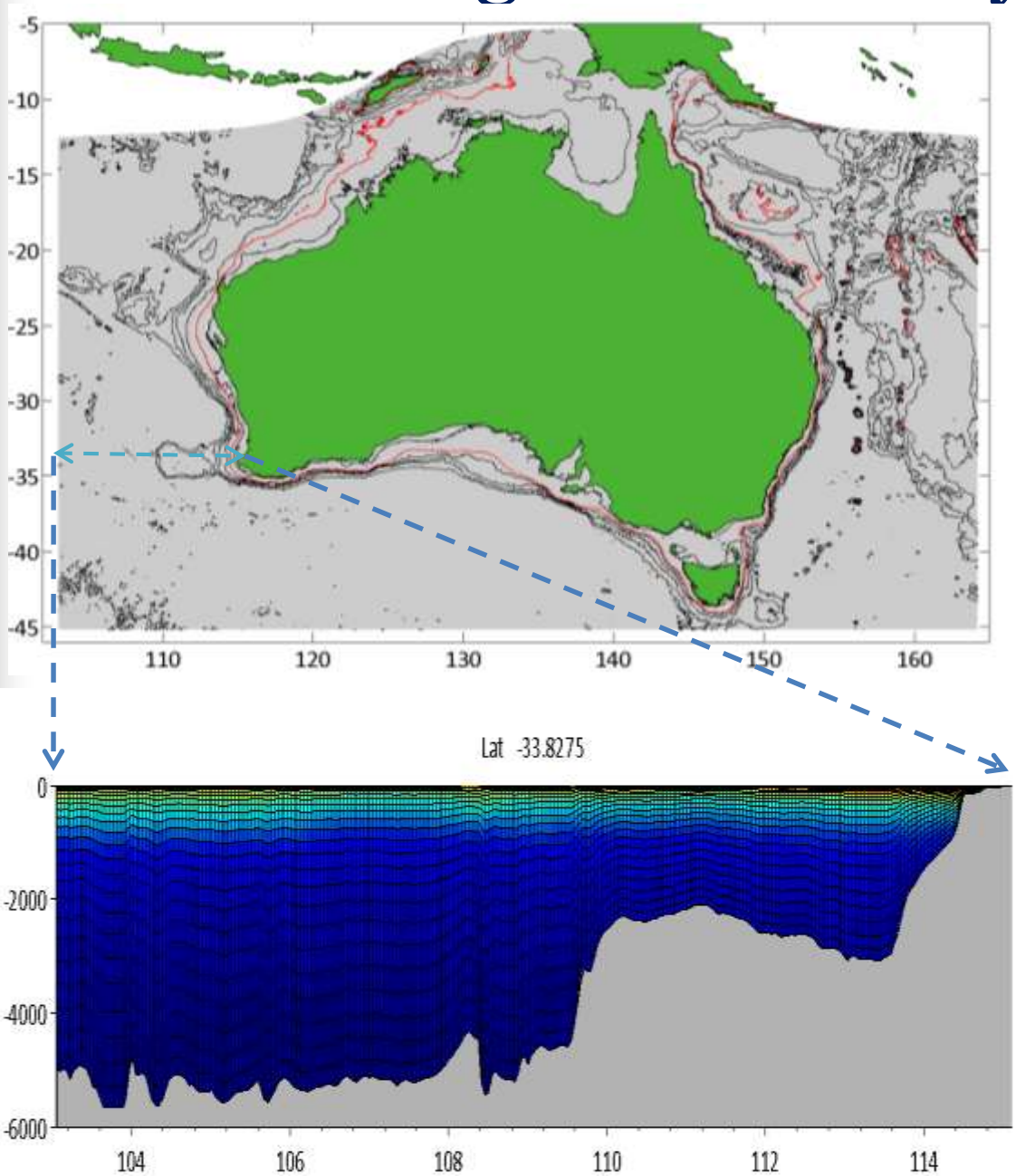
Storm Surges

- Continental shelf waves
- Tropical to extra-tropical transition

Effects of Surface gravity waves (wave set-up)

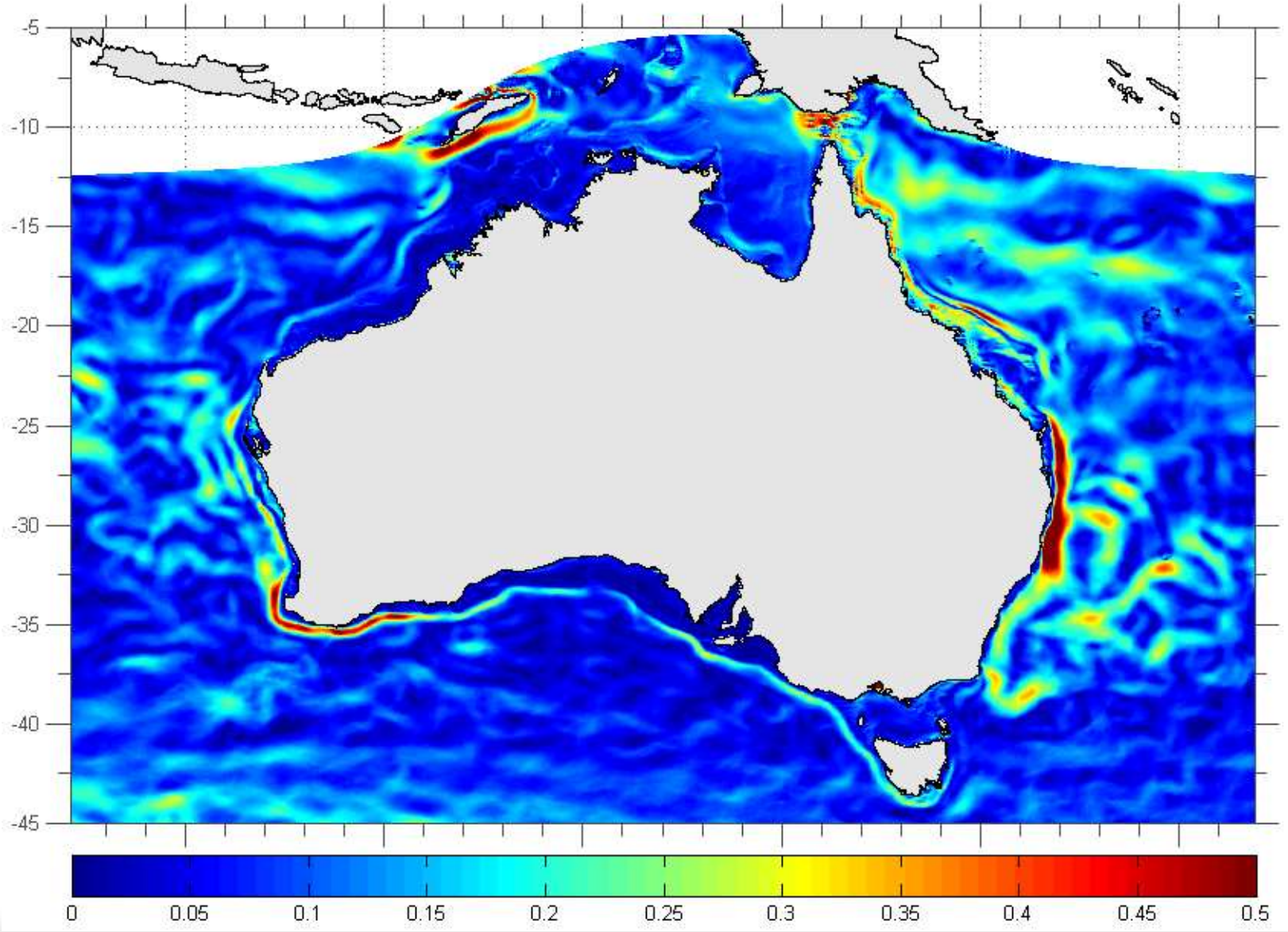
Meteorological tsunamis

OzROMS grid and bathymetry

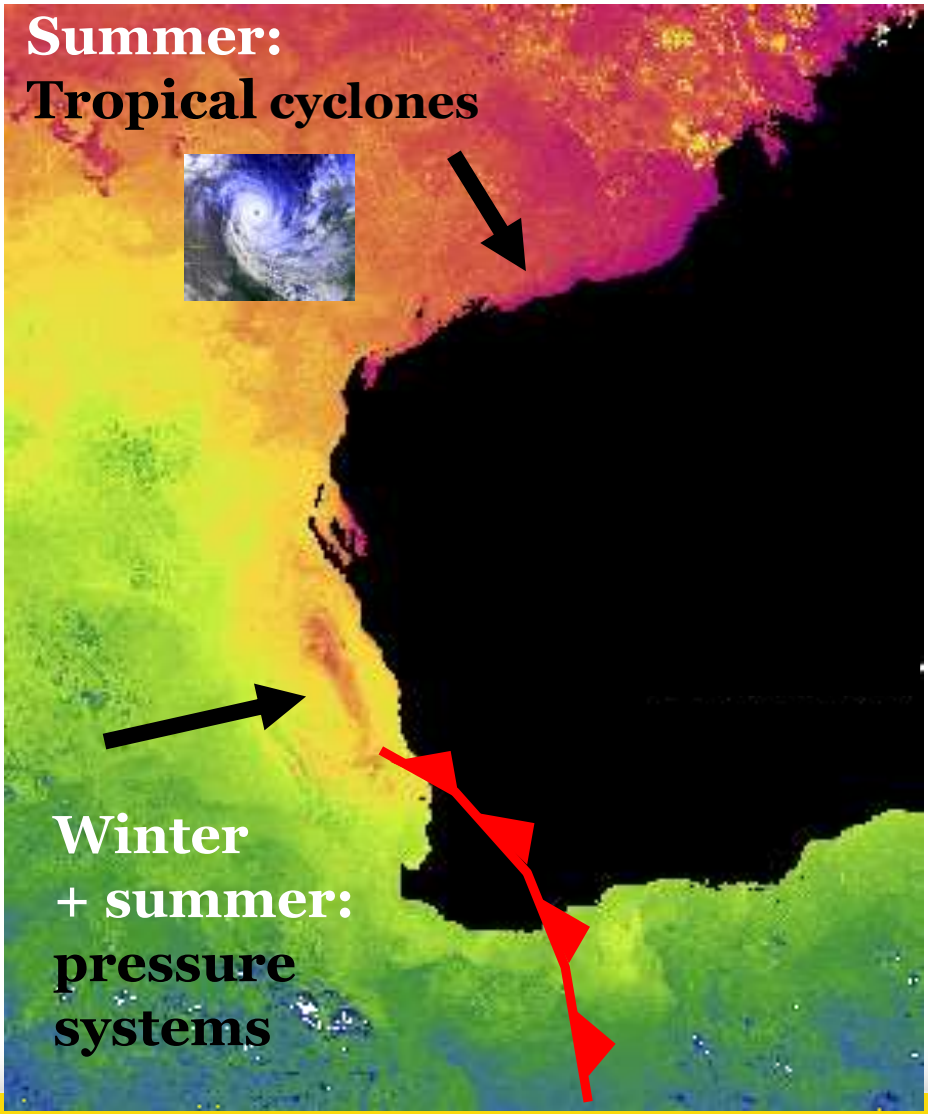


- Total Coverage > 36 million km²
- Curvilinear-orthogonal
- ~2-4 km horizontal grid resolution (1460 × 1460)
- 30 sigma layers
- Total cells ~ 64 million
- Bathymetry: GA 250 m grid

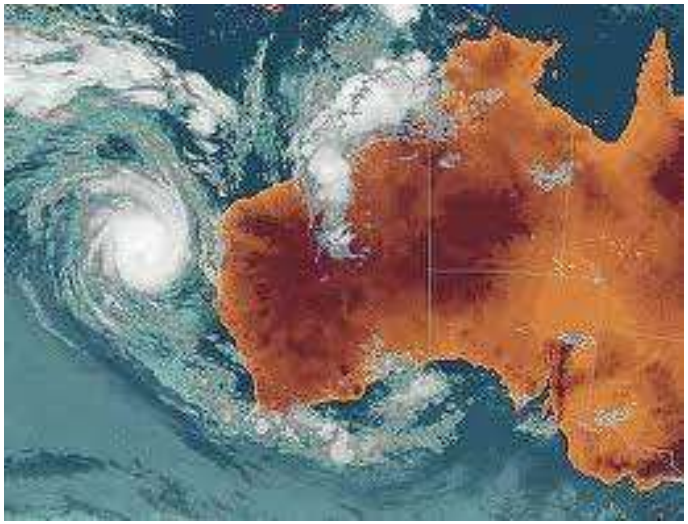
OzROMS surface currents: mean speed

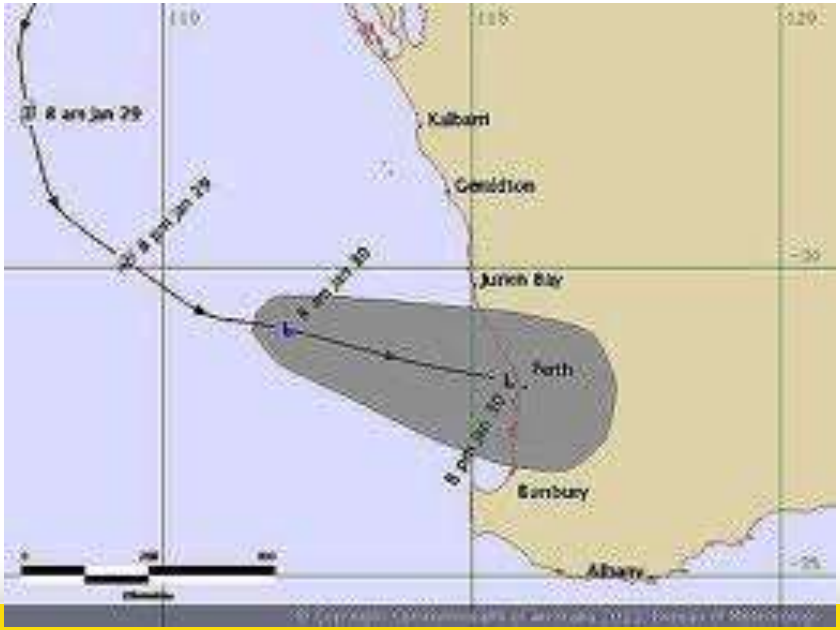


Continental Shelf Wave Generation

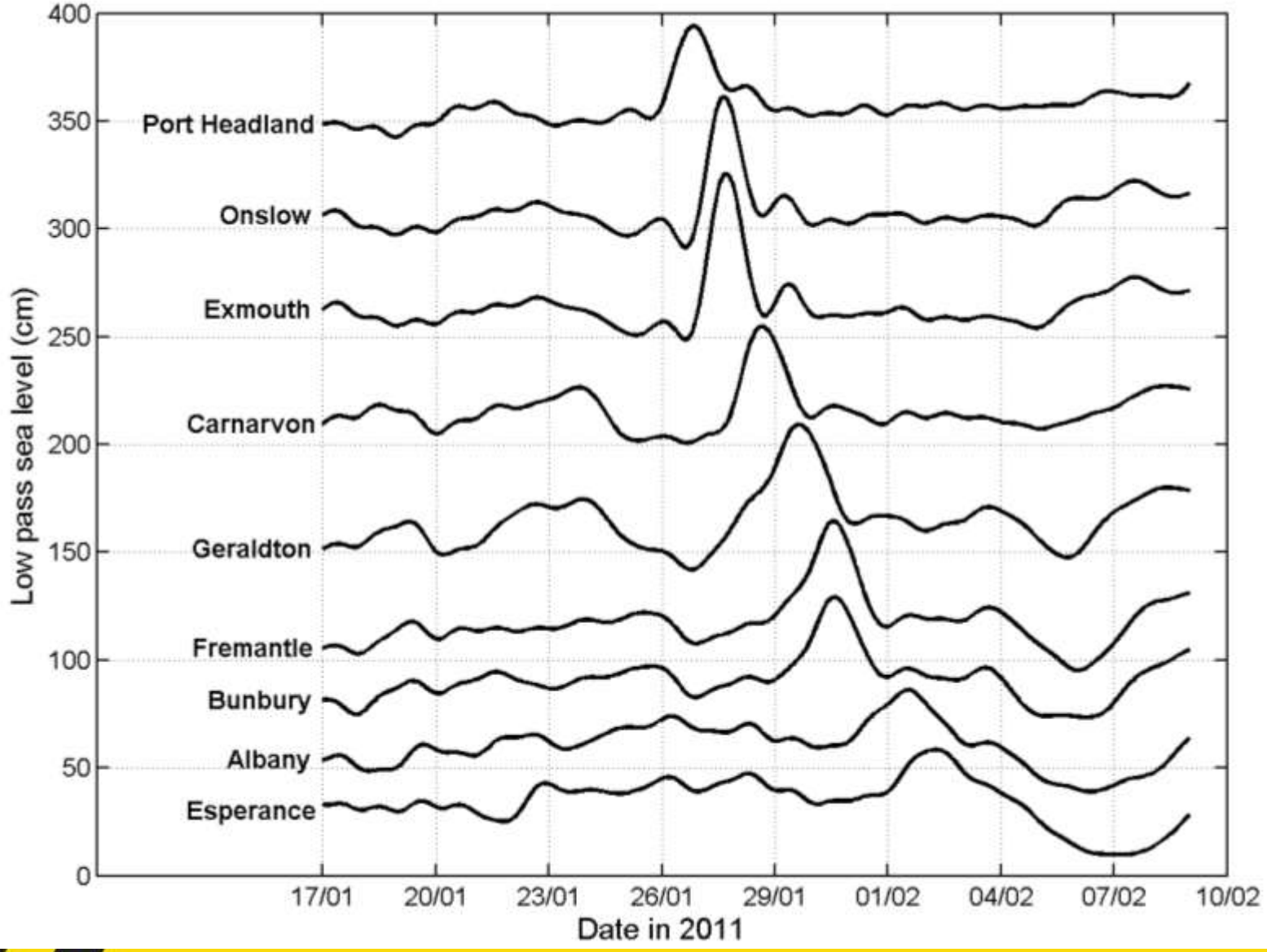


TC Bianca: 30 January 2011

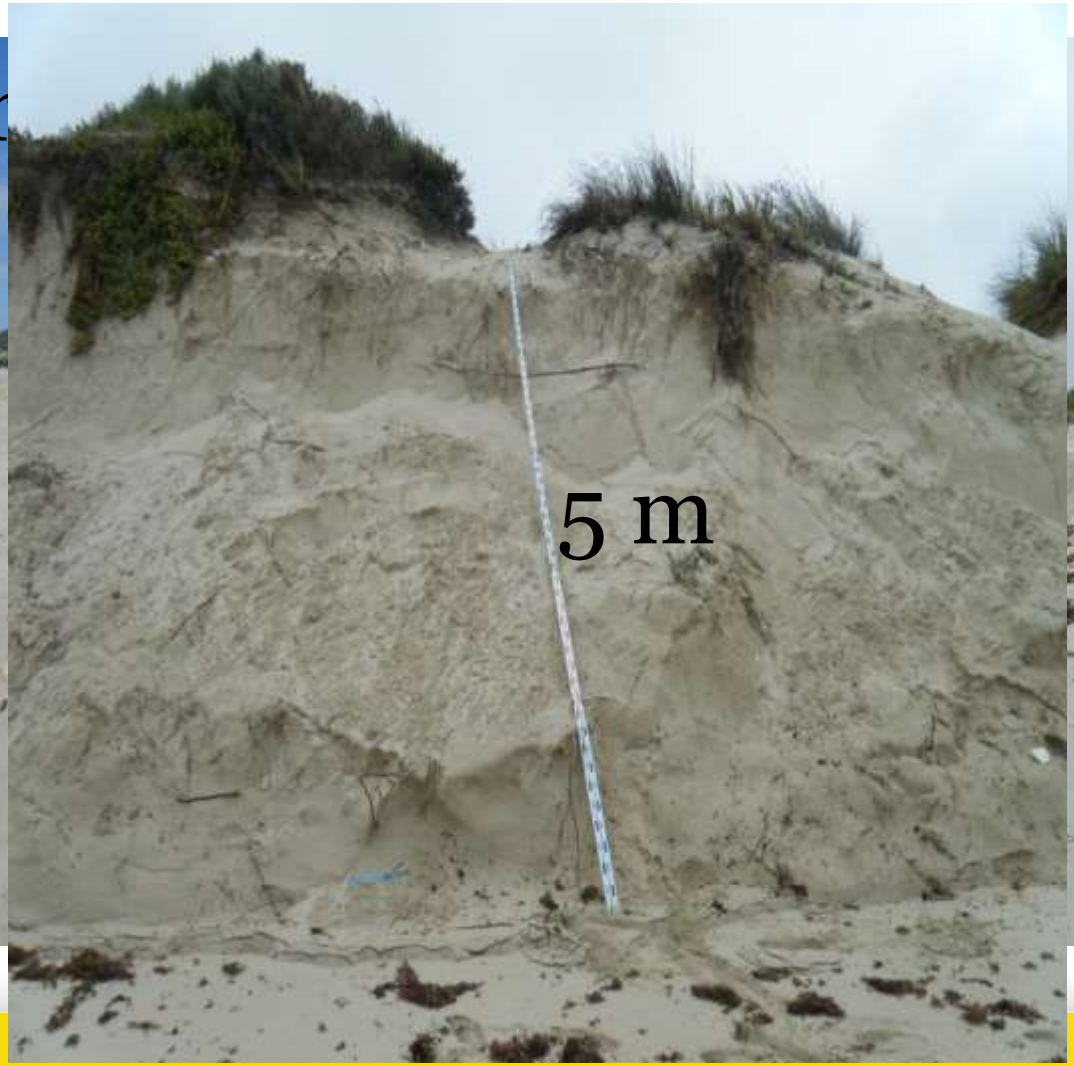




Continental Shelf Waves (TC Bianca)



Tropical Cyclone Bianca Impacts @ Yanchep Beach

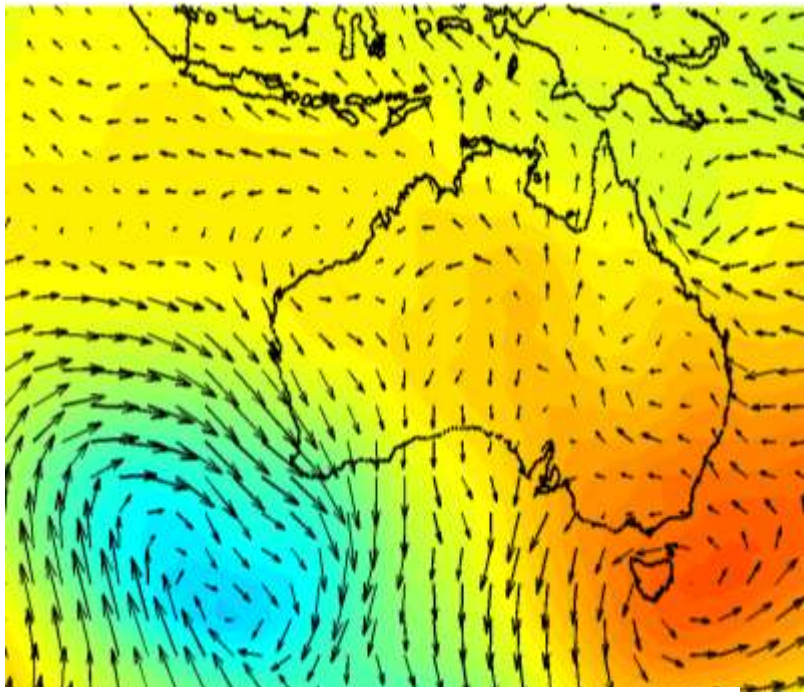


Tropical Cyclone Bianca

Impacts @ Perth CBD ?

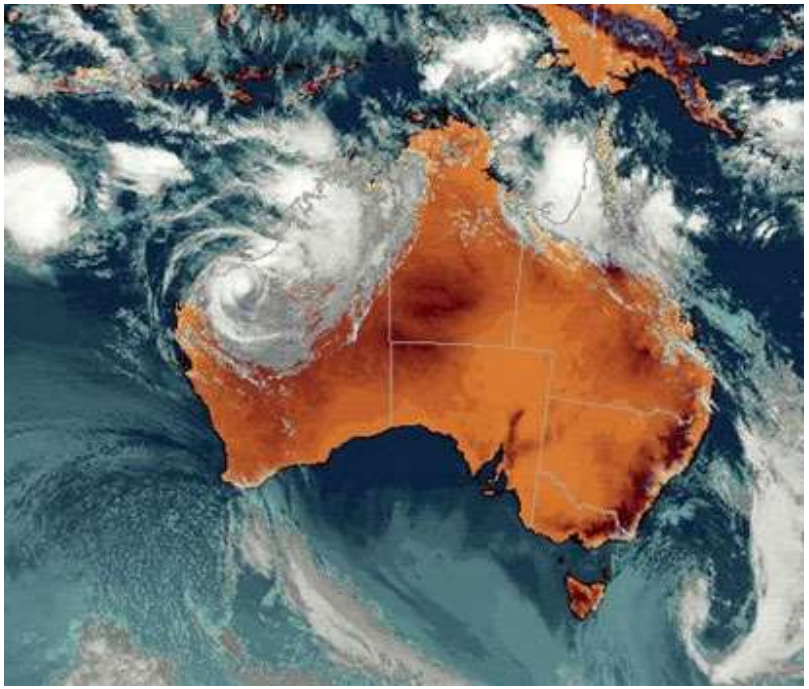
Extreme Events – storm surge

Extra-tropical



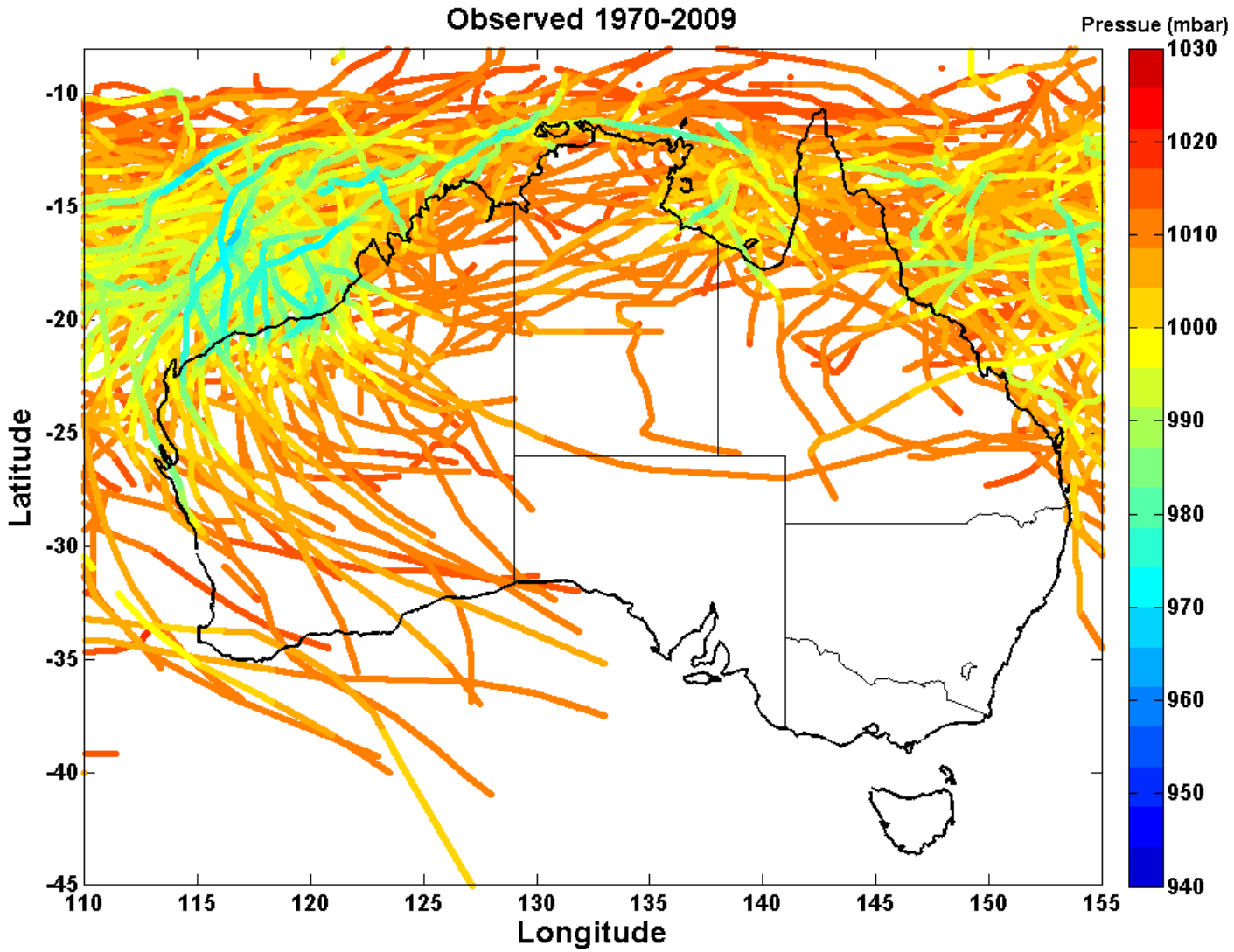
1,000 ± 500 km
Surge - 2-5 days
Several hundred km
Sprawling geometry
Apr-Aug

Tropical (cyclones)

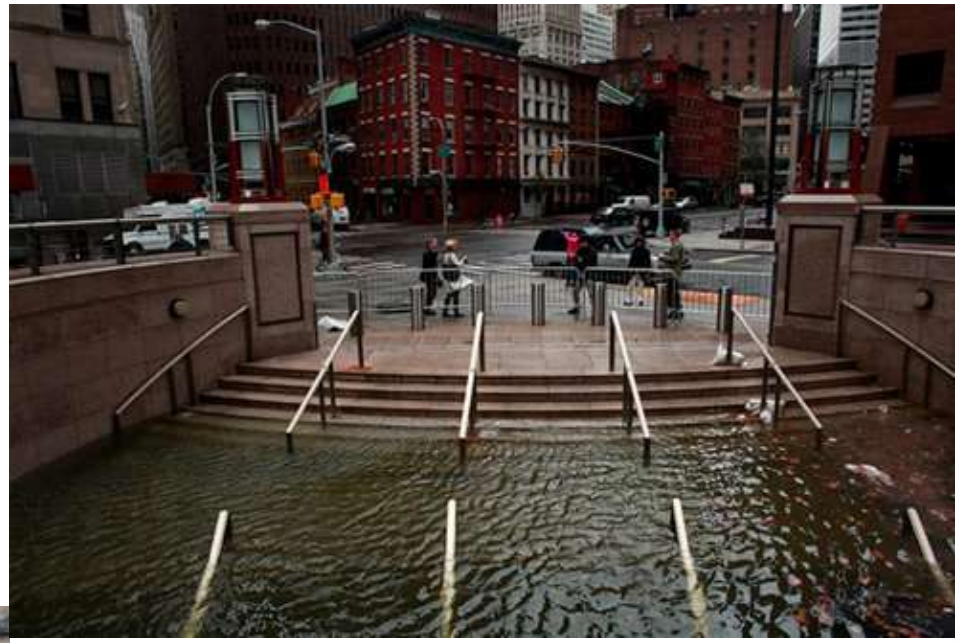


500 ± 200 km
Surge - up to half a day
Usually < 200 km
Compact and nearly symmetrical
Nov-Apr

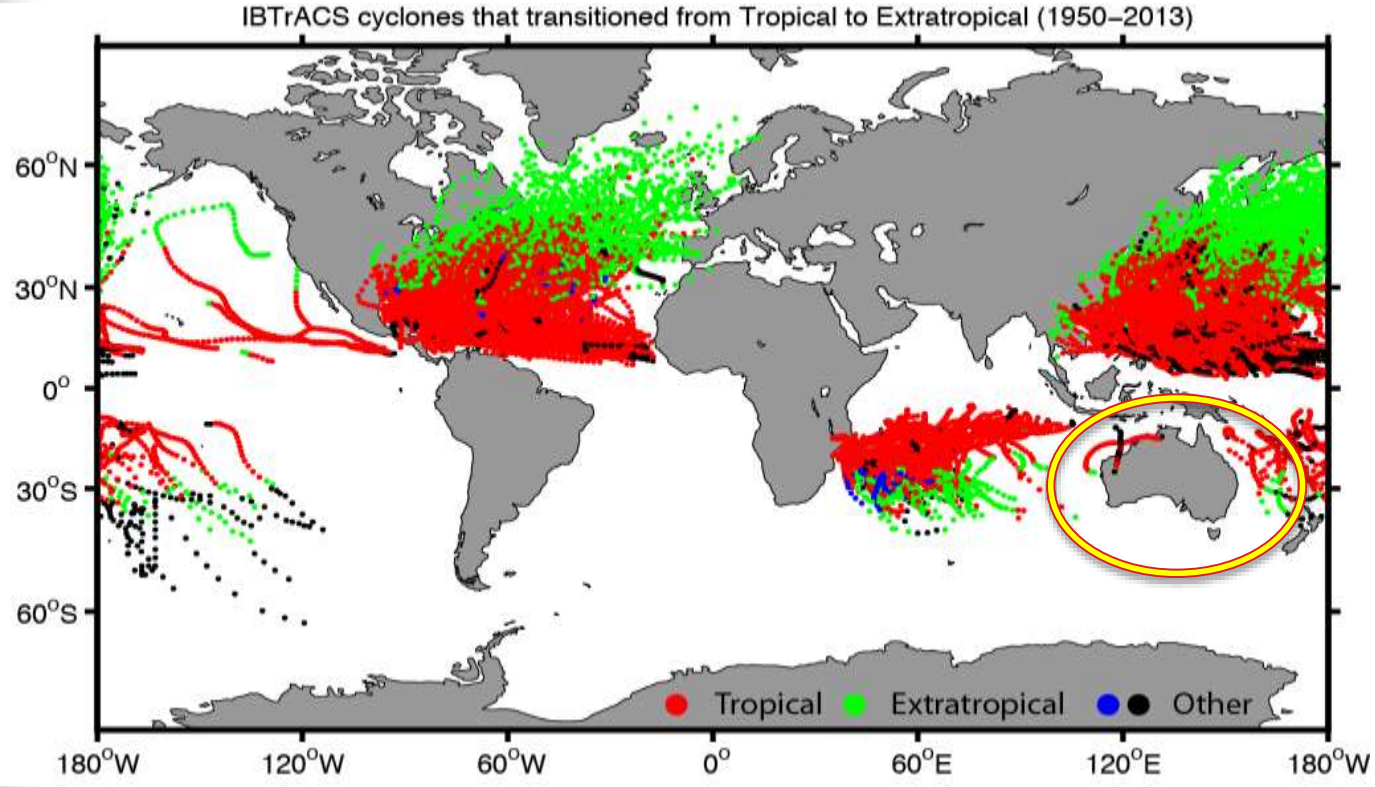
Tropical to extra-tropical cyclone transition



Hurricane Sandy



Extratropical Transition Globally



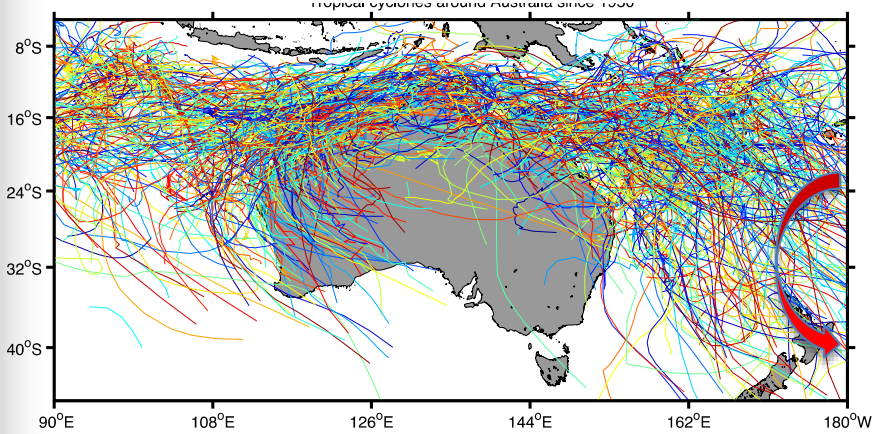
Storms in global database that transitioned from tropical to extra-tropical

The lack of activity around Australia illustrates the lack of information about ET rather than occurrence

ET occurs closer to the equator around Australia than in any other ocean basin

Australian Tropical Cyclone Tracks

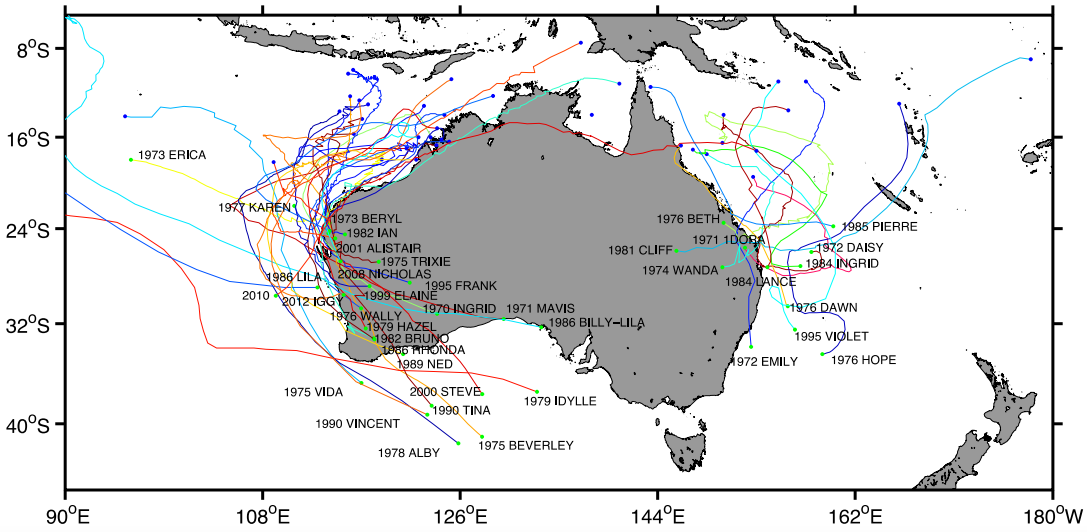
All TC tracks 1950-2013



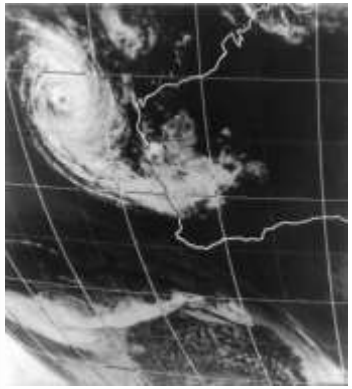
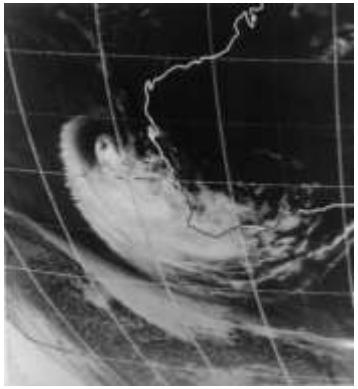
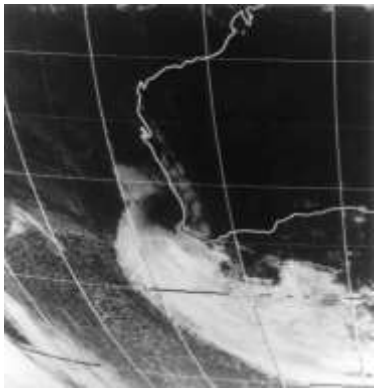
Storms recorded to have undergone ET

Mavis 1971 (nw WA)
Vida 1975 (sw WA; not well documented)
Alby 1978 (sw WA)
Hazel 1979 (Shark Bay)
Idylle 1979 (sw WA)
Herbie 1988 (Shark Bay)
Ned 1989 (sw WA)

- TC curvature toward east somewhat lessens risk to east coast of Australia
- Cyclones passing south of 24 deg and within 100 km of coast ----> potential for ET to cause damage

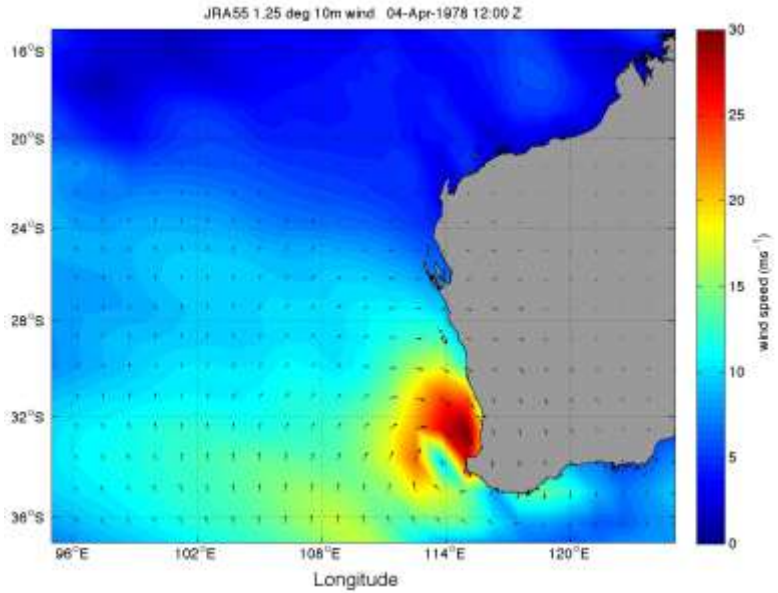


Cyclone Alby 1978

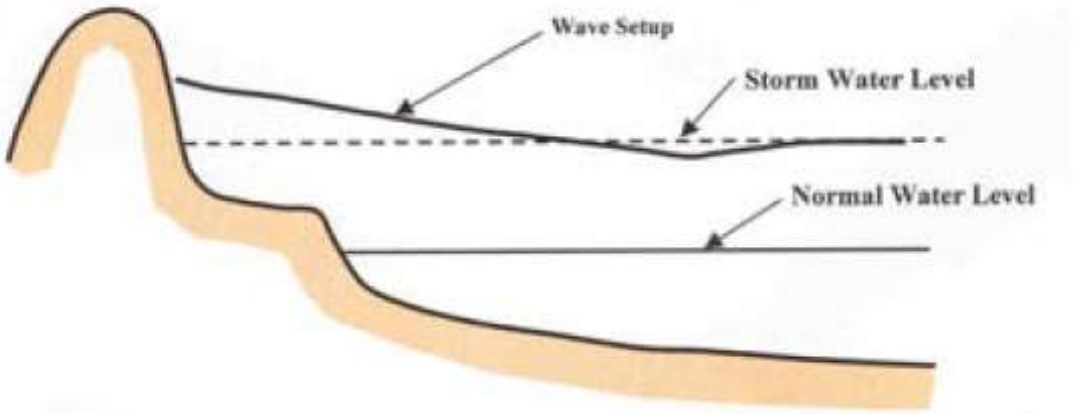
- Most destructive ET event in Australia
- Strong dry northerly winds caused: bushfires, erosion, storm surge and flooding

Source: Australian Bureau of Meteorology (http://www.bom.gov.au/cyclone/history/wa/alby.shtml)



JRA-55 model simulation of Alby winds

Effects of surface gravity waves



Which regions of Australia are susceptible for wave set-up ?

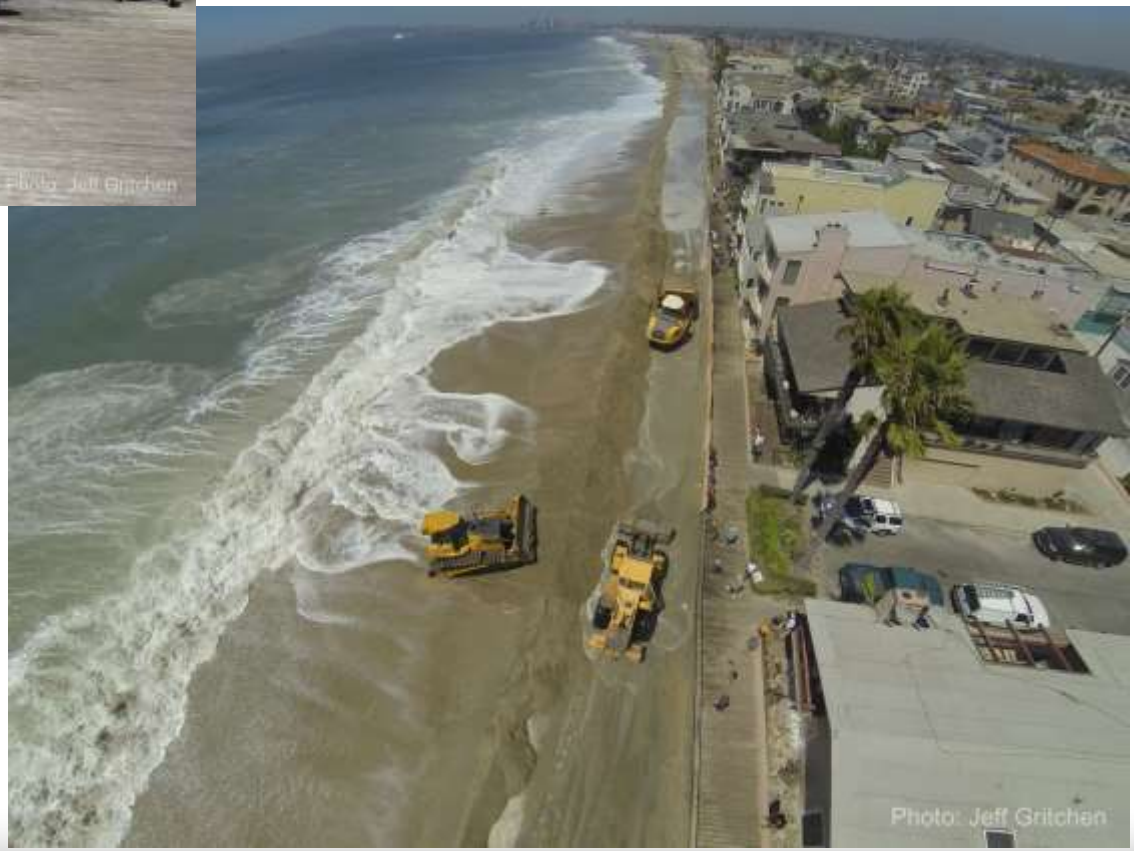
What coastal types are important ?

Geomorphic classification of the Australian Coastal Zone developed by GA

PhD project

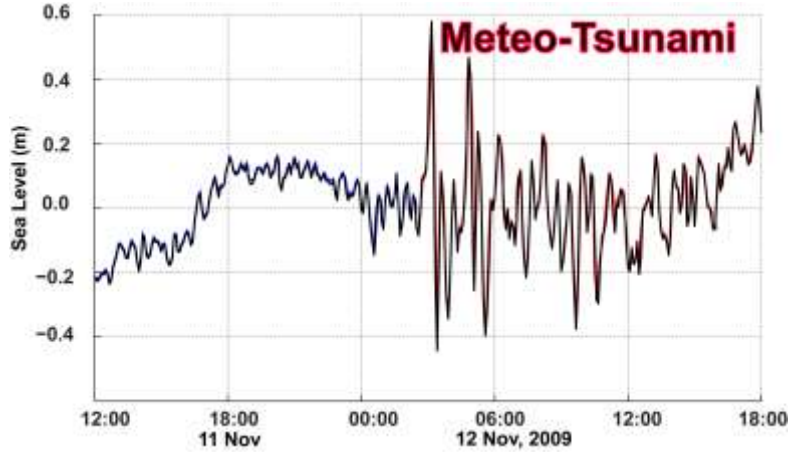
Wave set-up - Hurricane Marie, Aug, 2014

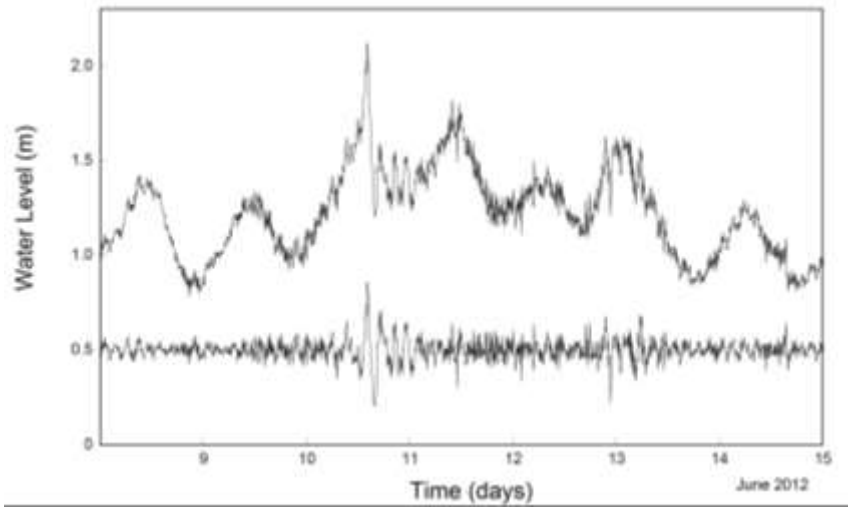
Wave set-up - Hurricane Marie, Aug, 2014

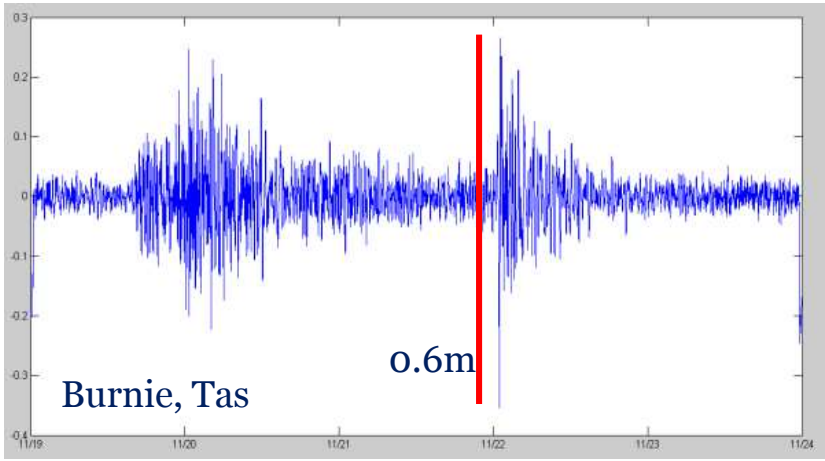


Meteo-tsunamis

large amplitude short period sea level oscillations forced by meteorological disturbances

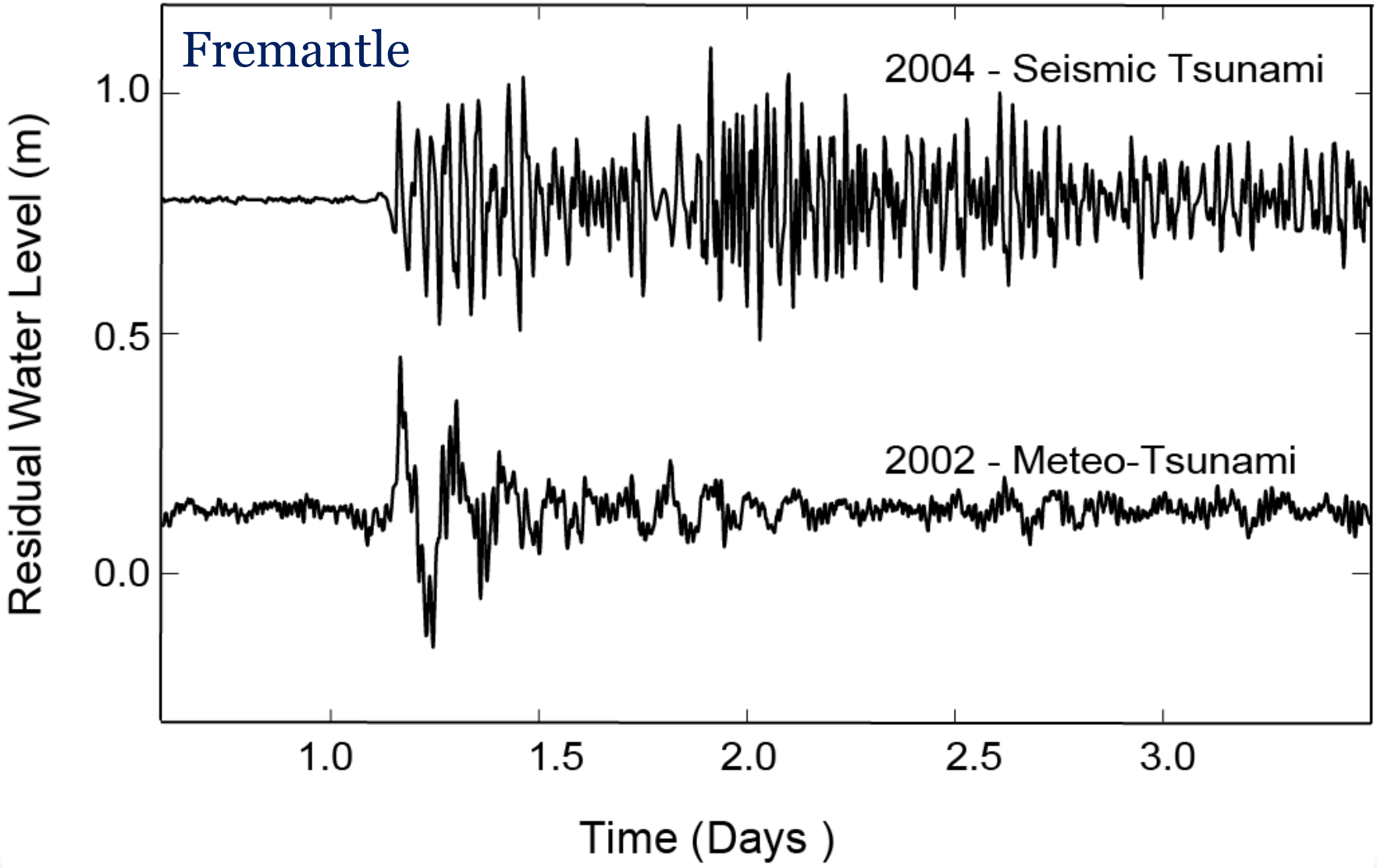




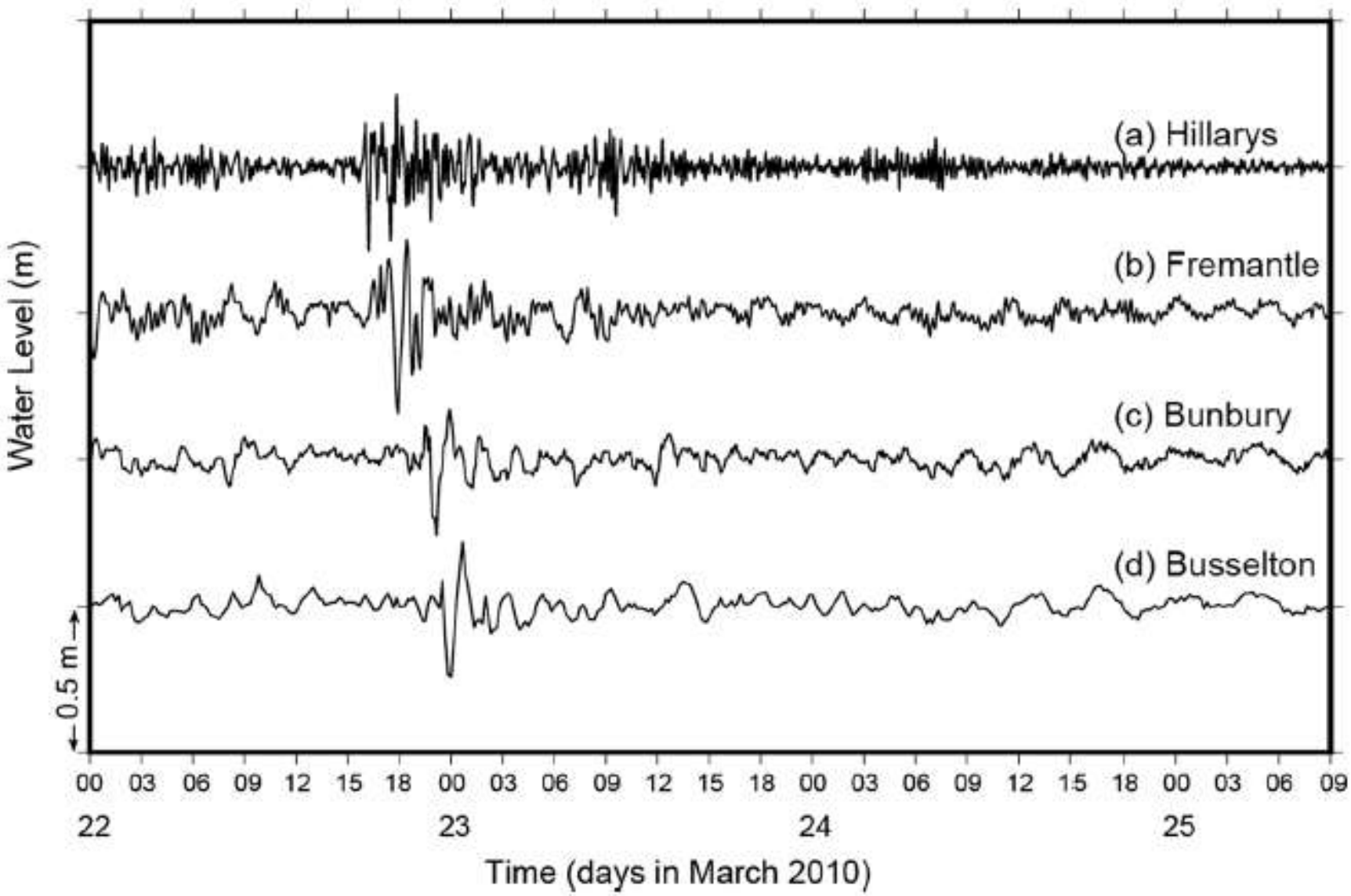


Highest water level recorded in 115 years

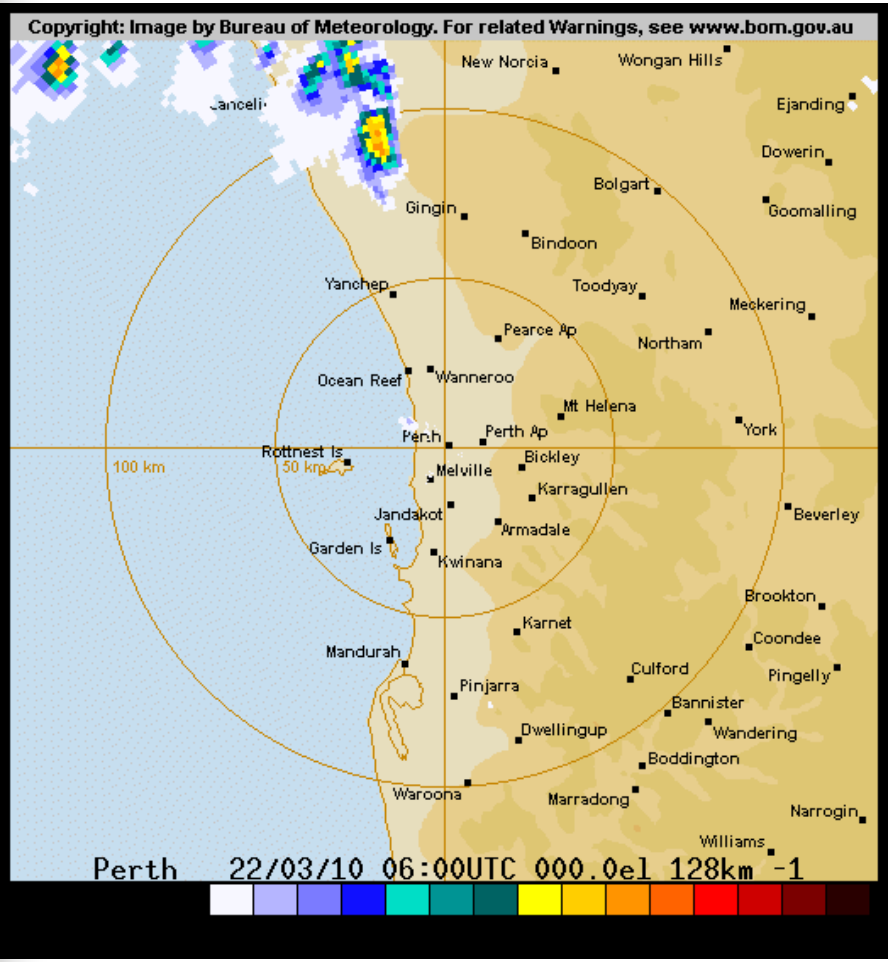
Seismic and Meteorological Tsunami



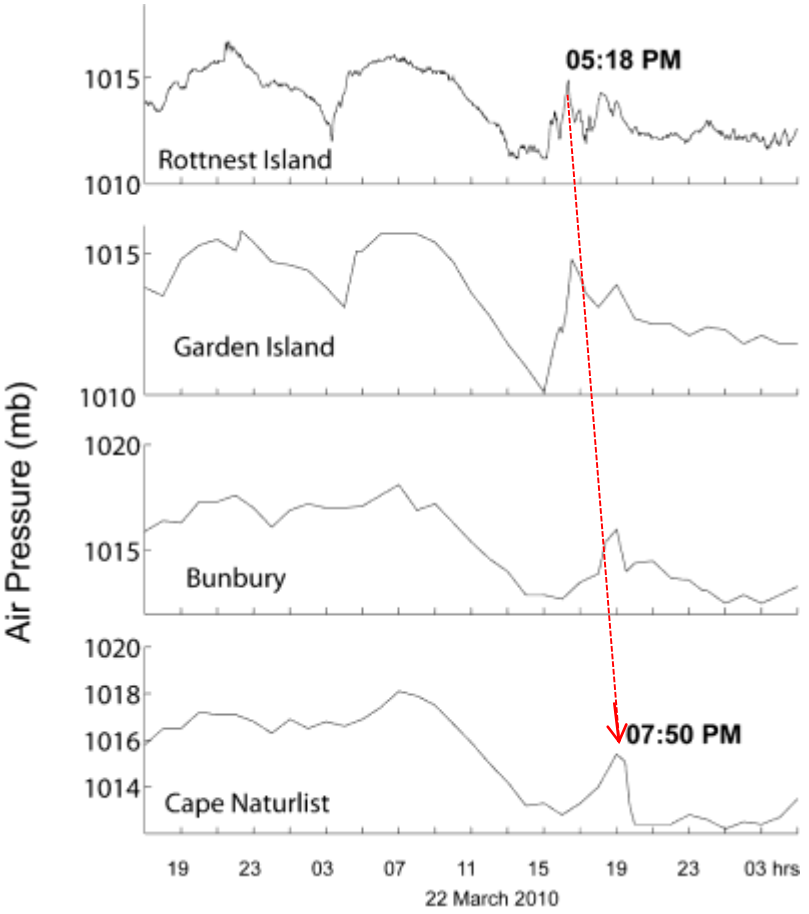
Meteo-tsunami: 22 March 2010



Meteo-tsunami: 22 March 2013



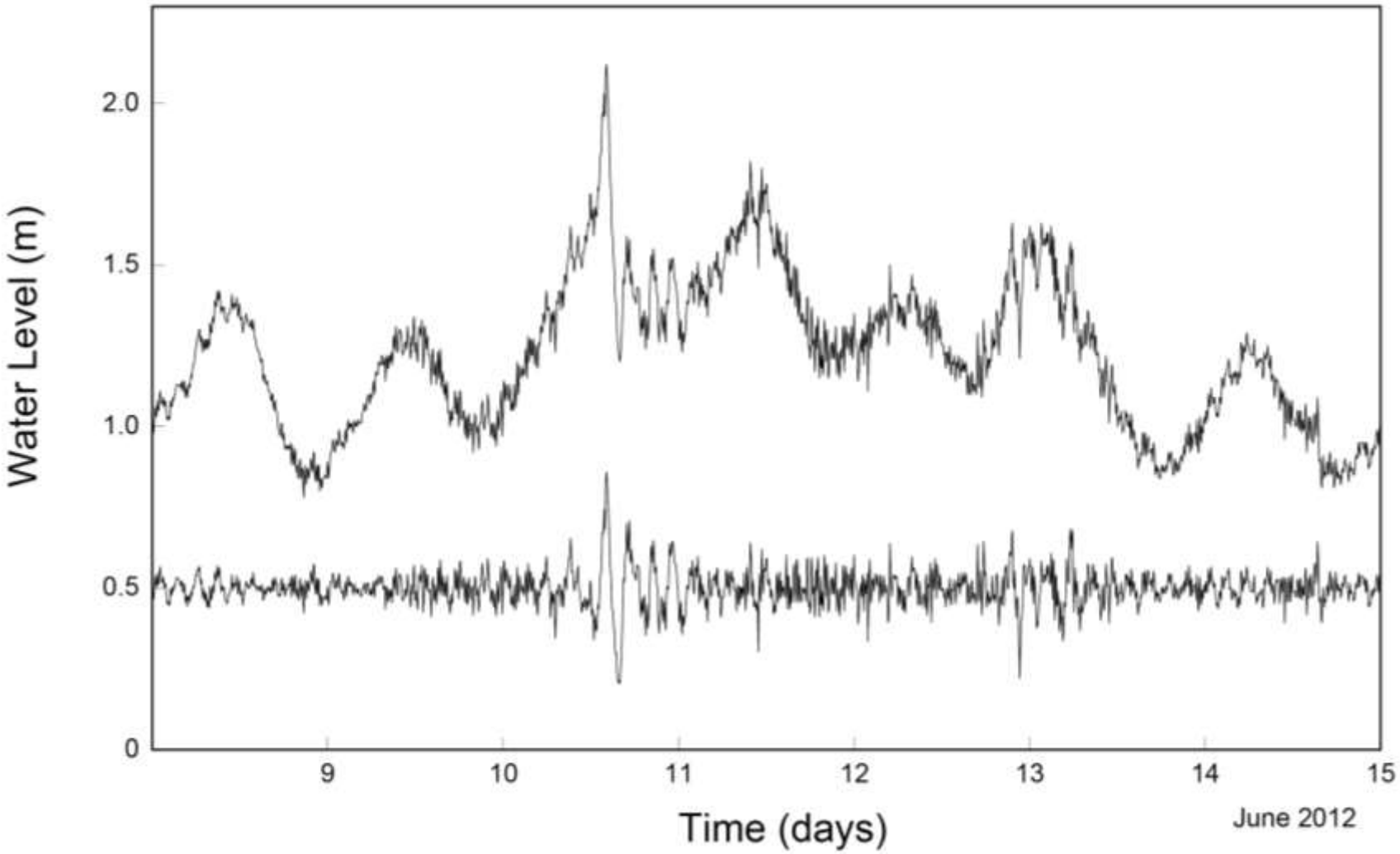
Source : *Bureau of Meteorology, WA*



Cap ≈20 ms^{-1} V ≈25 ms^{-1}

Generating Mechanism: Proudman and shelf resonance

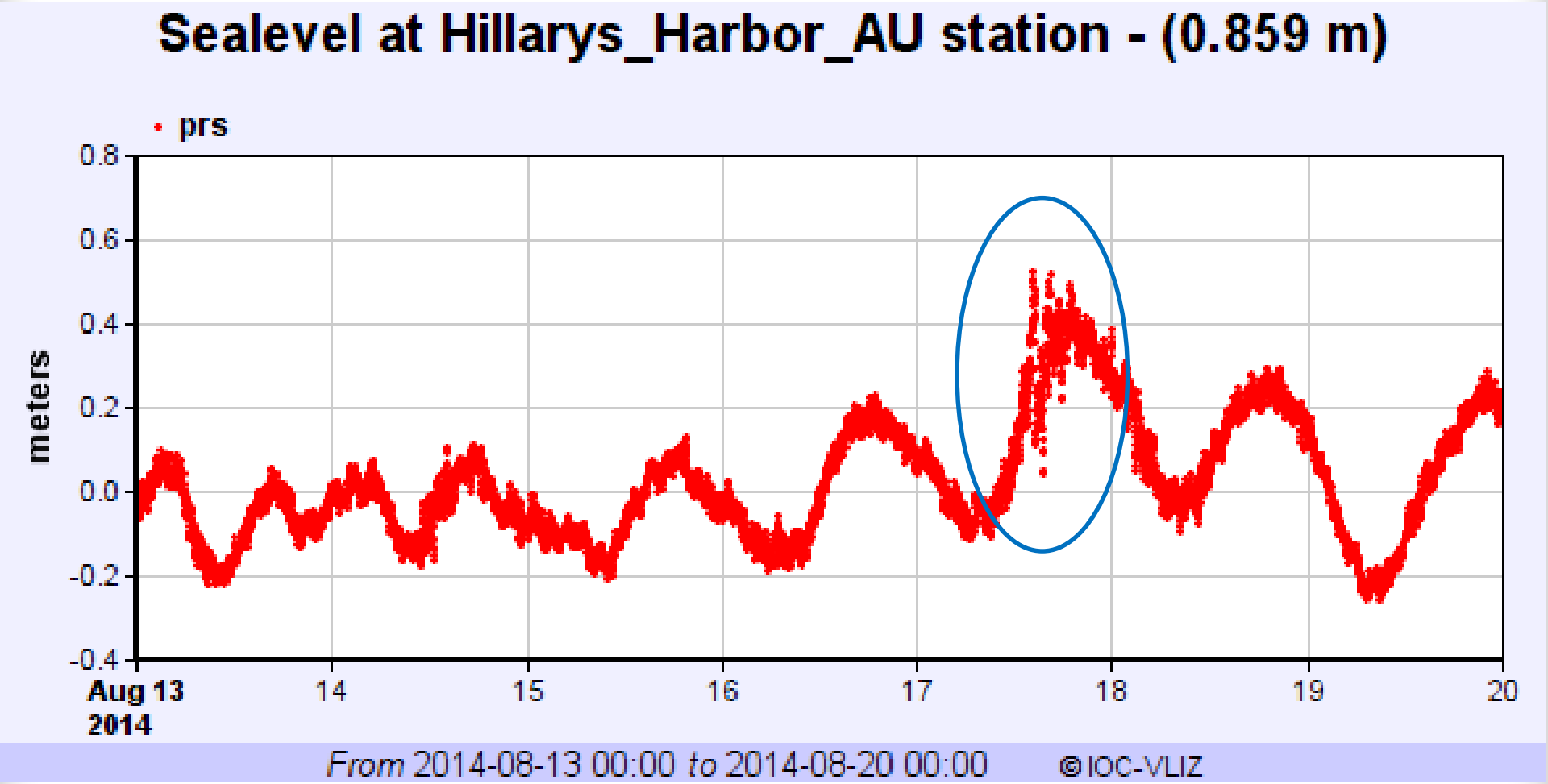
Meteo-tsunami: 10 June 2012



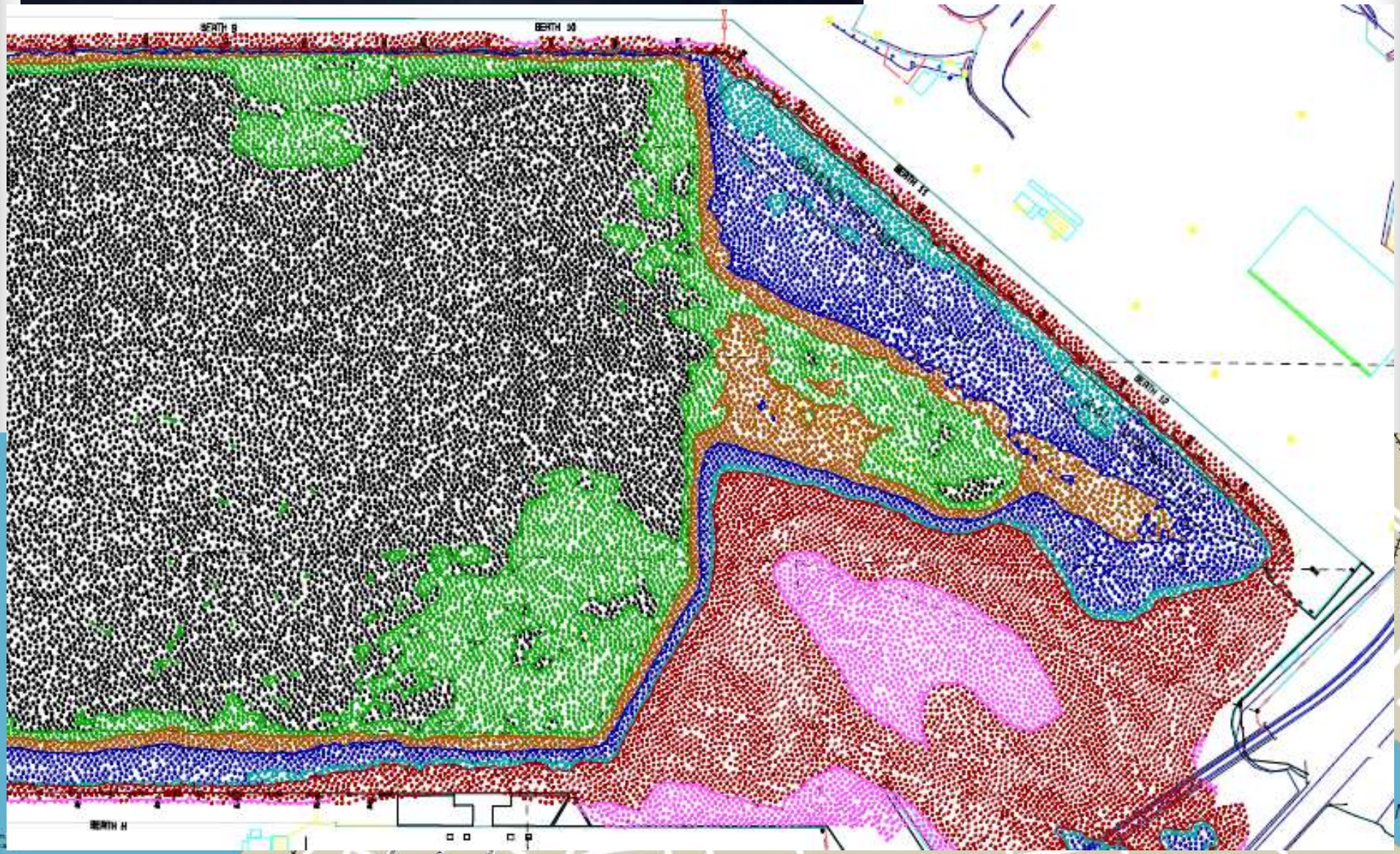
Highest water level recorded in 115 years

Coastal flooding: Riverside Drive

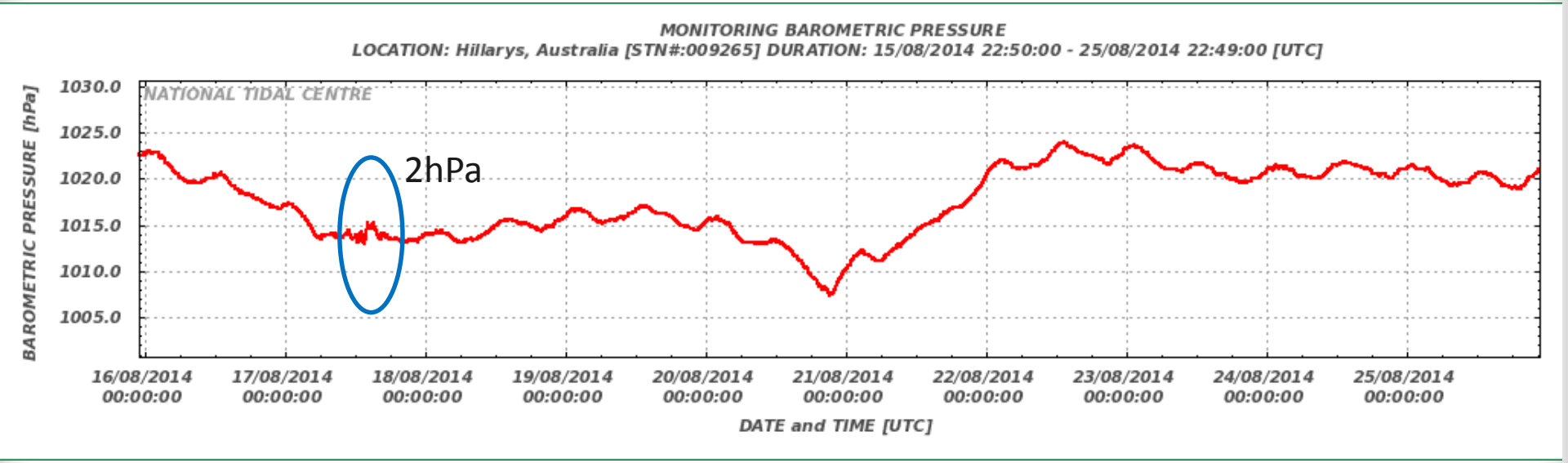
Event of 17 August



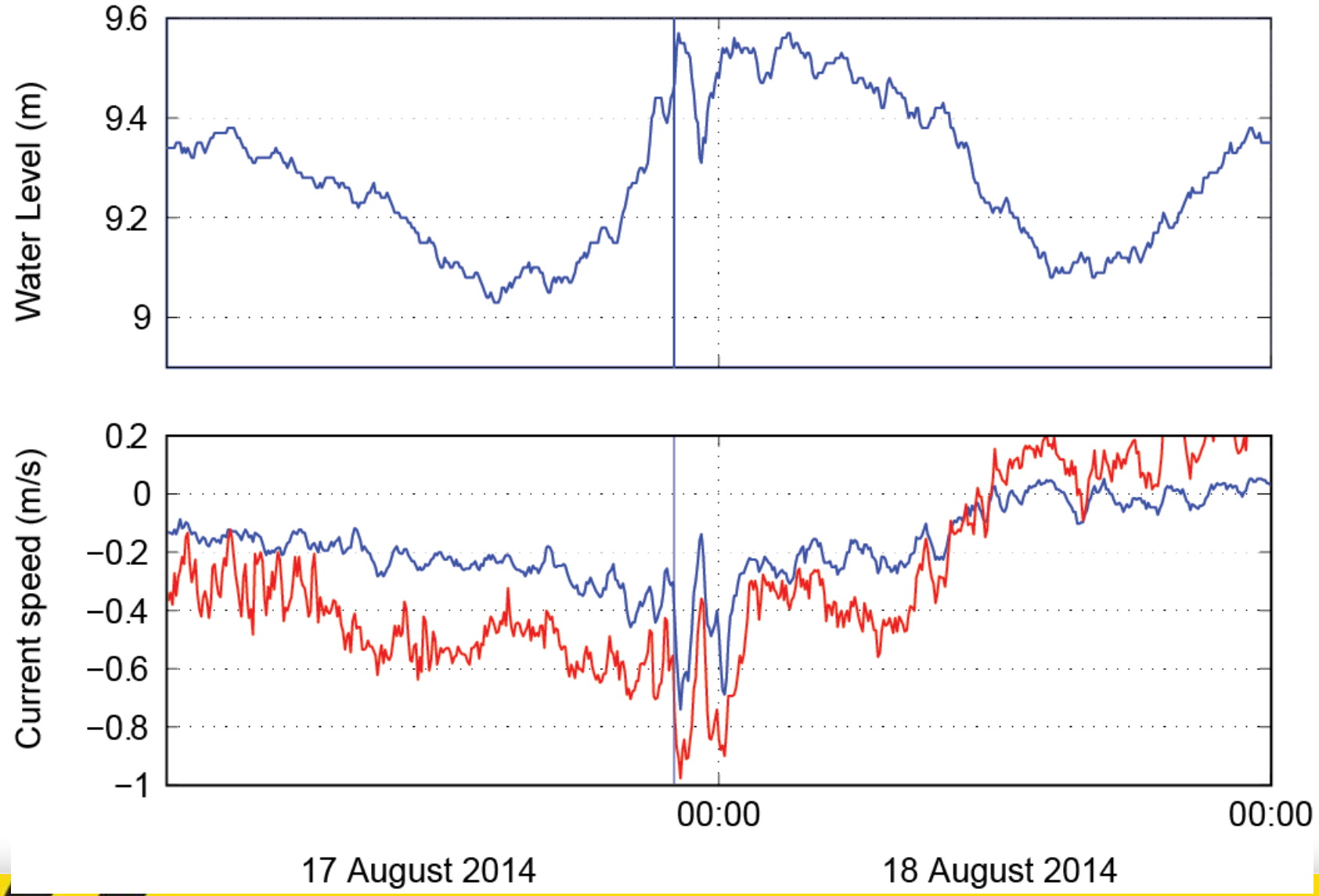
Event of 17 August: ship accident



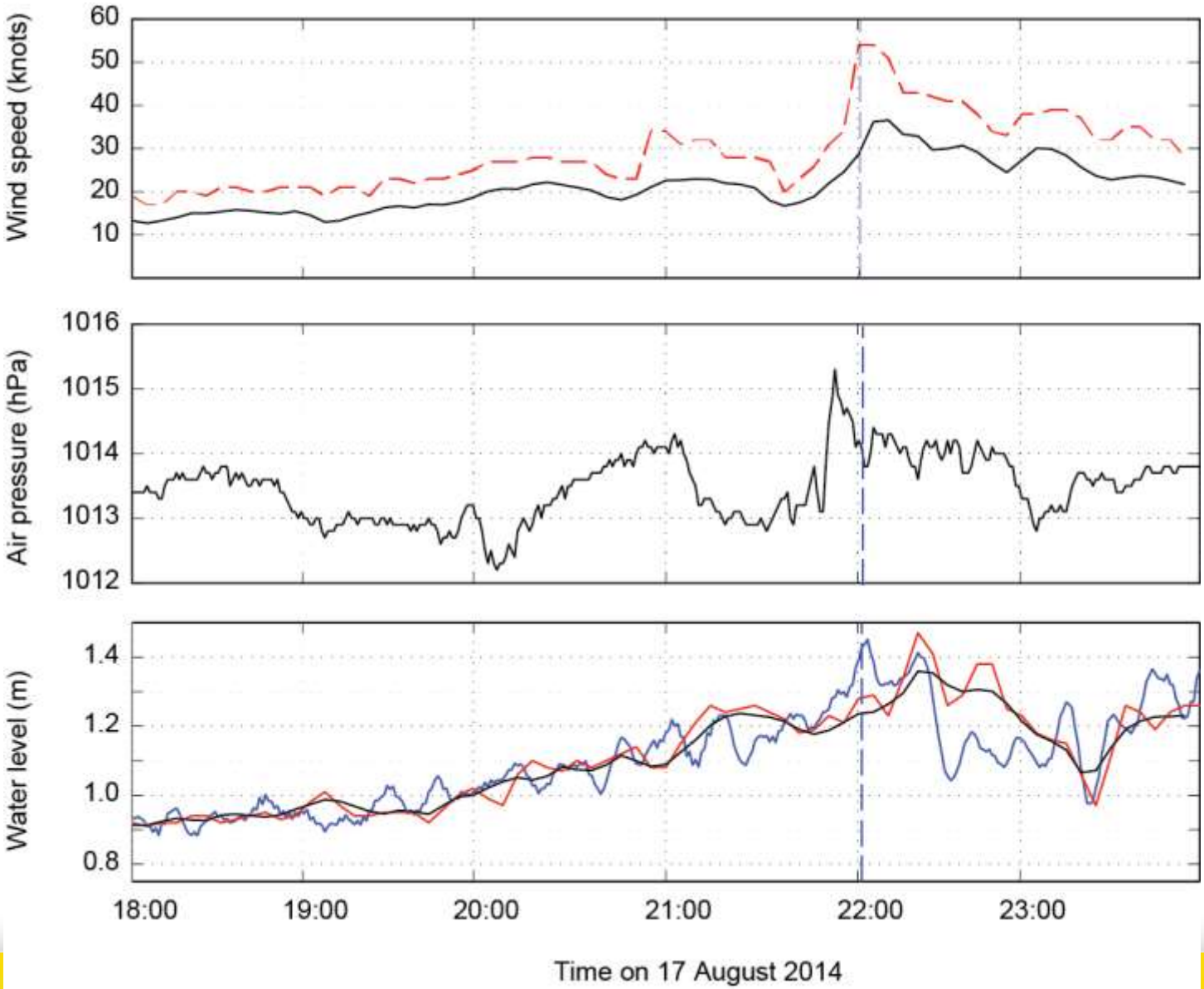
Event of 17 August: air pressure



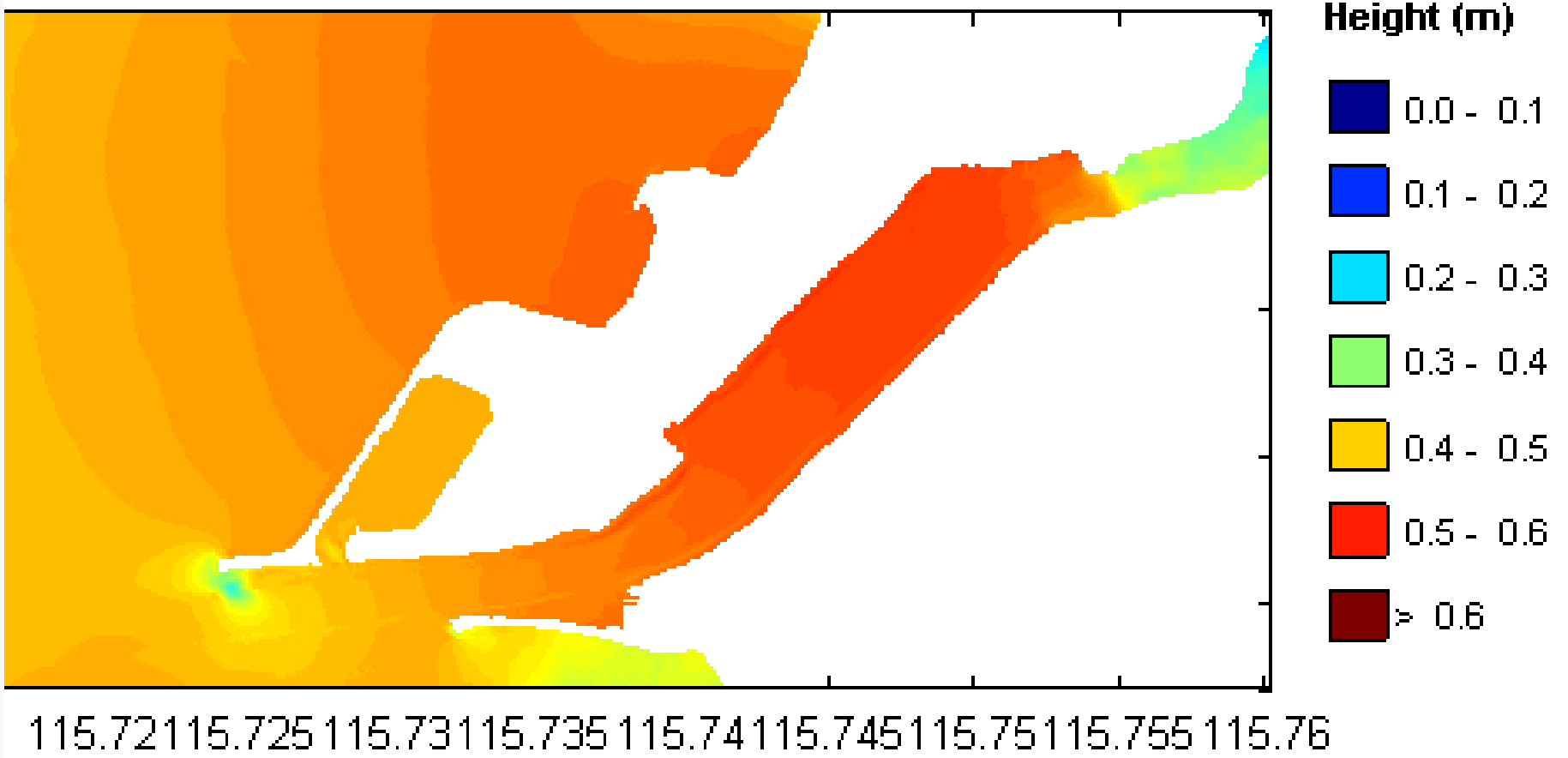
Event of 17 August: currents & WL (AWAC)



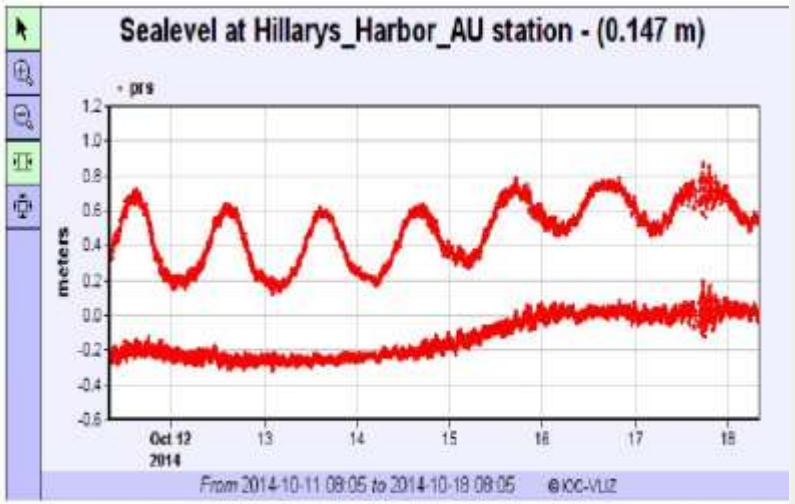
Event of 17 August: Met & WL



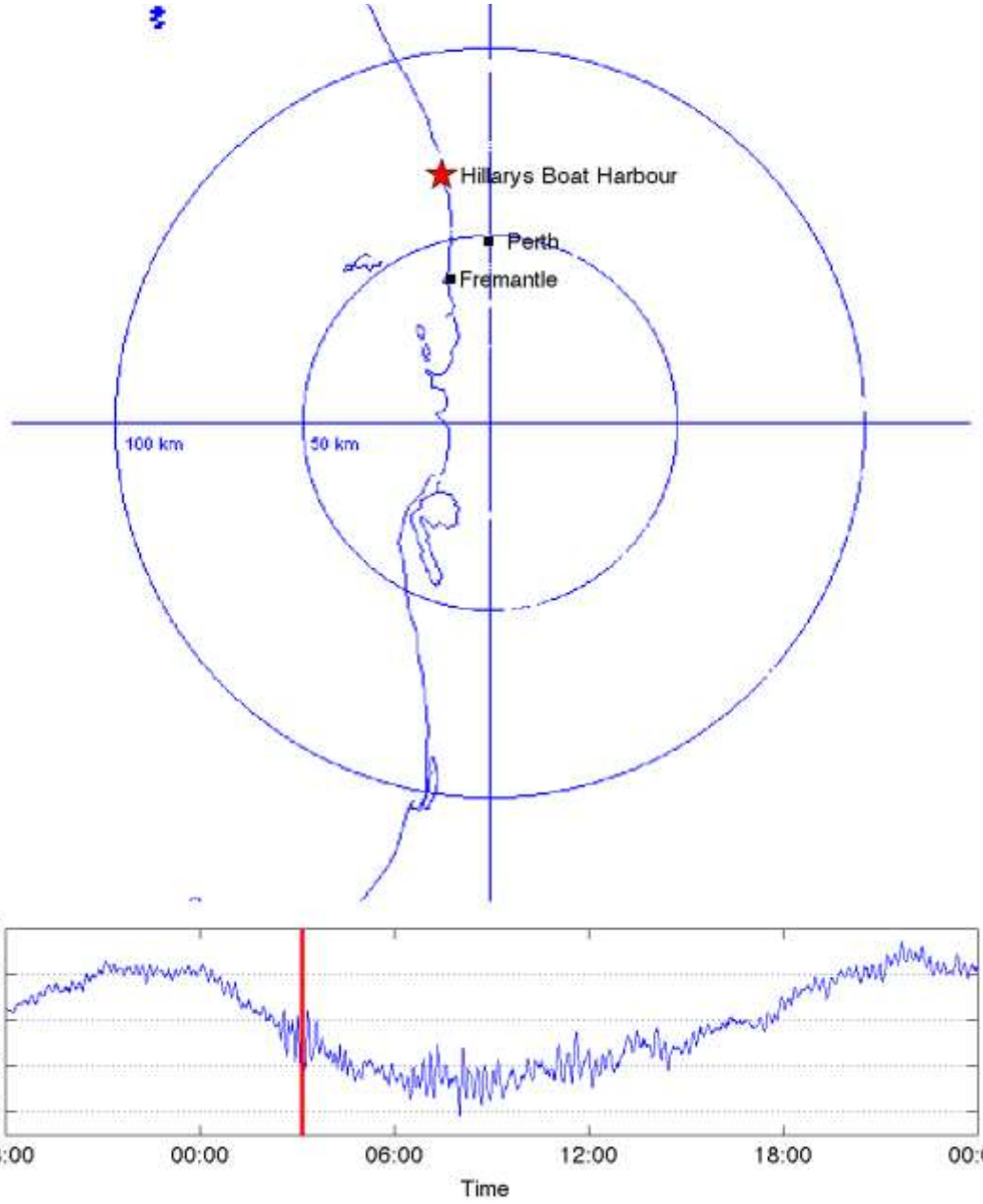
Event of 17 August: wave height



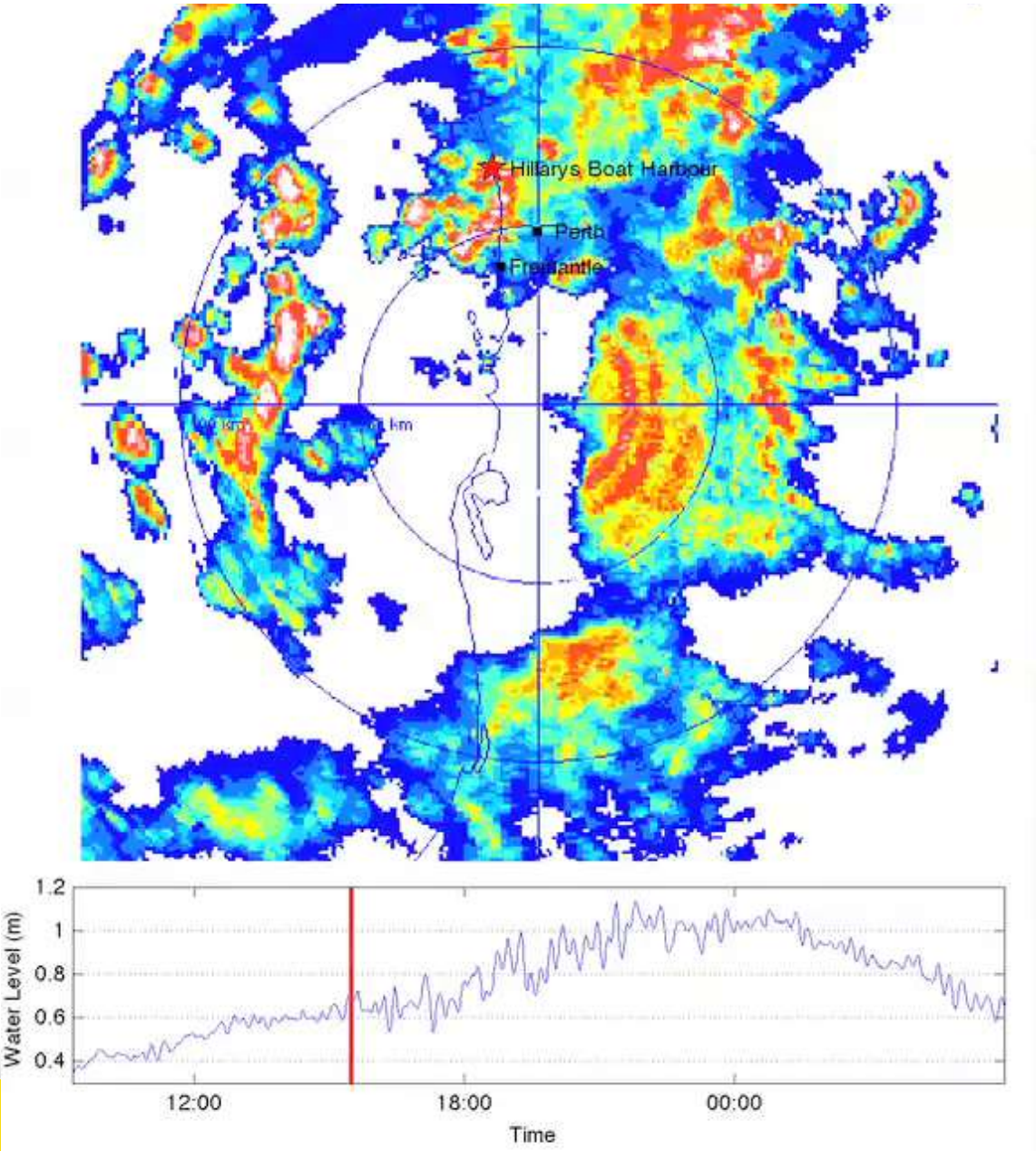
Hailstorm 18 October



Thunderstorms 10 November



Thunderstorms 26 November



Objectives

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

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Surface gravity waves
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Tsunamis (meteorological)


Thank
You