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HAZARDSCRC



Australian Government
Department of Industry,
Innovation and Science

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THE UNIVERSITY OF
WESTERN
AUSTRALIA

Estimates of extreme water levels around Australia

Charitha Pattiaratchi, Ivica Janekovic, Yasha Hetzel, Sarath Wijeratne

School of Civil, Environmental and Mining Engineering

The UWA Oceans Institute

The University of Western Australia

UWA Oceans Institute

Coastal Oceanography

 **IMOS** Integrated **Marine Observing** System

NCRIS
National Research
Infrastructure for Australia
An Australian Government Initiative

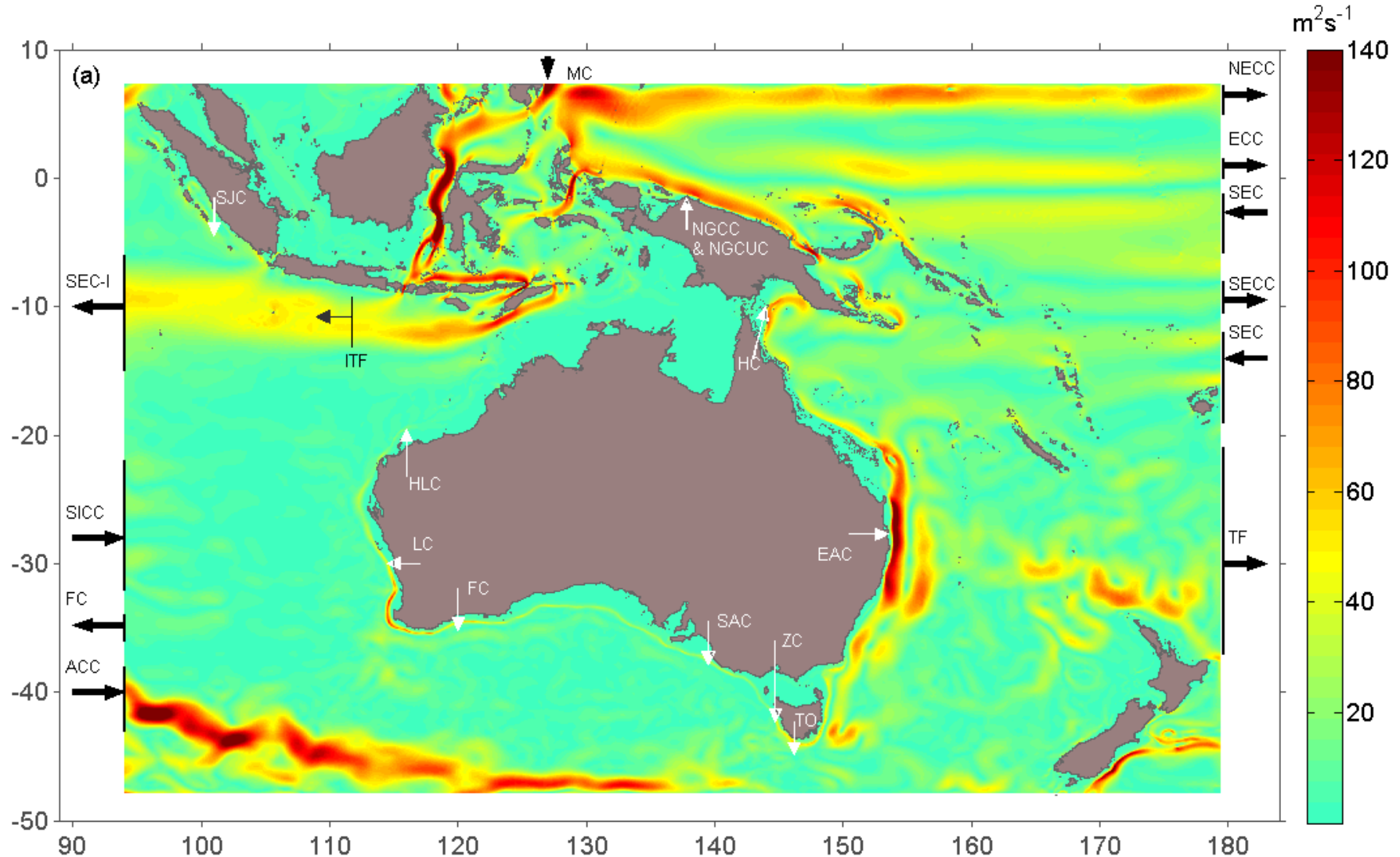
Dedication: to the memory

Prof Michael Collins

40 year association as teacher, supervisor, employer, mentor
Life-long friend

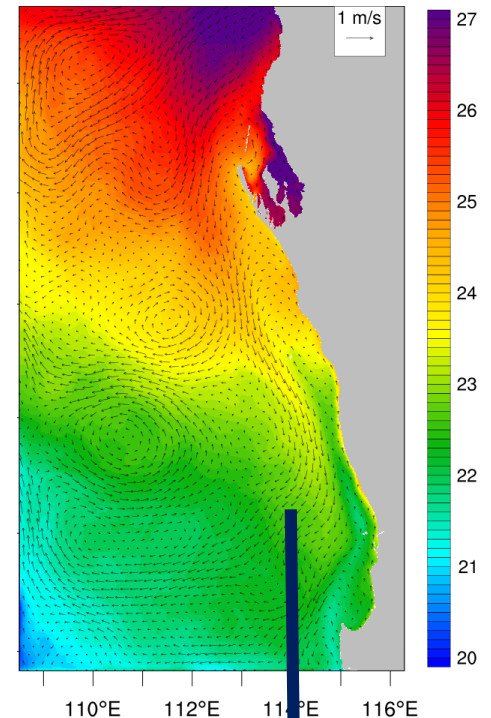
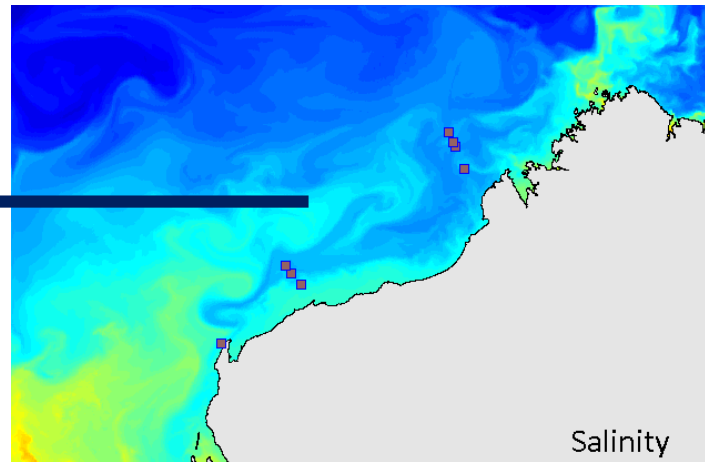
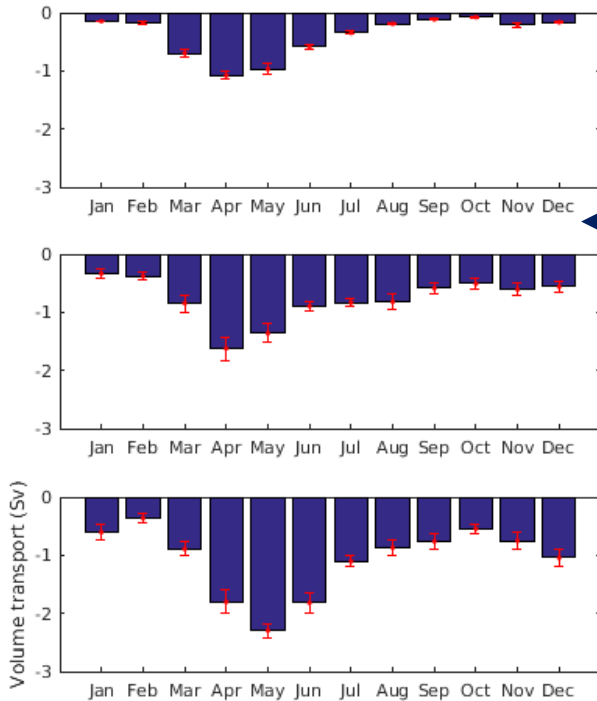


Australian Boundary Currents ozROMS (2000-2014)

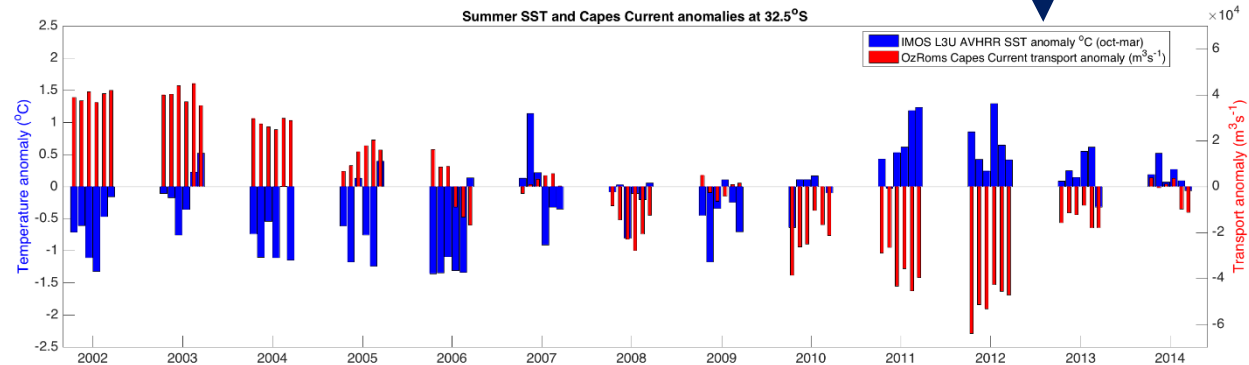


Variability: shelf currents

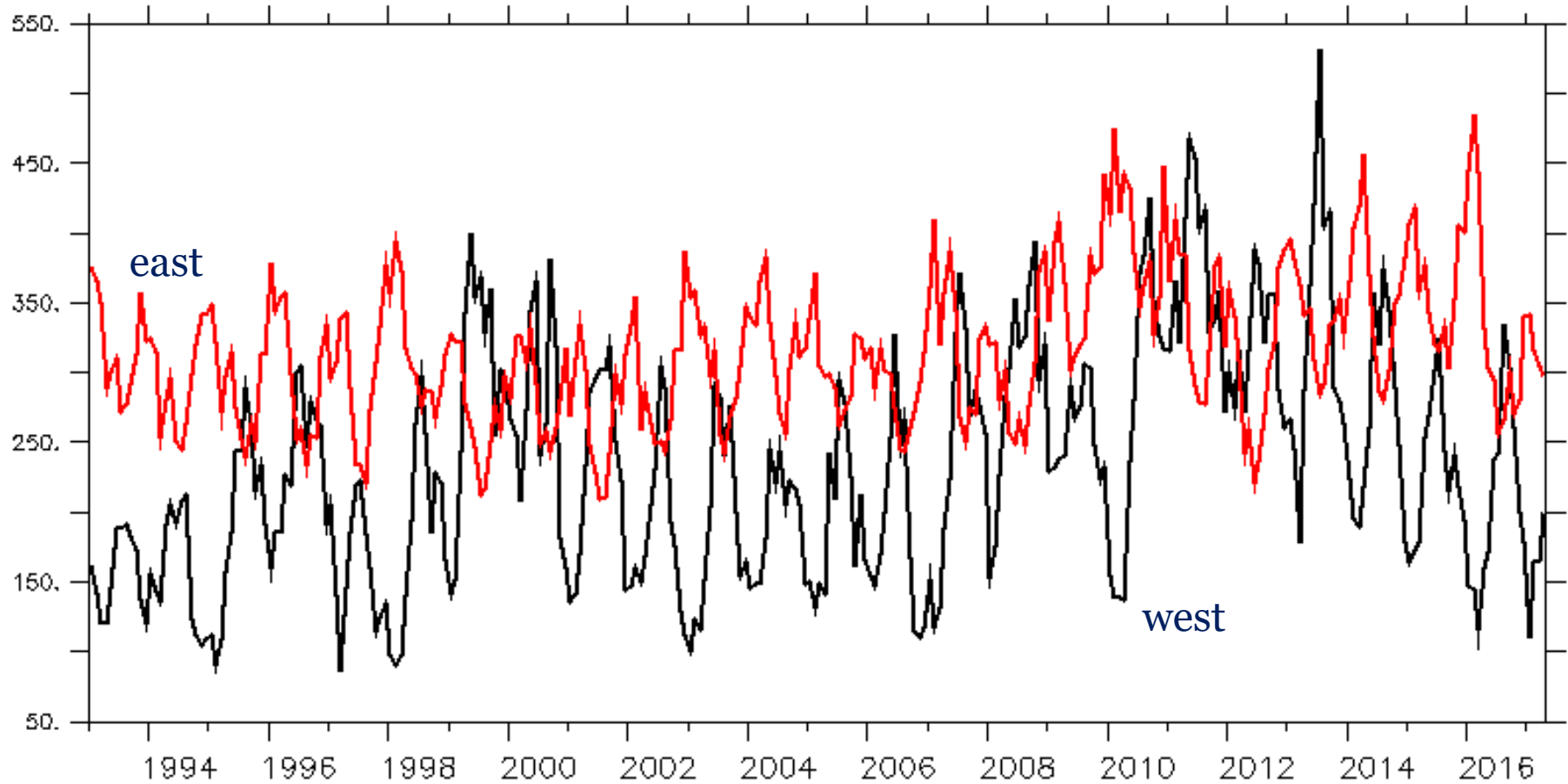
Holloway Current



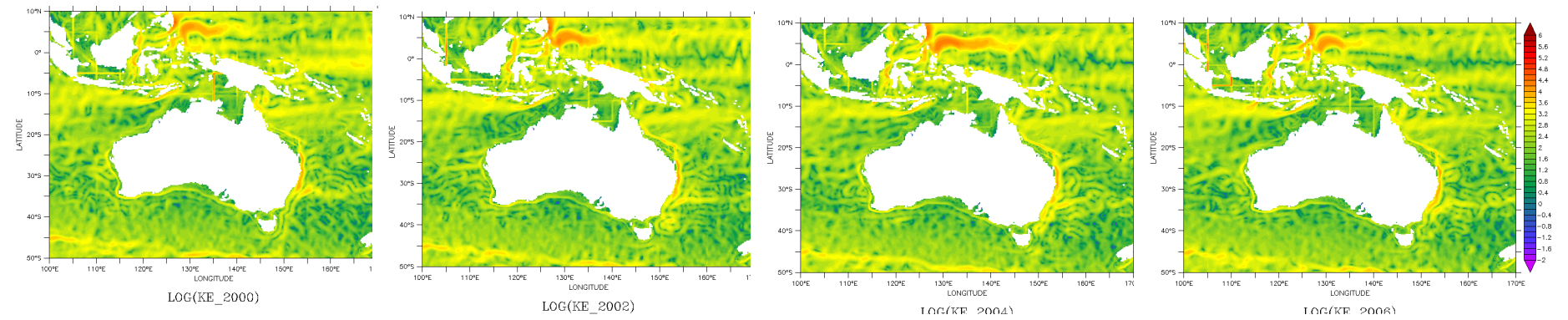
Capes Current



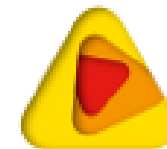
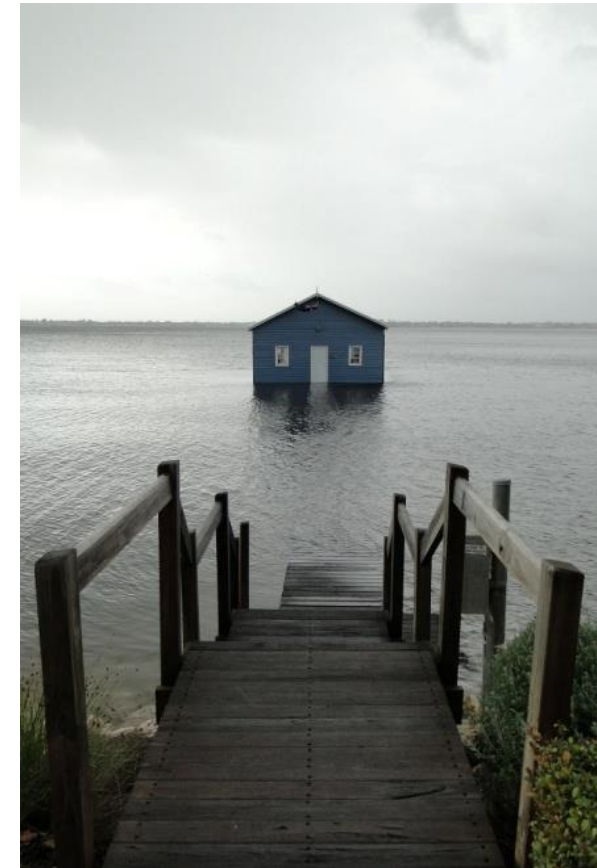
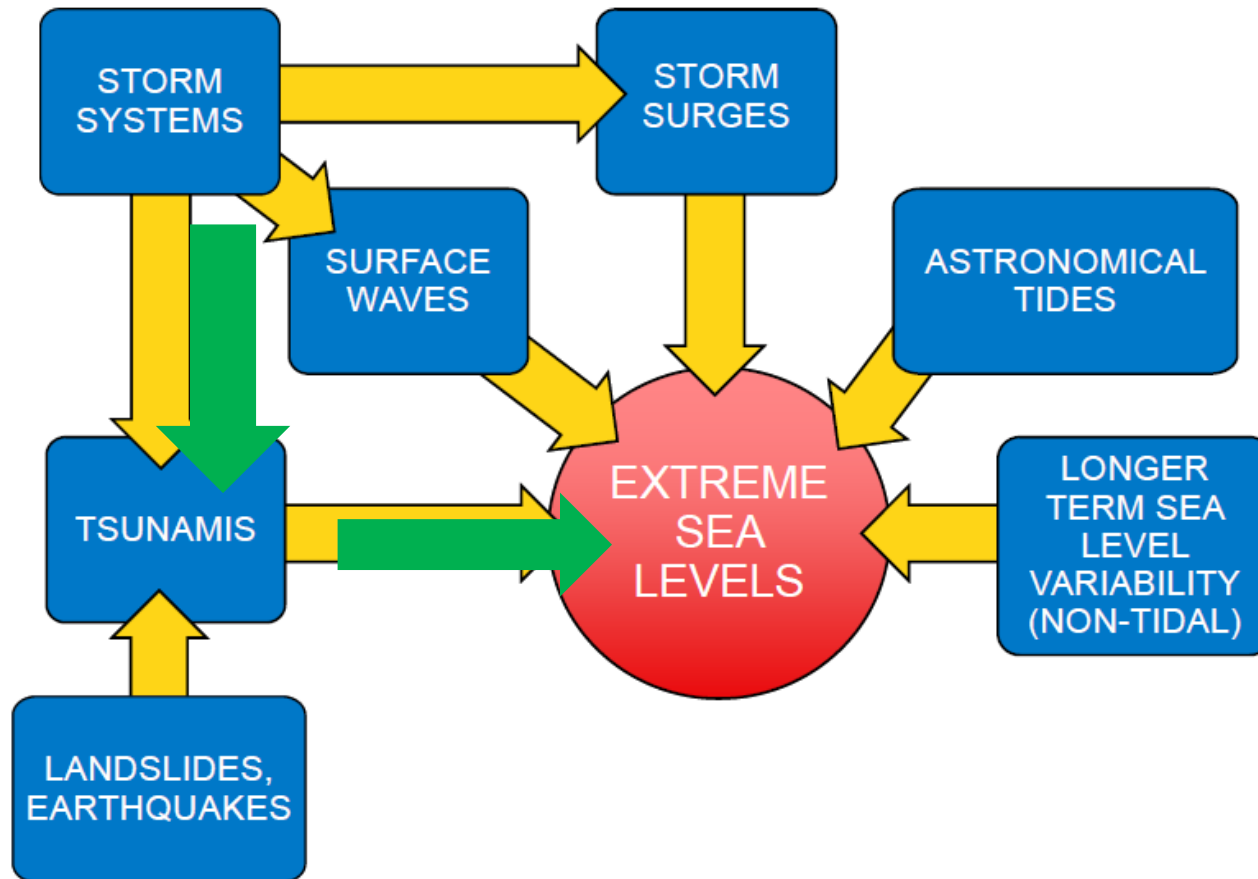
Kinetic Energy



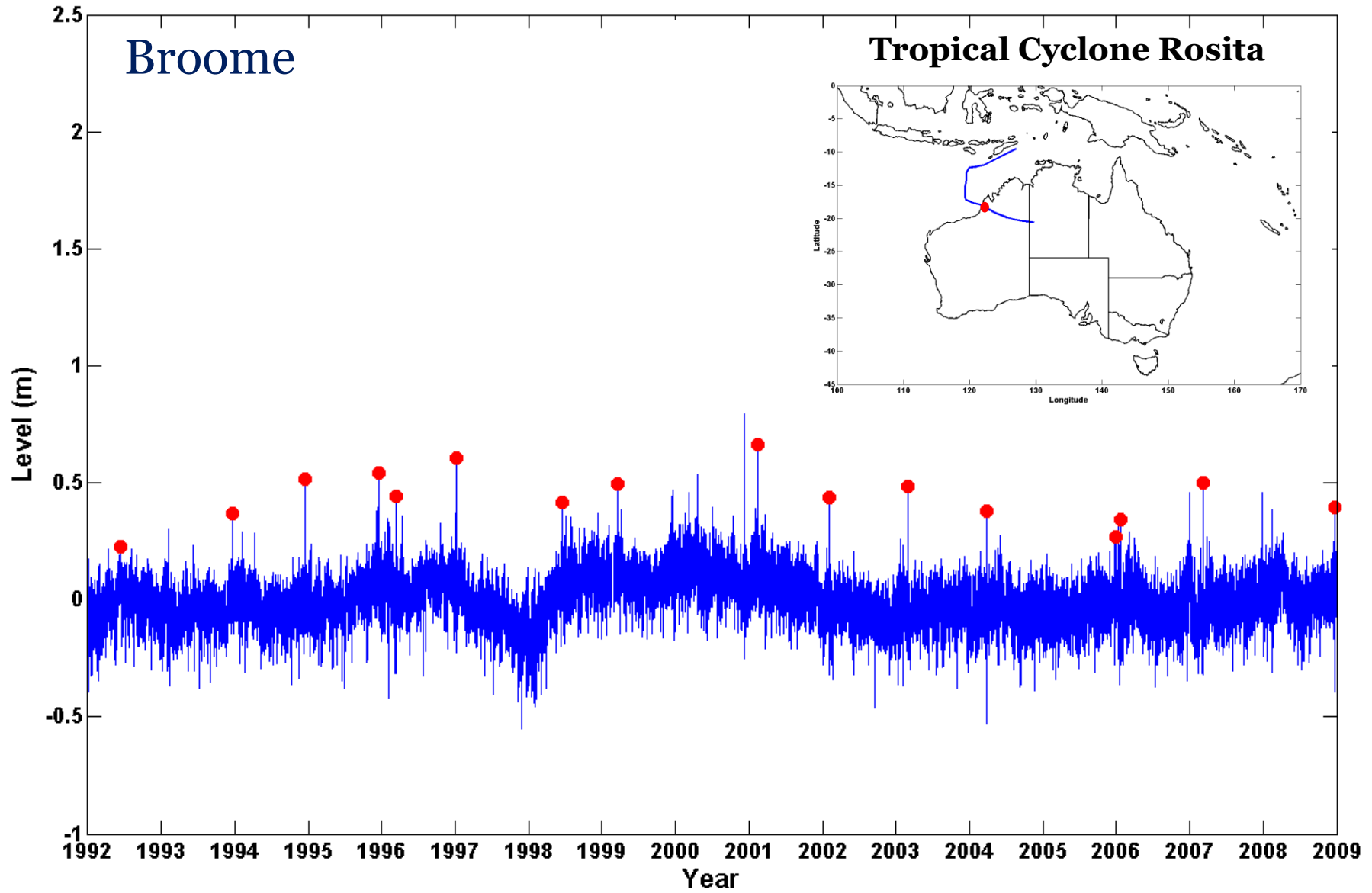
Kinetic Energy



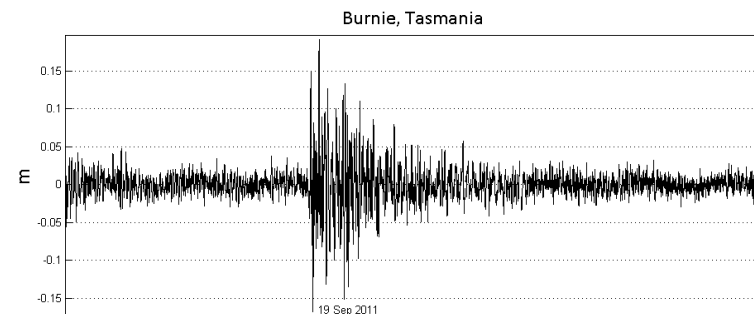
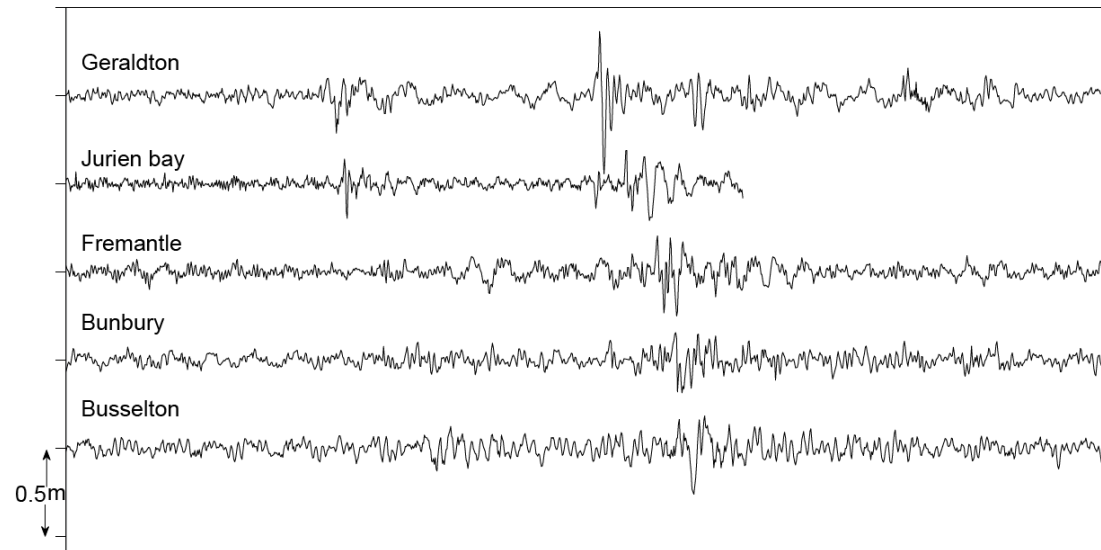
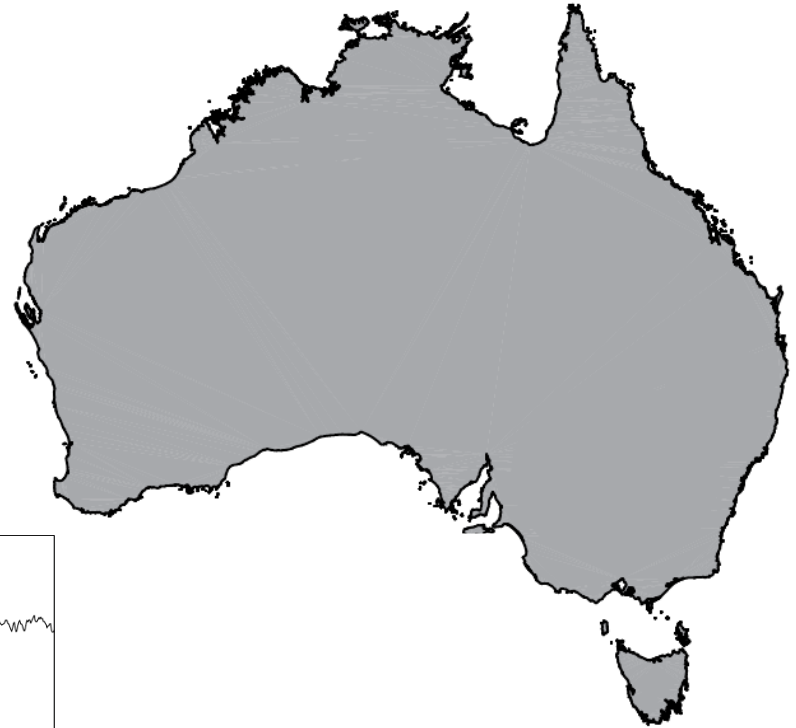
Extreme Sea levels



Extreme Events – storm surge

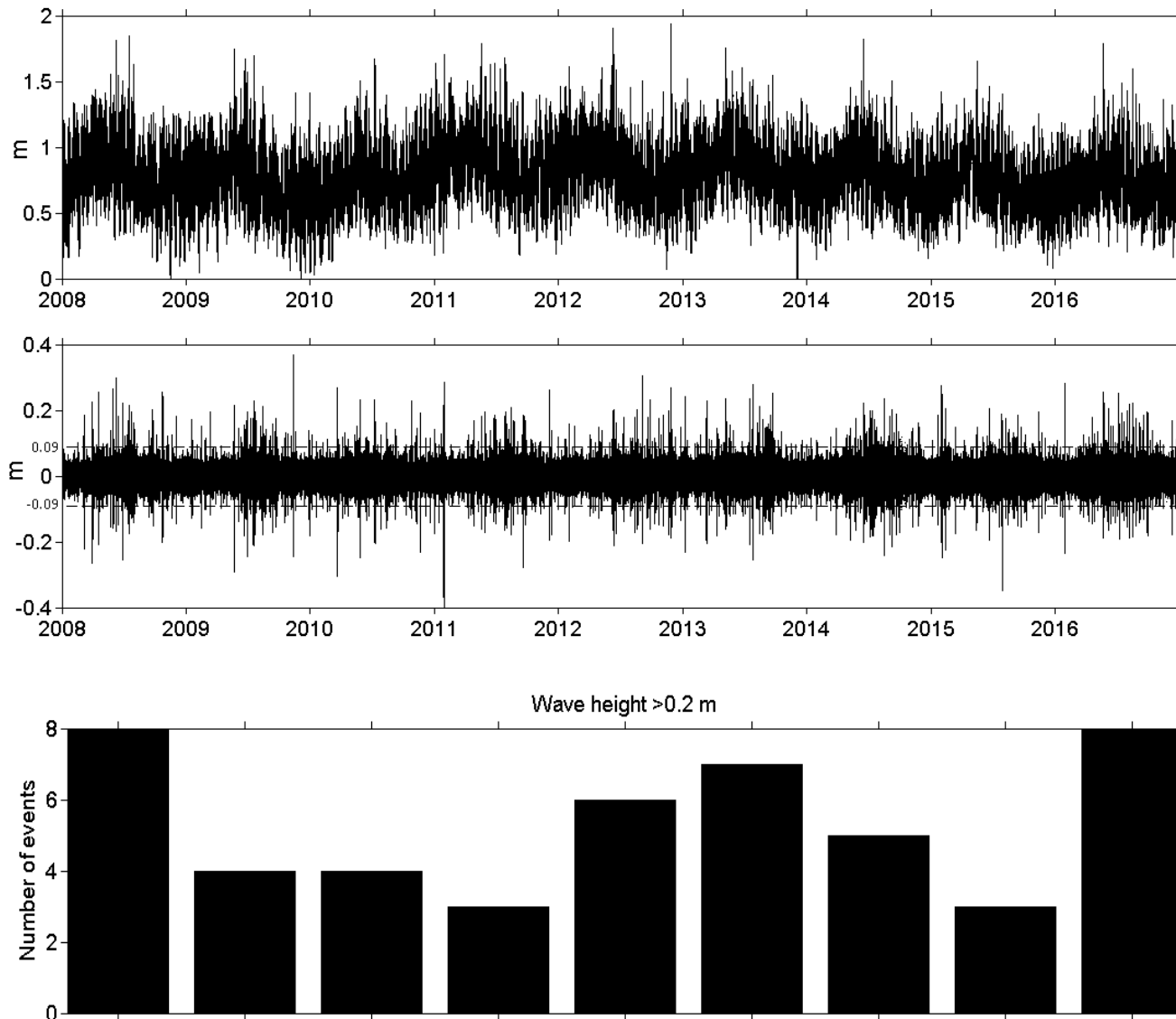


Meteorological tsunamis



Meteorological tsunamis

Hillarys



Impacts



Flooded Riverside Drive closed

KATIE ROBERTSON • PERTHNOW • JUNE 11, 2012 8:45AM

Predictions

Coastal Oceanography

Home

Time series

HF radar

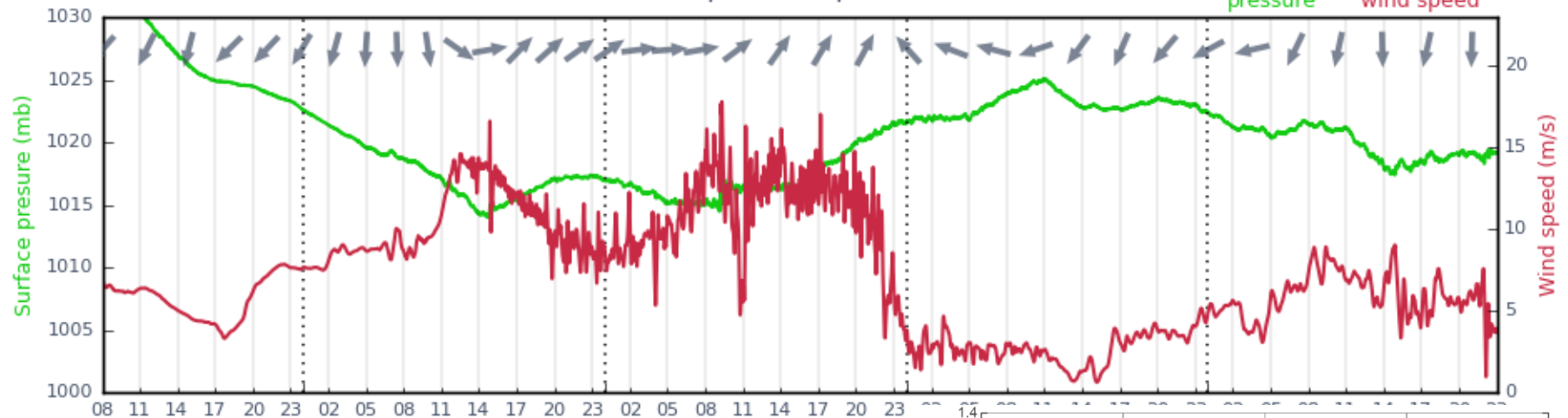
Events

Info

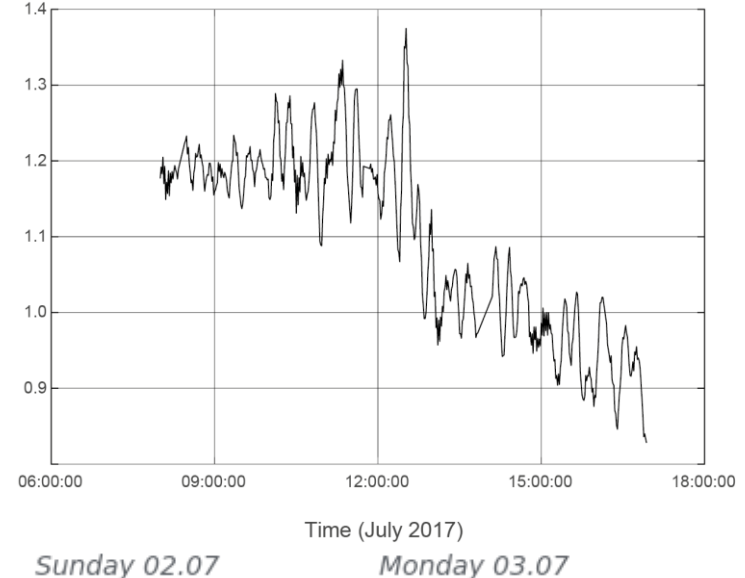
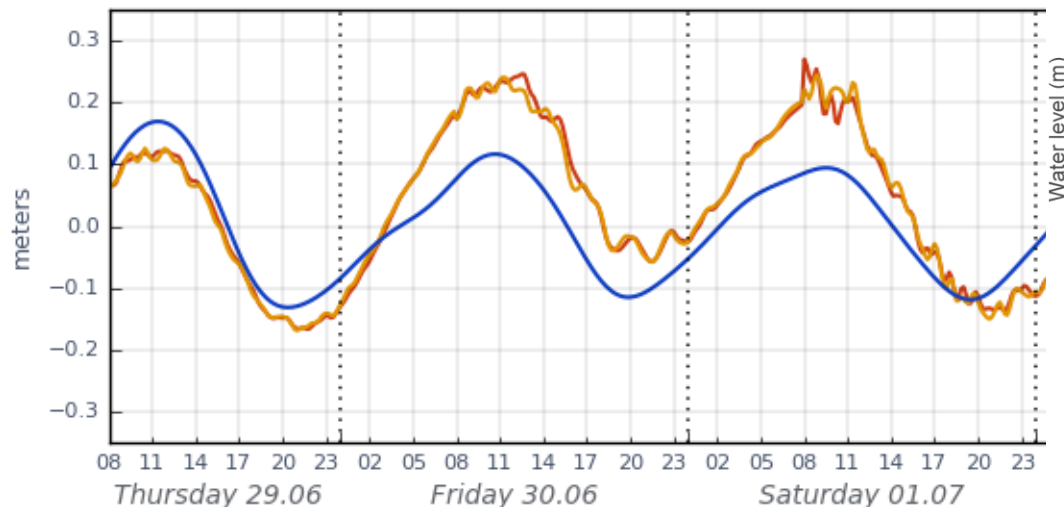
Contact

coastaloceanography.org

Wind speed and pressure

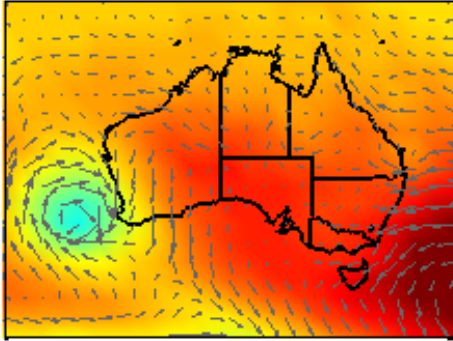


Sealevel

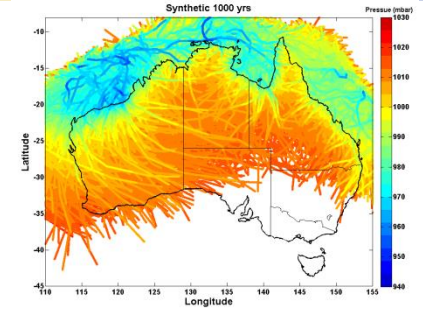


Sea level hindcasts

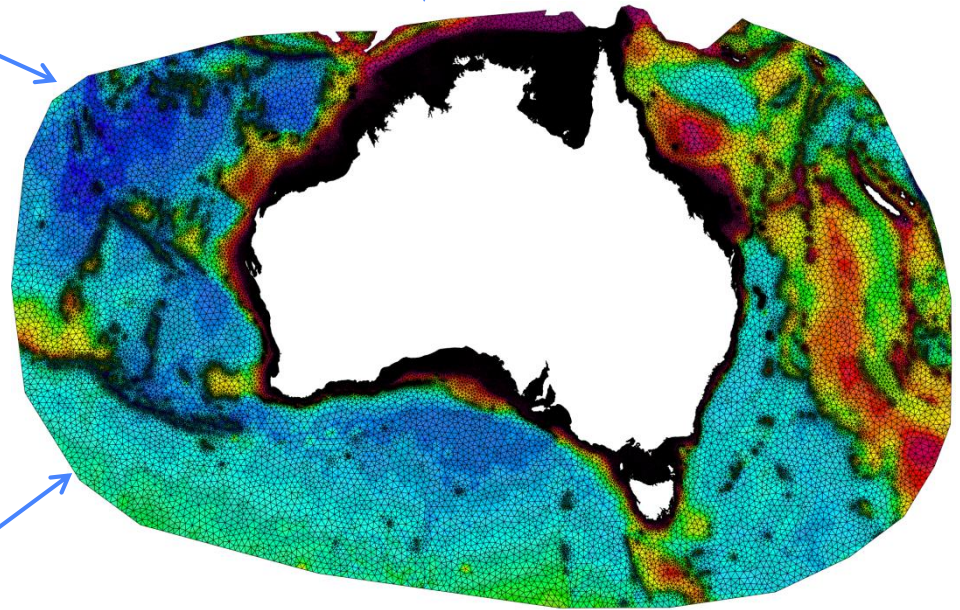
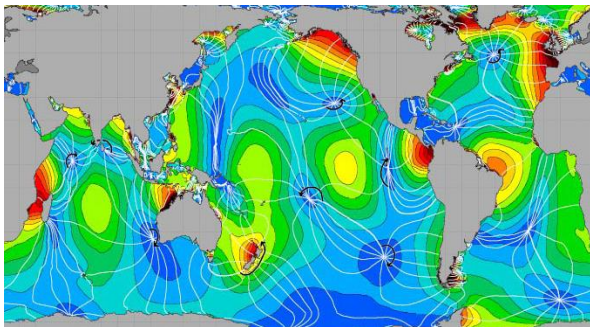
JRA55/ NCEP: 1949-2016



Tropical
Cyclones



Global tidal model

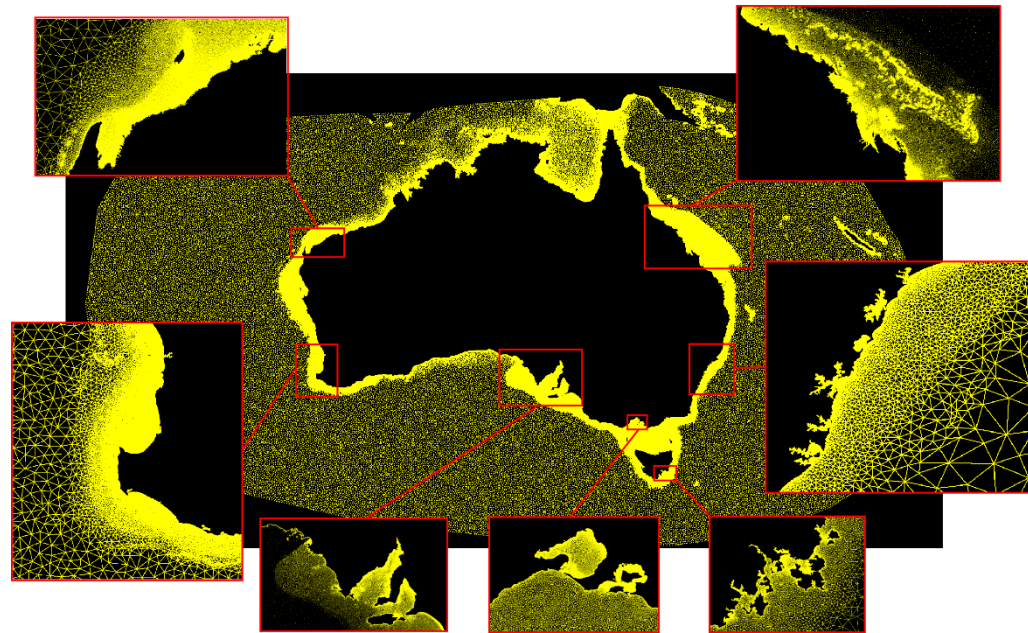


Total Sea level
(~60 year time series)

Coupled wave-surge model

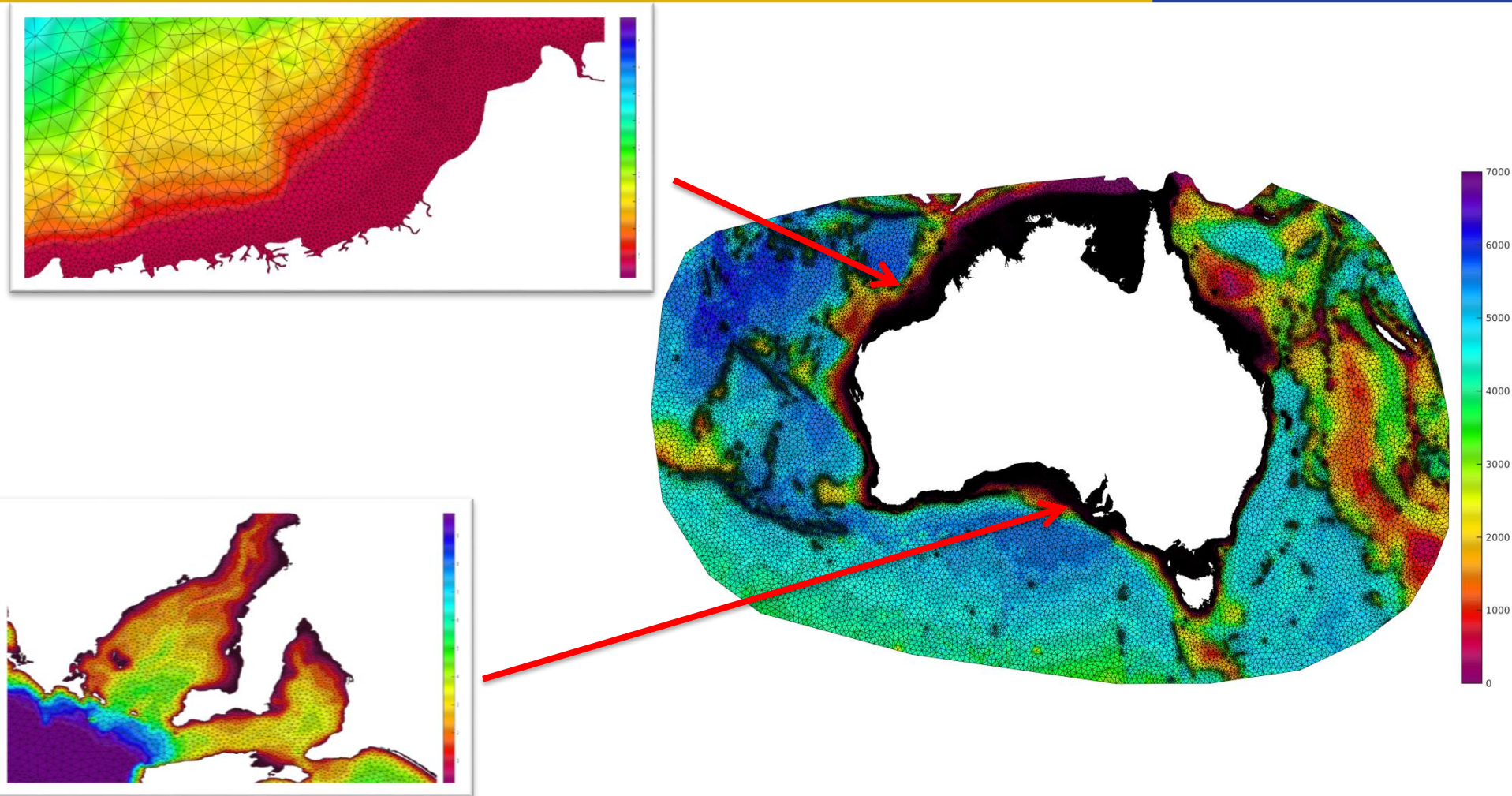
- The **SCHISM** hydrodynamic model coupled with the advanced Wind Wave III (WWMIII model)
- 3D Finite element **unstructured** hydrodynamic model (~100 m resolution at coast)
- Inundation (wet/dry)
- Supercomputer enables simulations for entire Australian coast

SCHISM storm surge model grid



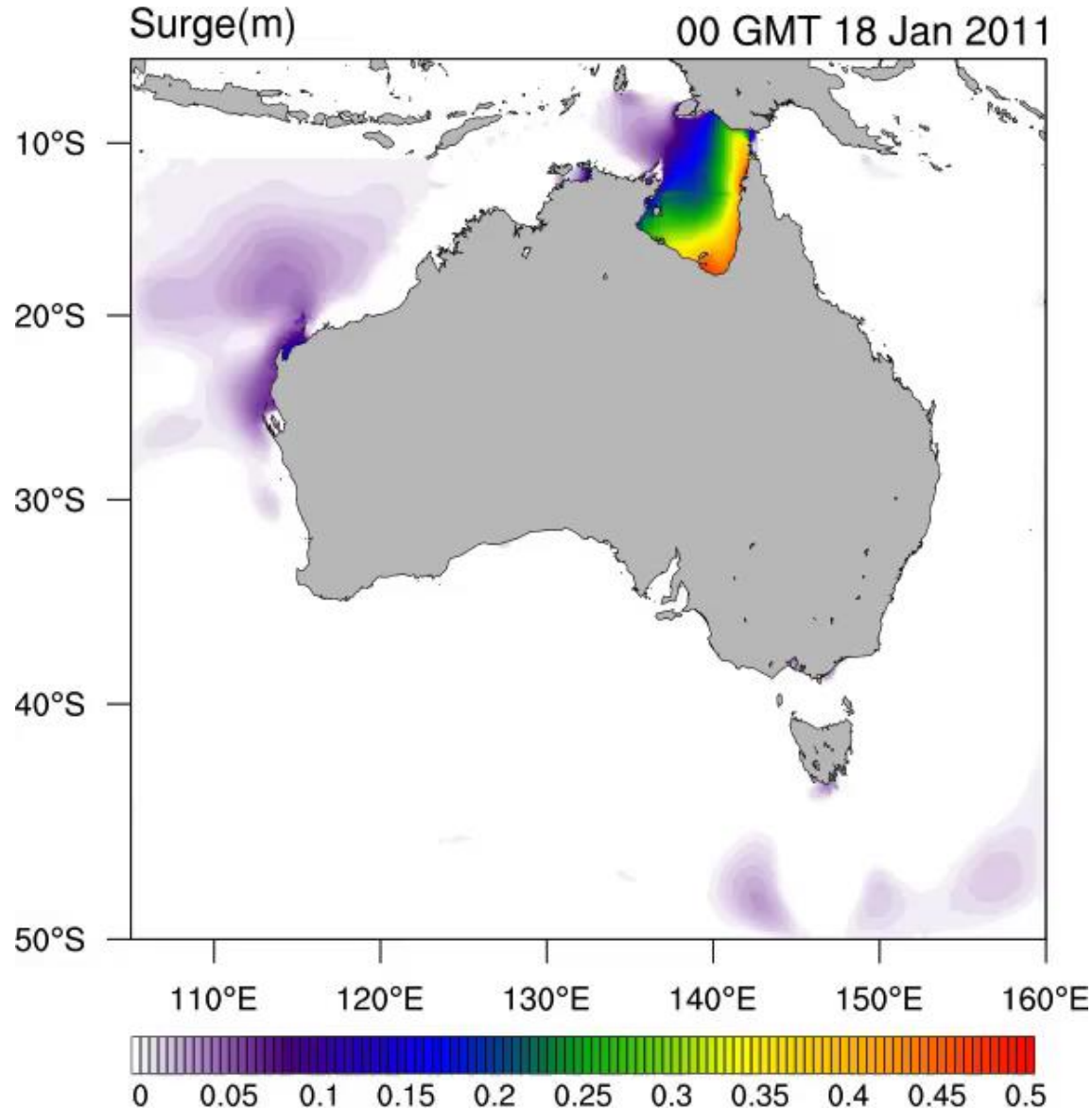
100 m resolution near the coast!

Final grid Refined and tested



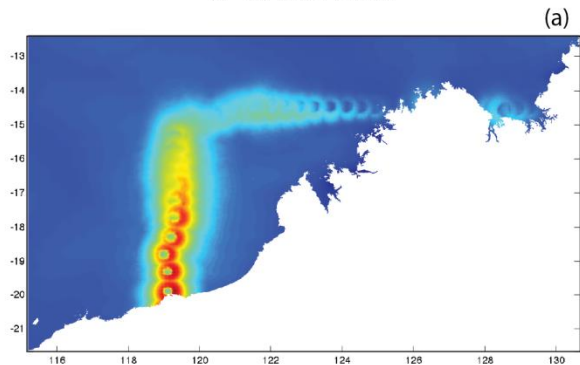
Australia-wide simulation

TC Anthony, QLD (23,28-30 Jan)
TC Bianca, WA (27-30 Jan)
TC Yasi, QLD (2-4 Feb)
Cold fronts, SA & Tas (1-4 Feb)

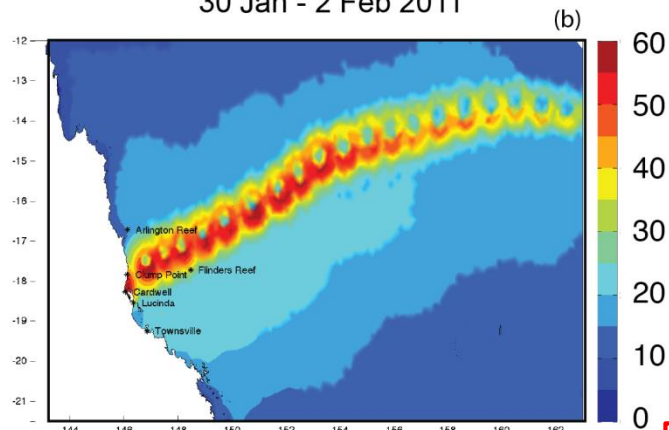


events – detailed investigation

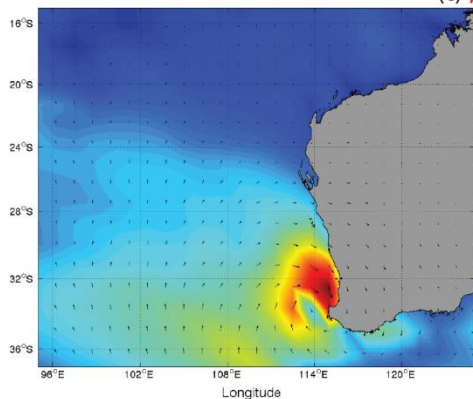
Tropical Cyclone George
3-10 Mar 2007



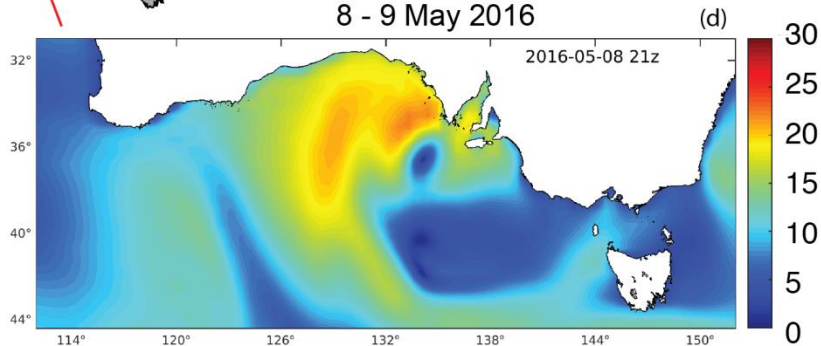
Severe Tropical Cyclone Yasi
30 Jan - 2 Feb 2011



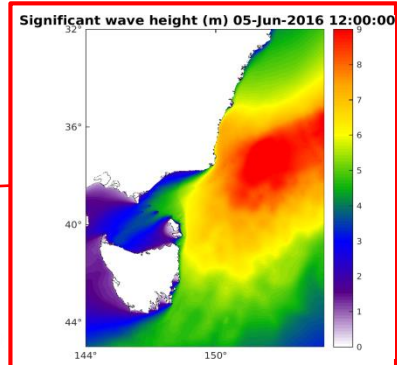
Tropical-extratropical cyclone Alby
27 Mar - 4 Apr 1978



Extratropical low pressure system
8 - 9 May 2016

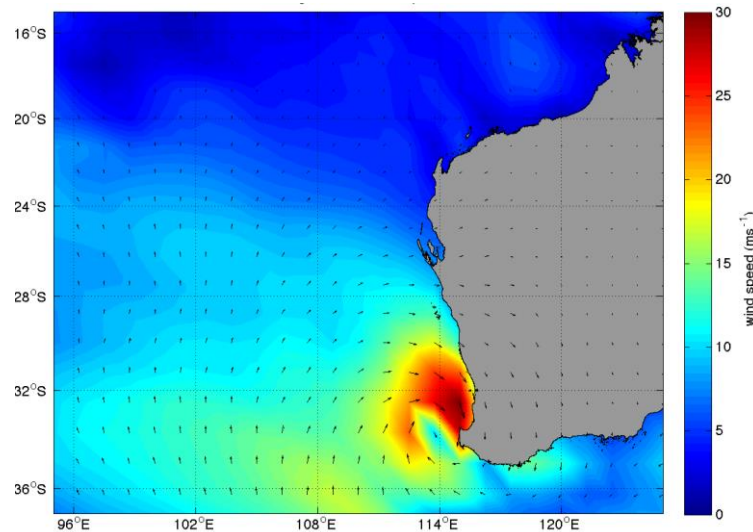


East coast low
June 2016

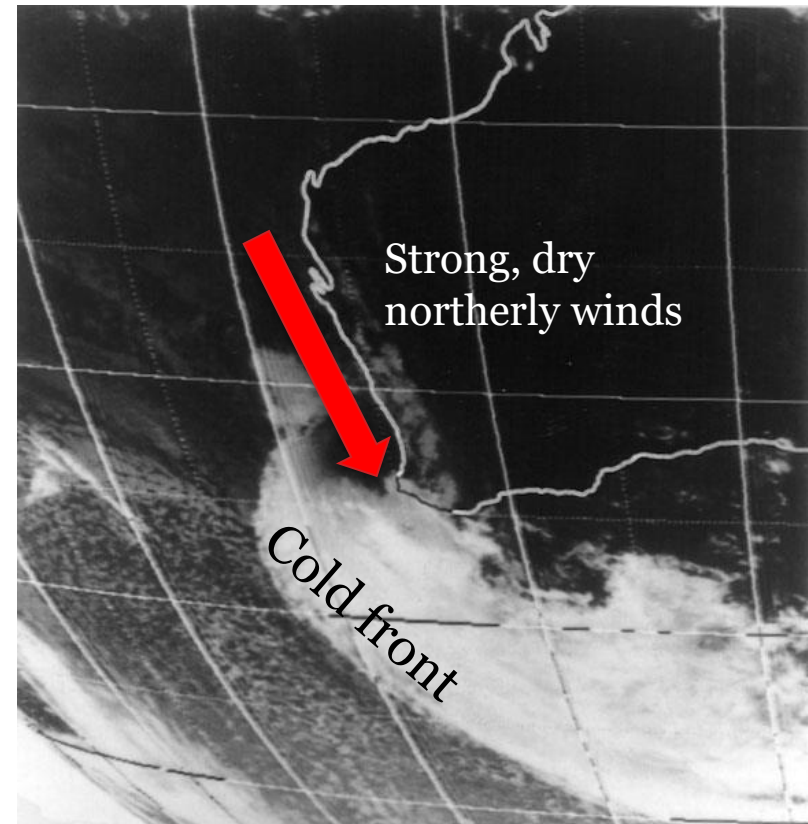


Cyclone Alby, April 1978

- ◆ Alby accelerated to 80 km/h as it passed the SW of the state.
- ◆ Wind gusts of 150 km/h were recorded with little or no rain along the coast
- ◆ 10 m waves reported offshore

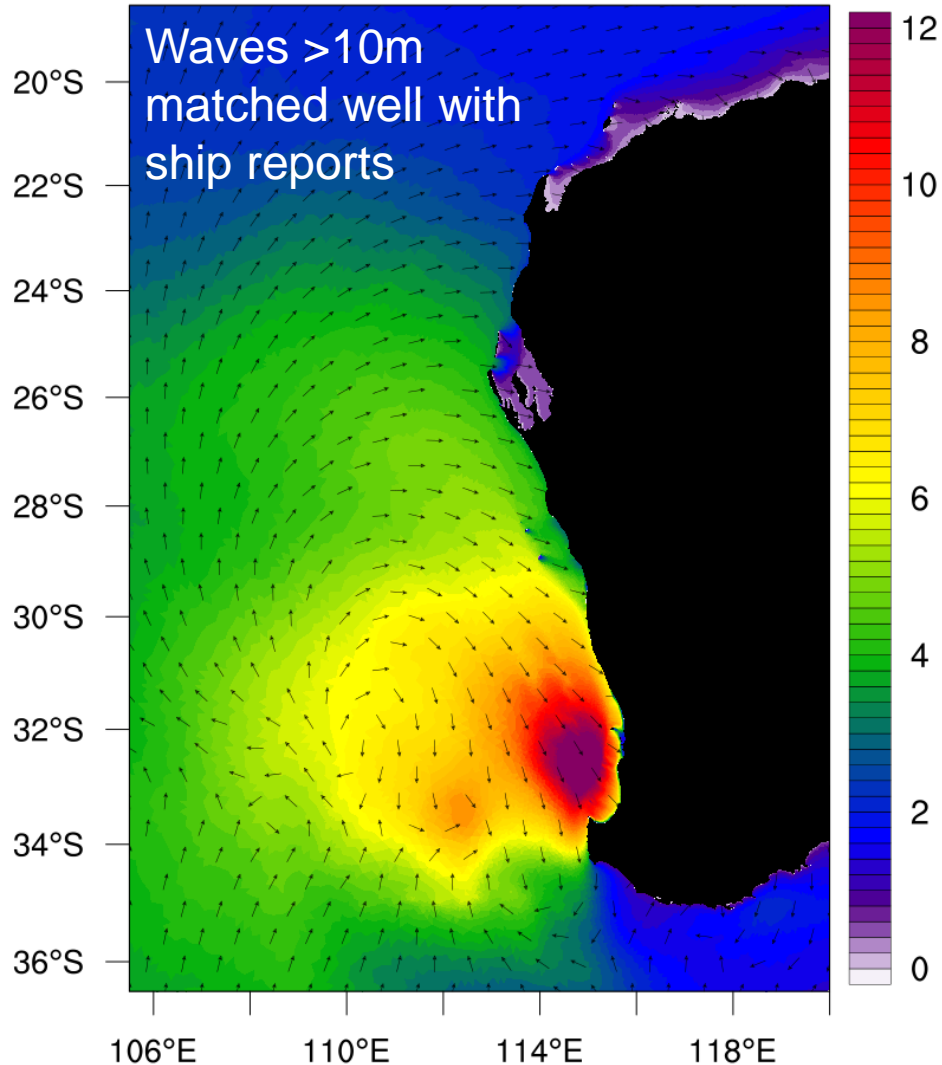


JRA55 reanalysis winds

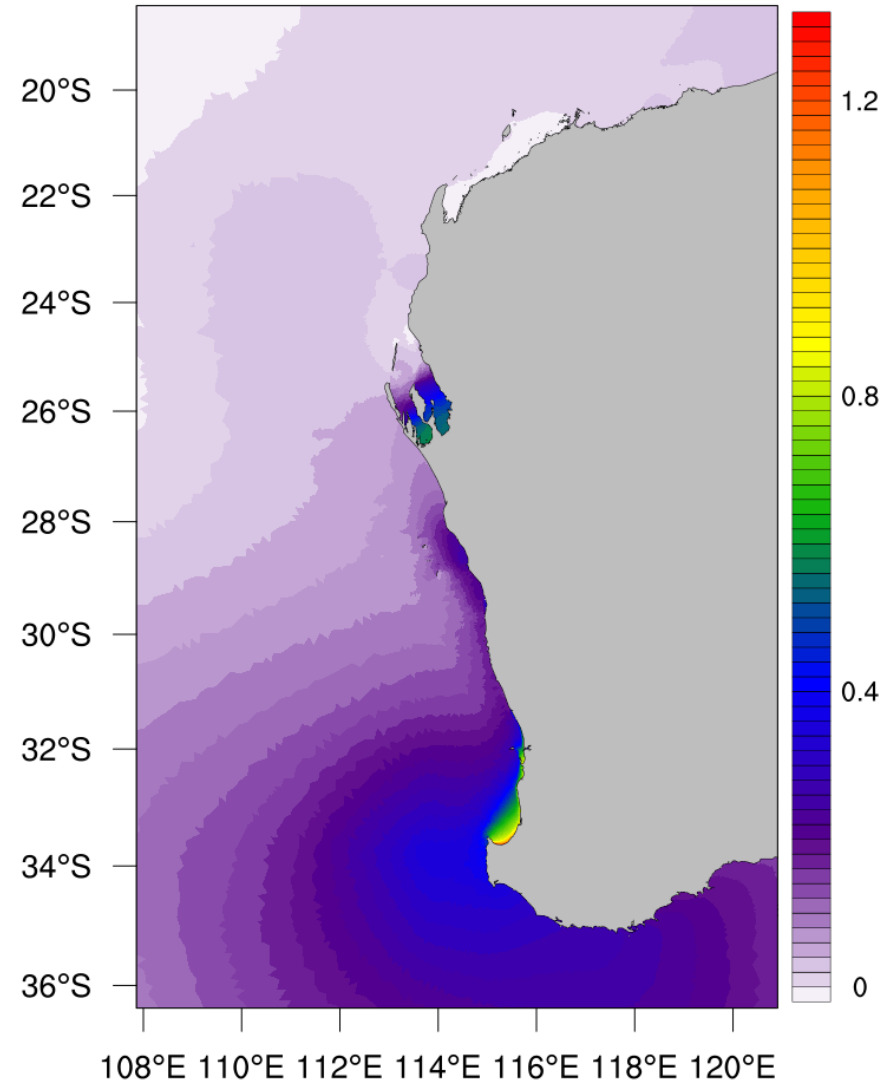


Simulated waves & surge

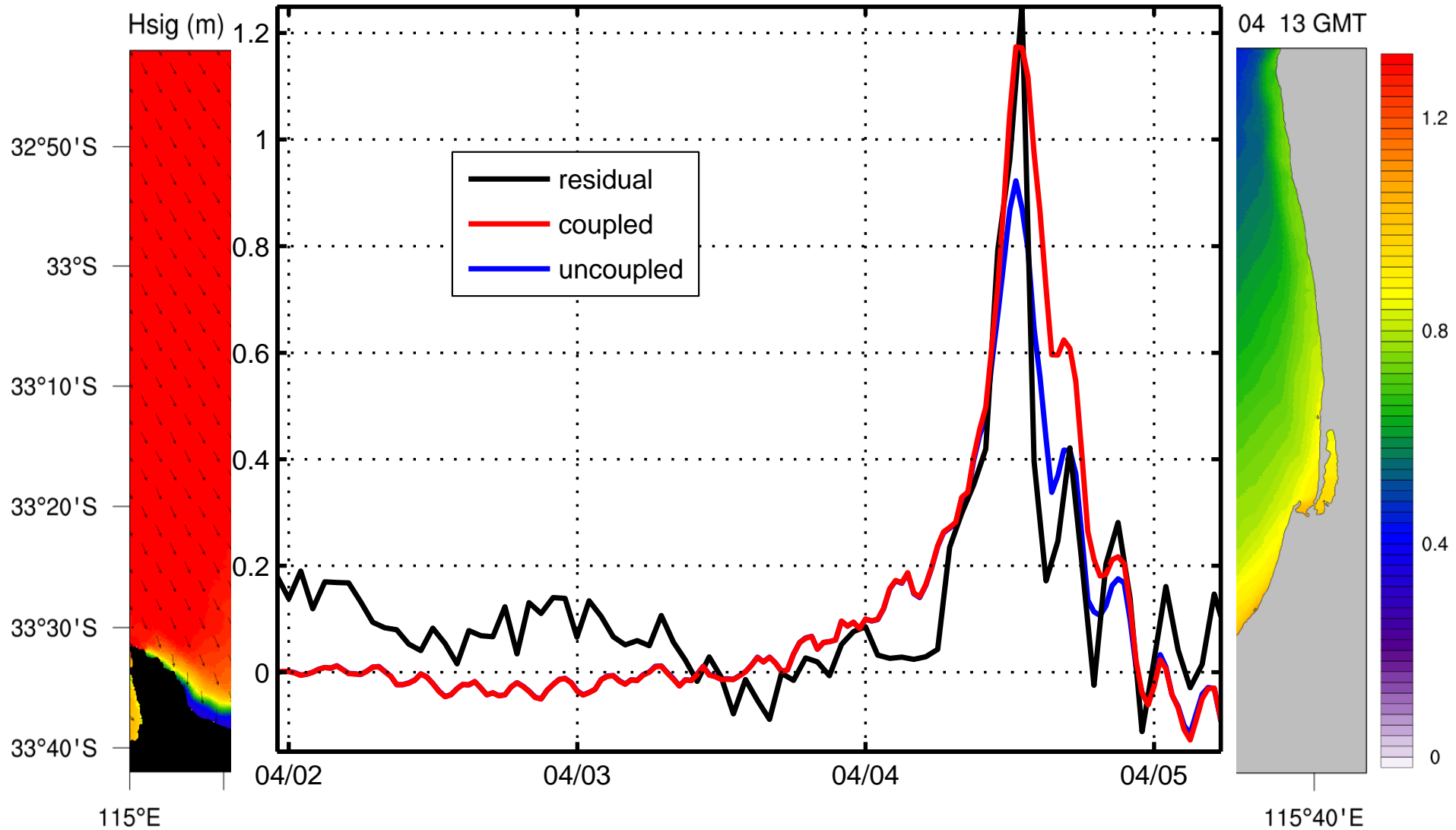
Hsig (m) 1978 Apr 04 13 GMT



SLA (m) 1978 Apr 04 13 GMT

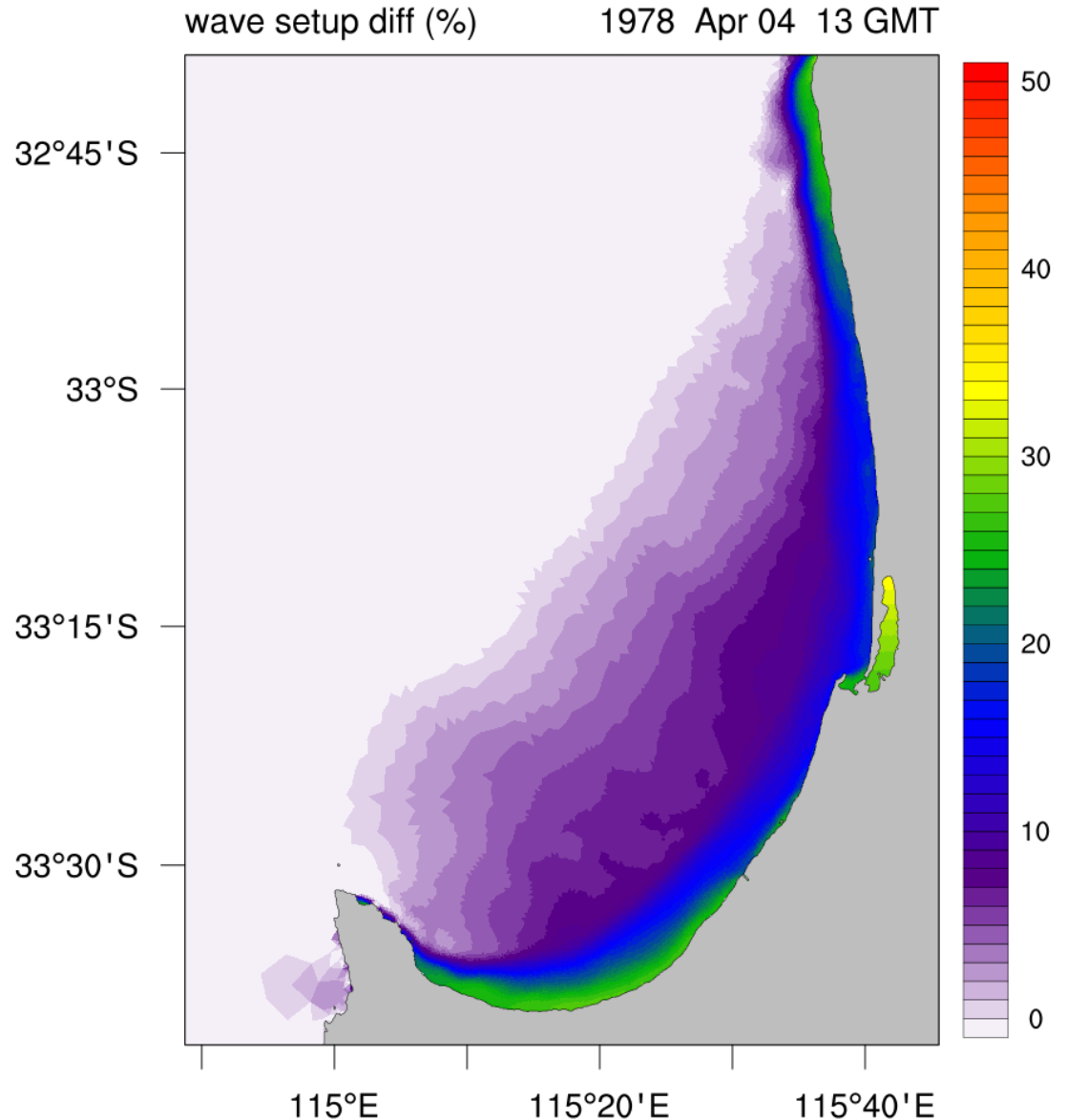


Simulated waves & surge

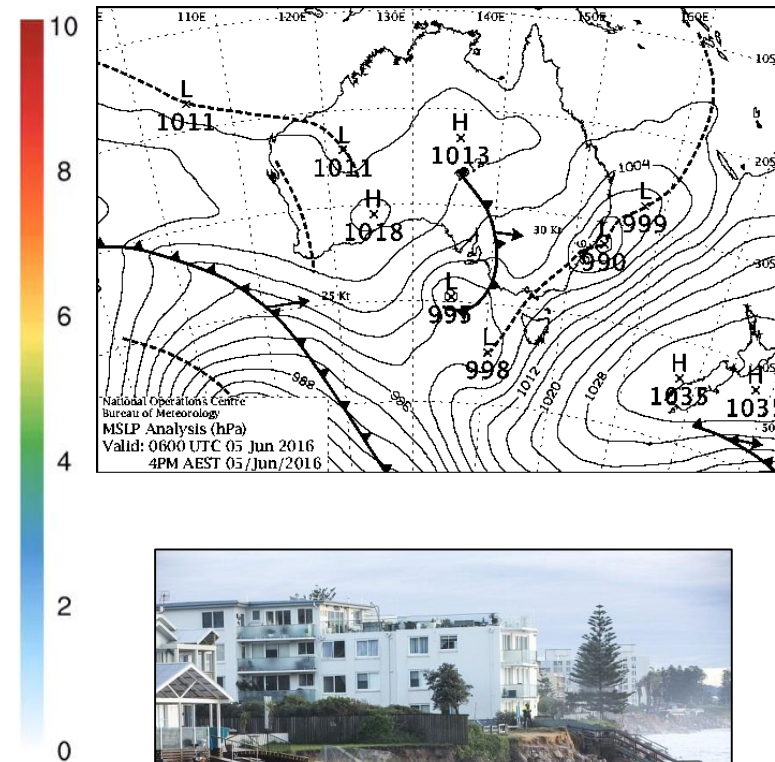
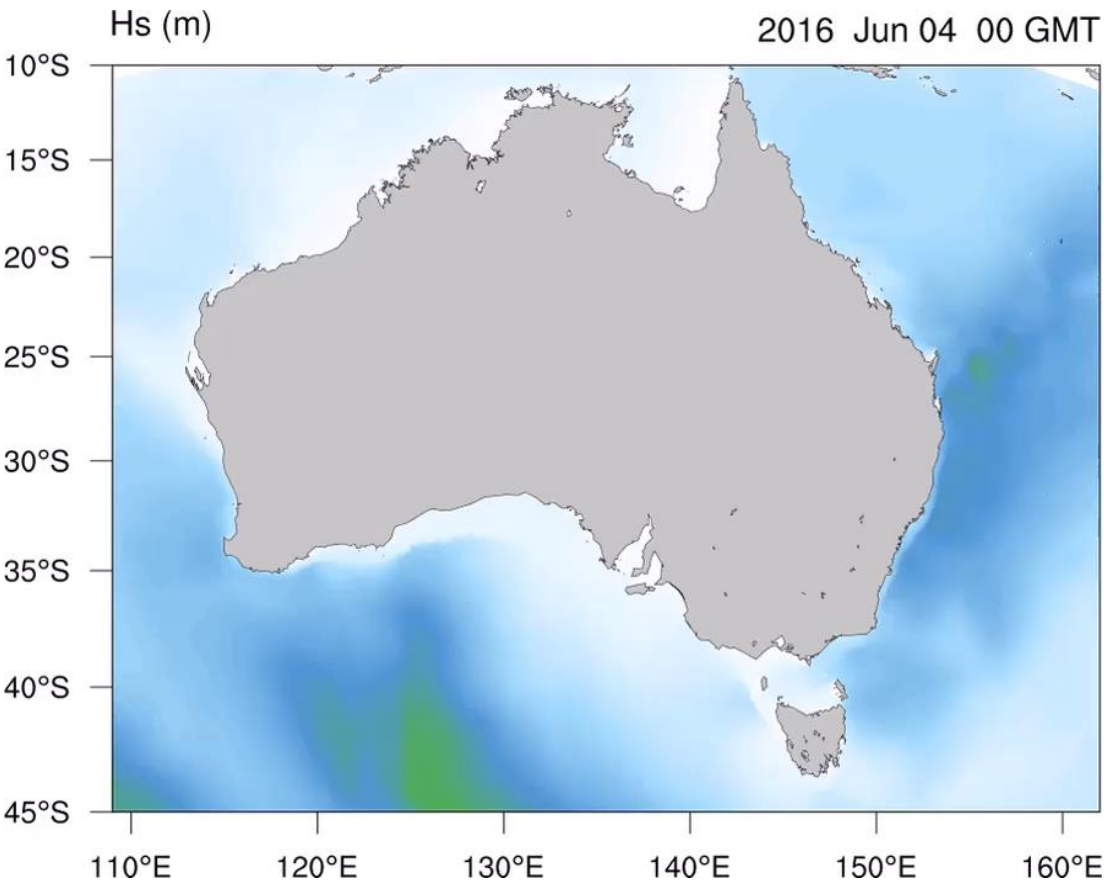


Wave set-up contribution

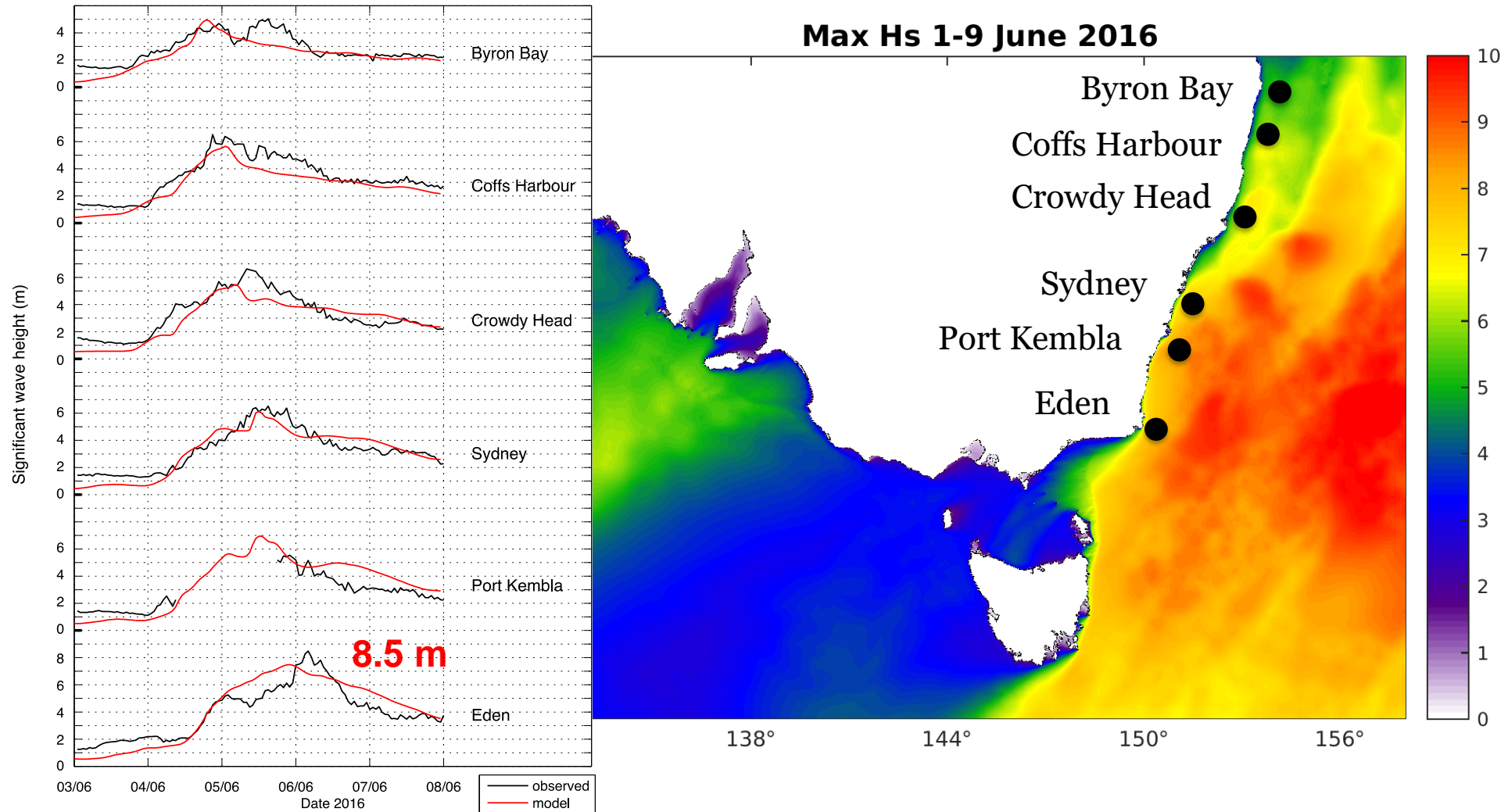
10-35% storm
surge height
difference due to
waves



4-7 June 2016 east coast low NSW to Tasmania

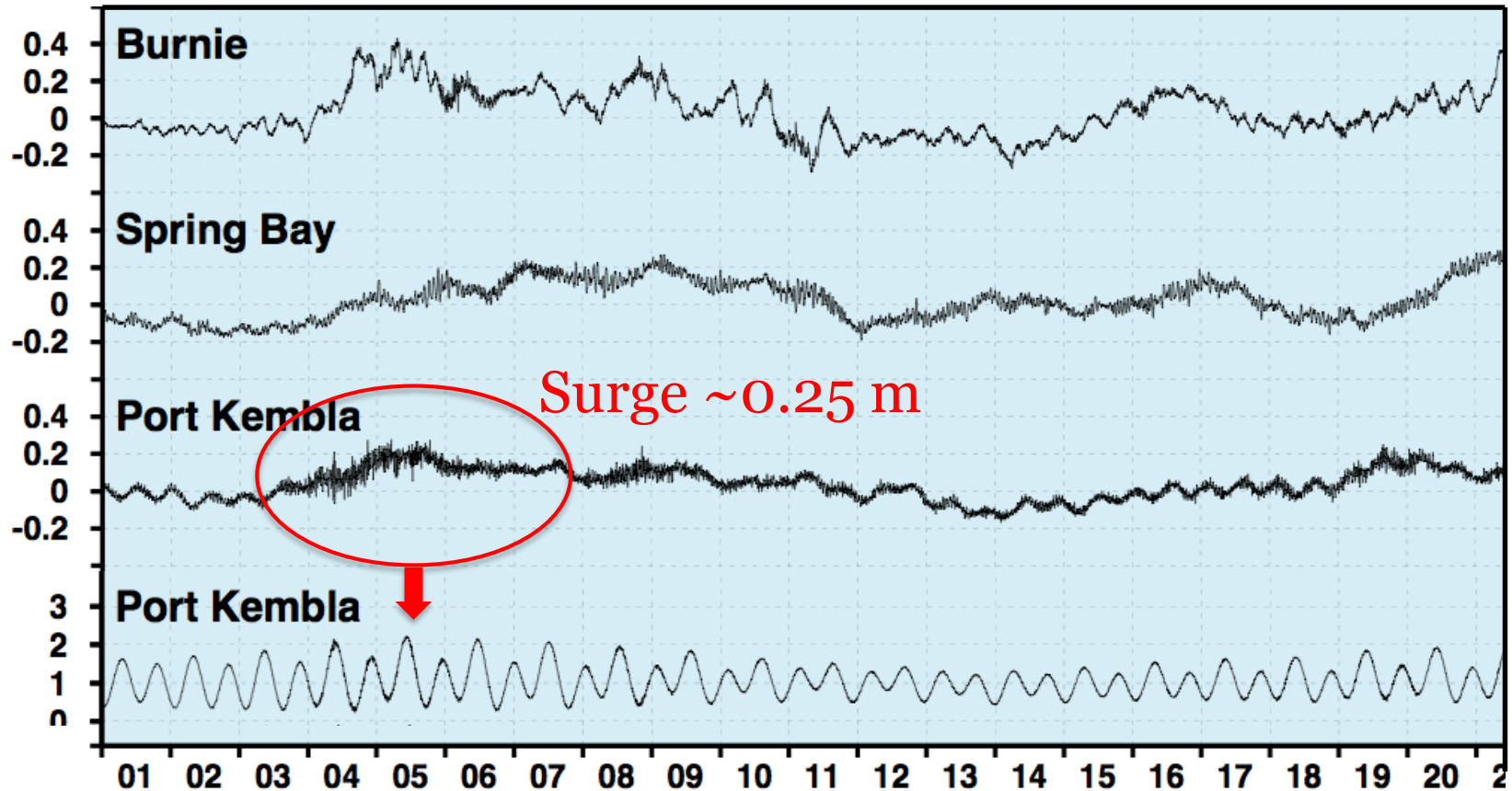


Observed and Predicted wave heights



Tidal stage & storm surge

Timing is critical!

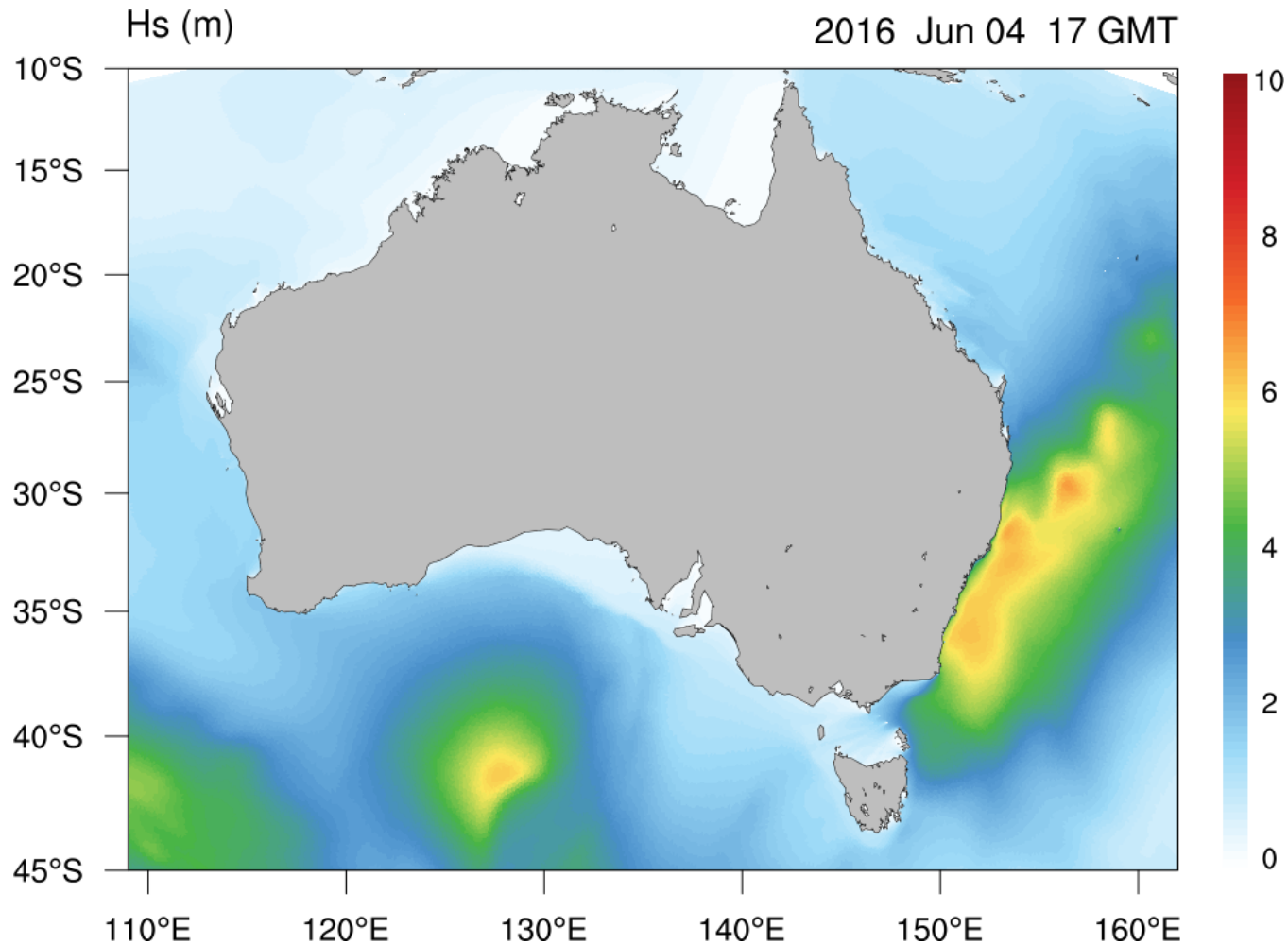


Spring tides: ~2m

Neap tides: ~1m

Winter storm – South Australia

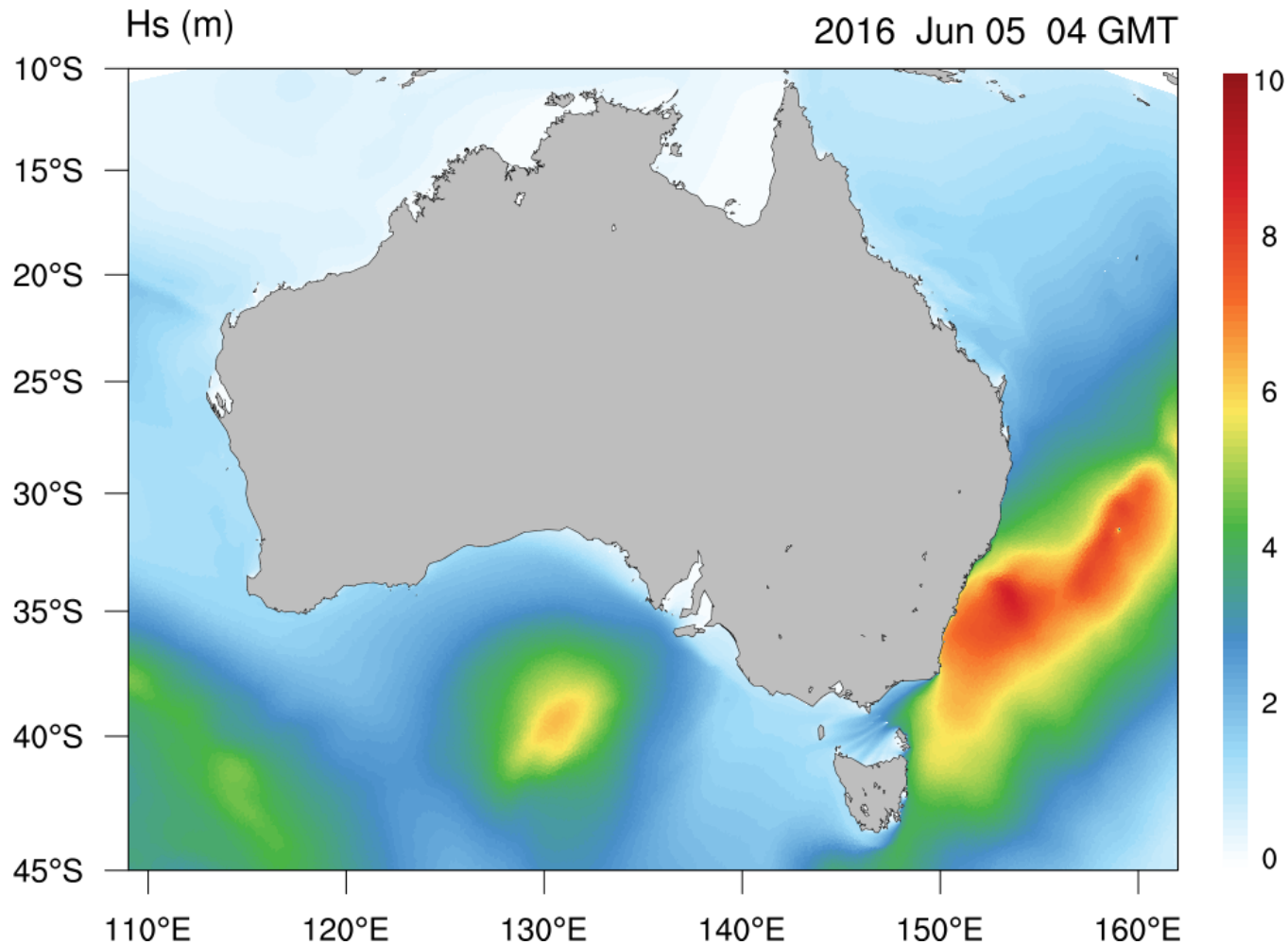
8 June 2016



Wave height (m)

Winter storm – South Australia

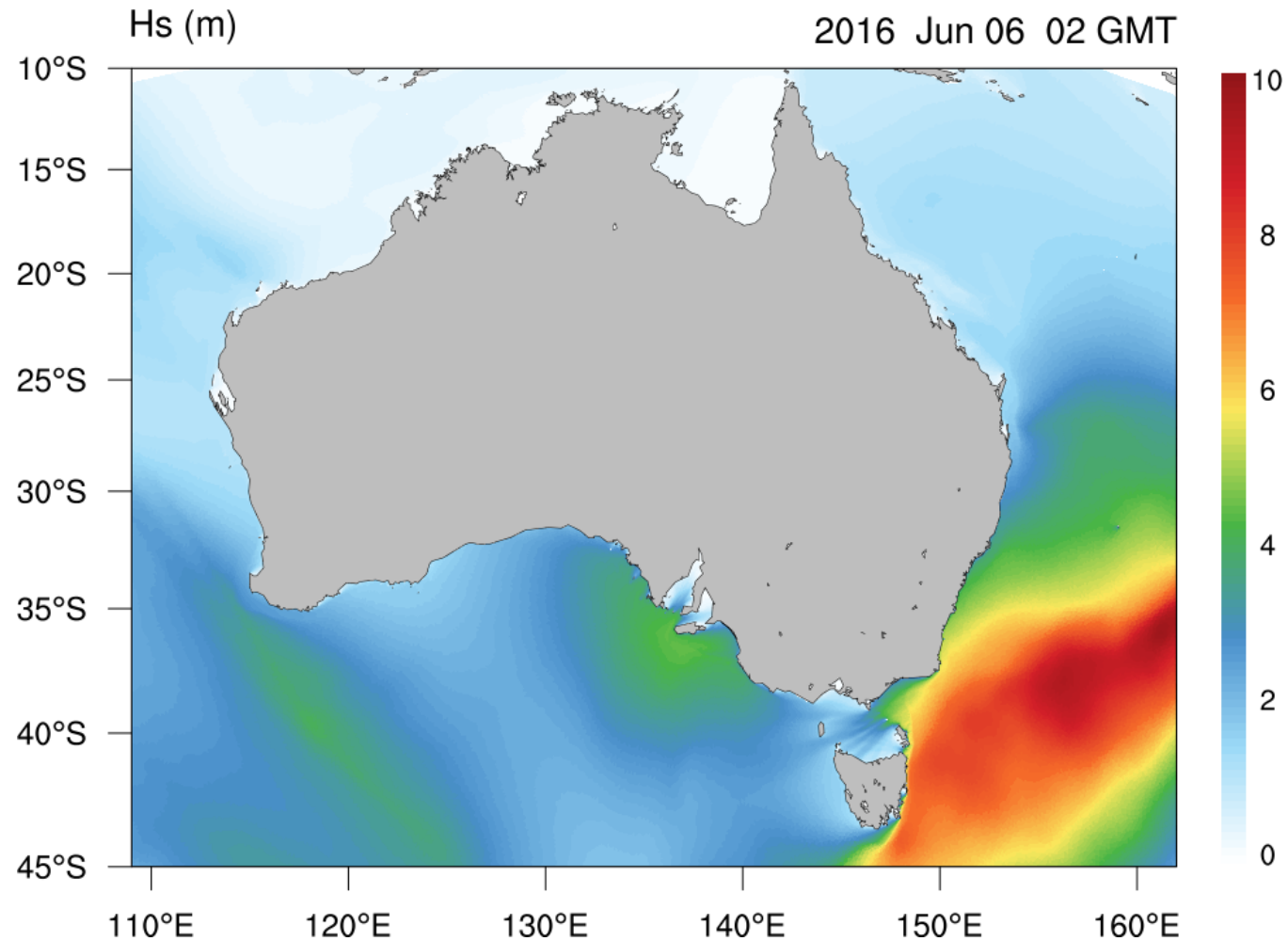
8 June 2016



Wave height (m)

Winter storm – South Australia

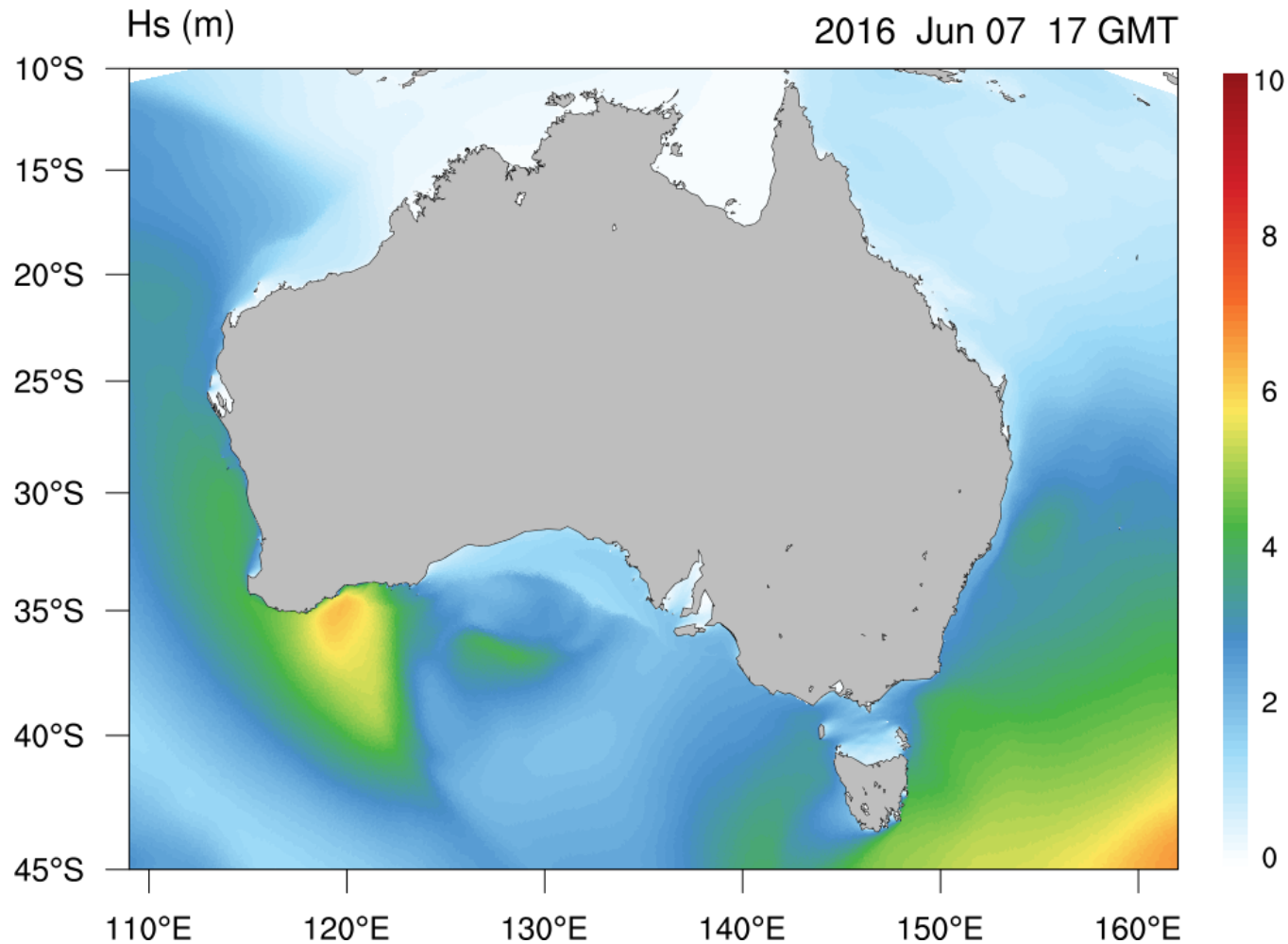
8 June 2016



Wave height (m)

Winter storm – South Australia

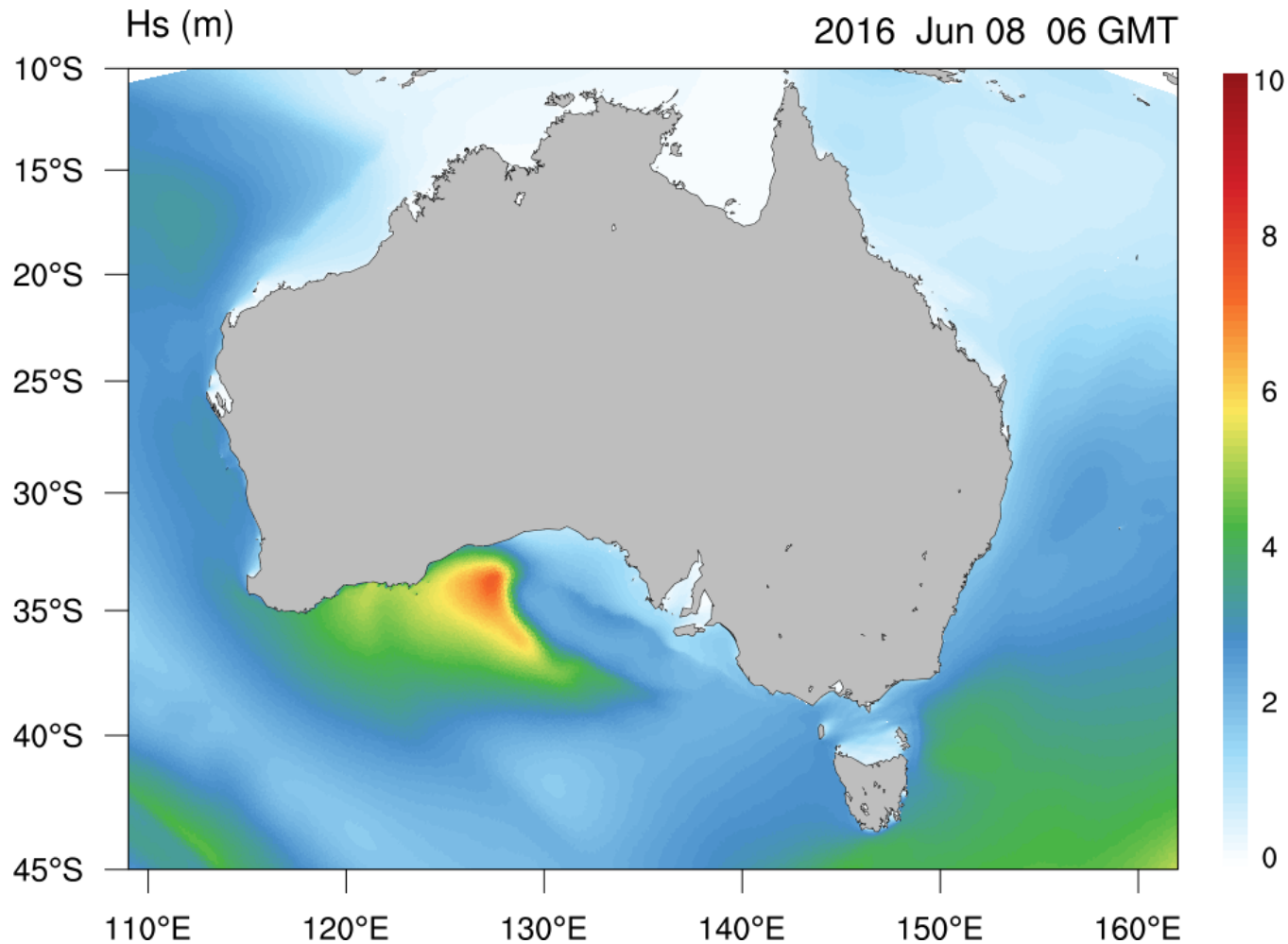
8 June 2016



Wave height (m)

Winter storm – South Australia

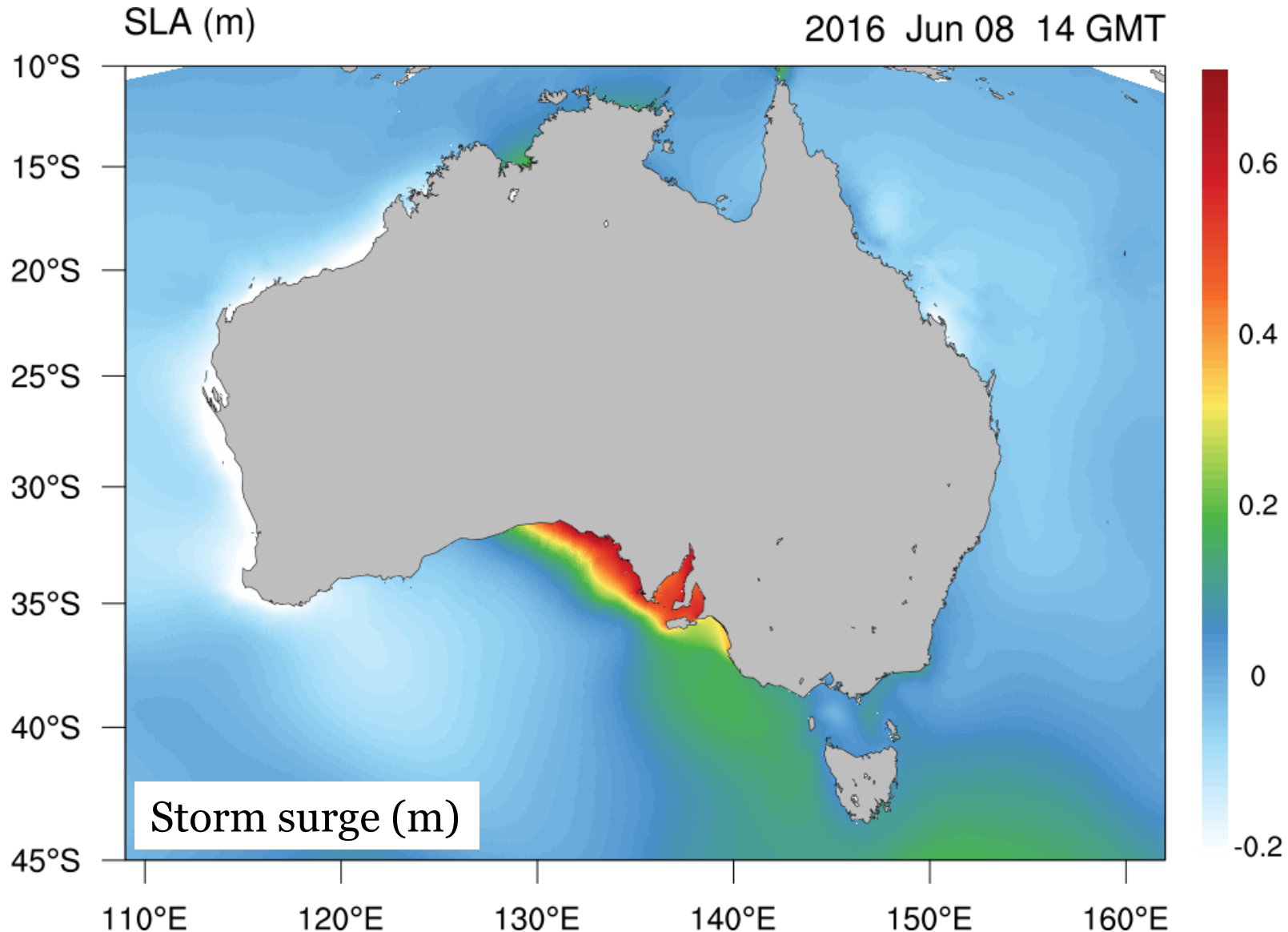
8 June 2016



Wave height (m)


Winter storm – South Australia

8 June 2016



Winter storm – South Australia

8 June 2016

NEWS 

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Adelaide beachfront housing 'facing erosion risks' like those at Collaroy, Sydney

891 ABC Adelaide

Updated 8 Jun 2016, 12:20pm


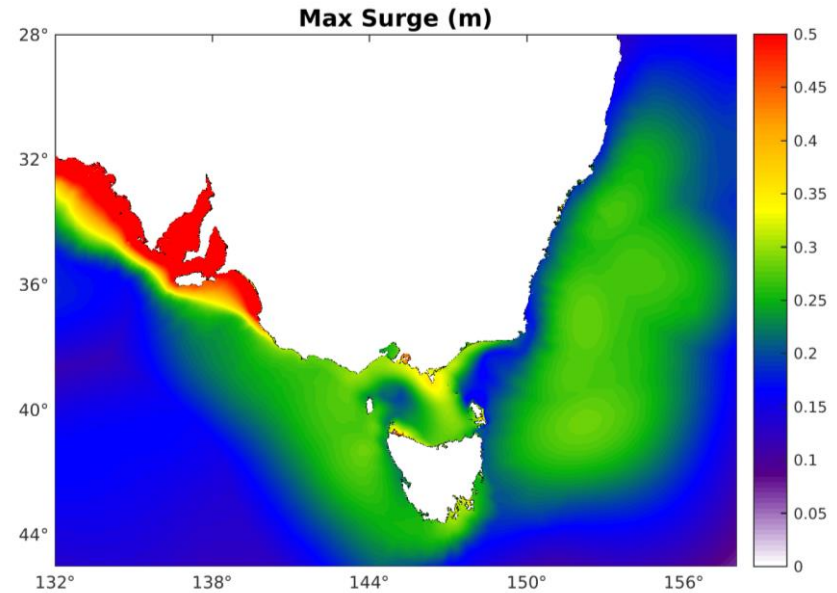


PHOTO: Storm damage has left little access to West Beach in Adelaide. (Supplied: City of Charles Sturt)



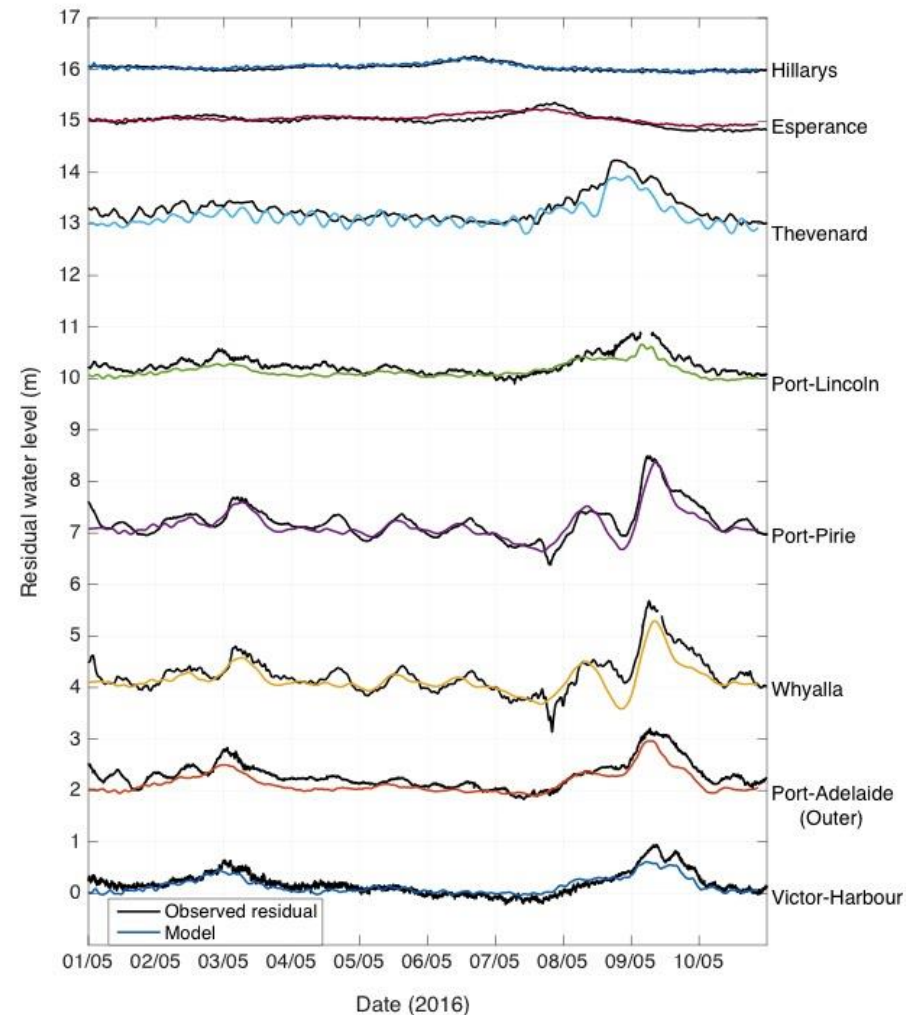
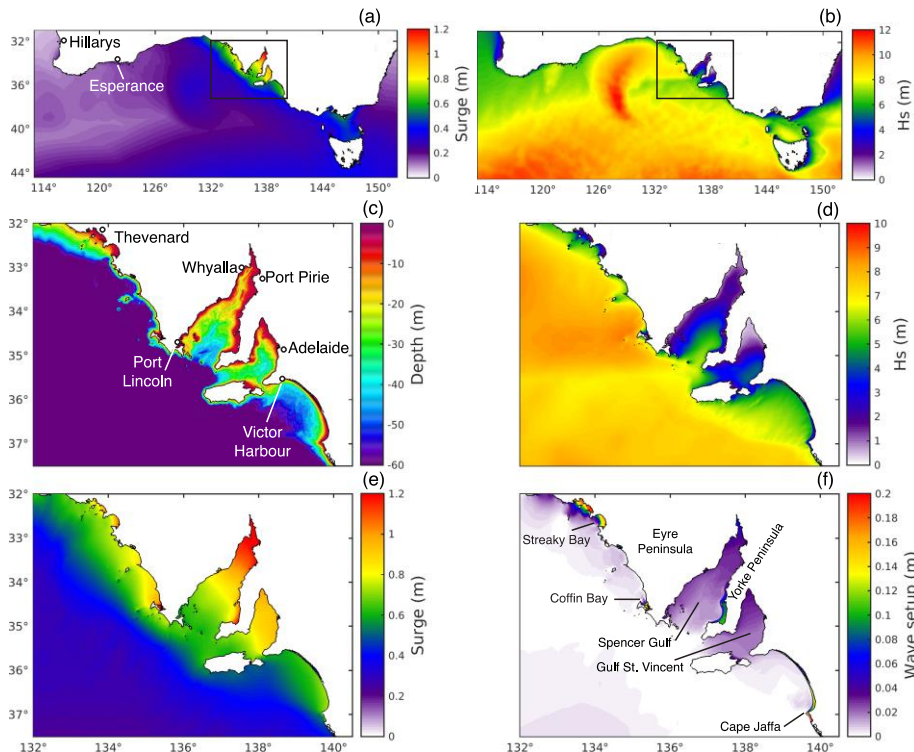
Sandra Storey checks out the waves at the Glenelg North foreshore. Pic: Tricia Watkinson

Winter storm – South Australia

1-9 May 2016

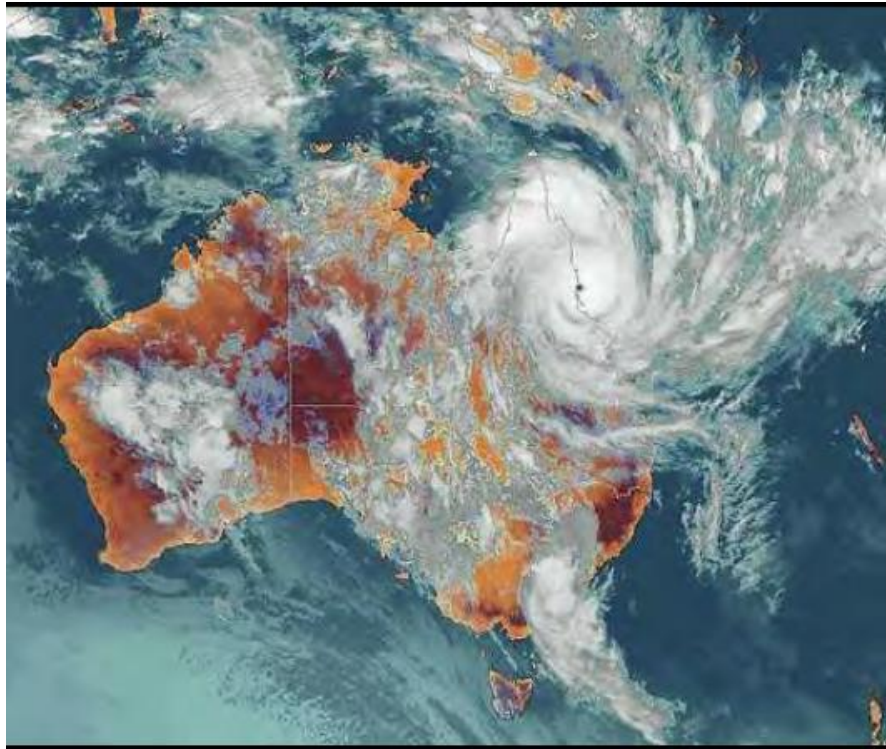
Record Water Levels

Maximum 1-9 May 2016



Tropical cyclone Yasi

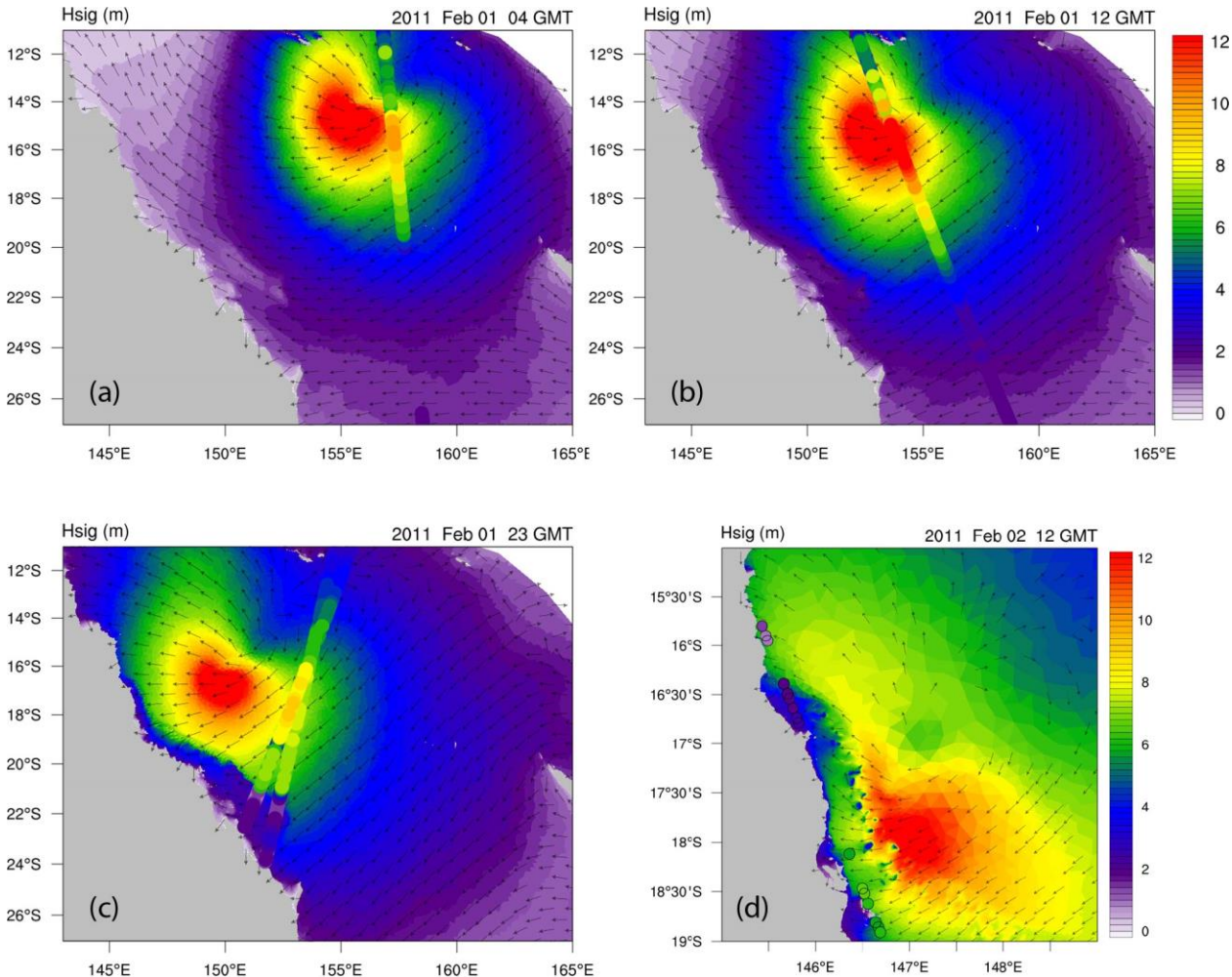
Feb 2011



- One of the most intense and largest tropical cyclones to cross the coast in Australia
- Major damage (~\$800 M) caused by inundation and erosion from extreme waves ($>5\text{m}$) and storm surge (up to 5.3 m)

Tropical cyclone Yasi

Feb 2011

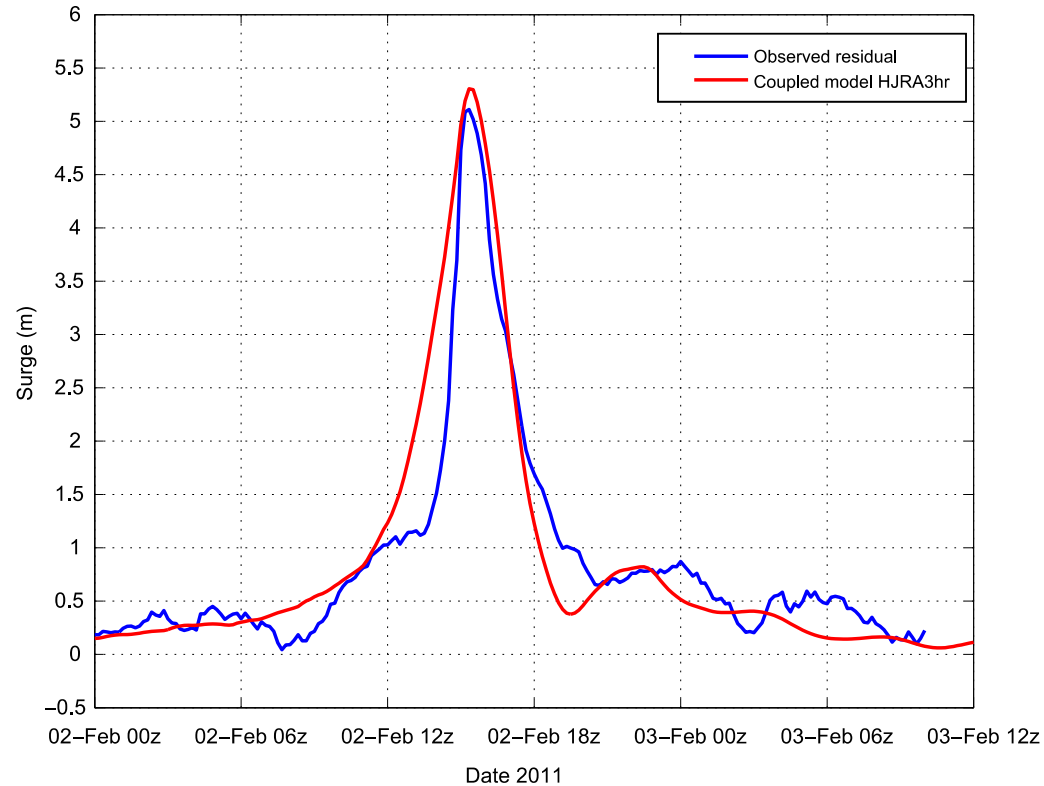
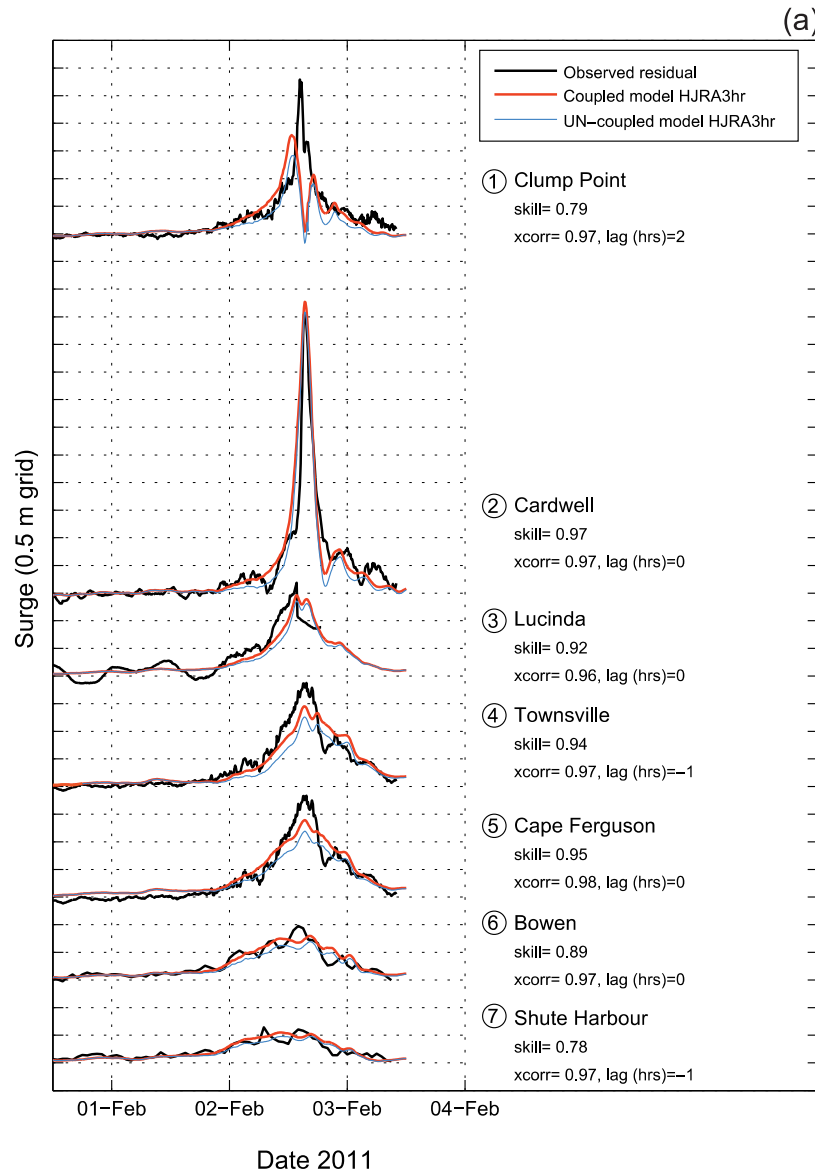


- Yasi waves > 12 m offshore and 6 m nearshore
- Great Barrier Reef dissipated much of the wave energy
- Waves made a significant contribution to extreme sea levels and improved model accuracy

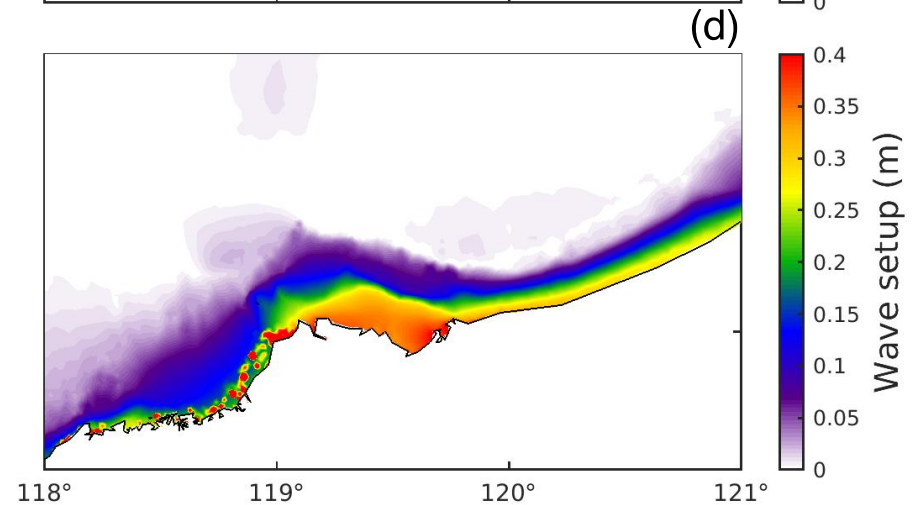
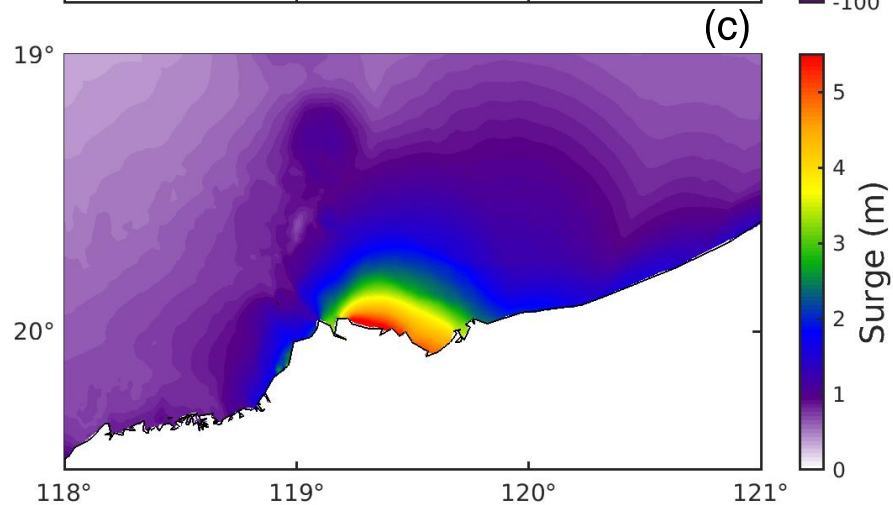
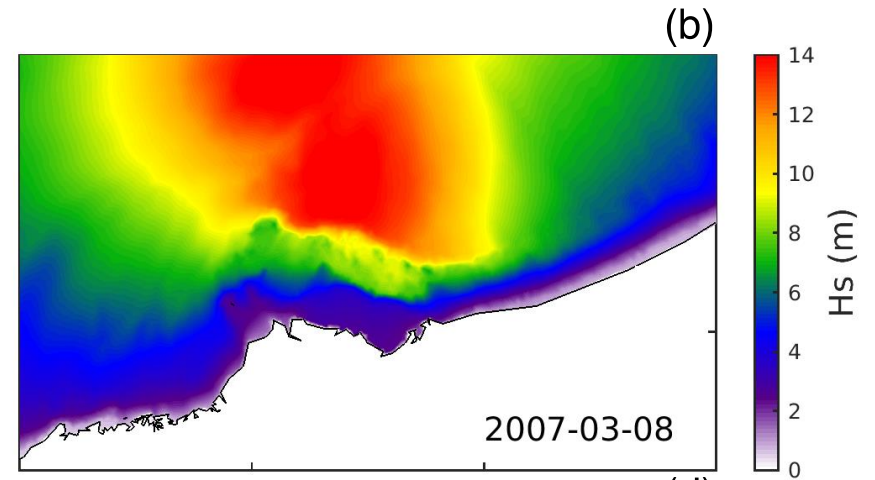
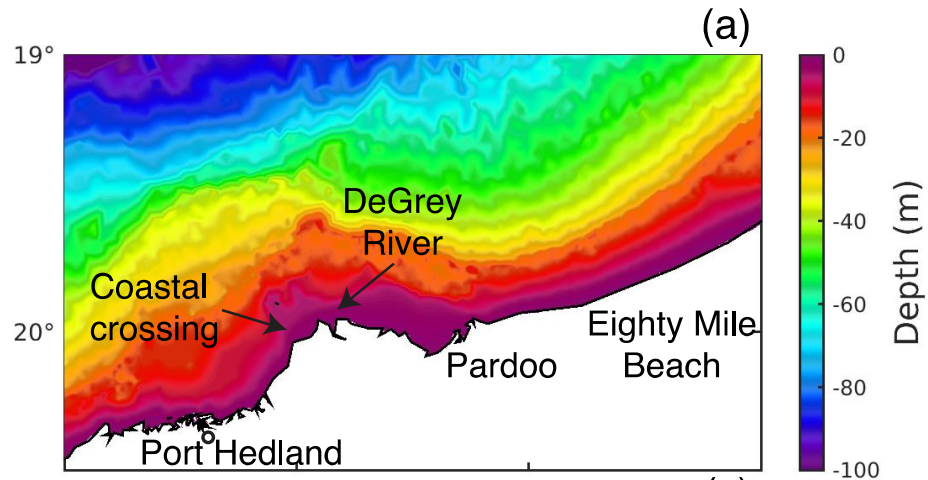
Simulated waves matched well with satellite observations

Tropical cyclone Yasi

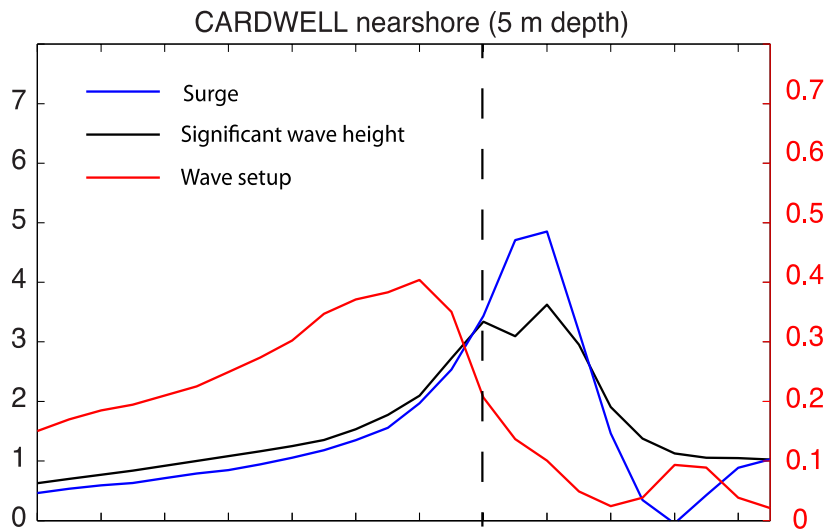
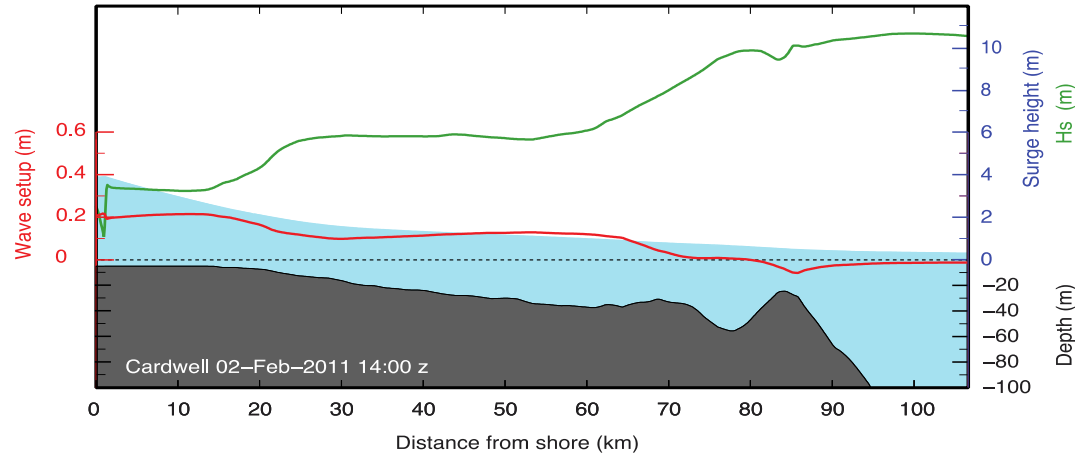
Feb 2011



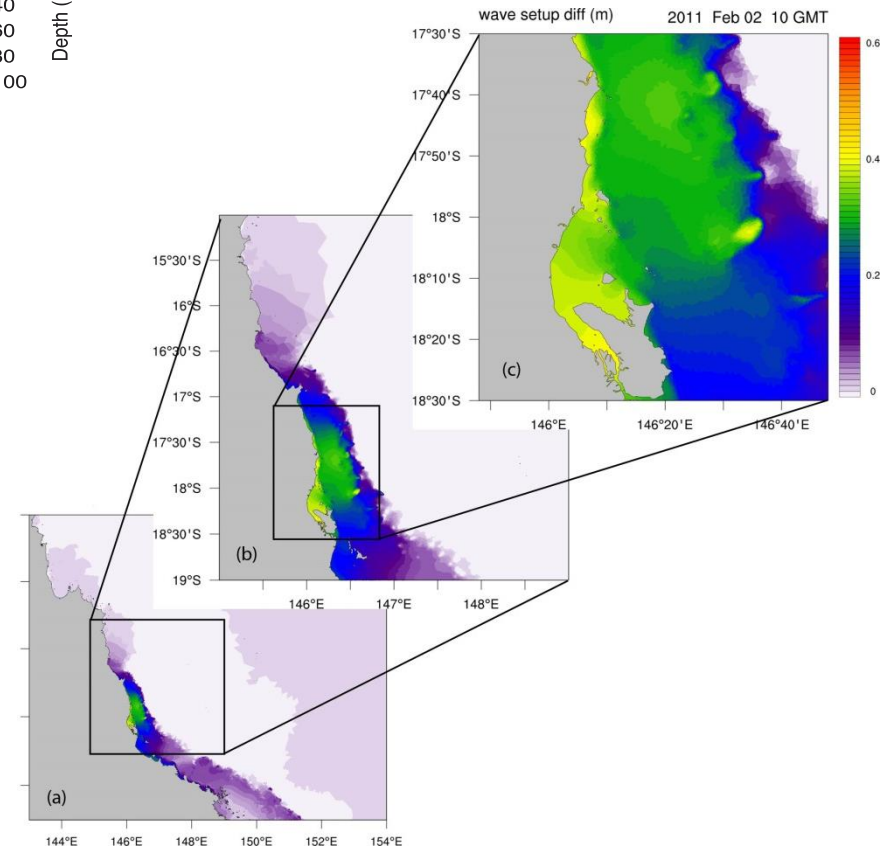
TC George



TC Yasi – wave setup



- Wave setup up to 0.4 m
- depends on exposure and local bathymetry



Utilisation tool

Coastal Flooding Visualisation Tool

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Tides...

Tide & Storm Surge Wave Runup Wave Setup Scenario Result

Values are dynamic

name	count	min	mean	max	.. off ..
H.A.T (calm)	264	0.19	0.96	1.64	
1:10yr storm	264	0.63	1.34	1.90	
1:50yr storm	264	0.73	1.45	2.07	off
1:100yr storm	264	0.77	1.50	2.13	
1:250yr storm	264	0.82	1.55	2.22	



CANUTE
THE SEA LEVEL CALCULATOR

12,000 Data Points Around Coastline

Access your location through a Google Map interface

GENERATOR Climate Science for Australia's Future

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Left sidebar menu:

- About Sea-Level Rise
- About Canute
- Access Canute 2.0
- Access Canute 1.0
- Wave Setup and Runup Calculator
- Shoreline Recession Calculator
- Story of Canute
- Scenario Information
- Important Information
- Registration and Training

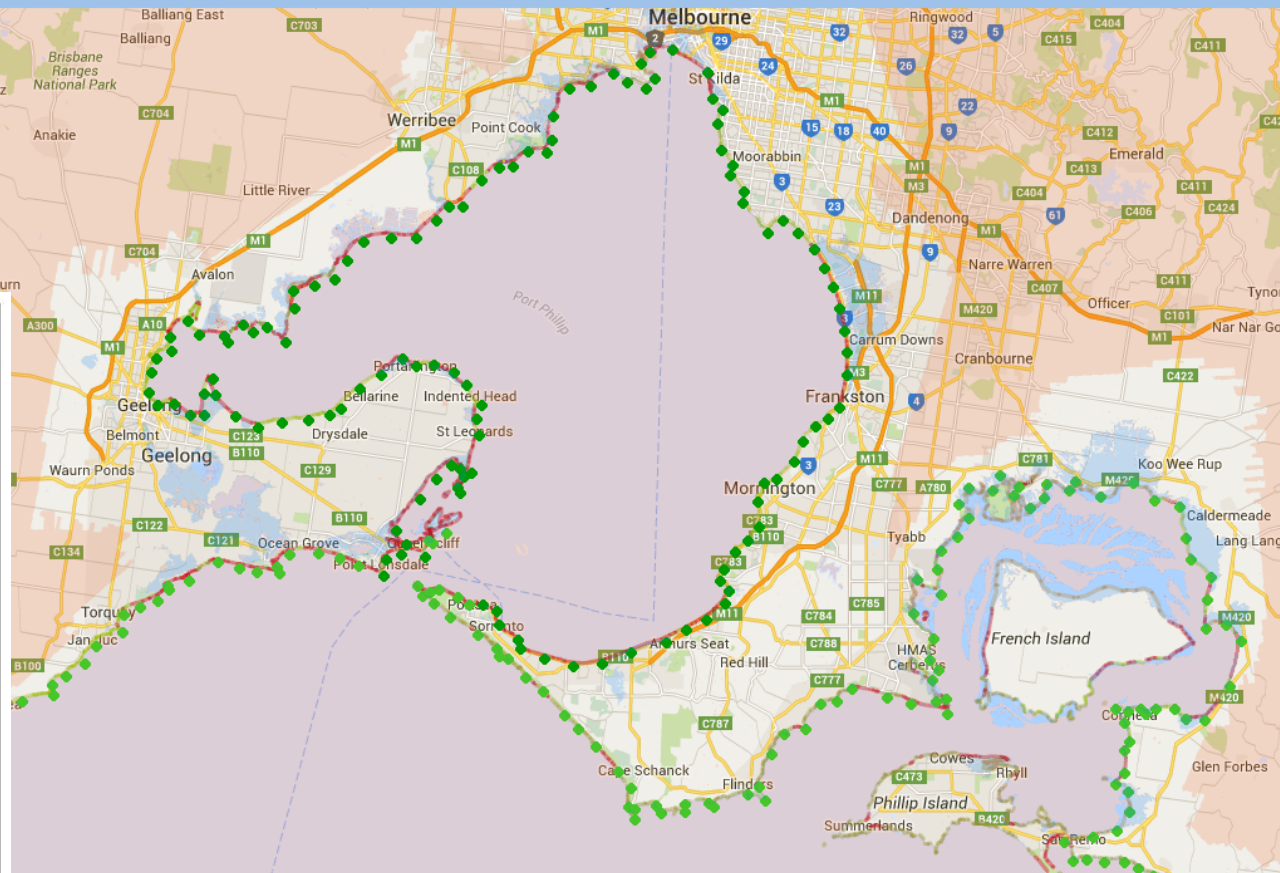
Main content area:

PICK A LOCATION, ZOOM IN FOR MORE DATA POINTS

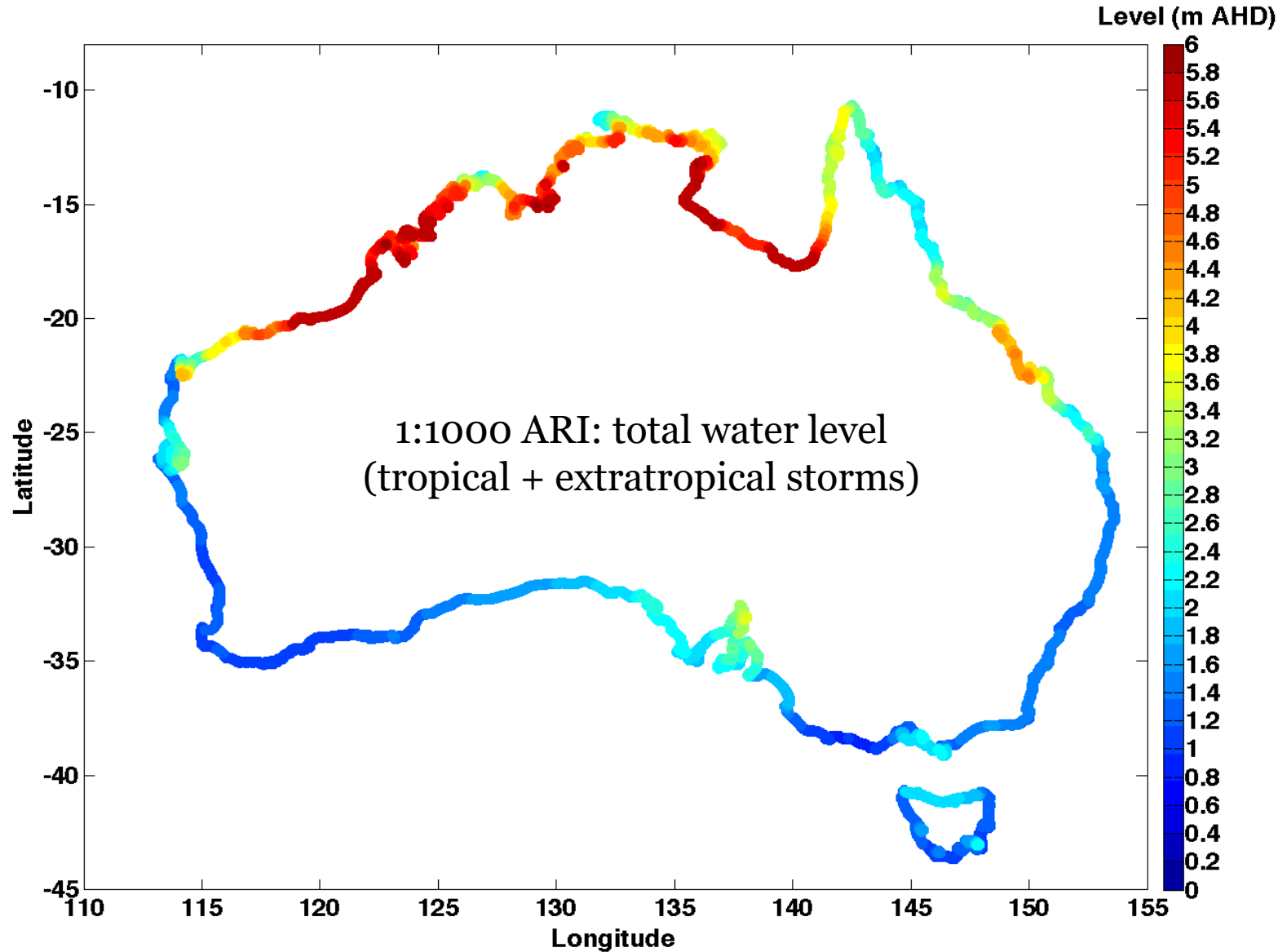
Dataset: ☐ Model ☐ Tide Gauge

Map showing Australia with red dots indicating data points along the coastline.

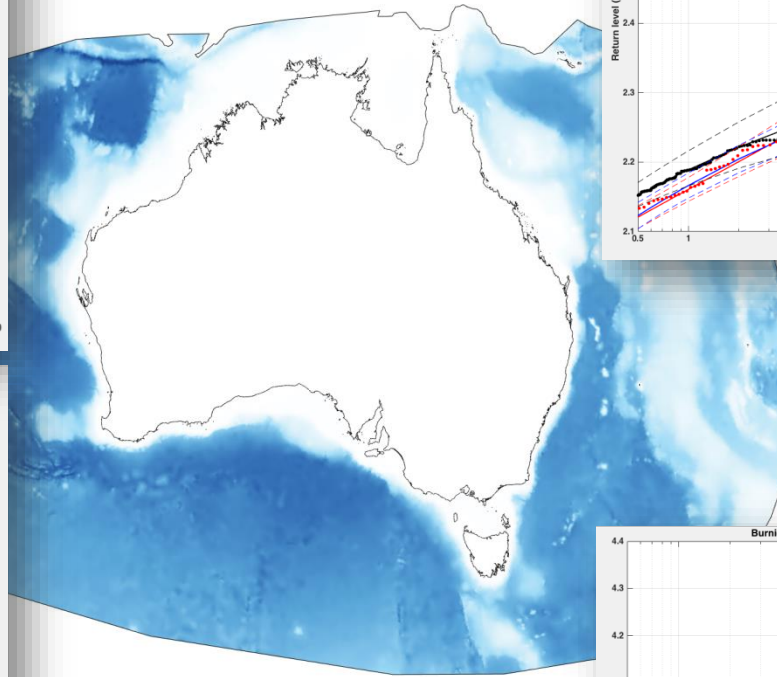
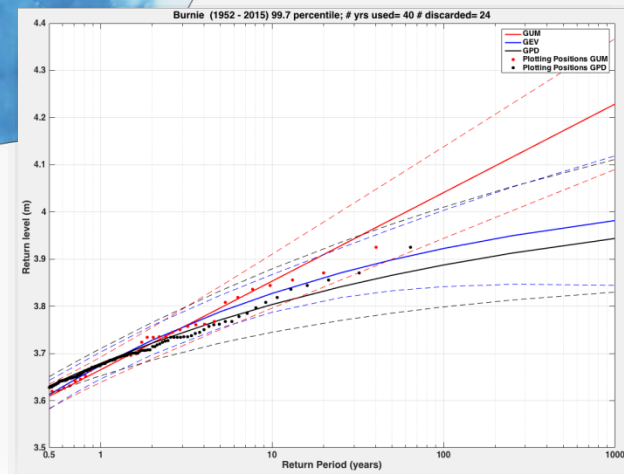
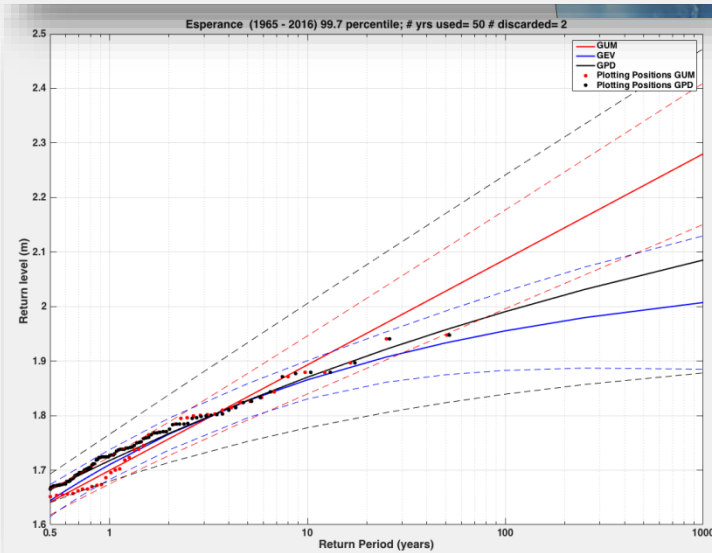
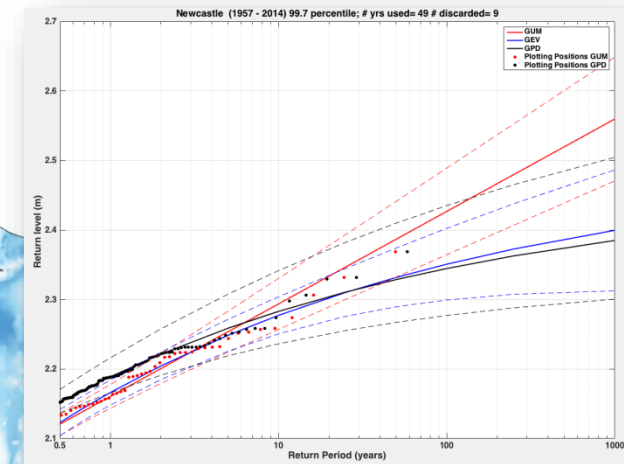
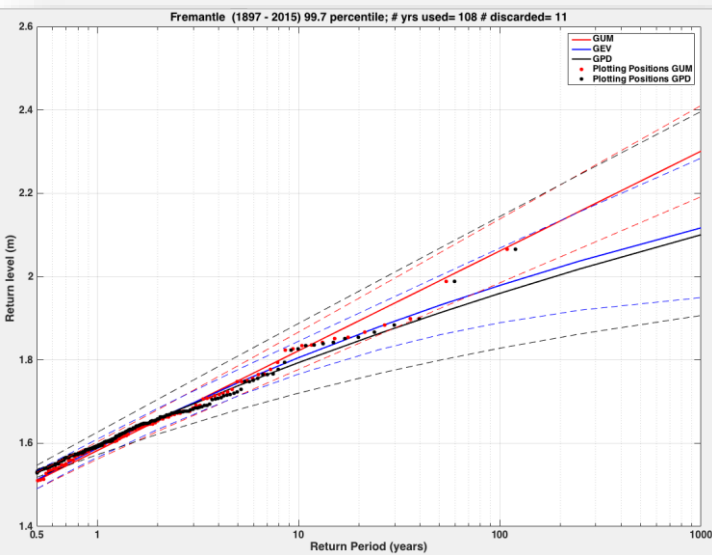
Bottom text: Select a spot from the map above to continue



Utilisation tool



Annual Recurrence Intervals



*based on tide gauge data

Thank You

