DEVELOPING BETTER PREDICTIONS FOR EXTREME WATER LEVELS

RAF 2015, Brisbane

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Extreme Events – storm surge

Broome

Tropical Cyclone Rosita
Extreme Events – storm surge

TC Alby
Forcing: a range of spatial scales

Astronomical

Meteorological

Oceanic: Indian + Pacific
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

Global tidal model

Tropical Cyclones

~75,000 simulations equivalent to 10,000 years

Total Sea level (~60 year time series)
1:1000ARI: total water level (tropical + extra-tropical)
Extreme water levels

Coastal Flooding Visualisation Tool

<table>
<thead>
<tr>
<th>Name</th>
<th>Count</th>
<th>Min</th>
<th>Mean</th>
<th>Max</th>
<th>Off</th>
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</thead>
<tbody>
<tr>
<td>H.A.T (calm)</td>
<td>254</td>
<td>0.19</td>
<td>0.96</td>
<td>1.84</td>
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<tr>
<td>1:10yr storm</td>
<td>254</td>
<td>0.63</td>
<td>1.34</td>
<td>1.90</td>
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<tr>
<td>1:50yr storm</td>
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<td>0.73</td>
<td>1.46</td>
<td>2.07</td>
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<td>1:100yr storm</td>
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<td>1:250yr storm</td>
<td>254</td>
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<td>1.65</td>
<td>2.22</td>
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http://www.vistool.com.au
Northern NSW
Coastal flooding – ‘bathtub’
Coastal flooding – ‘bathtub’
Meteotsunamis
Tsunamis: Seismic and Meteorological

2004 - Seismic Tsunami

2002 - Meteo-Tsunami

0.62 m
Meteotsunami

Perth region: 14 November 2015: 1145 UTC
Meteotsunami – Perth region: 14 November 2015: 1145 UTC

0.39m change in 5 mins
Max @ 1145 UTC

2.2 hPa
Meteotsunami

Perth region: 1 February 2015: 1210 UTC
Port Geographe
Cape Cuvier - WA

0.62 m
Cape Cuvier - WA

Gravity waves

Cape Cuvier
Port Kembla
Meteotsunami events around Australia

Total events: 214
5 Year Period
2009 to 2014
## Potential Meteotsunami Events

5 years (2009 to 2014)

<table>
<thead>
<tr>
<th>Station</th>
<th>Total Number of Events</th>
<th>Events with $H &gt; 40\text{cm}$</th>
<th>Max $H$ (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Bay, TA</td>
<td>4</td>
<td>1</td>
<td>50</td>
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<tr>
<td>Burnie, TA</td>
<td>25</td>
<td>4</td>
<td>46</td>
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<tr>
<td>Portland, VIC</td>
<td>21</td>
<td>5</td>
<td>60</td>
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<tr>
<td>Thevenard, SA</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Esperance, WA</td>
<td>38</td>
<td>27</td>
<td>97</td>
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<td>Hillarys Harbor, WA</td>
<td>28</td>
<td>6</td>
<td>48</td>
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<td>Cape Cuvier Wharf, WA</td>
<td>35</td>
<td>32</td>
<td>146</td>
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<tr>
<td>Broome, WA</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Darwin, NT</td>
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<td>0</td>
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<td>Groote Eylandt, NT</td>
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<td>Cape Ferguson, QLD</td>
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<td>30</td>
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<td>Rosslyn Bay, QLD</td>
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</tr>
<tr>
<td>Port Kembla, NSW</td>
<td>25</td>
<td>3</td>
<td>60</td>
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</tbody>
</table>
COUPLED WAVE-SURGE MODEL
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

Summer:
Tropical cyclones

Winter
+ summer:
pressure systems

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)

Port Headland
Onslow
Exmouth
Carnarvon
Geraldton
Fremantle
Bunbury
Albany
Esperance

Date in 2011

17/01 20/01 23/01 26/01 29/01 01/02 04/02 07/02 10/02
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

bnhcrc.com.au
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

bnhcrc.com.au
TC Bianca
TC Bianca
TC Bianca

Surge (m) 12 GMT 30 Jan 2011

0 0.25
Perth CBD
Perth CBD

Coastal Flooding Visualisation Tool
SOUTH AUSTRALIA FROM TC

408 km/hr wind
SIMULATING MULTIPLE STORM SURGES AROUND AUSTRALIA

National Meteorological and Oceanographic Centre
Bureau of Meteorology

MSL Analysis (hPa)
Valid: 1200 UTC 02 Feb 2011
11PM EDT 02/Feb/2011

Severe TC "Yasi"

L 1002
H 1015
L 1009
H 1026
L 1009
H 1019

bnhcrc.com.au
ANIMATION- SIMULATING MULTIPLE STORM SURGES

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