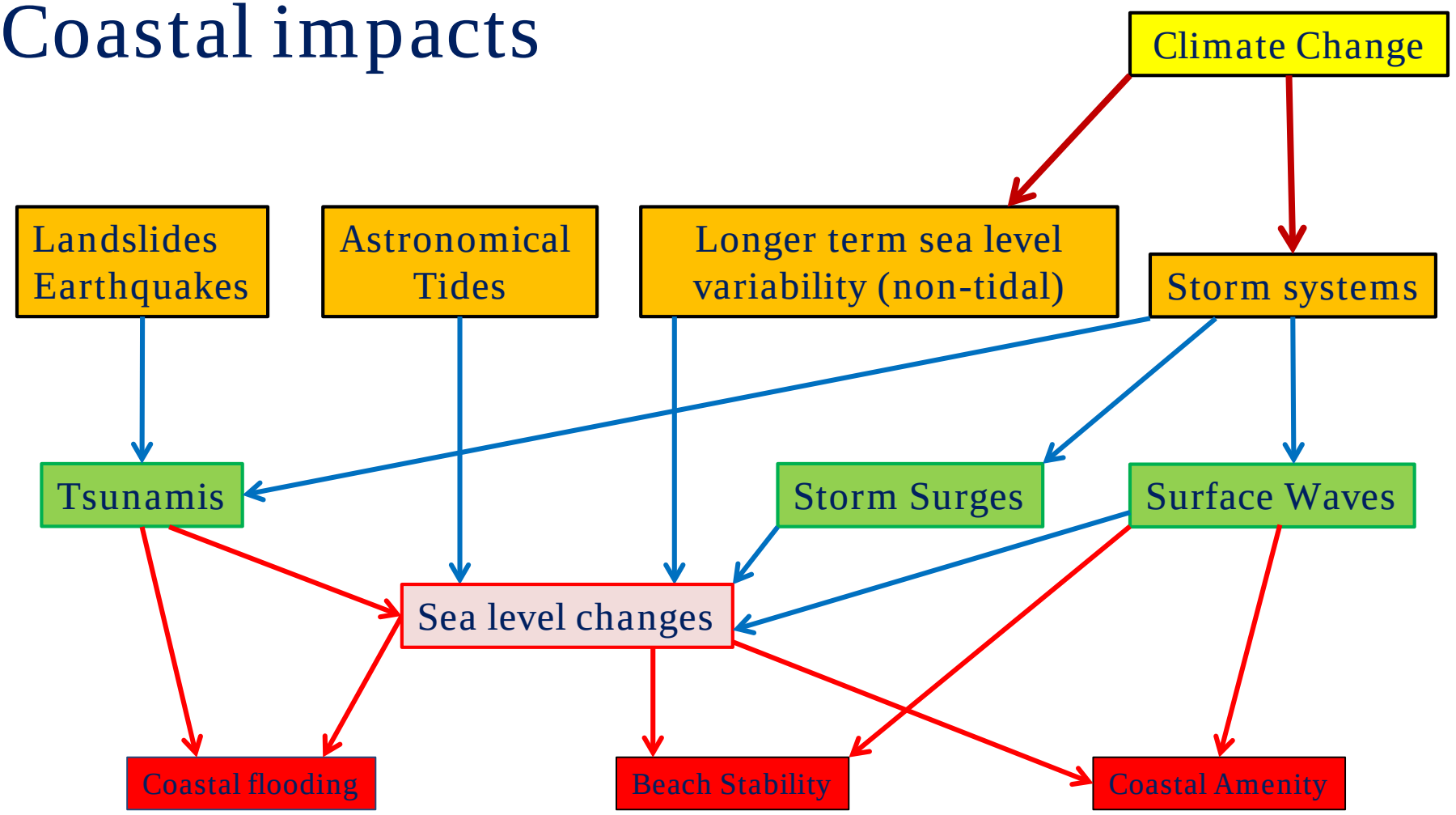
DEVELOPING BETTER PREDICTIONS FOR EXTREME WATER LEVELS

RAF 2015, Brisbane

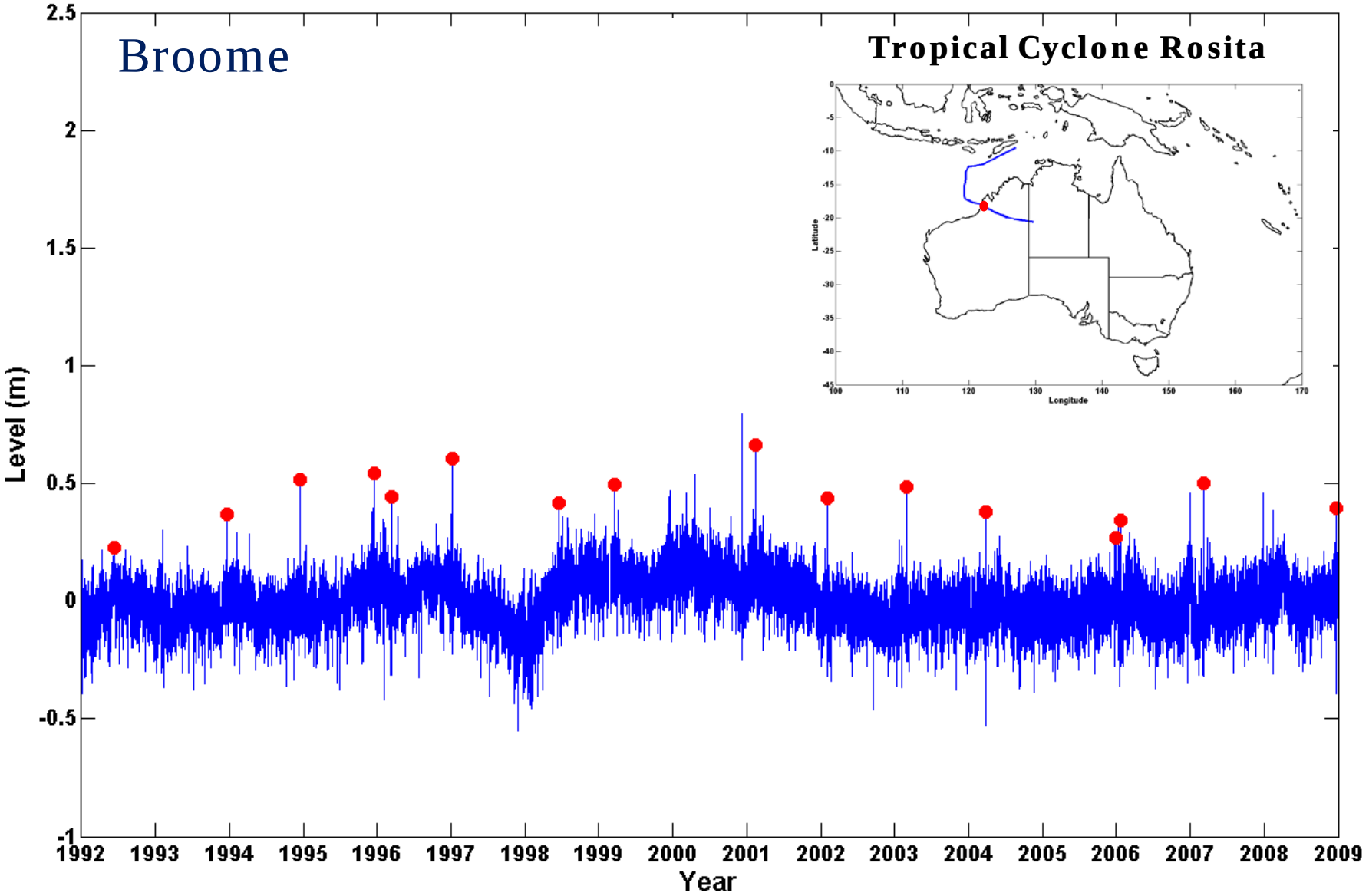
Charitha Pattiaratchi, Ivica Janekovic, Yasha Hetzel

School of Civil, Environmental and Mining Engineering/ UWA Oceans Institute
The University of Western Australia, WA

Coastal impacts

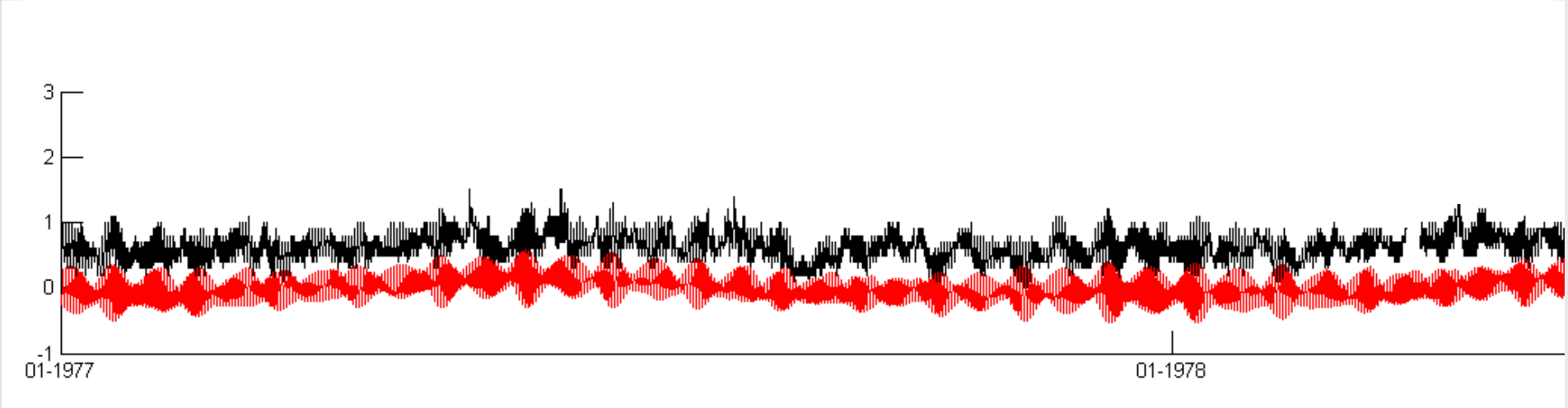


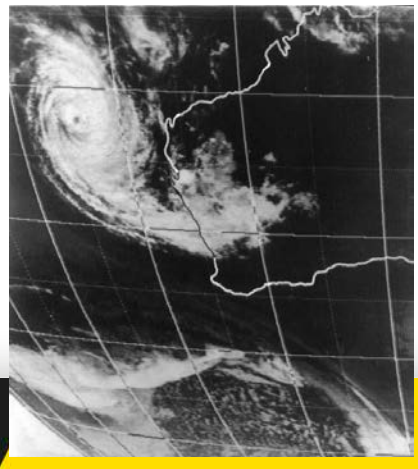
Extreme Events – storm surge

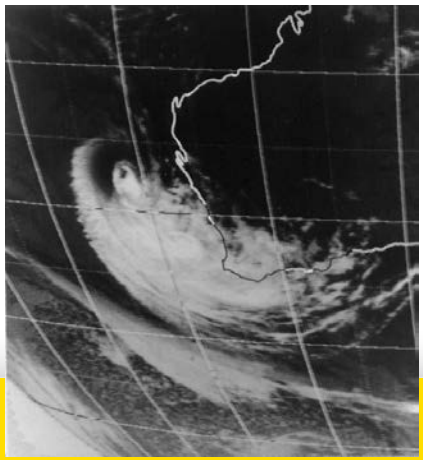


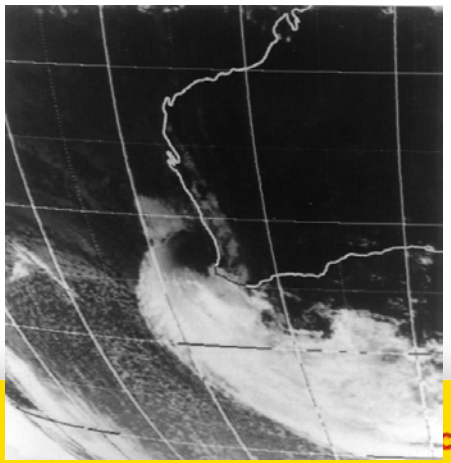
Extreme Events – storm surge

TC Alby



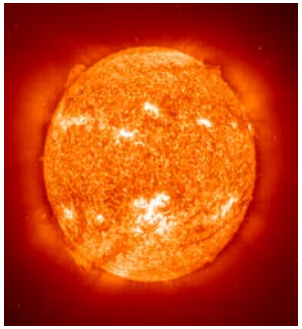




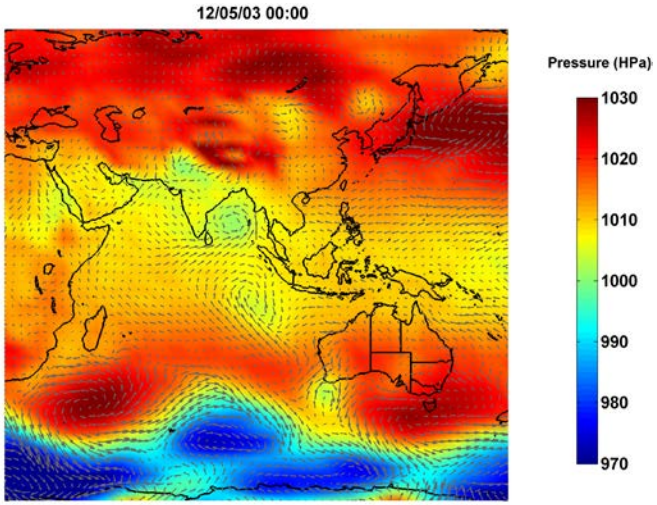


Forcing: a range of spatial scales

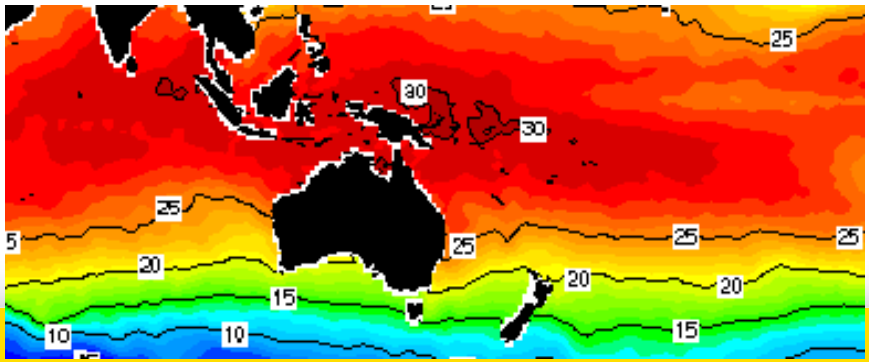
Astronomical



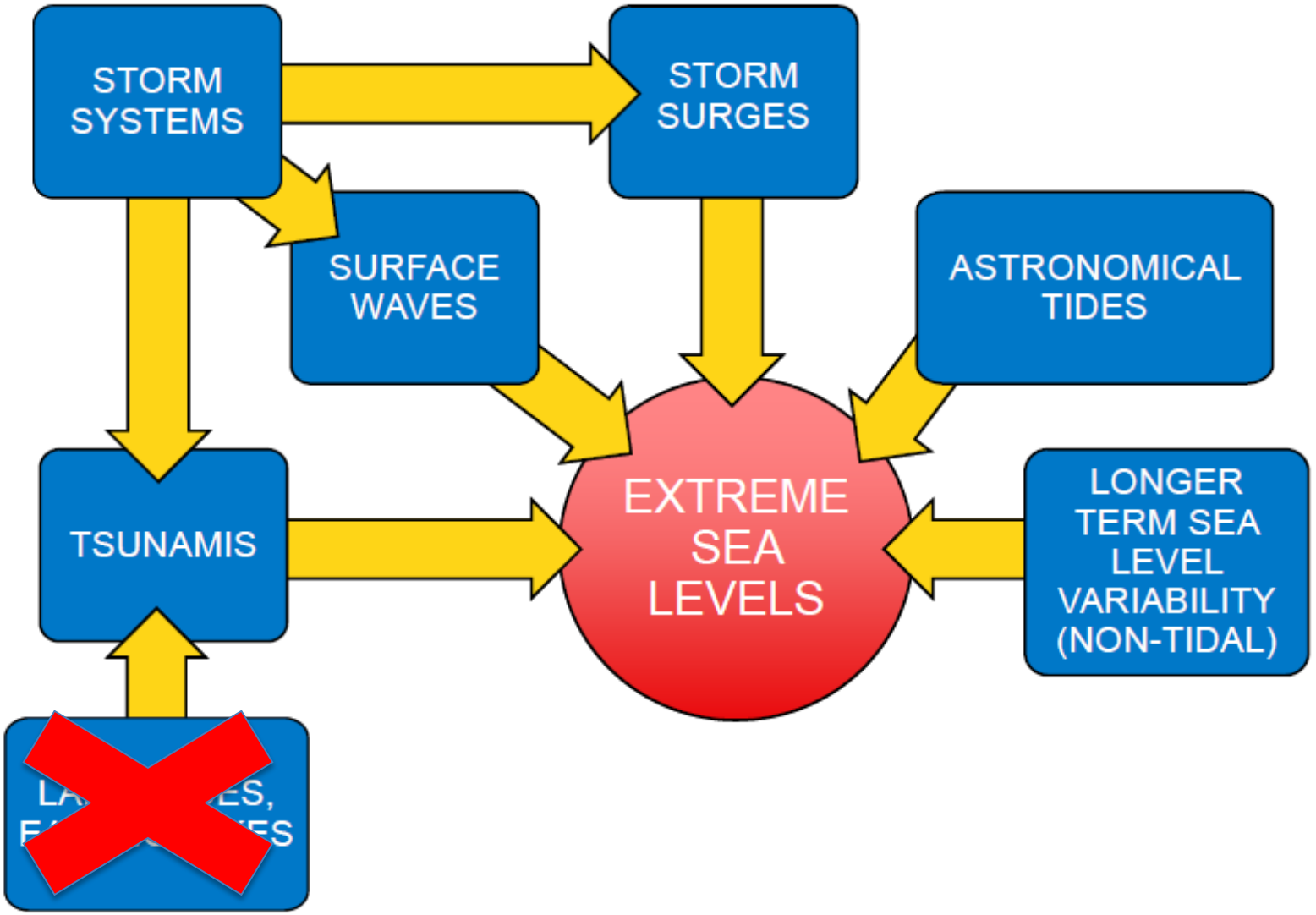
Meteorological



Oceanic: Indian + Pacific



Extreme Sea levels

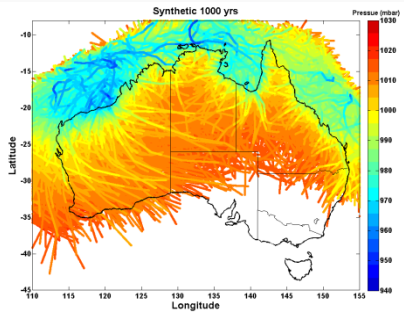


OBJECTIVES

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

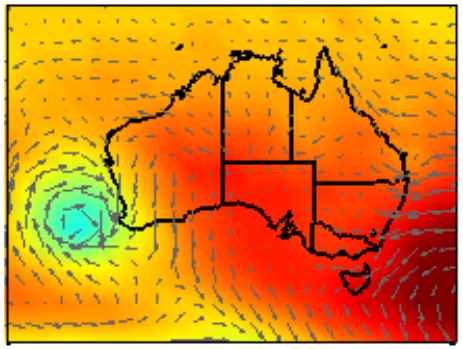
Tides
Storm surges
Surface gravity waves
Continental shelf waves
Tsunamis (meteorological)

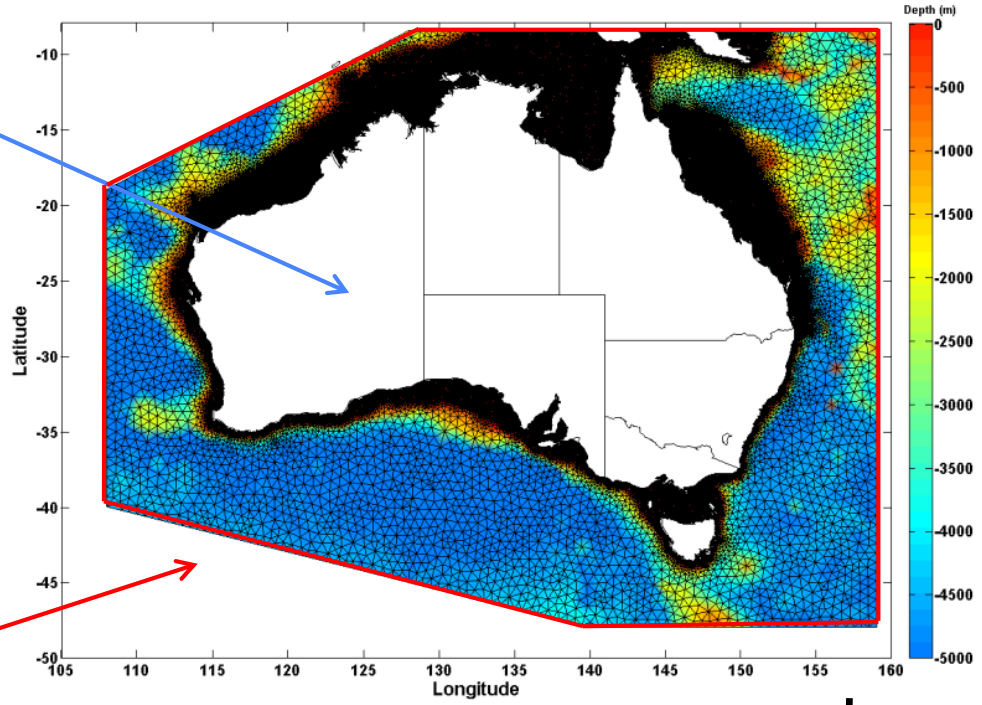
Sea level hindcasts



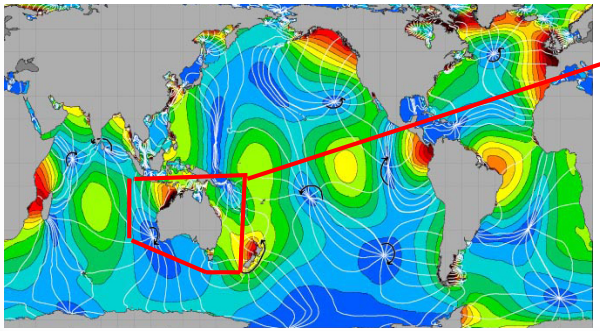
Tropical Cyclones

NCEP: 1949-2014





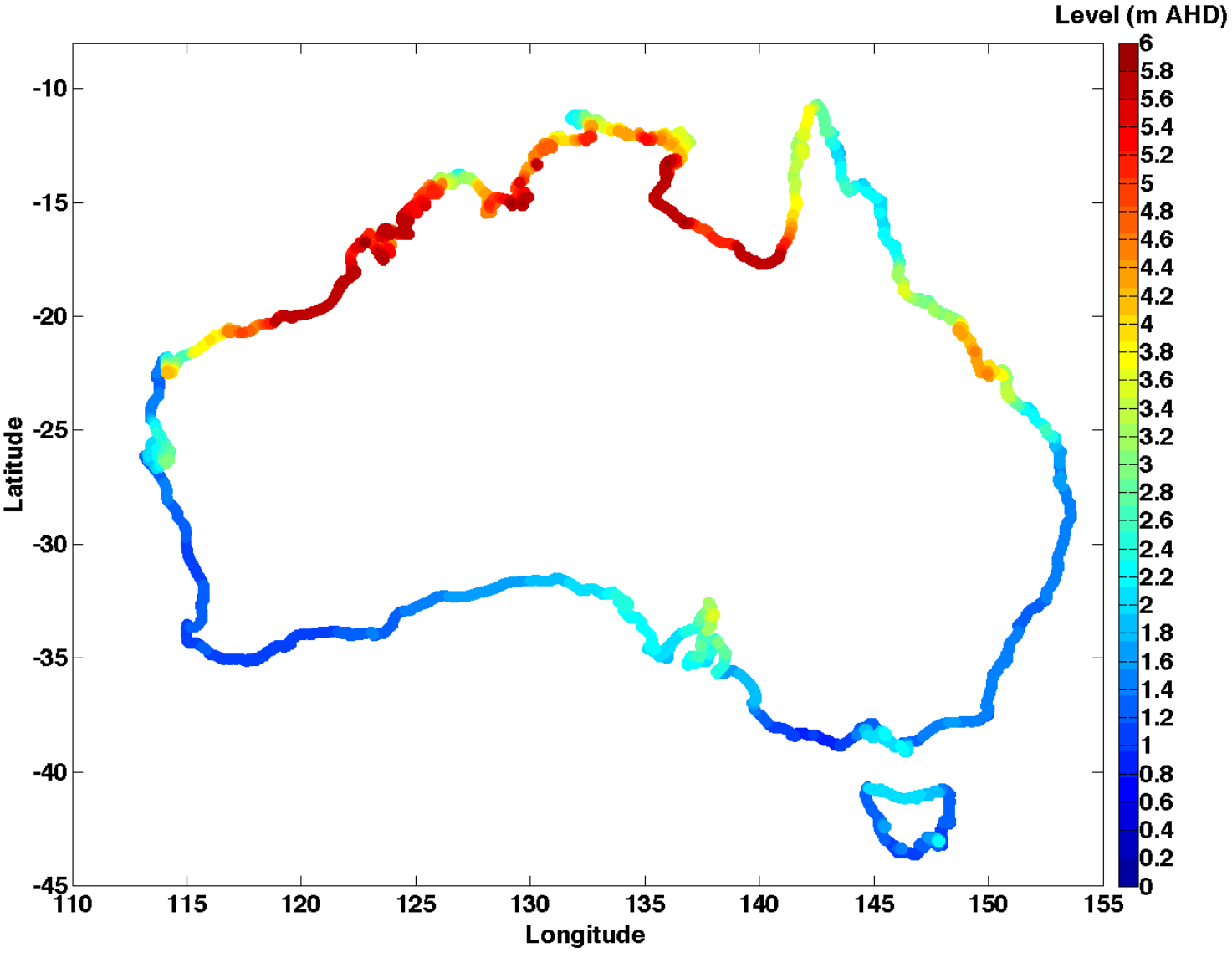
Global tidal model



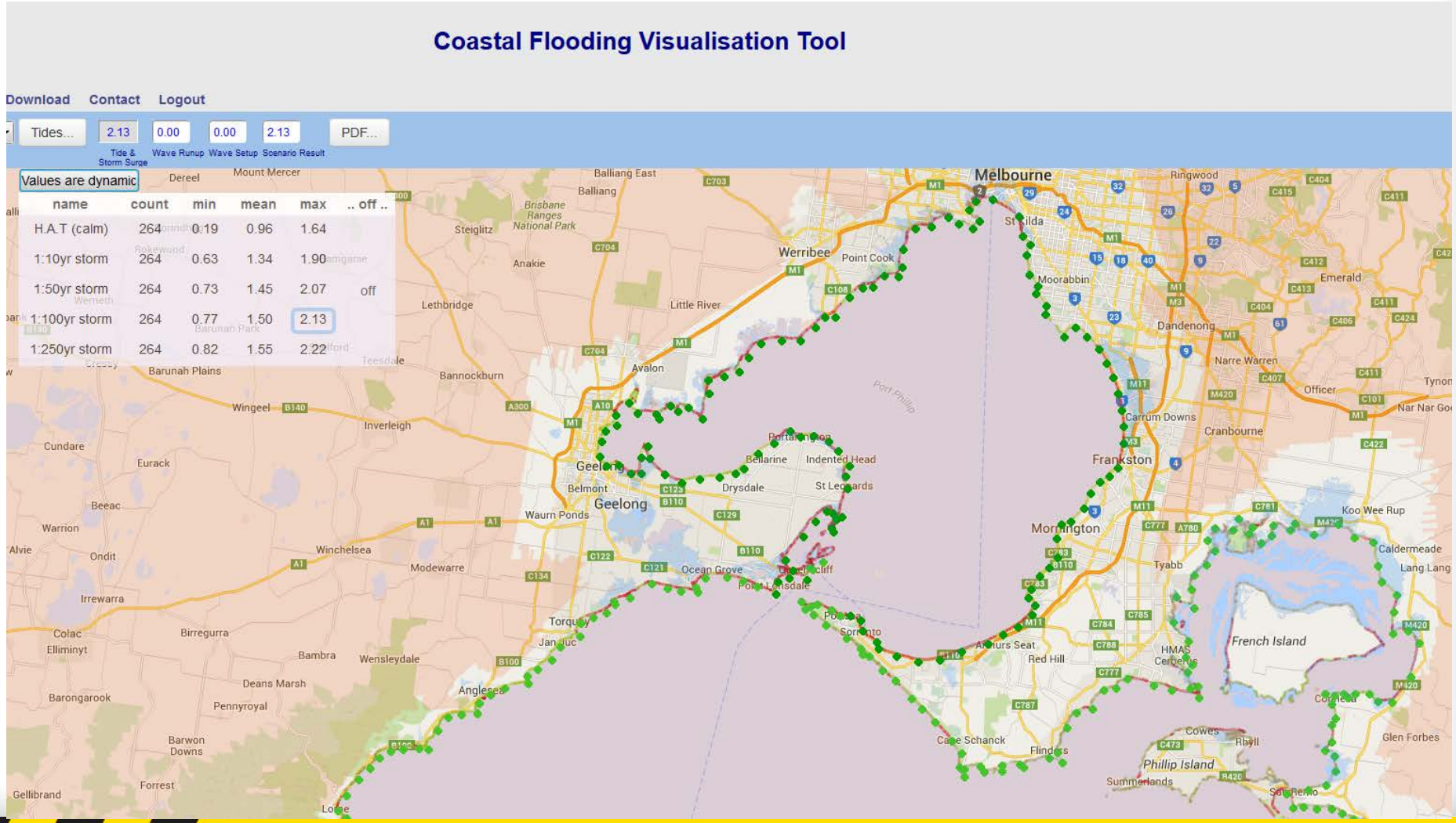
~75,ooo simulations equivalent to 10,000 years

Total Sea level (~60 year time series)

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



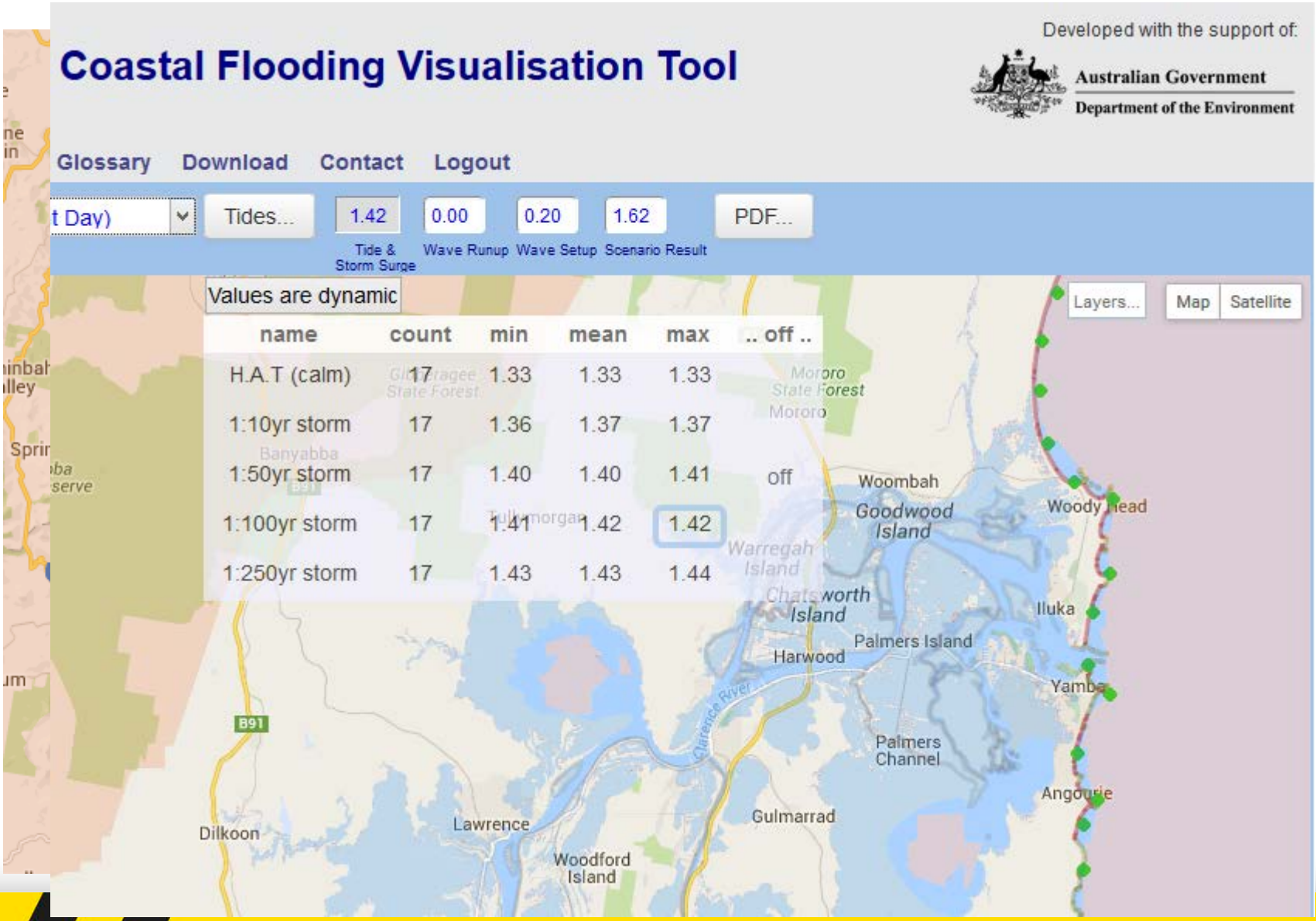
Extreme water levels



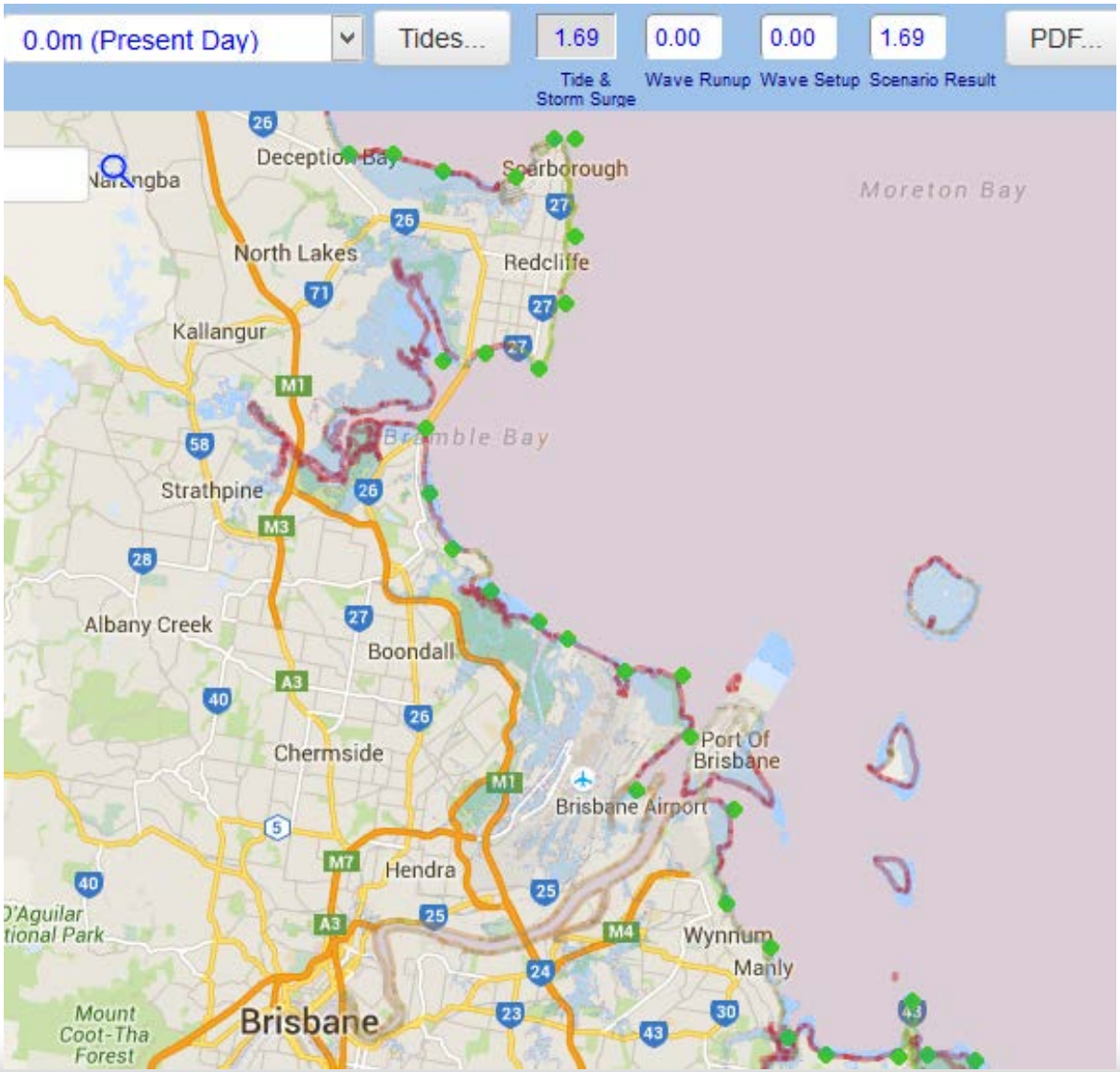
http://www.vistool.com.au

bnhcrc.com.au

Northern NSW



Coastal flooding – ‘bathtub’



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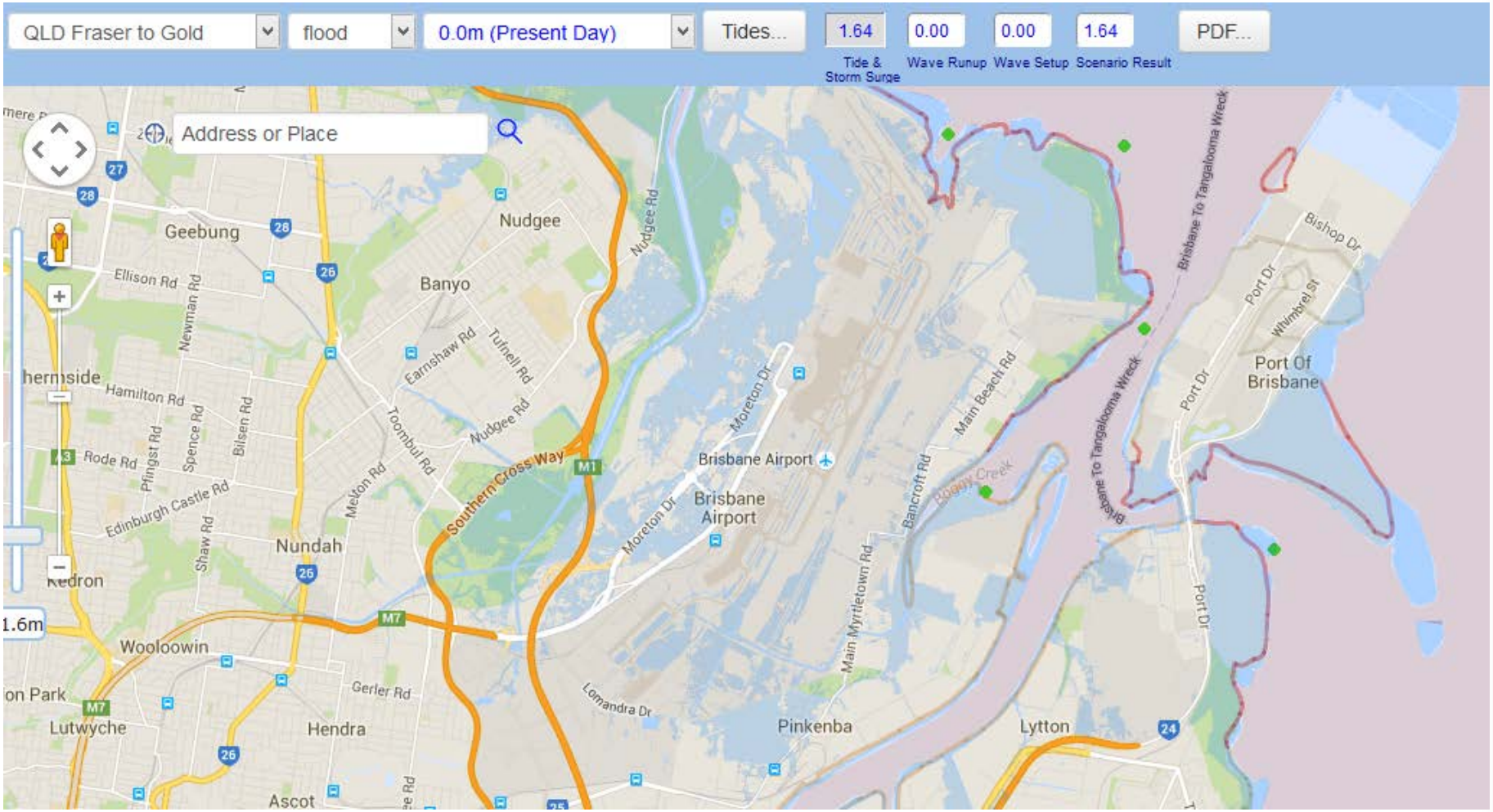
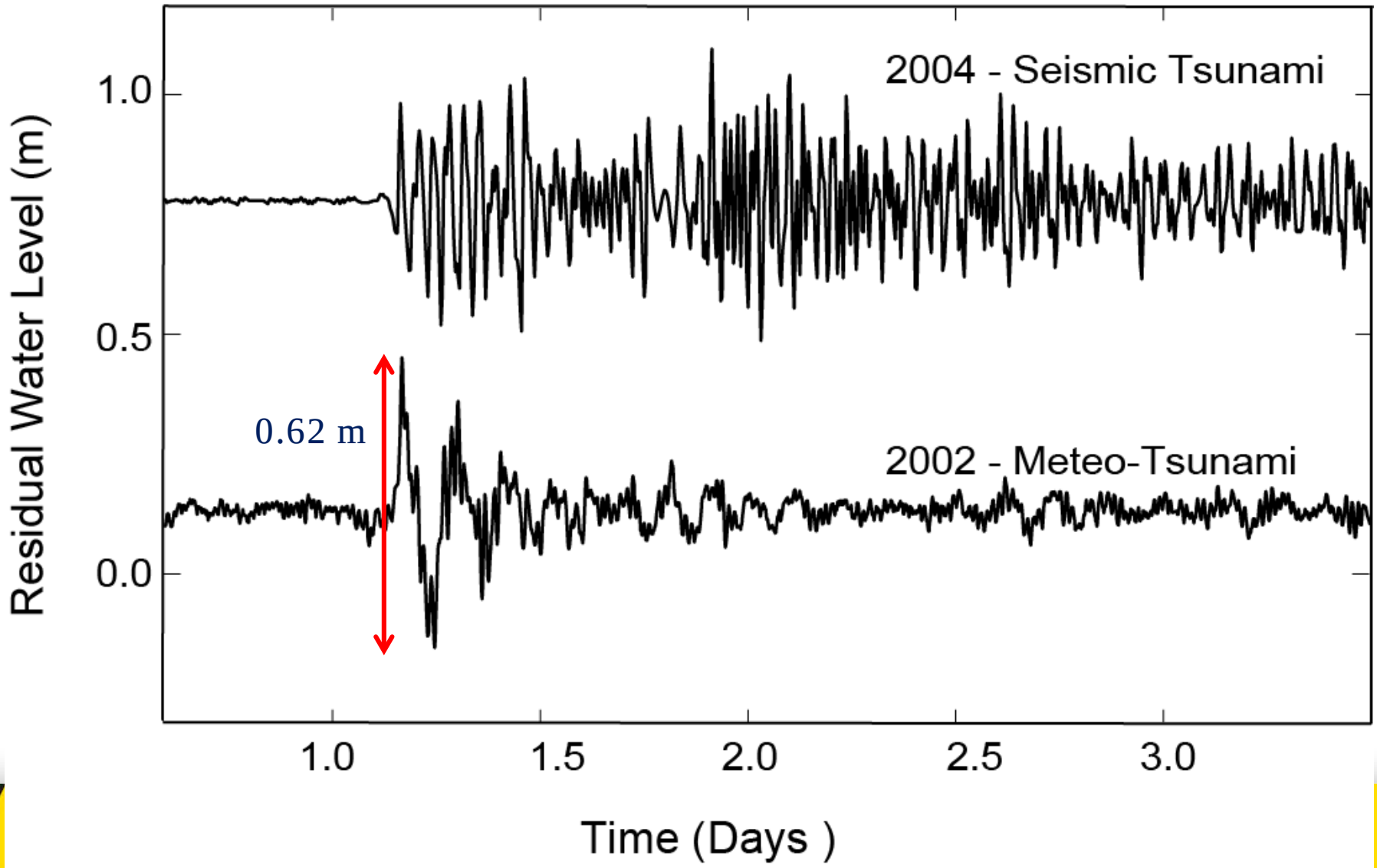


Meteotsunamis

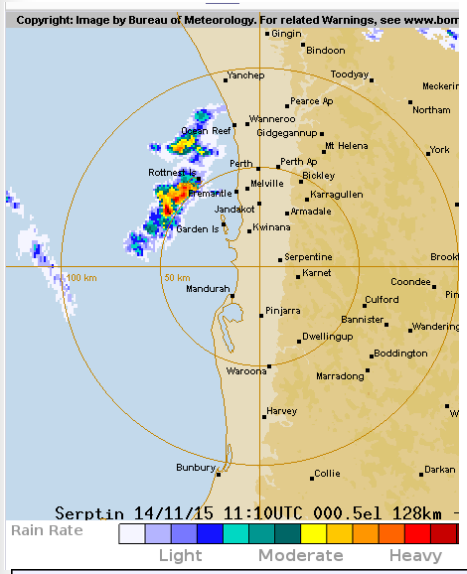
Tsunamis: Seismic and Meteorological

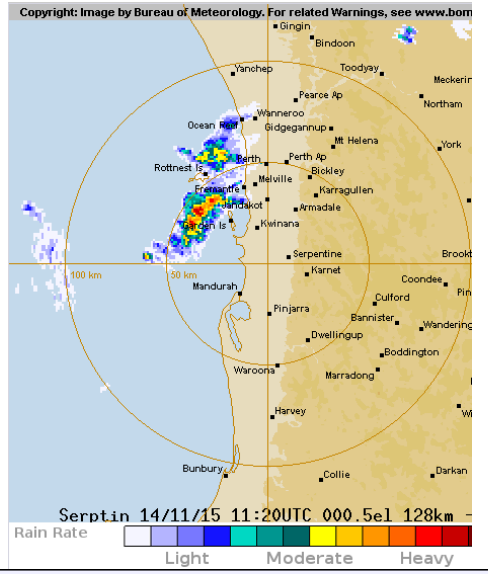


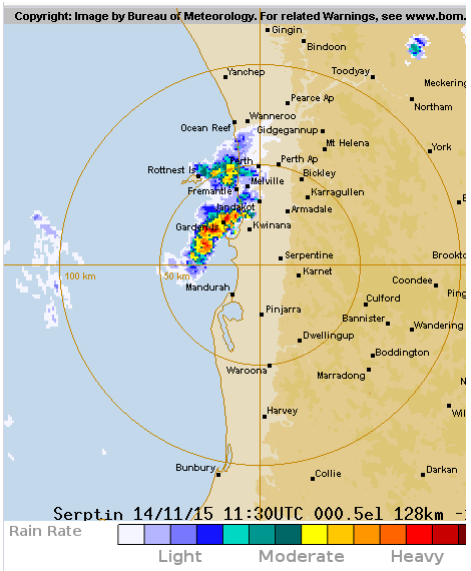
Meteotsunami

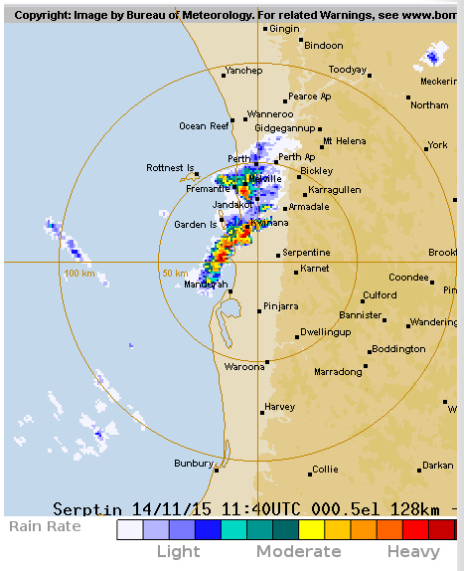
Perth region: 14 November 2015: 1145 UTC

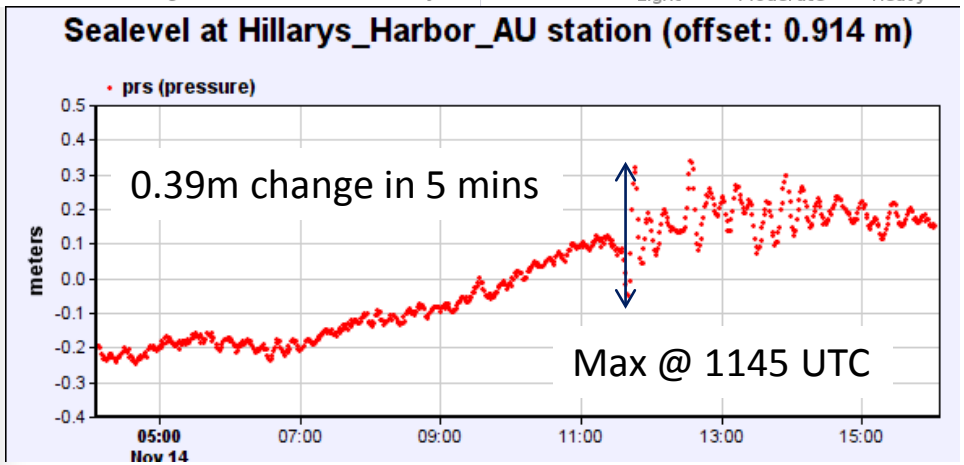
Meteotsunami – Perth region: 14 November 2015: 1145 UTC

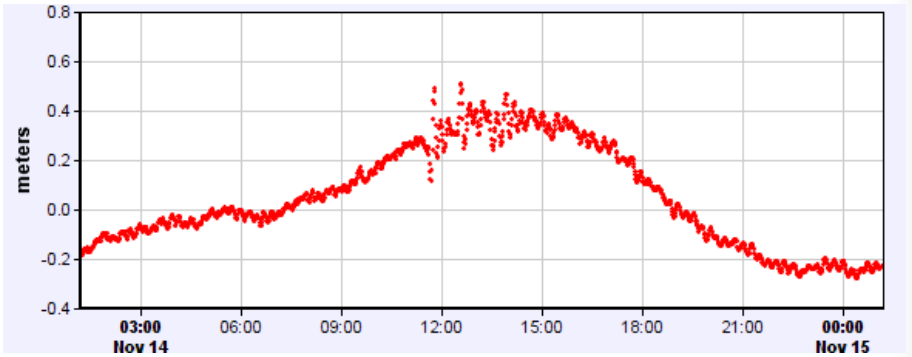


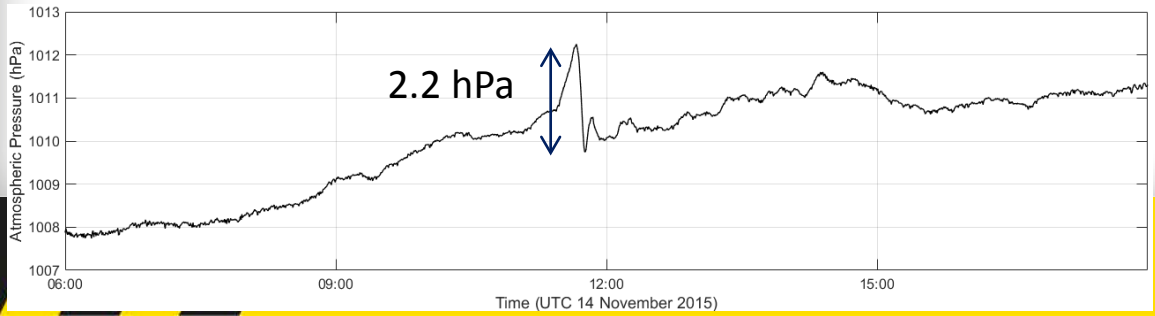






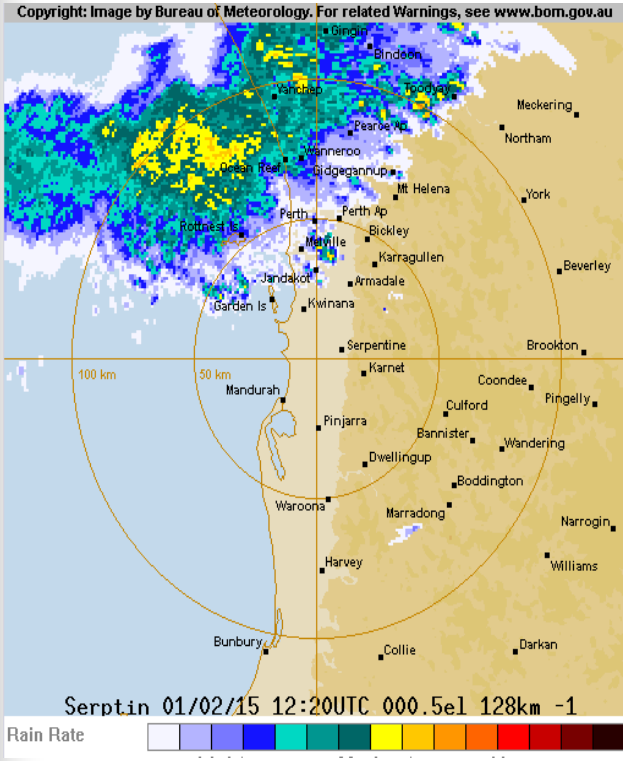


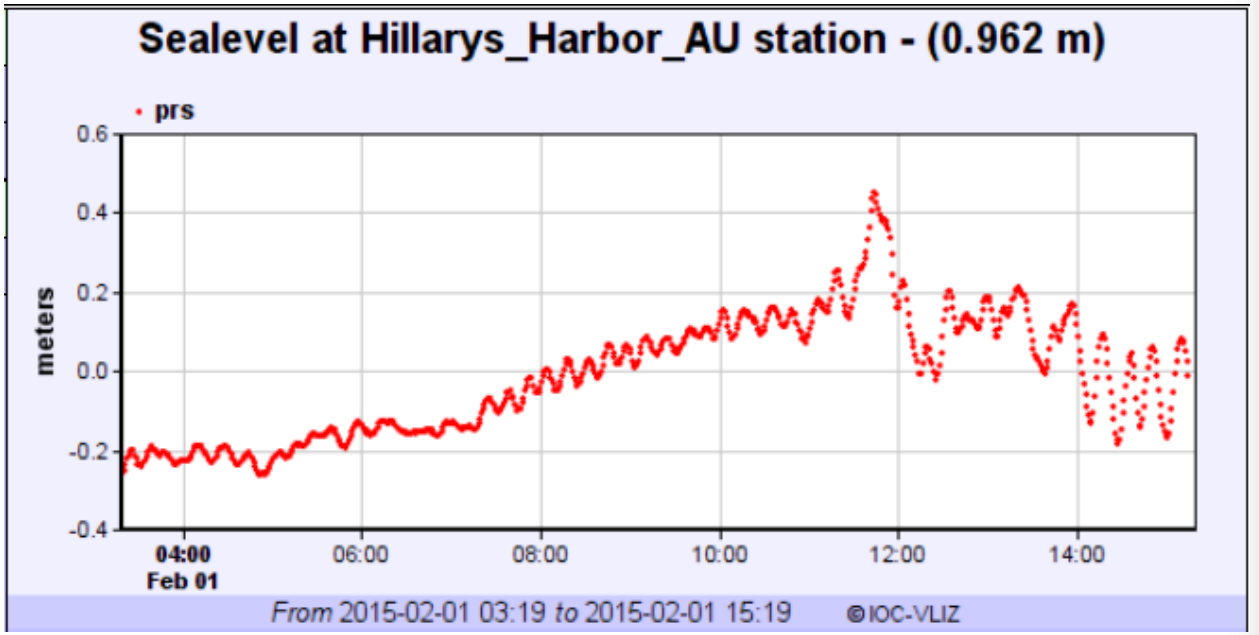




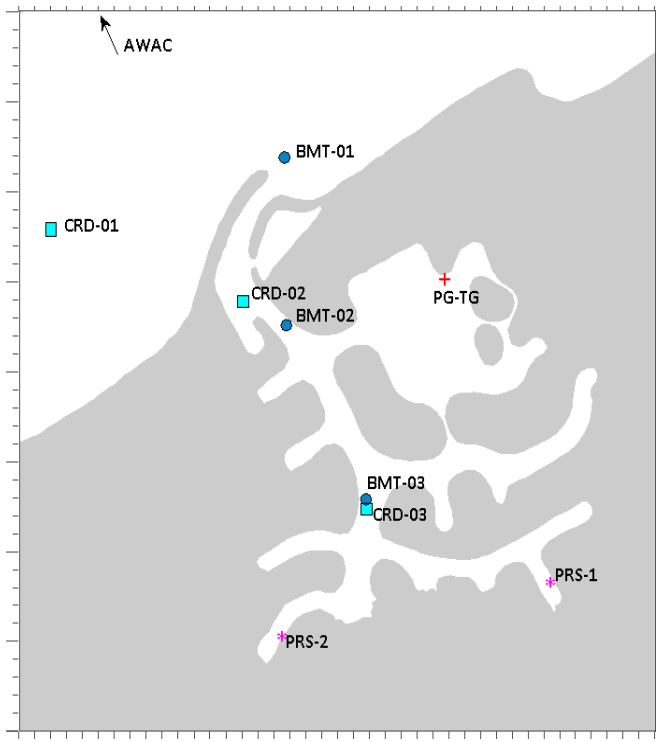
Meteotsunami

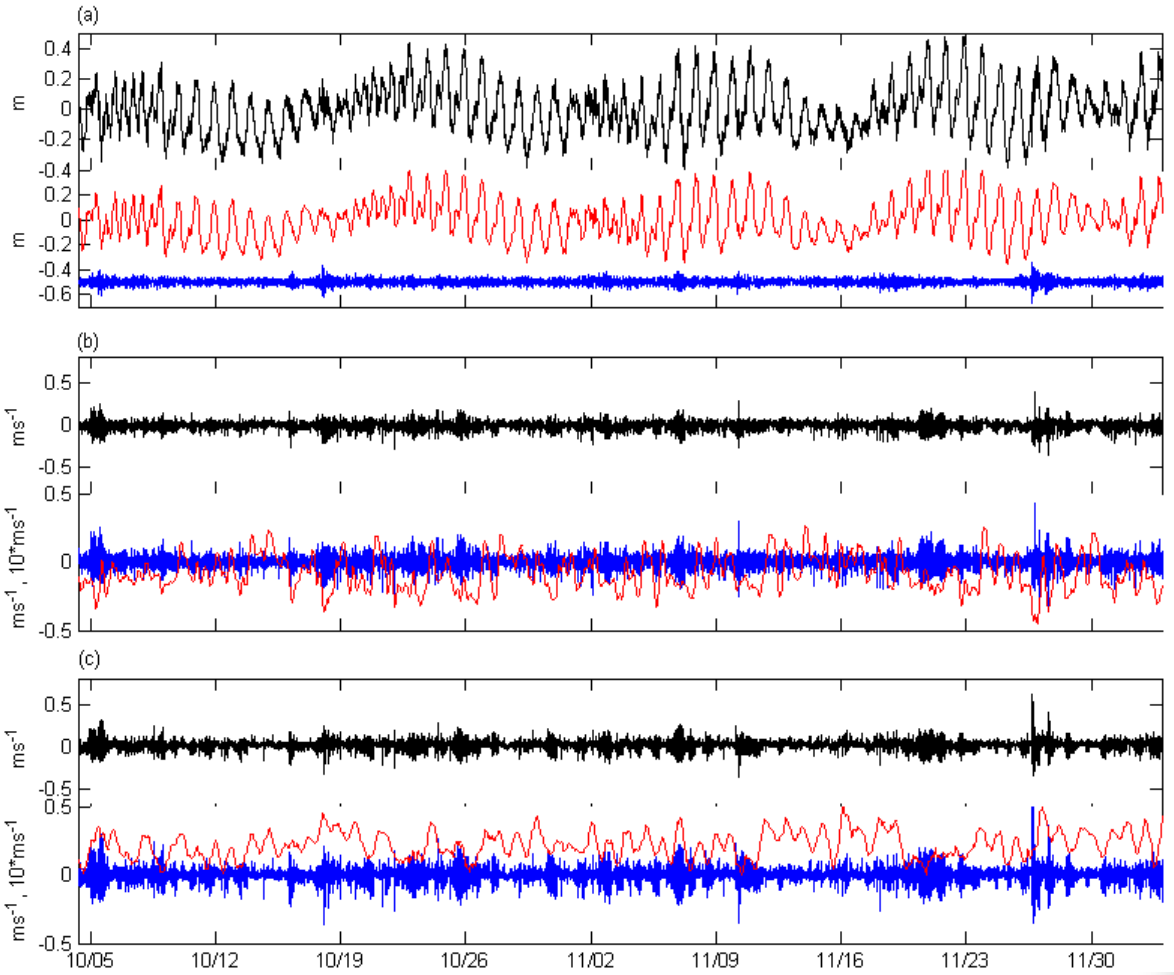
Perth region: 1 February 2015: 1210 UTC



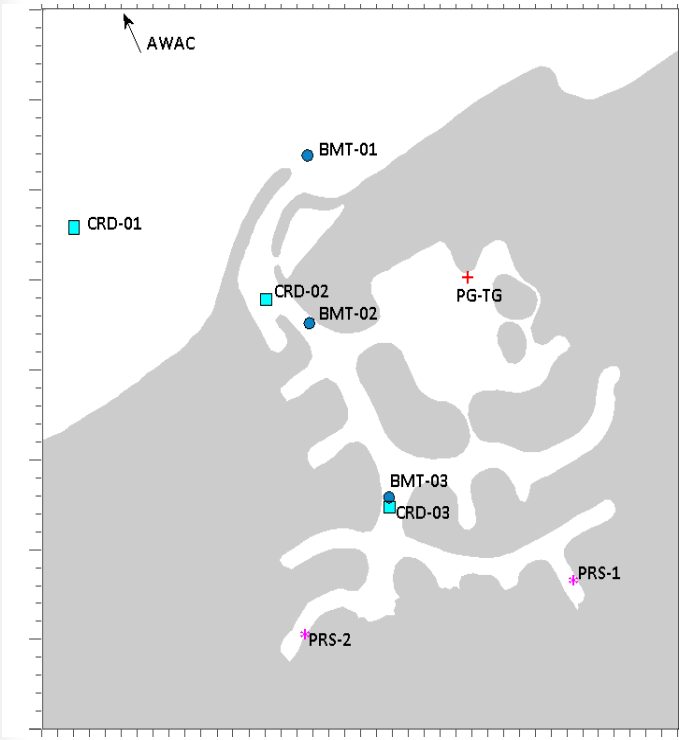


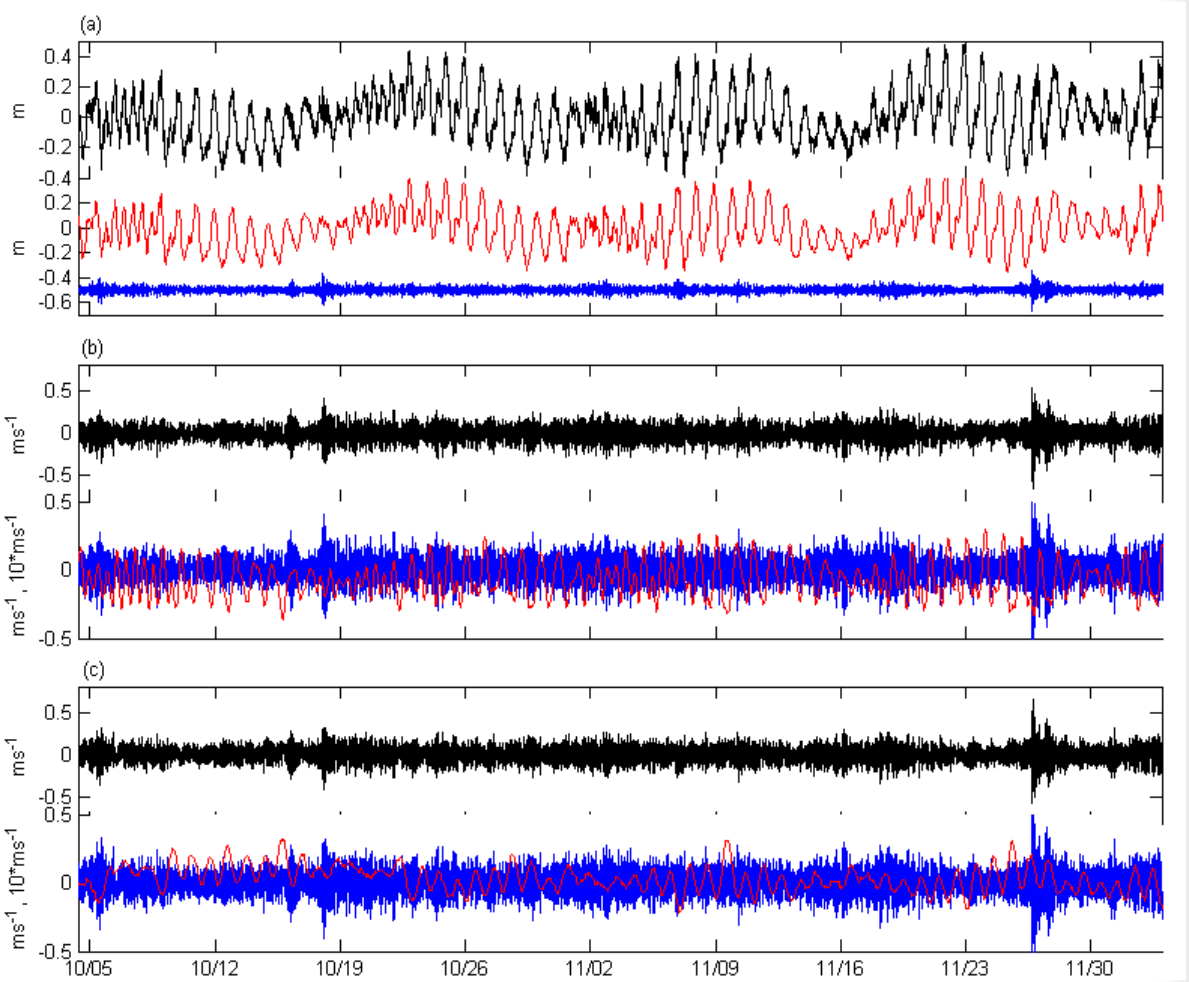
Port Geographe



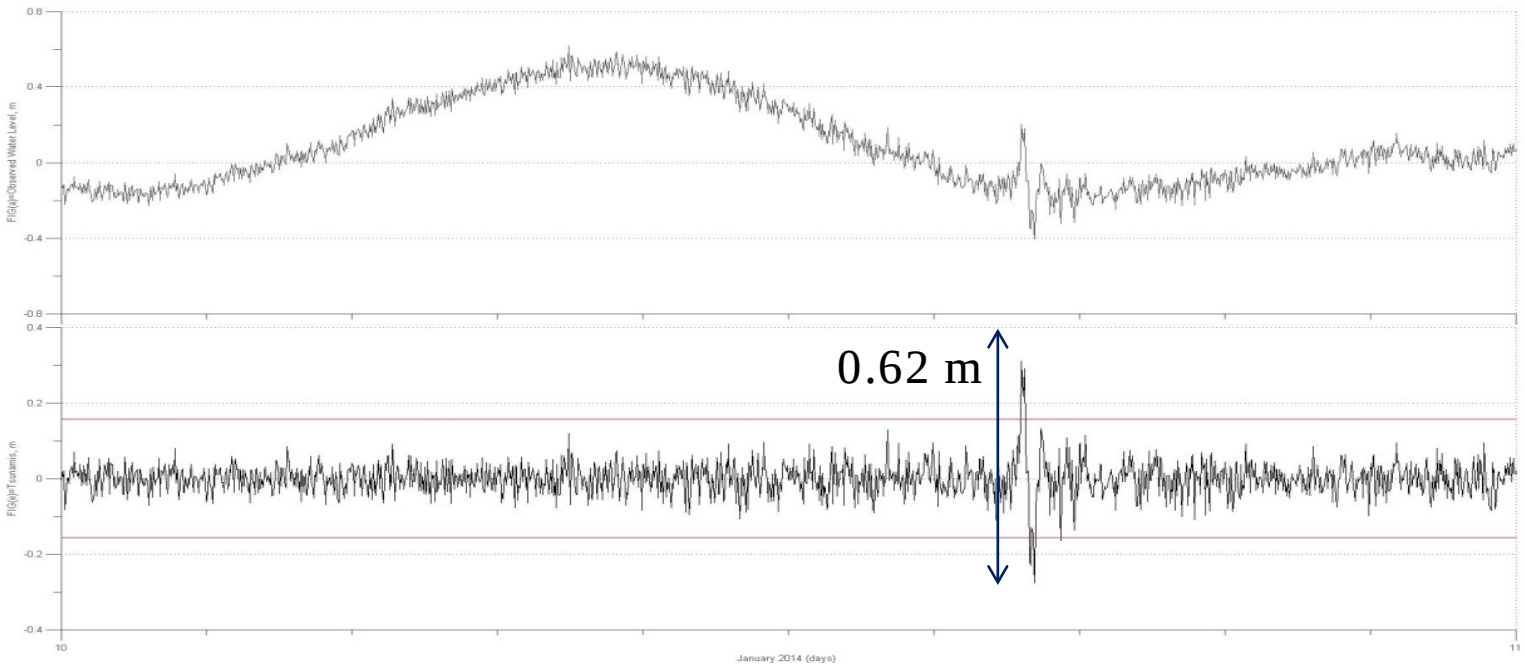


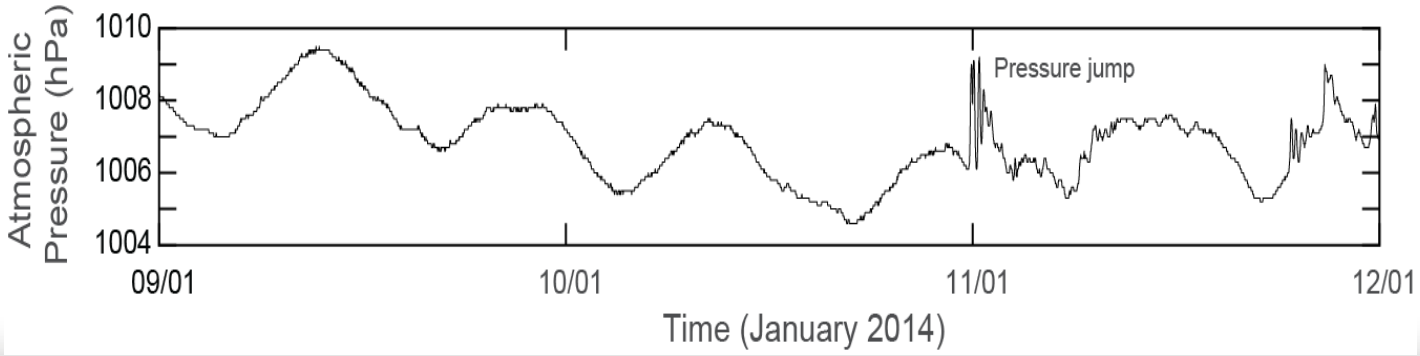
Port Geographe



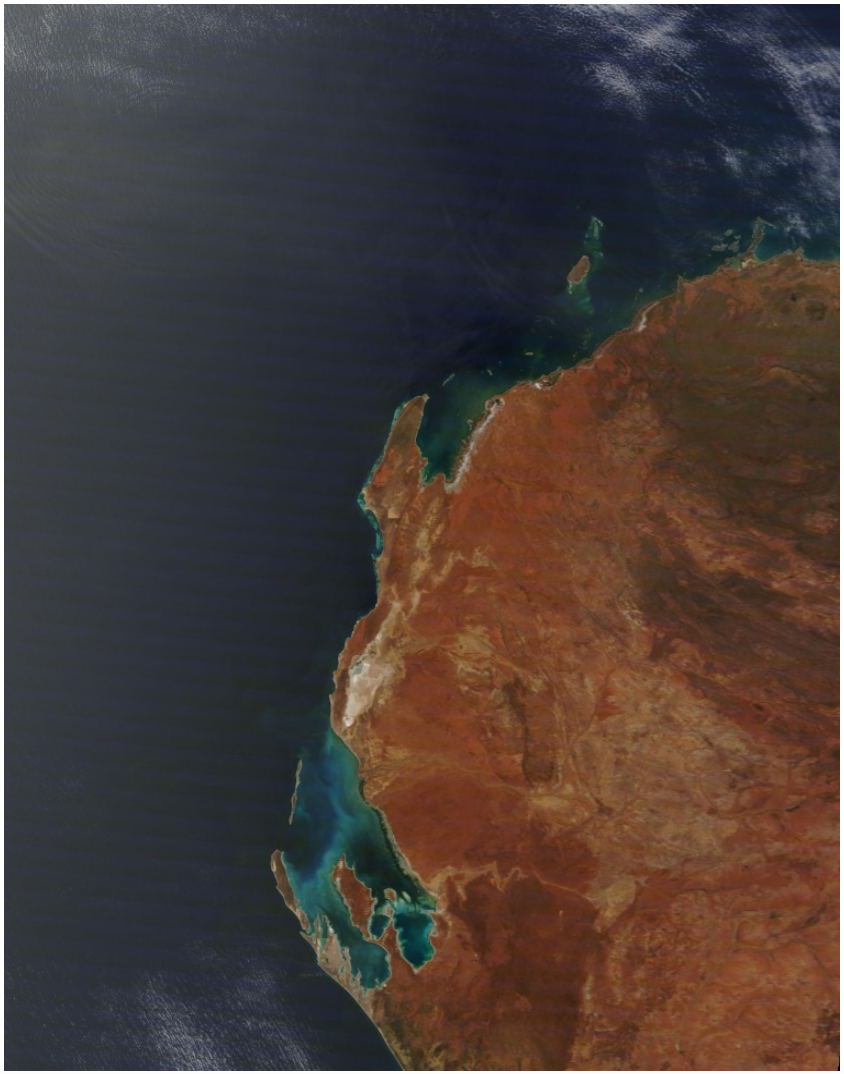


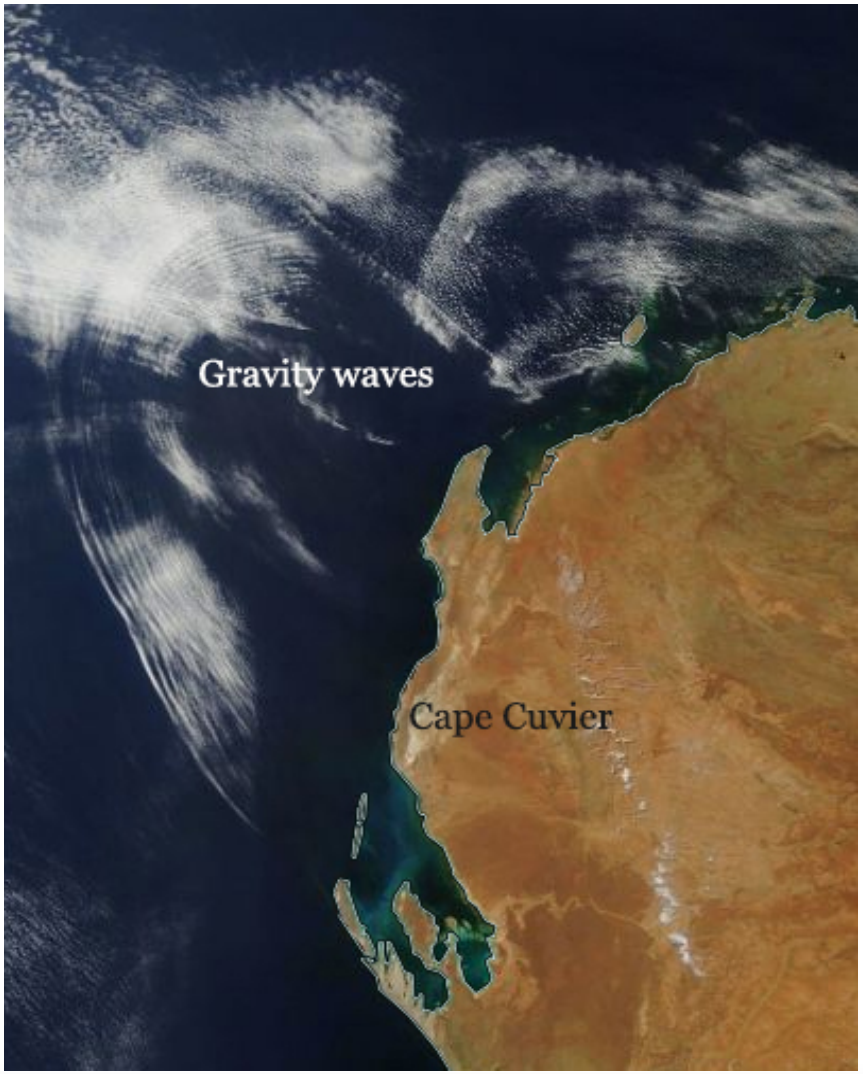
Cape Cuvier - WA



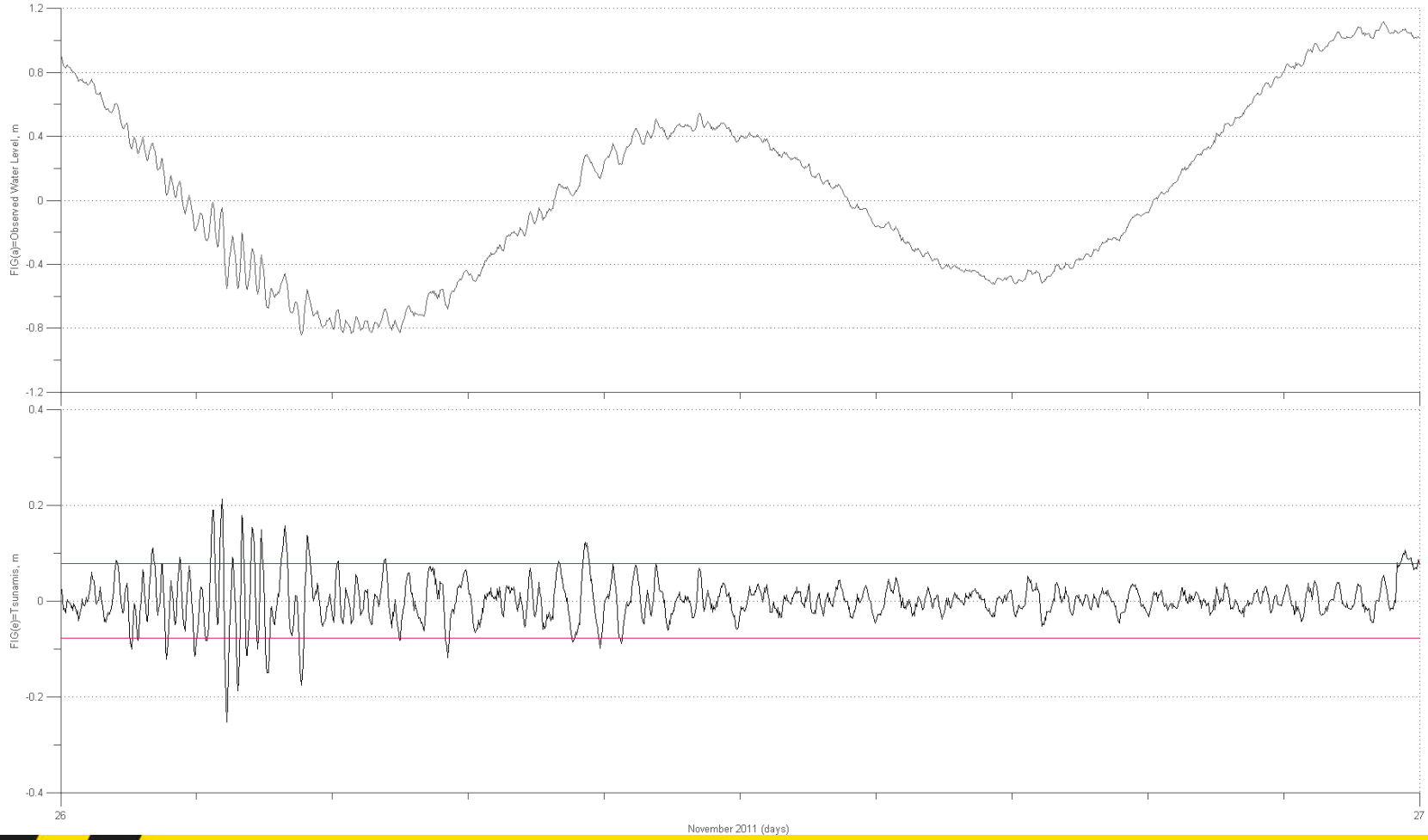


Cape Cuvier - WA

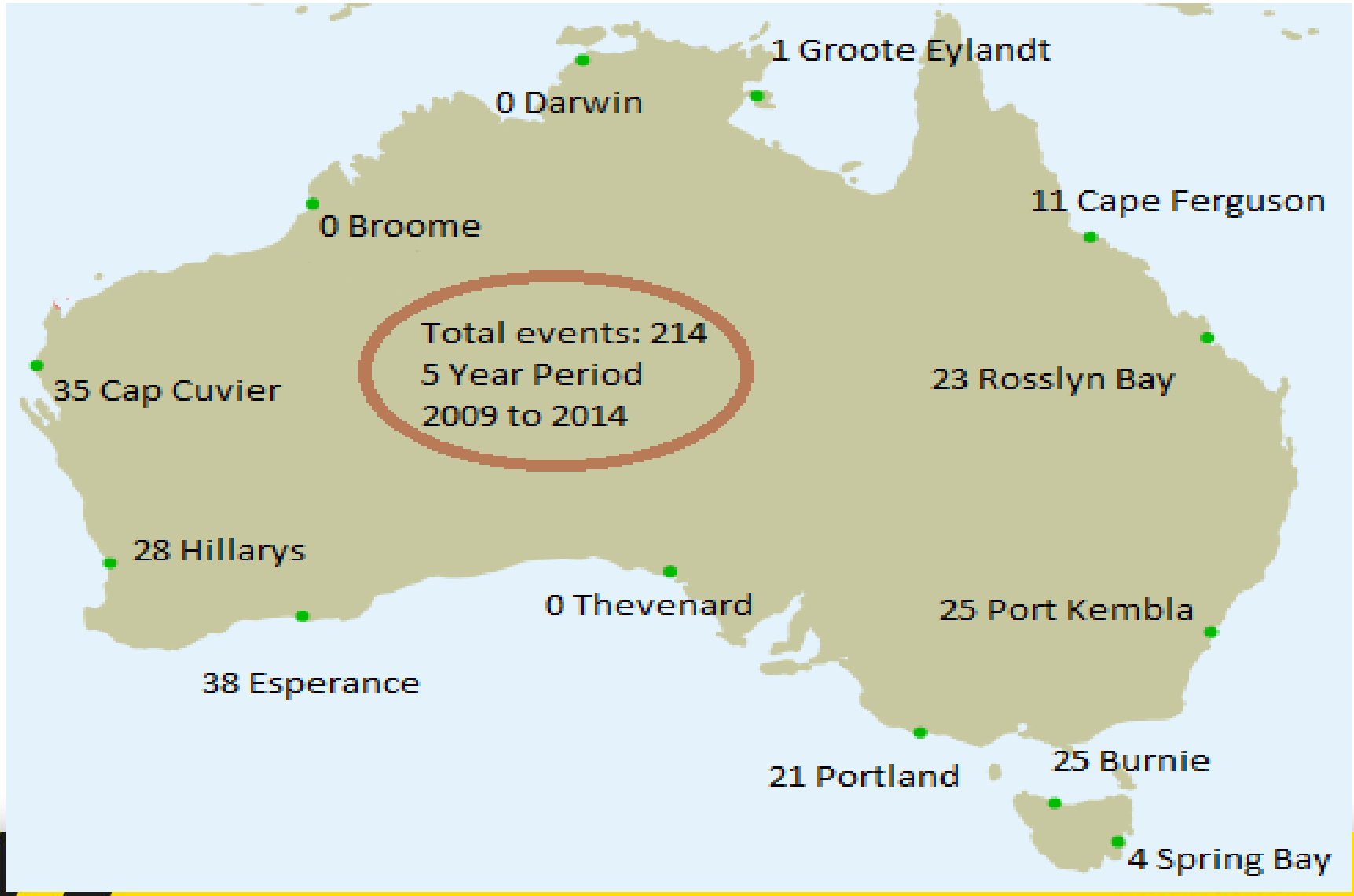




Port Kembla


1.2
0.8
0.4
0
-0.4
-0.8
-1.2
FIG(e)=Observed Water Level, m
0.4
0.2
0
-0.2
-0.4
FIG(e)=Tsunamis, m
26
27
November 2011 (days)

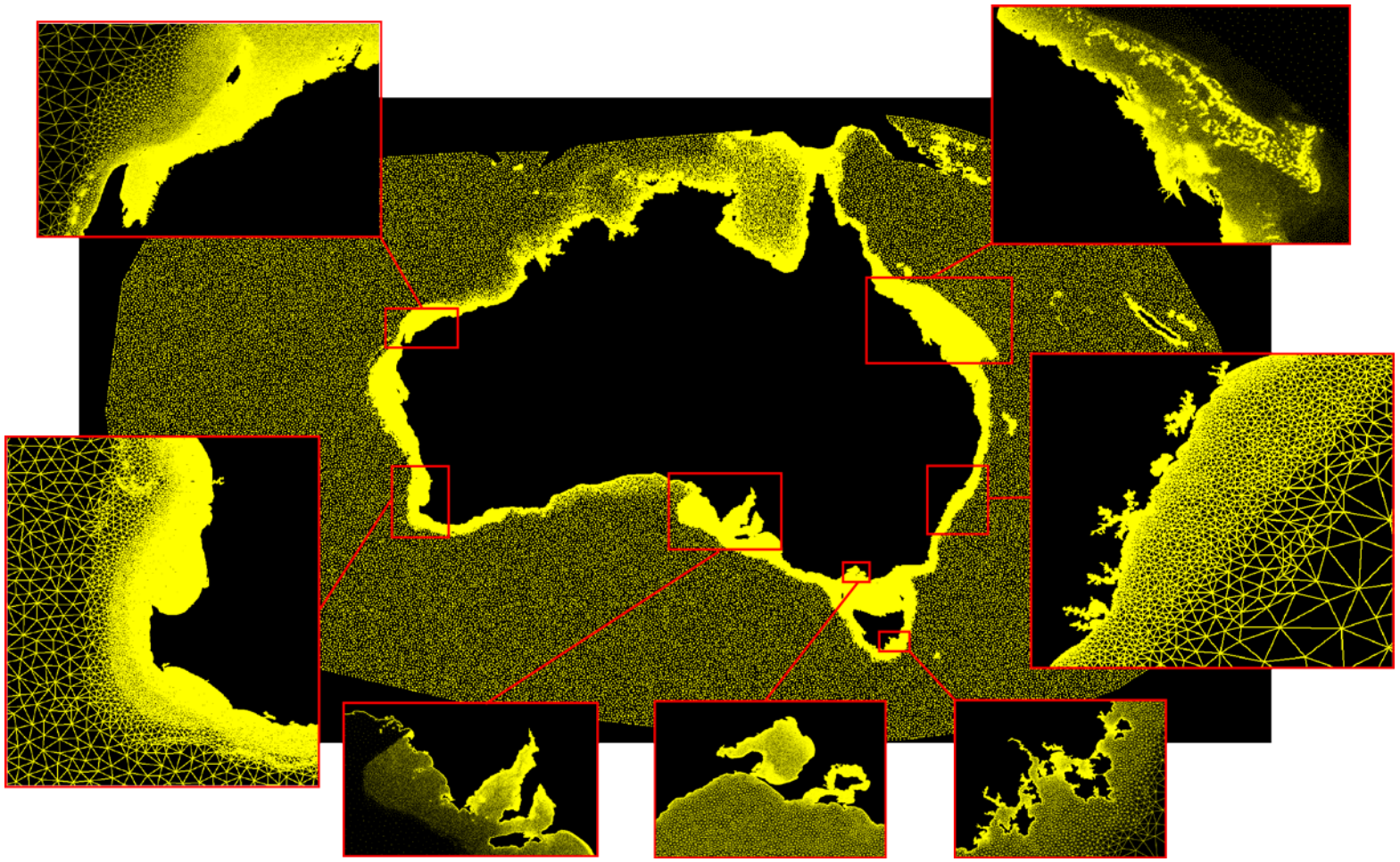
Meteotsunami events around Australia

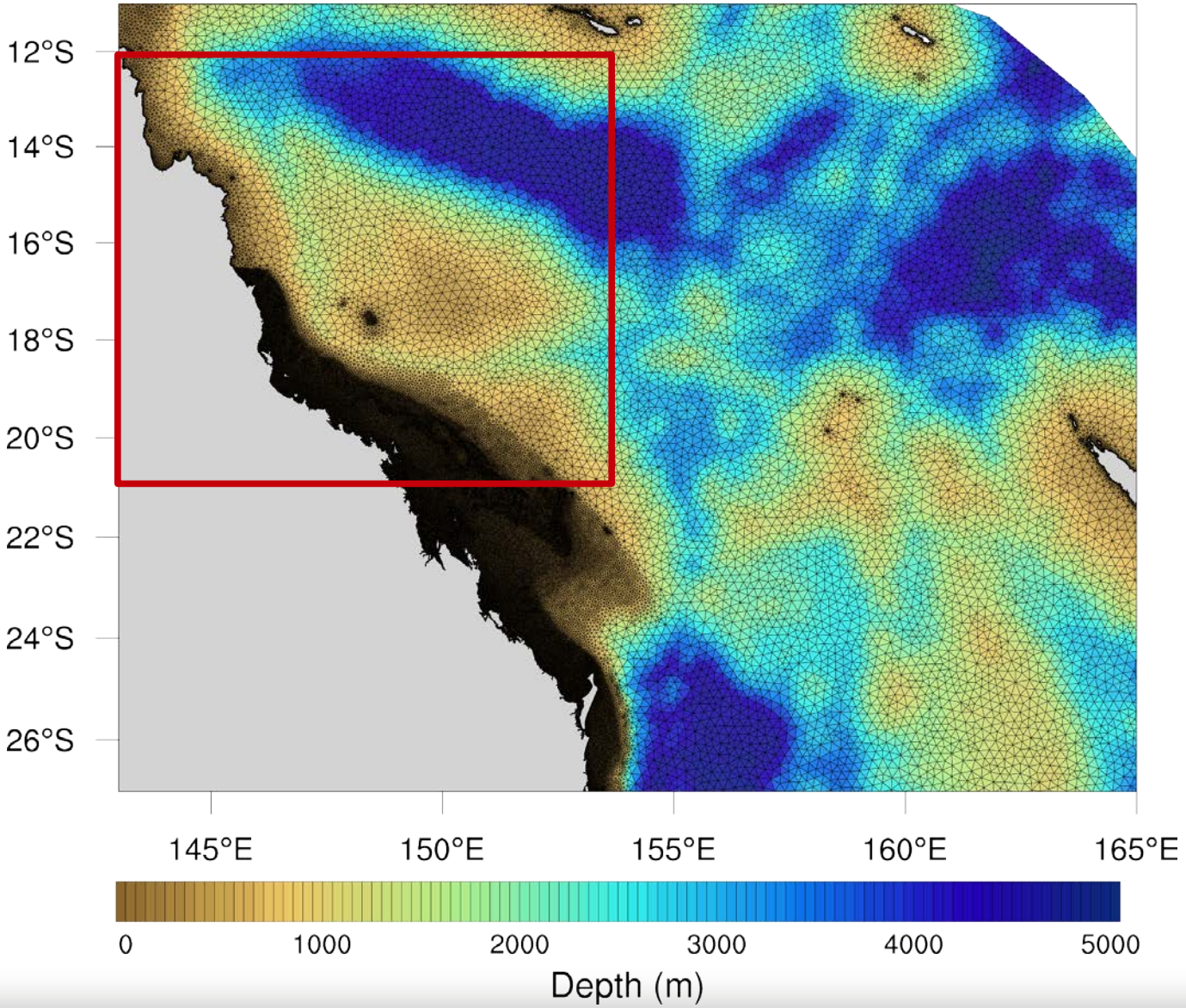


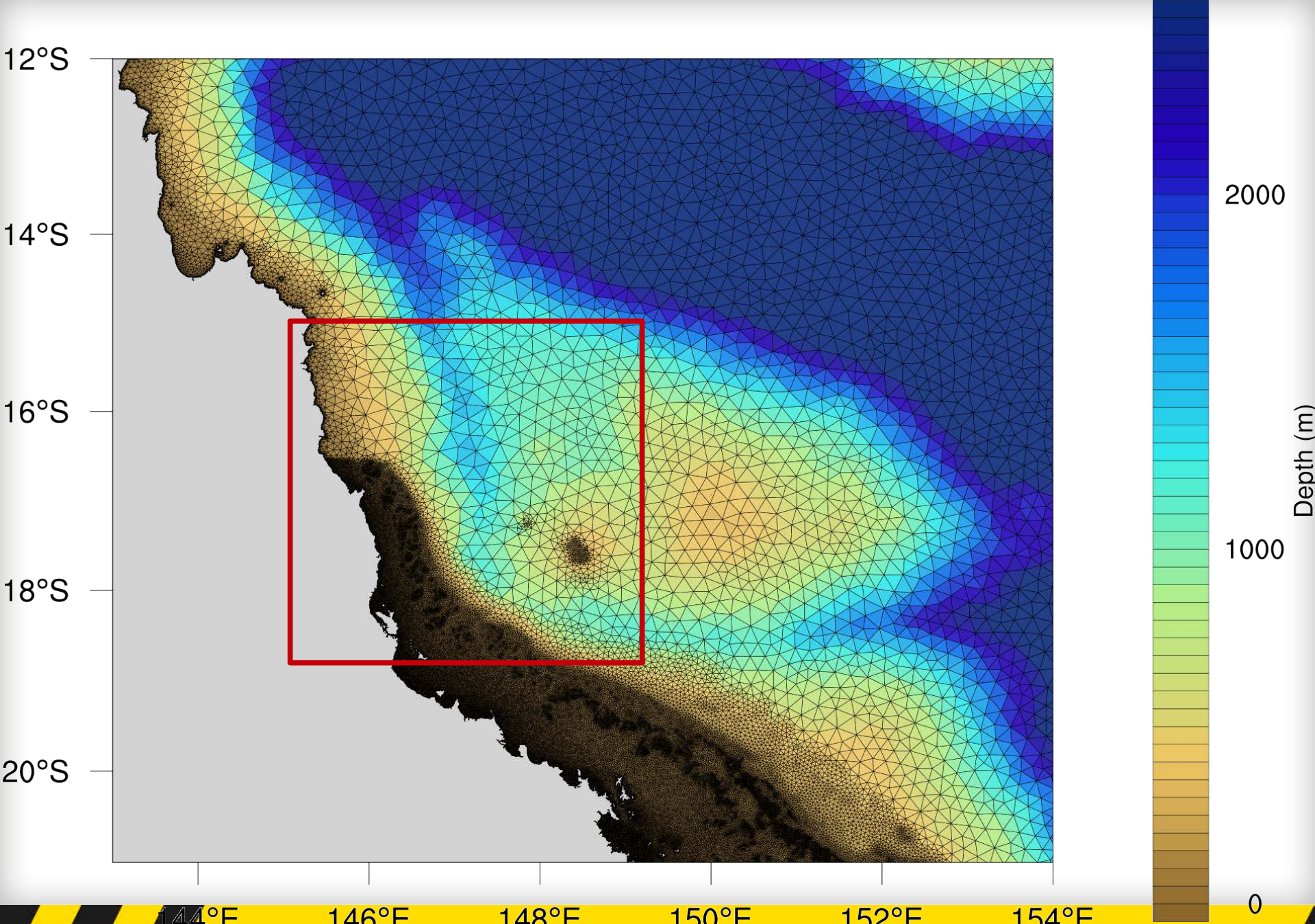
Potential Meteotsunami Events 5 years (2009 to 2014)

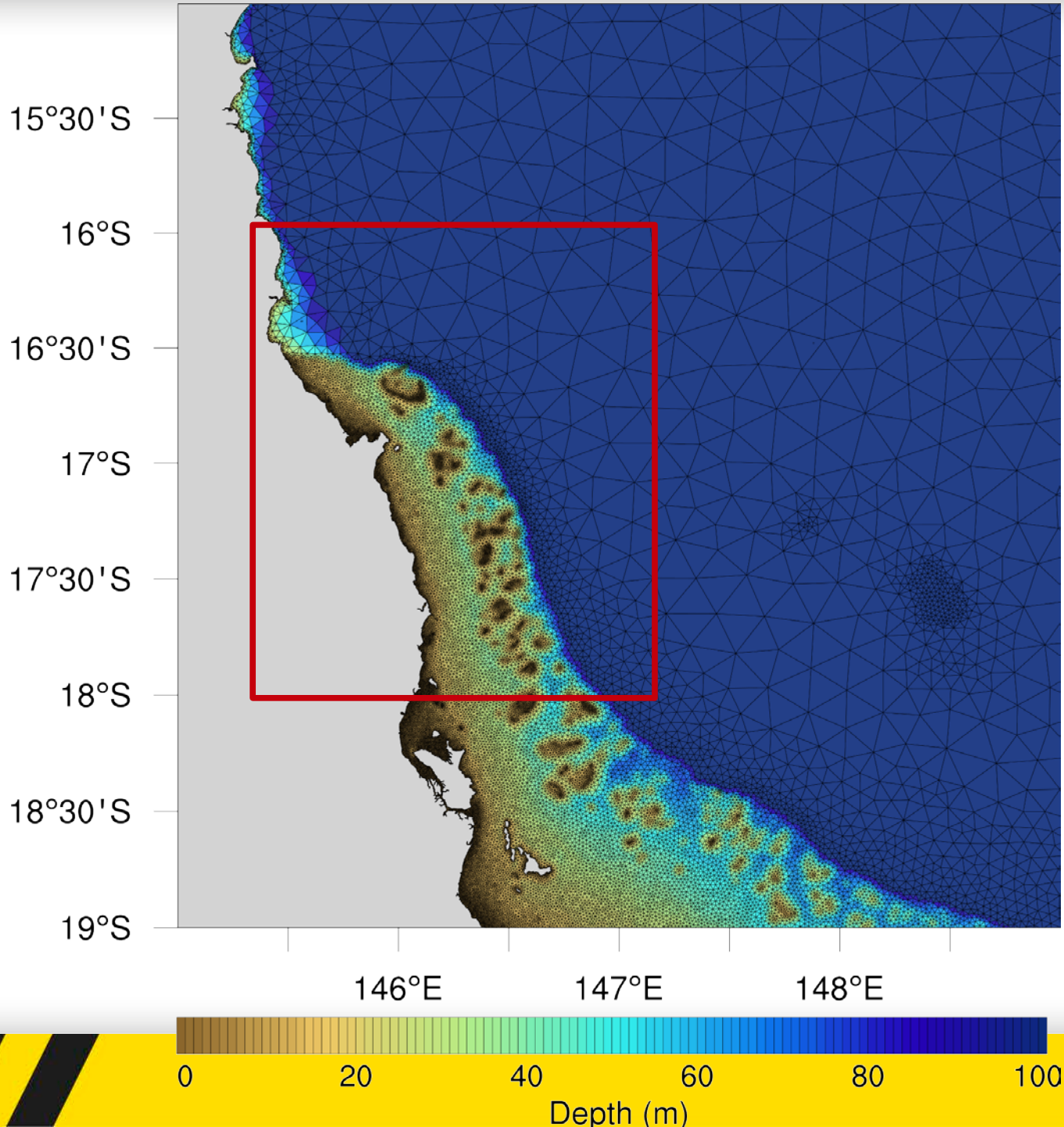
Station	Total Number of Events	Events with H > 40cm	Max H (cm)
Spring Bay, TA	4	1	50
Burnie, TA	25	4	46
Portland, VIC	21	5	60
Thevenard, SA	0	0	0
Esperance, WA	38	27	97
Hillarys Harbor, WA	28	6	48
Cape Cuvier Wharf, WA	35	32	146
Broome, WA	0	0	0
Darwin, NT	0	0	0
Groote Eylandt, NT	1	0	18
Cape Ferguson, QLD	11	0	30
Rosslyn Bay, QLD	23	2	50
Port Kembla, NSW	25	3	60

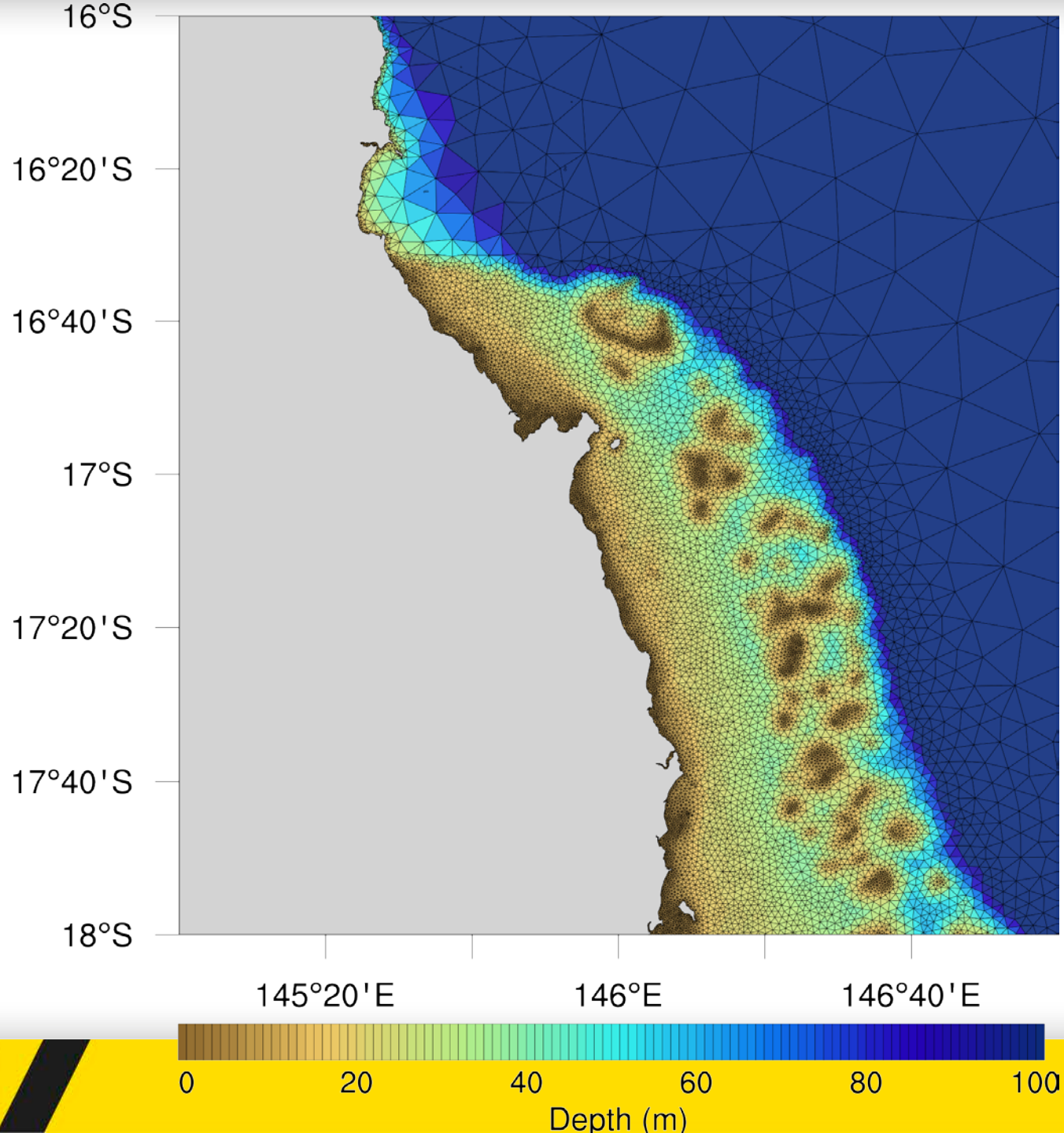
COUPLED WAVE-SURGE MODEL

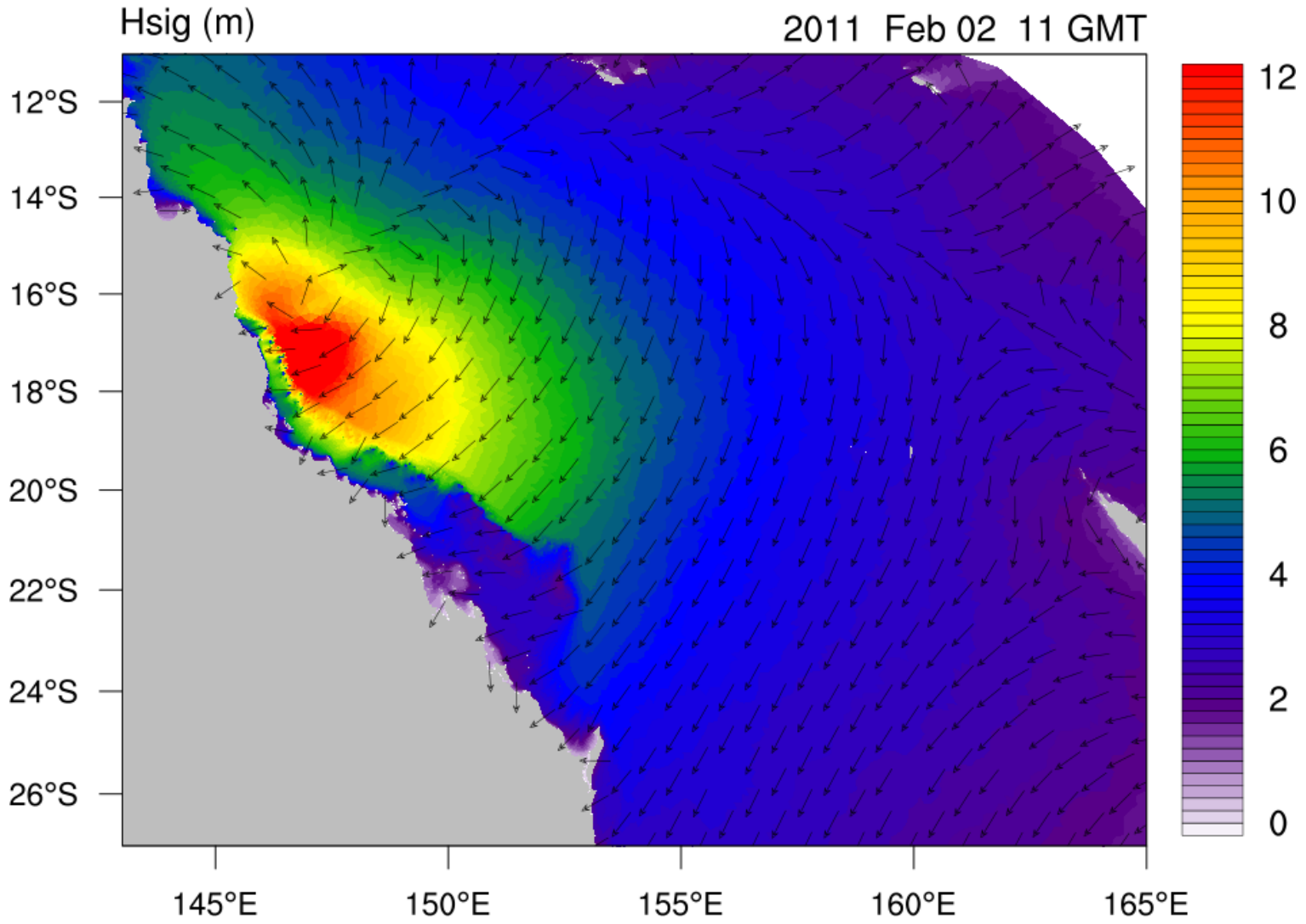


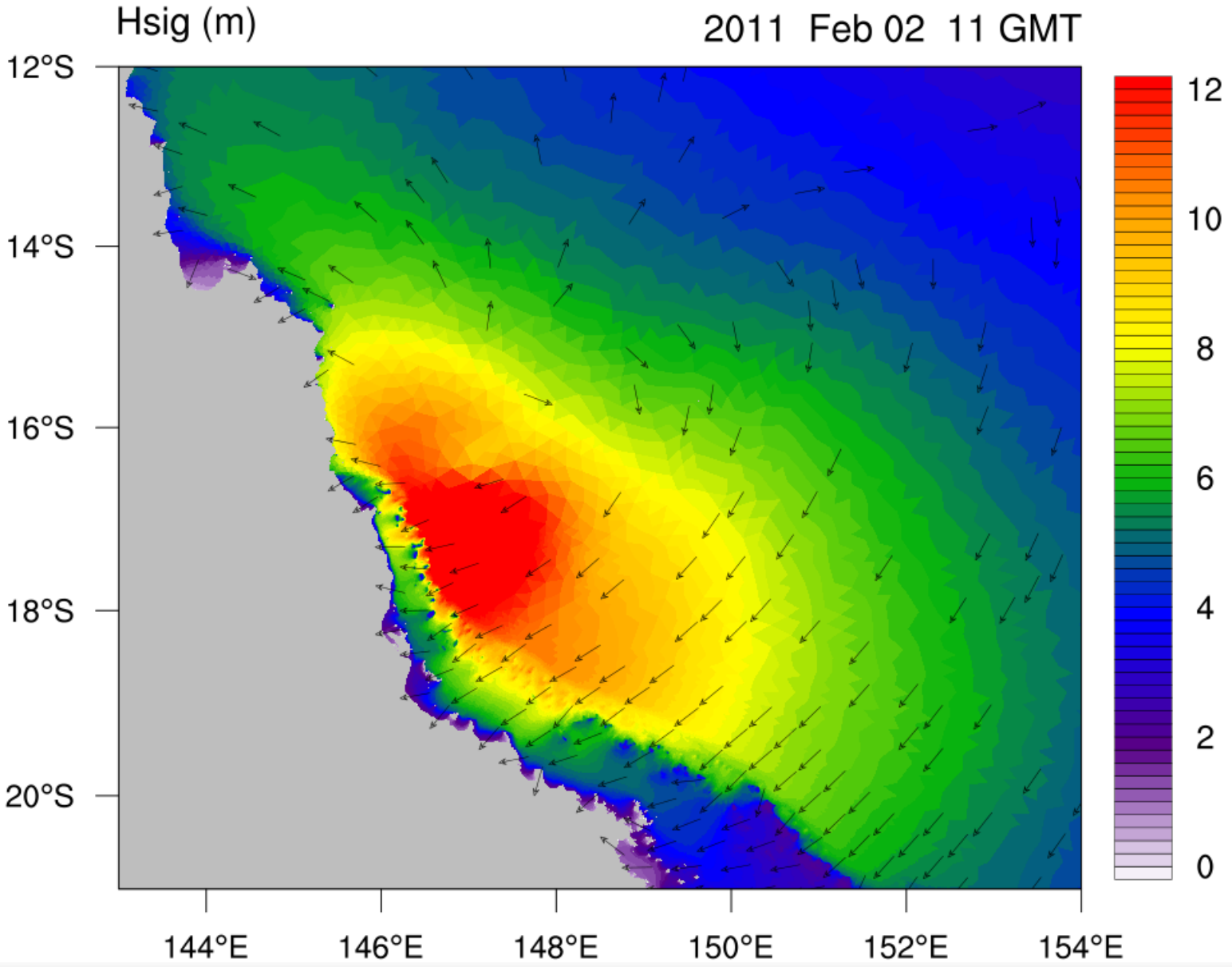

12°S
14°S
16°S
18°S
20°S
22°S
24°S
26°S
145°E
150°E
155°E
160°E
165°E
0
1000
2000
3000
4000
5000
Depth (m)

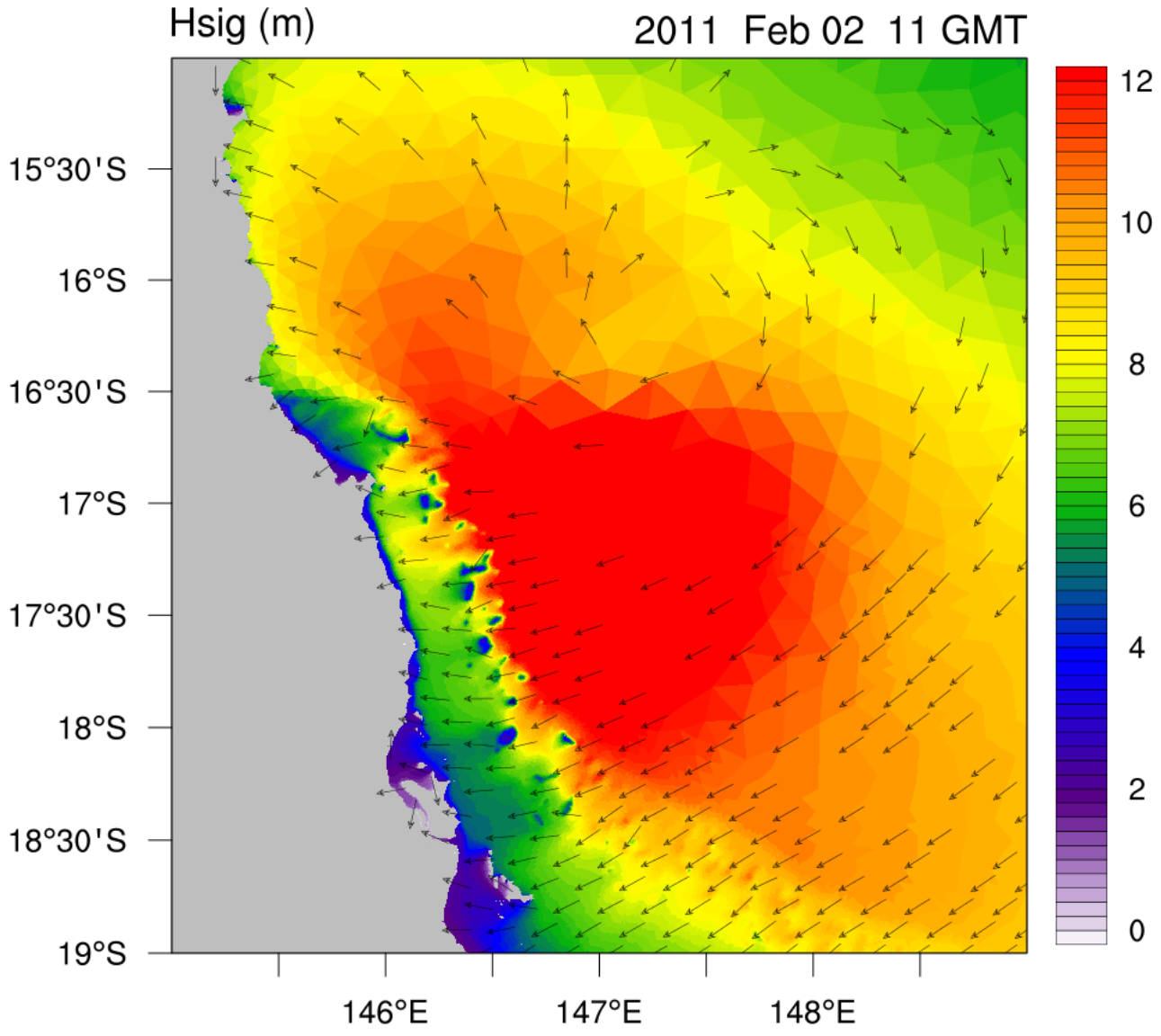

12°S
14°S
16°S
18°S
20°S
144°E
146°E
148°E
150°E
152°E
154°E
2000
1000
0
Depth (m)

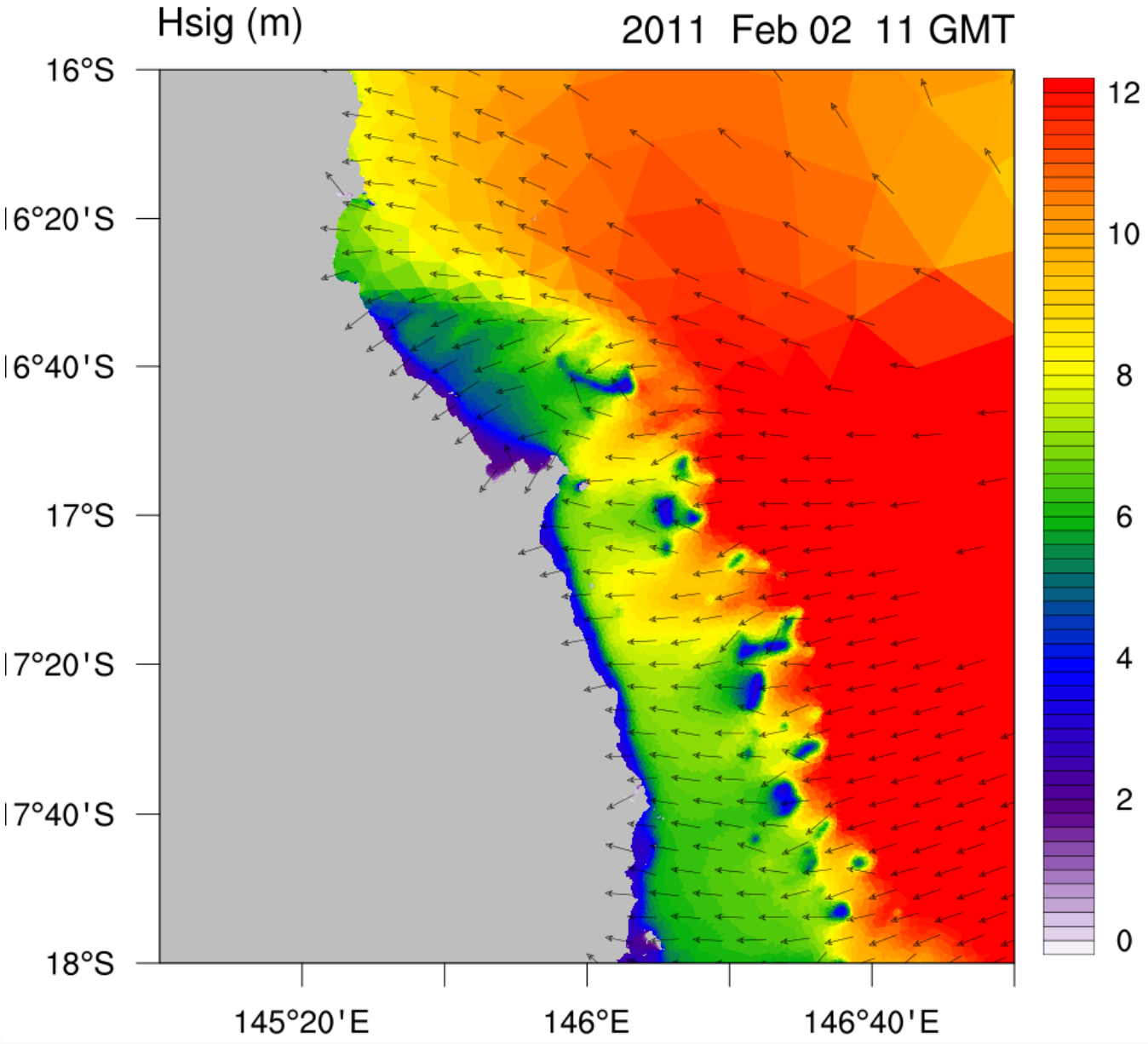

15°30'S
16°S
16°30'S
17°S
17°30'S
18°S
18°30'S
19°S
146°E
147°E
148°E
0
20
40
60
80
100
Depth (m)

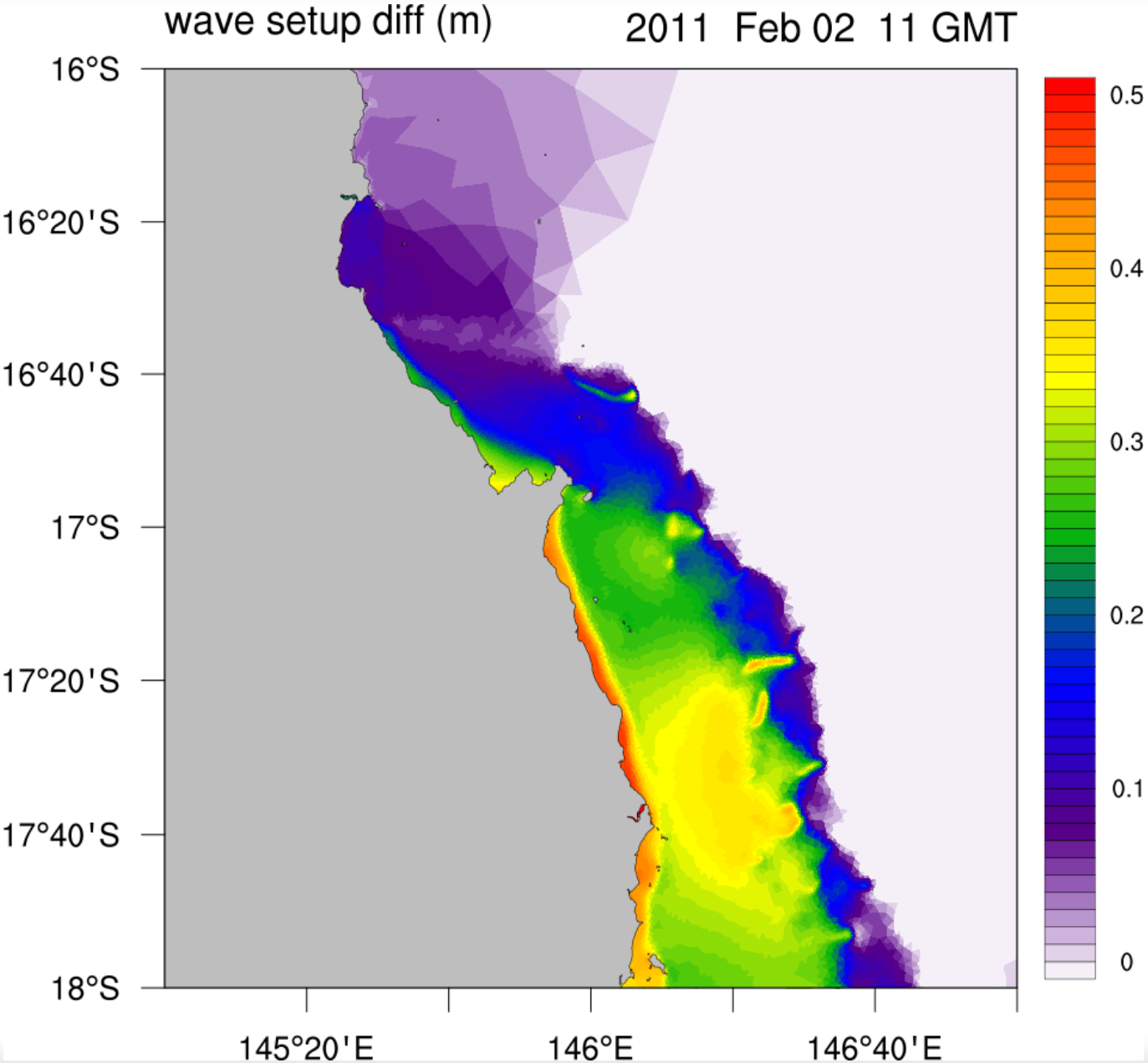

16°S
16°20'S
16°40'S
17°S
17°20'S
17°40'S
18°S
145°20'E
146°E
146°40'E
0
20
40
60
80
100
Depth (m)


Hsig (m)
2011 Feb 02 11 GMT
12°S
14°S
16°S
18°S
20°S
22°S
24°S
26°S
145°E
150°E
155°E
160°E
165°E
12
10
8
6
4
2
0

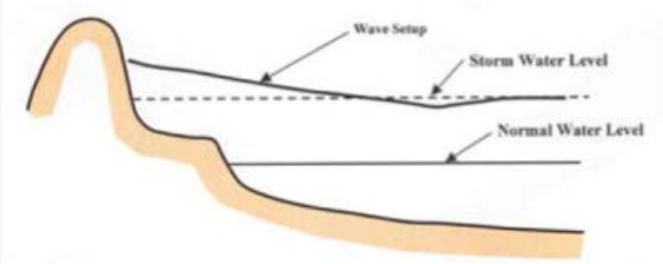

Hsig (m)
2011 Feb 02 11 GMT
12°S
14°S
16°S
18°S
20°S
144°E
146°E
148°E
150°E
152°E
154°E
12
10
8
6
4
2
0


Hsig (m)
2011 Feb 02 11 GMT
15°30'S
16°S
16°30'S
17°S
17°30'S
18°S
18°30'S
19°S
146°E
147°E
148°E
12
10
8
6
4
2
0


Hsig (m)
2011 Feb 02 11 GMT
16°S
16°20'S
16°40'S
17°S
17°20'S
17°40'S
18°S
145°20'E
146°E
146°40'E
12
10
8
6
4
2
0

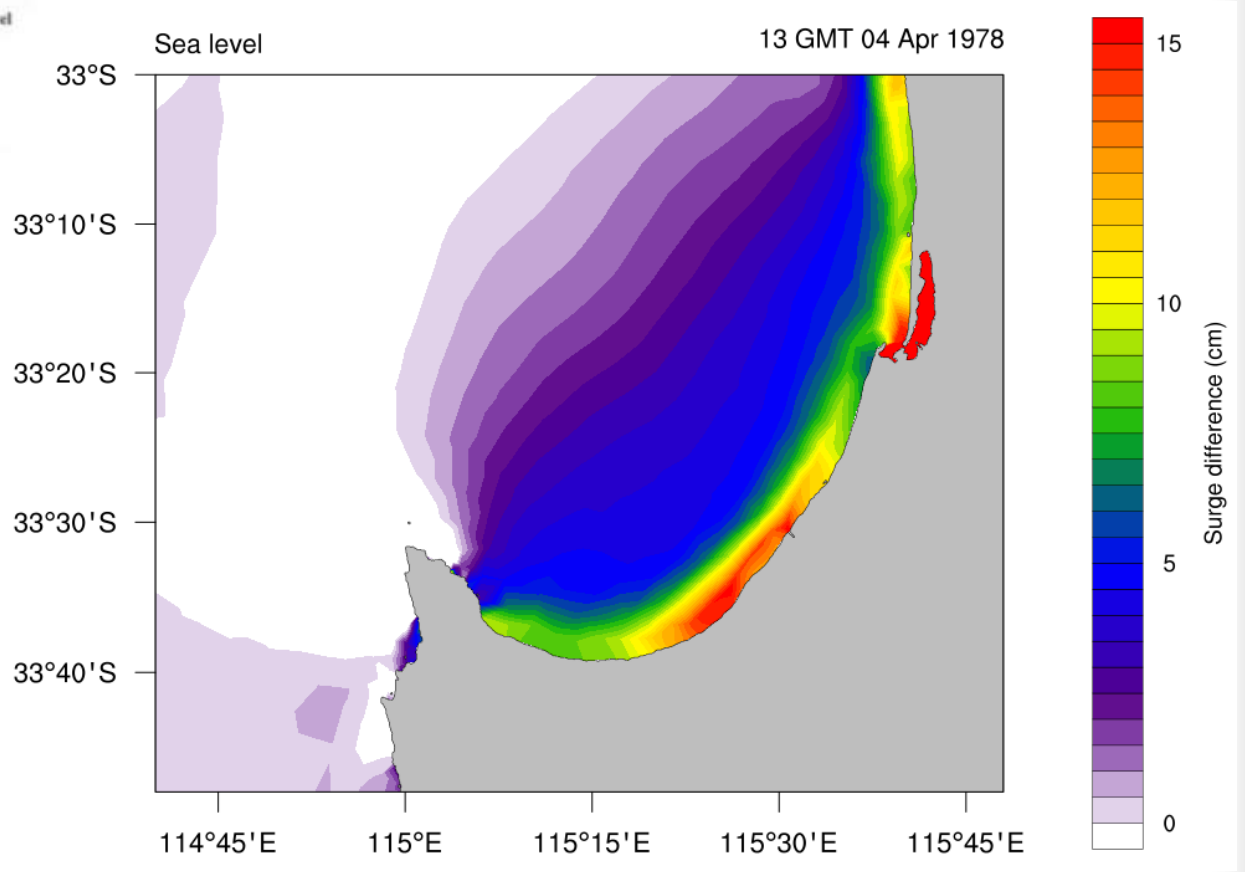

wave setup diff (m)
2011 Feb 02 11 GMT
16°S
16°20'S
16°40'S
17°S
17°20'S
17°40'S
18°S
145°20'E
146°E
146°40'E
0.5
0.4
0.3
0.2
0.1
0

WAVE EFFECTS

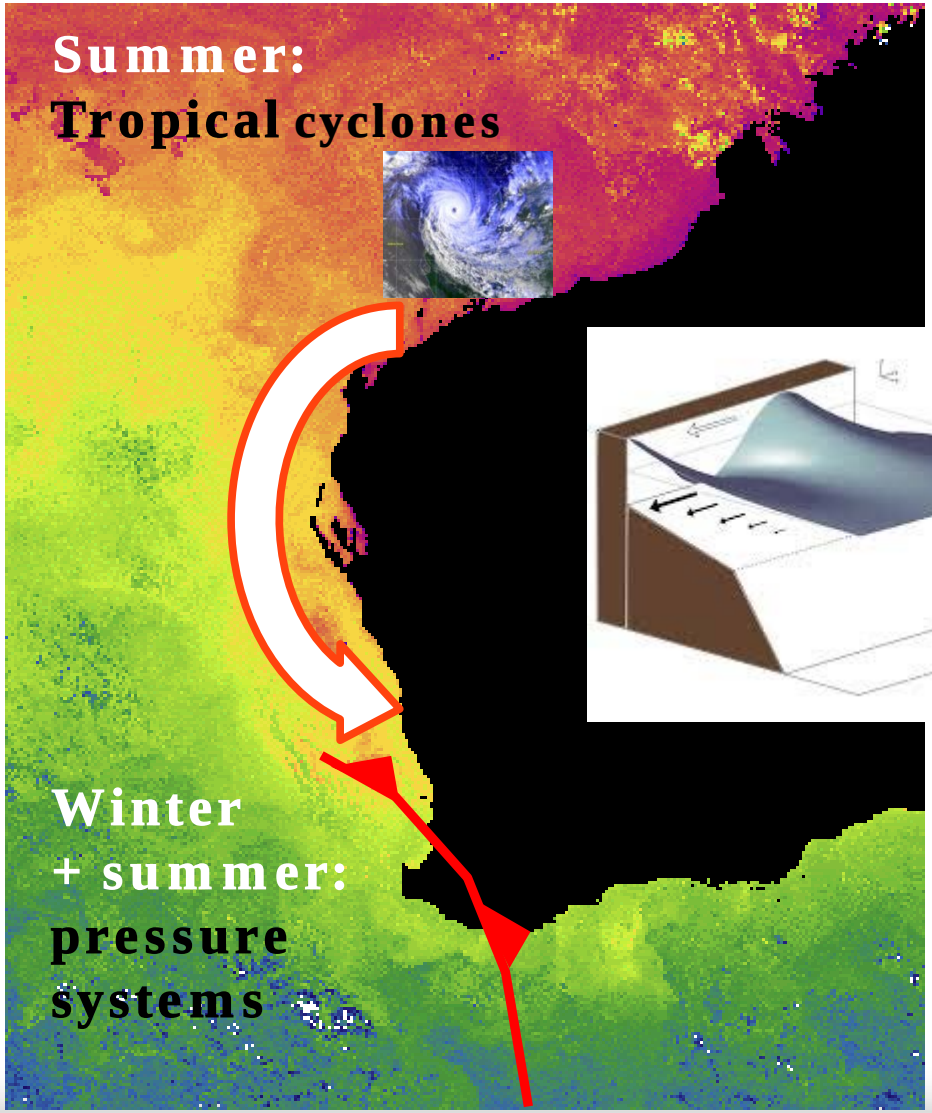


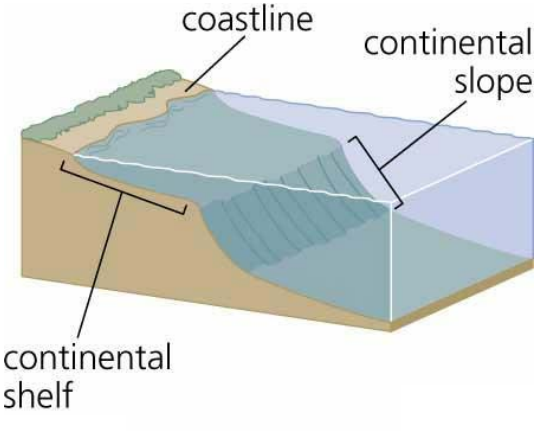
Increase in water level near the coast due to the presence of waves

~10-50% difference in surge height when waves included in simulation



COASTALLY TRAPPED WAVES

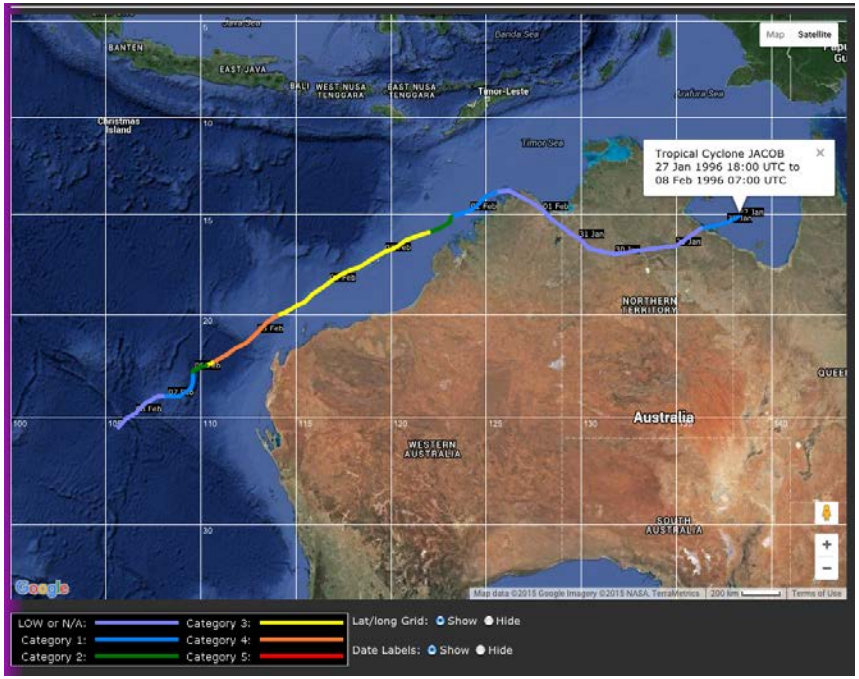




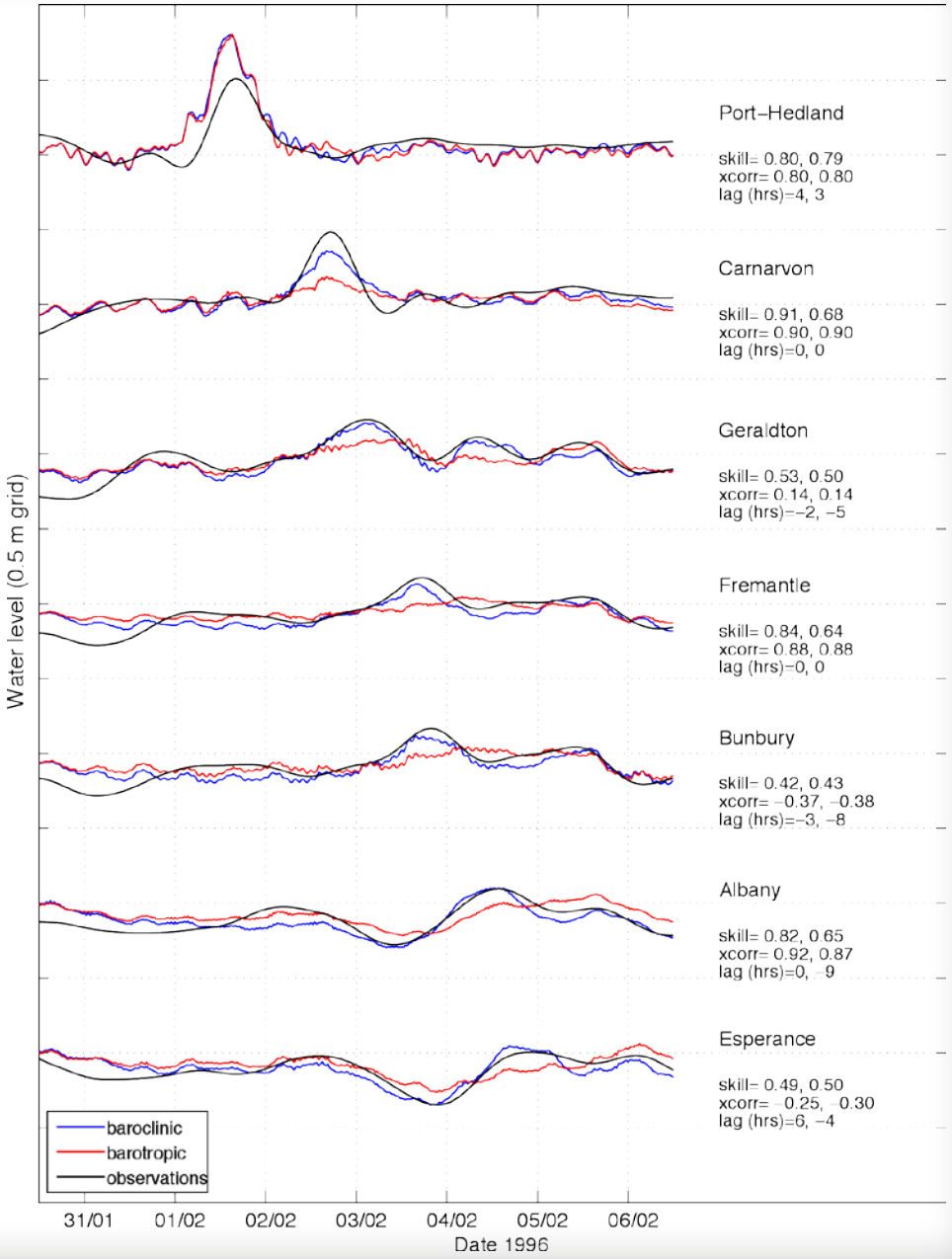
speed ~ 5m/s (~L)
periods ~ days to week
amp decrease off the coast
strong currents ~1m

CTW --- no stratification
Kelvin wave -- > CSW

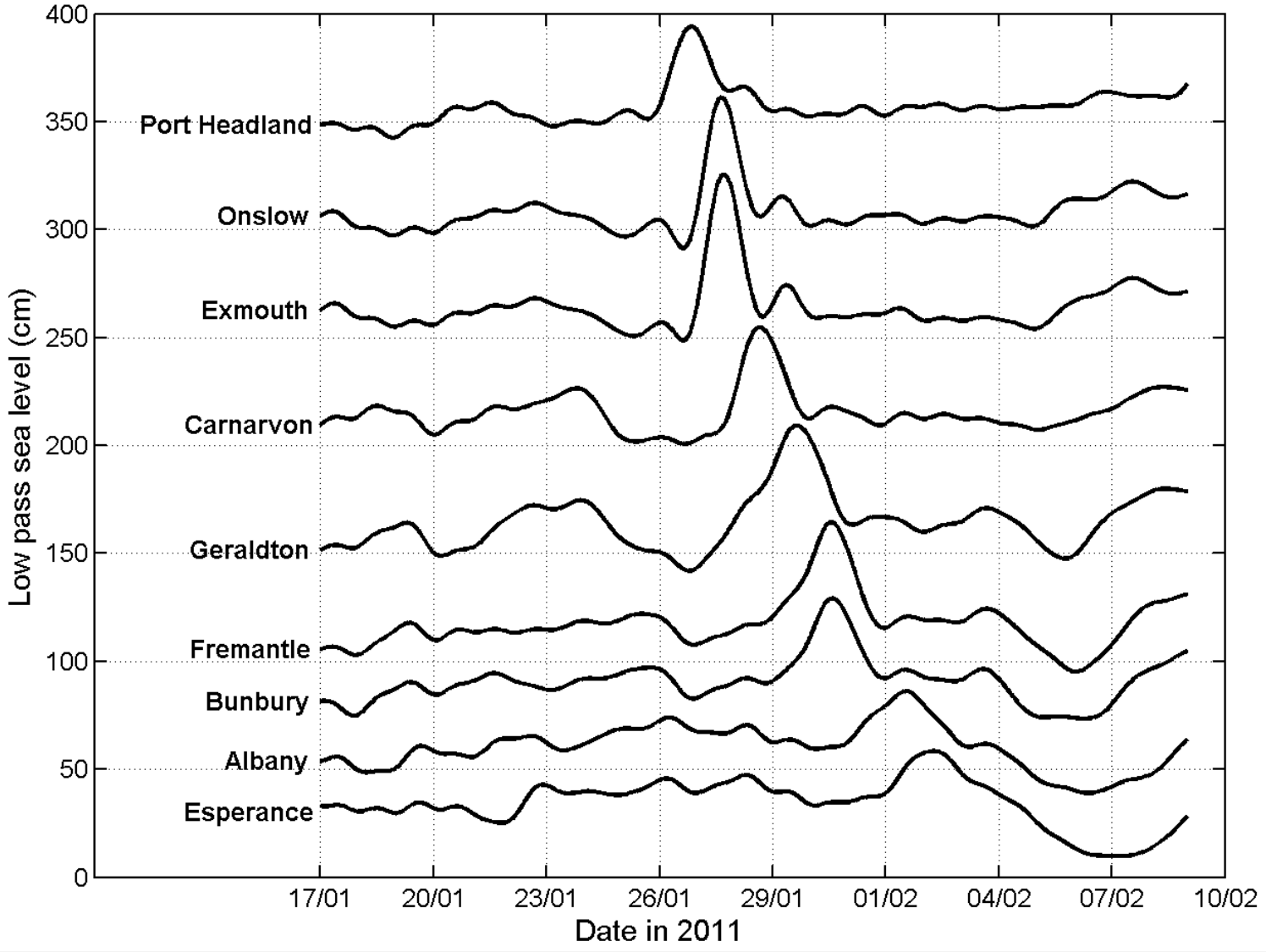
TC JACOB



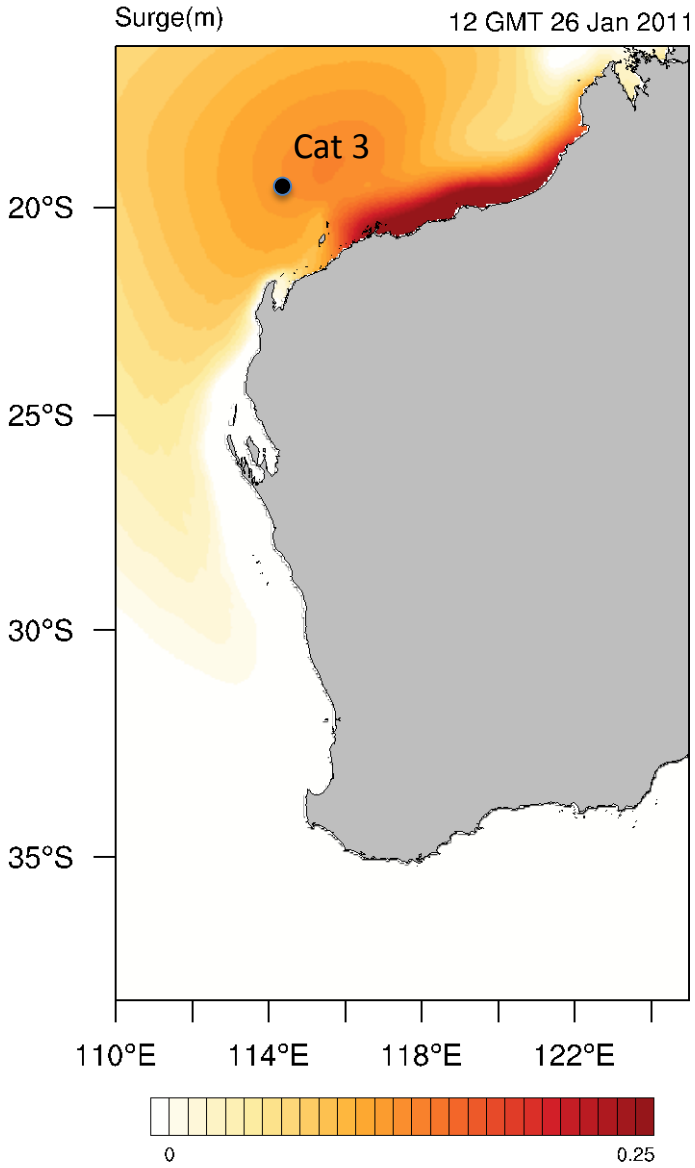
27 January - 8 February 1996



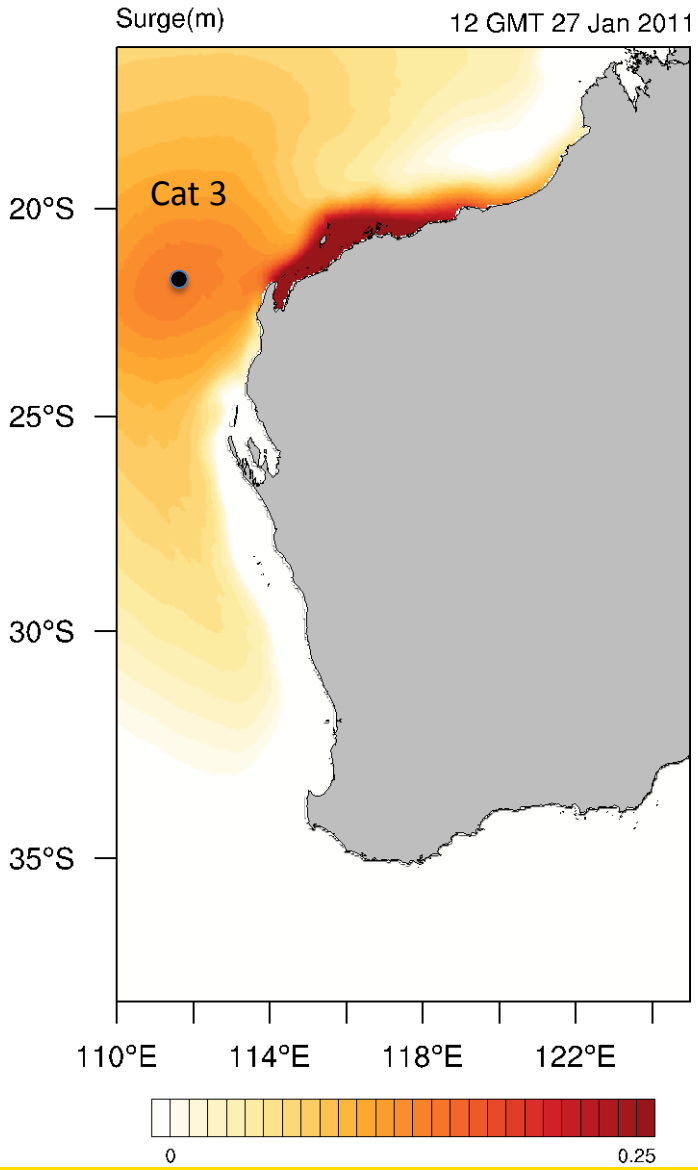
TC BIANCA


Low pass sea level (cm)
400
350
300
250
200
150
100
50
0
Port Headland
Onslow
Exmouth
Carnarvon
Geraldton
Fremantle
Bunbury
Albany
Esperance
17/01
20/01
23/01
26/01
29/01
01/02
04/02
07/02
10/02
Date in 2011

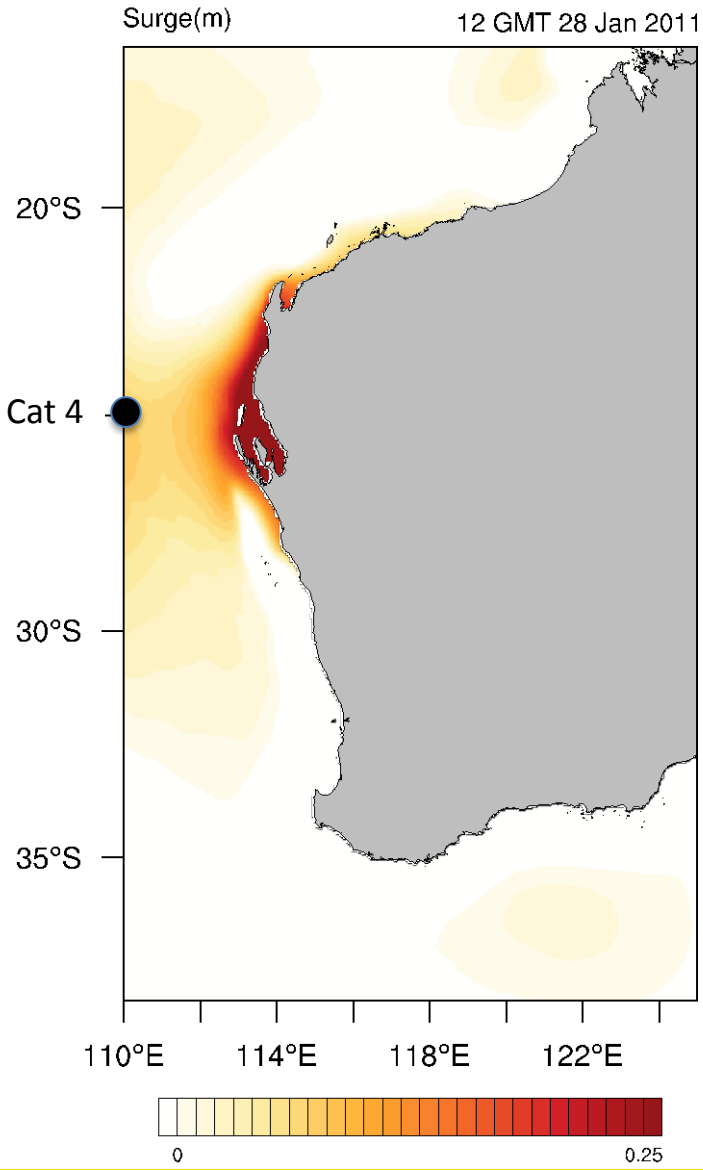
TC Bianca


Surge(m)
12 GMT 26 Jan 2011
Cat 3
20°S
25°S
30°S
35°S
110°E
114°E
118°E
122°E
0
0.25

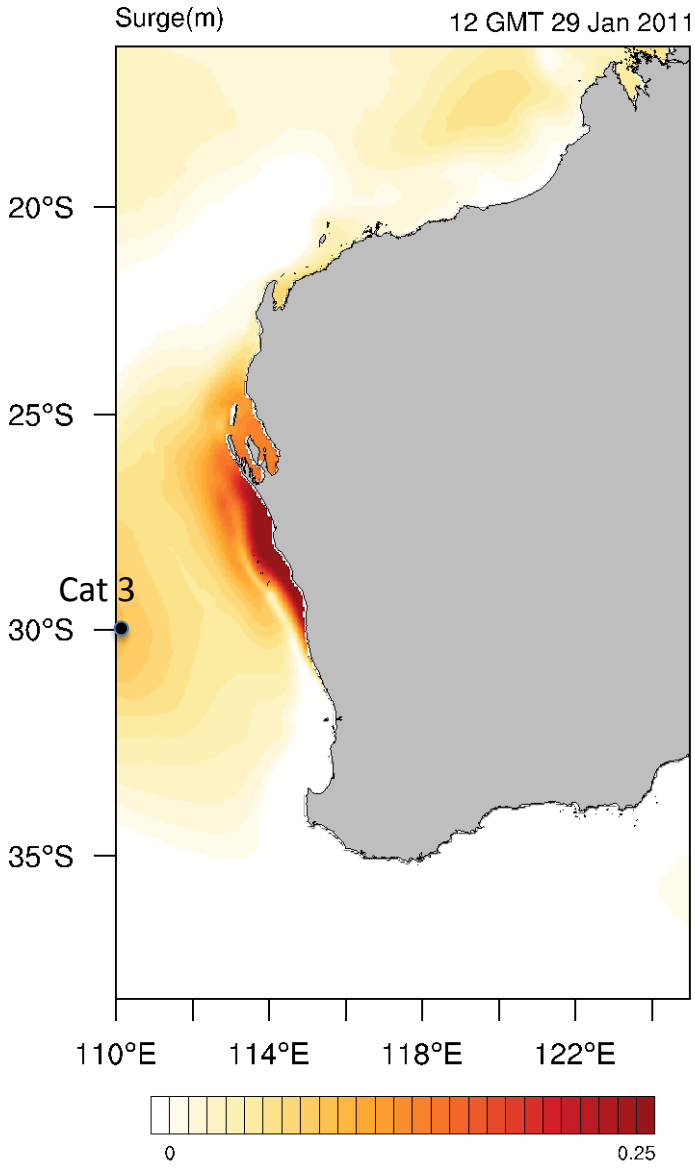
TC Bianca


Surge(m)
12 GMT 27 Jan 2011
Cat 3
20°S
25°S
30°S
35°S
110°E
114°E
118°E
122°E
0
0.25

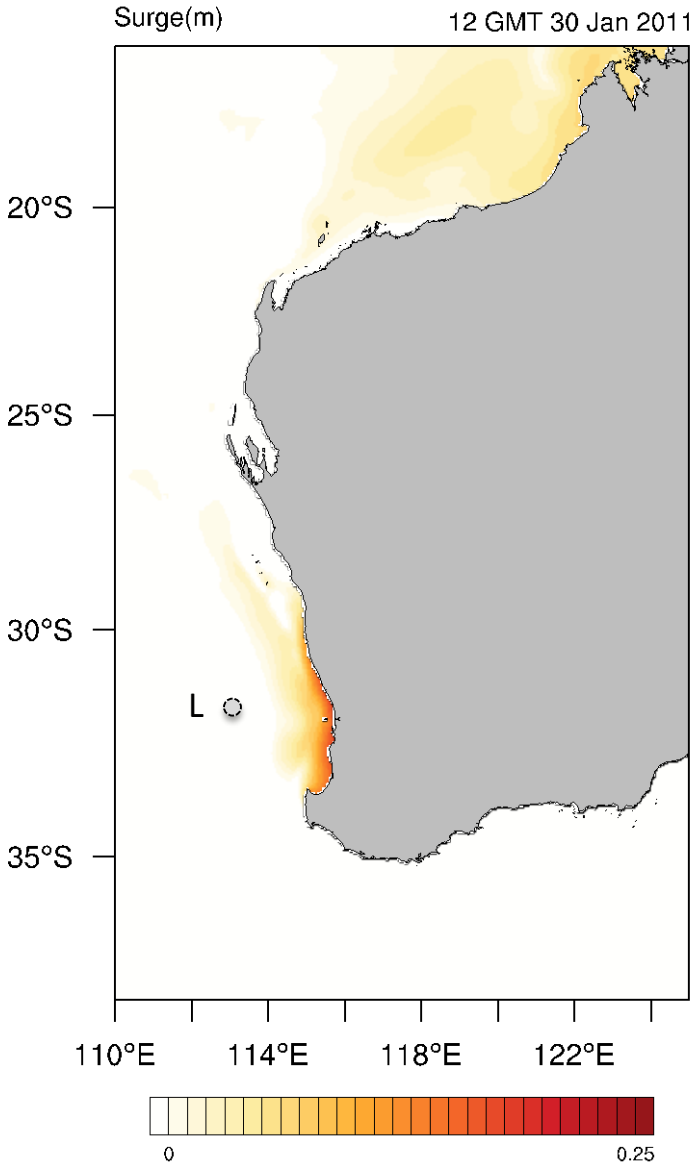
TC Bianca


Surge(m)
12 GMT 28 Jan 2011
20°S
Cat 4
30°S
35°S
110°E
114°E
118°E
122°E
0
0.25

TC Bianca

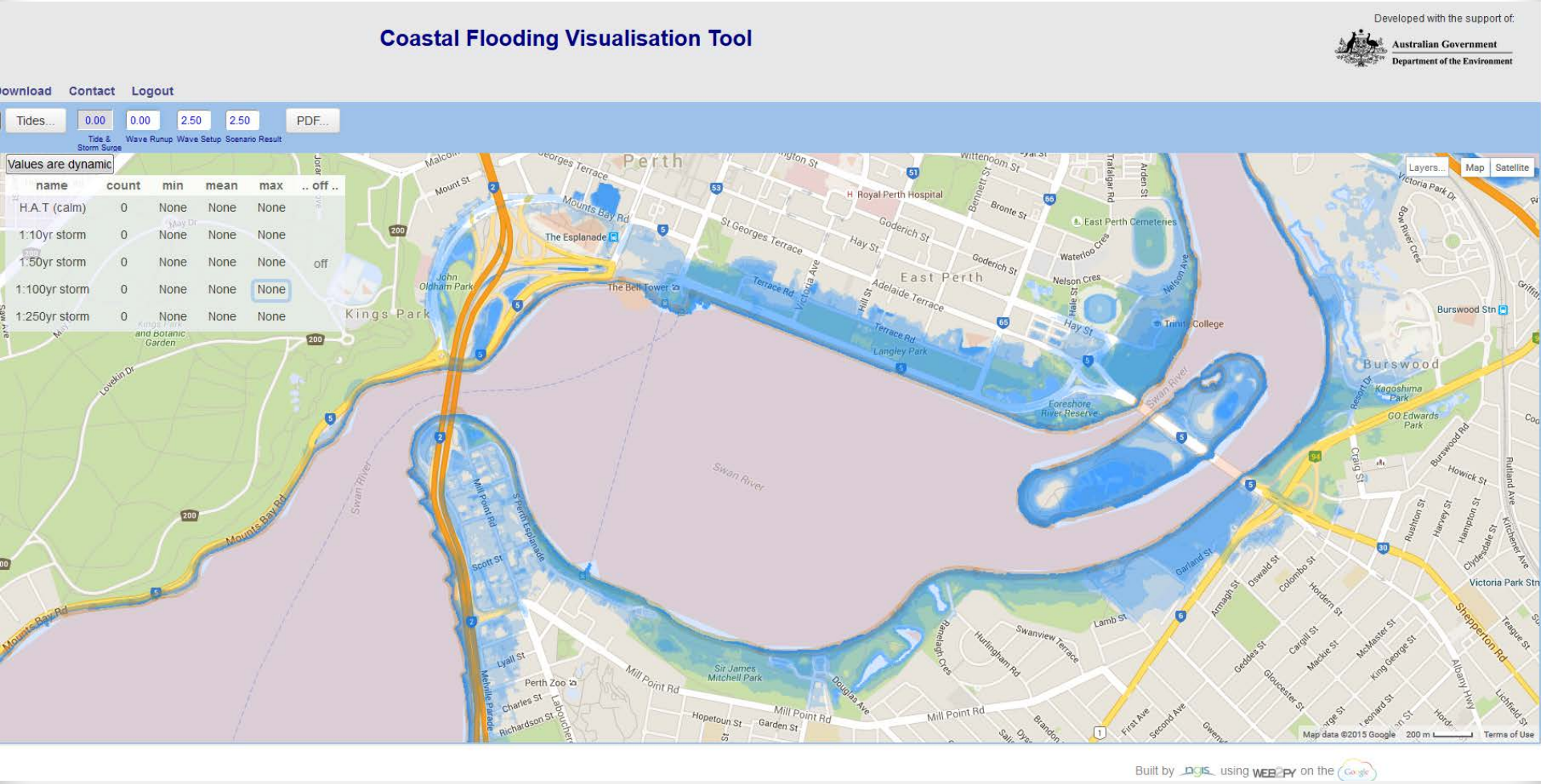

Surge(m)
12 GMT 29 Jan 2011
20°S
25°S
Cat 3
30°S
35°S
110°E
114°E
118°E
122°E
0
0.25

TC Bianca


Surge(m)
12 GMT 30 Jan 2011
20°S
25°S
30°S
35°S
L
110°E
114°E
118°E
122°E
0
0.25

Perth CBD

Perth CBD


Coastal Flooding Visualisation Tool
Developed with the support of:
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Department of the Environment
Download
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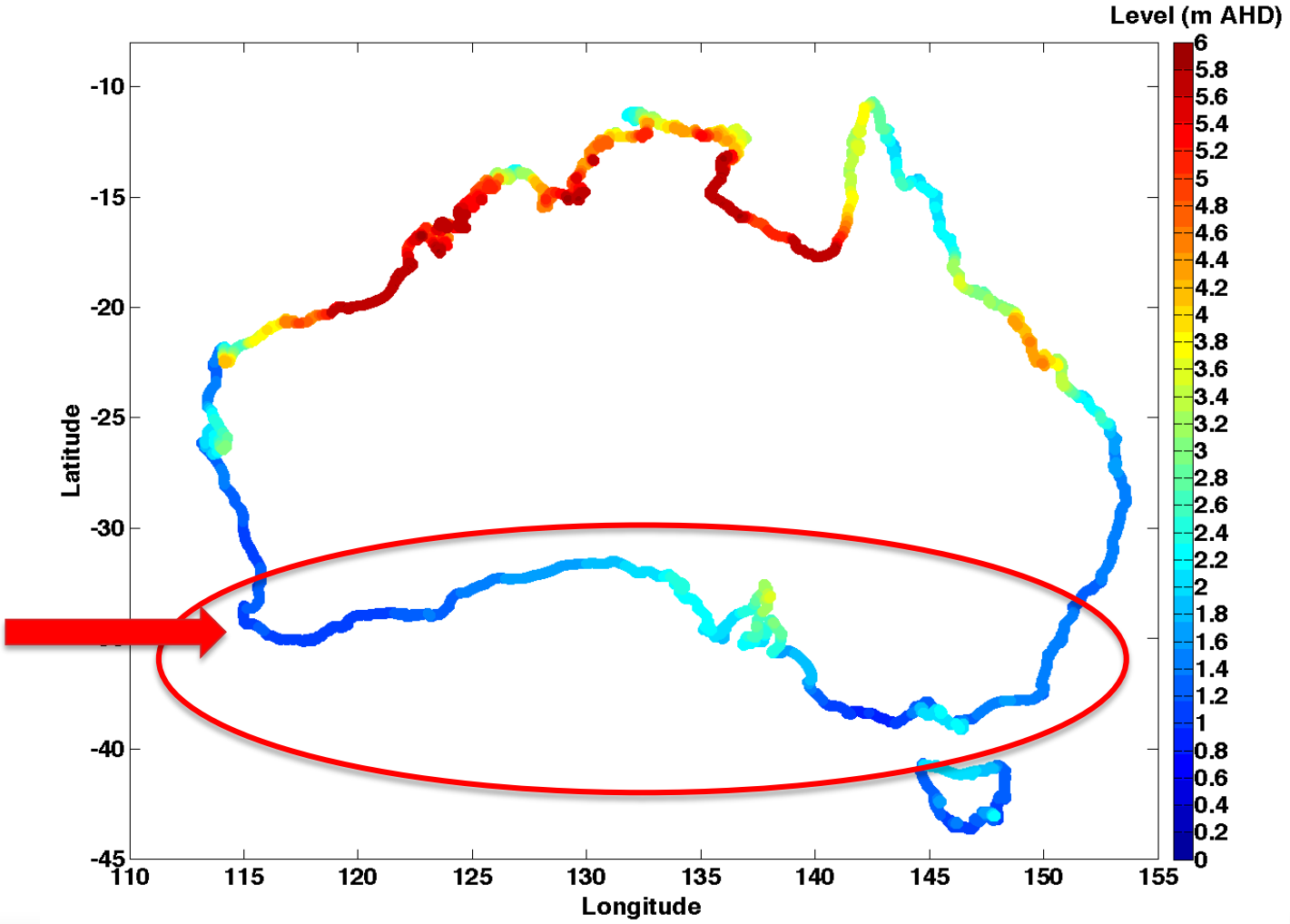
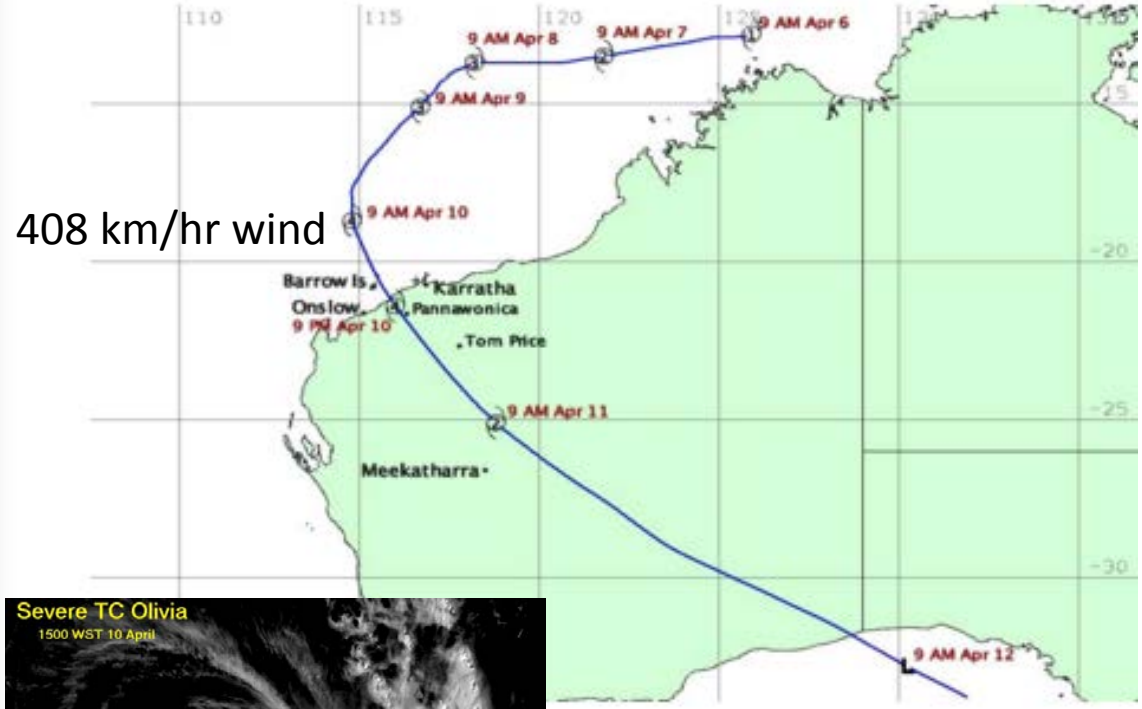
Tides...
0.00
0.00
2.50
2.50
PDF...
Tide & Storm Surge
Wave Runup
Wave Setup
Scenario Result
Values are dynamic
name
count
min
mean
max
.. off ..
H.A.T (calm)
1:10yr storm
1:50yr storm
1:100yr storm
1:250yr storm
off
None
Perth
Kings Park
East Perth
Burswood
Swan River
Mounts Bay Rd
The Esplanade
Royal Perth Hospital
East Perth Cemeteries
Trinity College
Burswood Stn
Victoria Park Stn
Sir James Mitchell Park
Perth Zoo
Layers...
Map
Satellite
Map data ©2015 Google
200 m
Terms of Use
Built by using on the

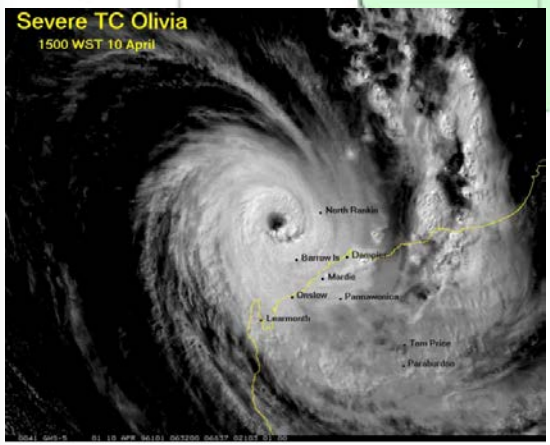
TROPICAL VS EXTRATROPICAL STORM SURGES

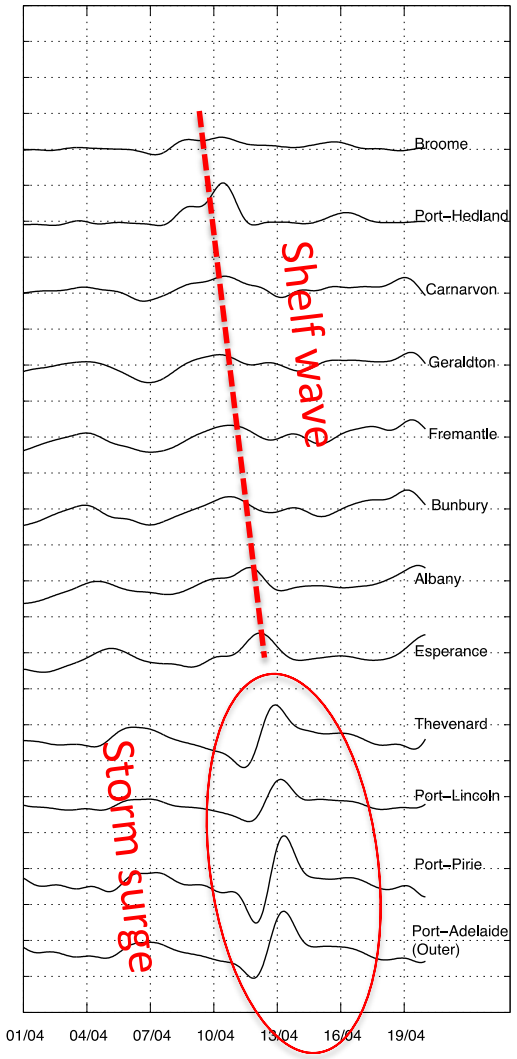


SOUTH AUSTRALIA FROM TC

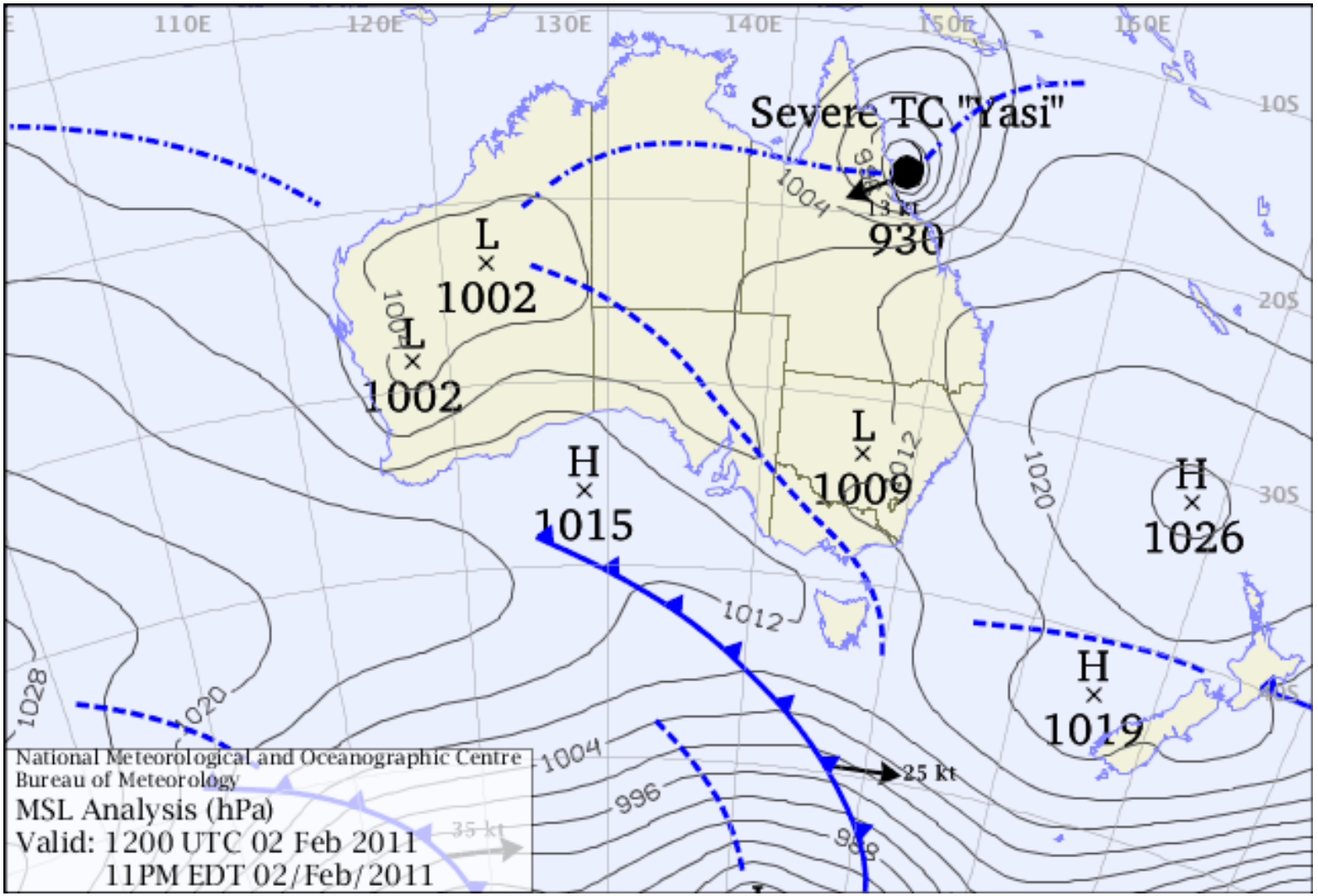
408 km/hr wind







SIMULATING MULTIPLE STORM SURGES AROUND AUSTRALIA



ANIMATION- SIMULATING MULTIPLE STORM SURGES

1. TC Bianca
2. TC Anthony
3. TC Yasi
4. Cold fronts (SA & Tas)

ANIMATION 25 JUNE – 6 JULY 2007