
6th June, 2016

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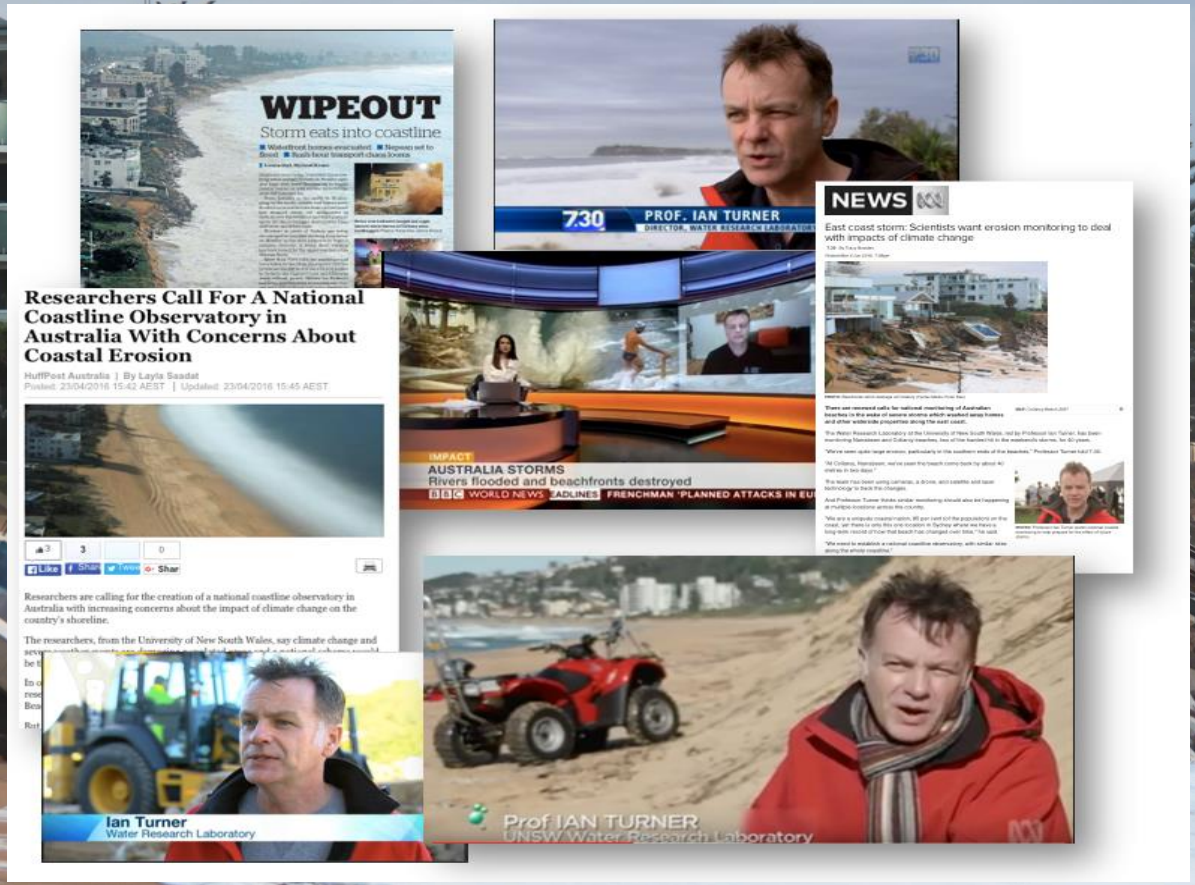
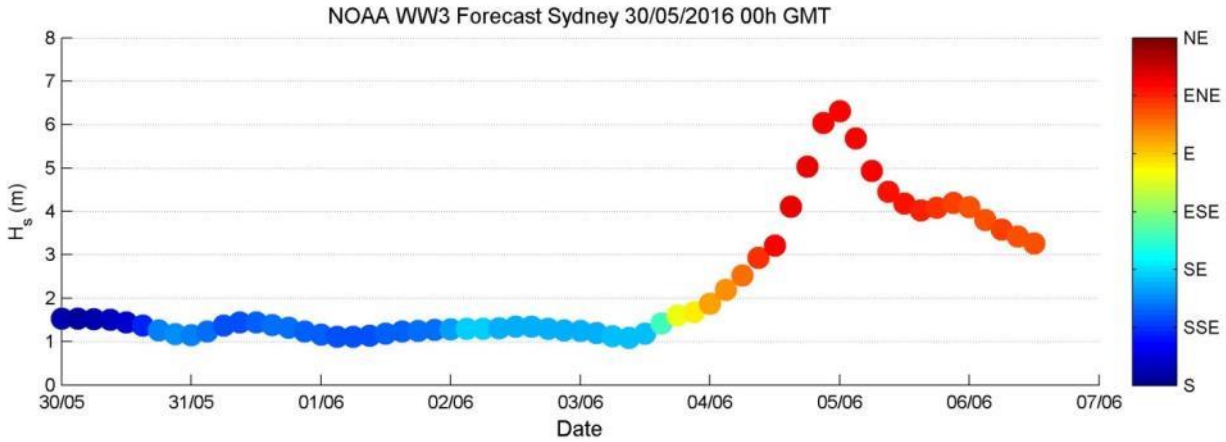



6th June, 2016
HEADLINE "COASTAL EROSION: POOL SMASHED ON BEACH !!!"

Bilgola Beach, 10th June, 1974

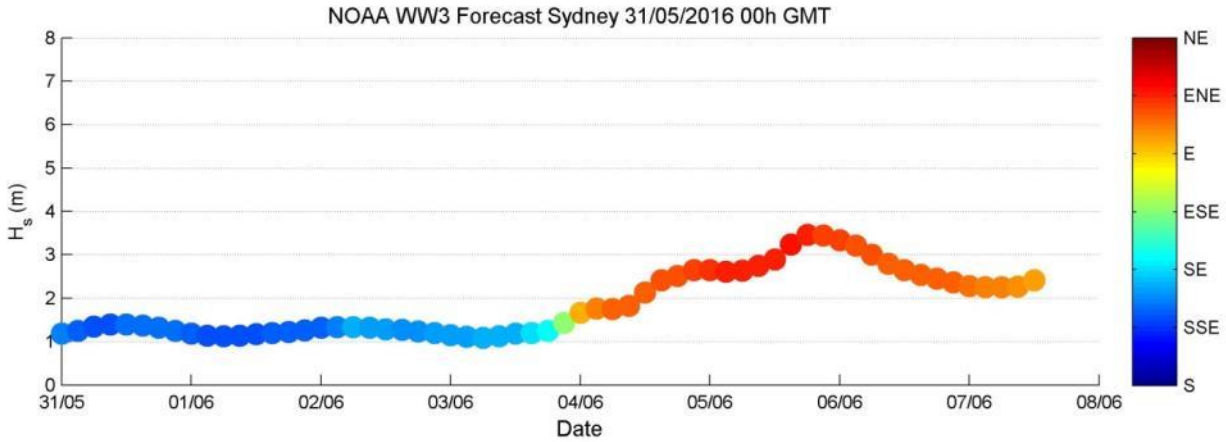
News Ltd Archives

Timeline of June 2016 storm: “t minus 5 days”



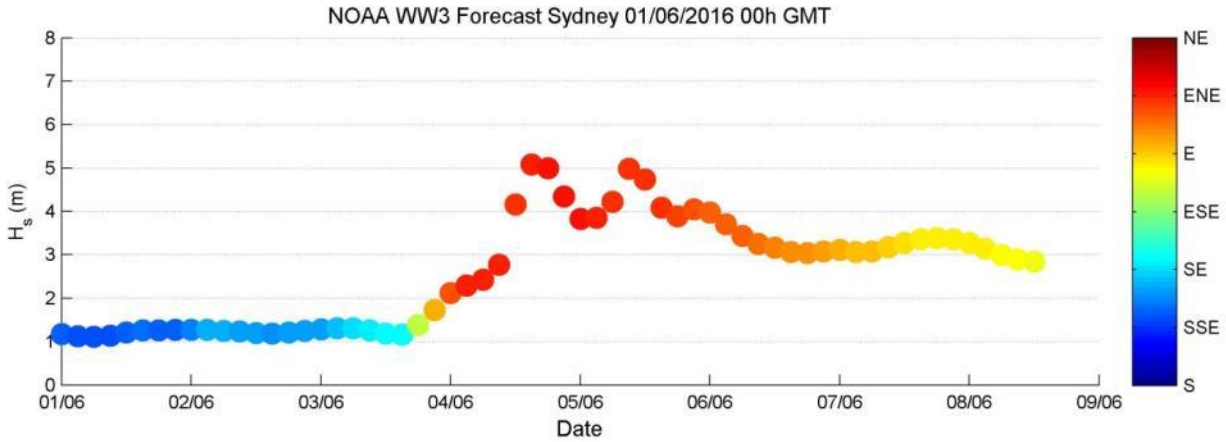
Significant (peak H_{sig} = 6.3 m) storm event from unusual ENE direction coincidentally forecast to coincide with king tides

Timeline of June 2016 storm: “t minus 4 days”



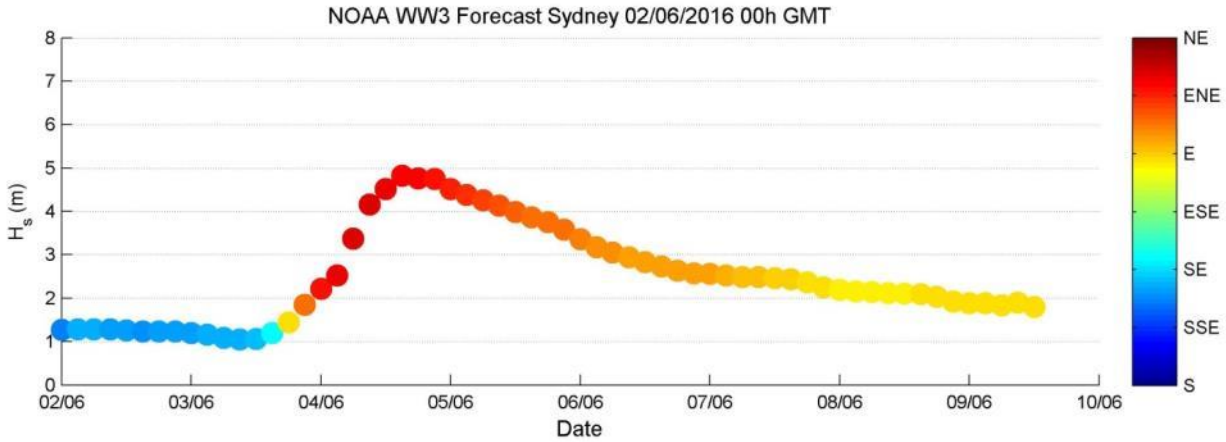
Storm forecast scaled back to smaller event (peak Hsig = 3.5 m)

Timeline of June 2016 storm: “t minus 3 days”



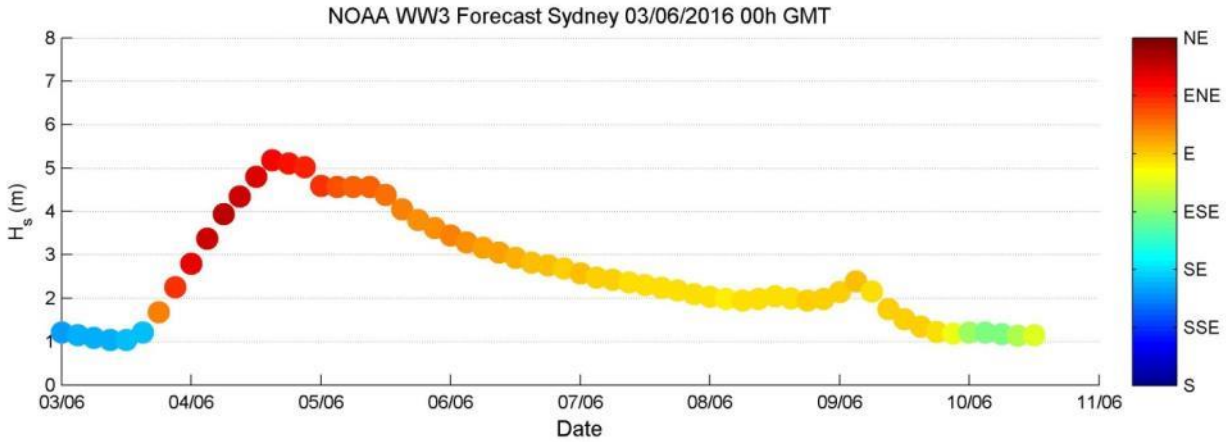
Storm forecast scaled back up to peak Hsig = 5.1 m

Timeline of June 2016 storm: “t minus 2 days”



Storm forecast converging around peak Hsig ≈ 5 m

Timeline of June 2016 storm: “t minus 1 days”



Storm forecast converging around peak Hsig ≈ 5 m

UNSW AUSTRALIA

Water Research Laboratory

Never Stand Still | Faculty of Engineering | School of Civil and Environmental Engineering

A handful of researchers knew a week in advance this event was likely to happen, but very few people who really needed to know had been informed….

→ and there is currently no existing mechanism to do so

Water Research Laboratory | School of Civil & Environmental Engineering

A new research initiative to deliver the knowledge framework and practical guidelines for a national coastal erosion Early Warning System (EWS)

Professor Ian Turner *FIEAust*, WRL Director

and many co-authors….

Australian Government
Australian Research Council

Australian Government
Bureau of Meteorology

UWA
PERTH, AUSTRALIA

NSW GOVERNMENT
Office of Environment & Heritage

northern beaches council

USGS
science for a changing world

City of MANDURAH

Department of Transport

Coastal Erosion in the Australian context: why does it matter?

- Australia is a distinctly coastal-focused nation
  - 85% of Australians are presently living within a narrow coastal strip and this is increasing

- Recent attempts to assess our national assets at risk to coastal hazards include[1]:
  - roads ($40 - 60 billion)
  - commercial buildings ($58 – 81 billion)
  - residential property ($41 – 63 billion)
  - enormous cultural and environmental value of beaches to Australians

- It is estimated that the amenity and storm protection provided by beaches nationally is in the range of[2]:
  $3.8 - $13 million for every kilometre of sandy shoreline.

[1] DCCE, 2011 [2] Blackwell, 2005

Coastal Erosion in the Australian context:
4 decades of coastline monitoring at Narrabeen-Collaroy

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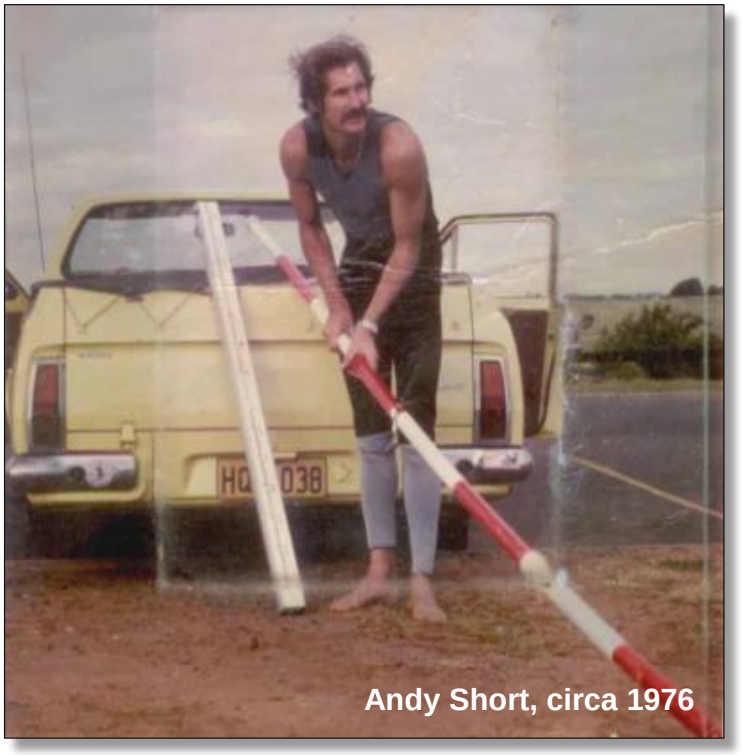
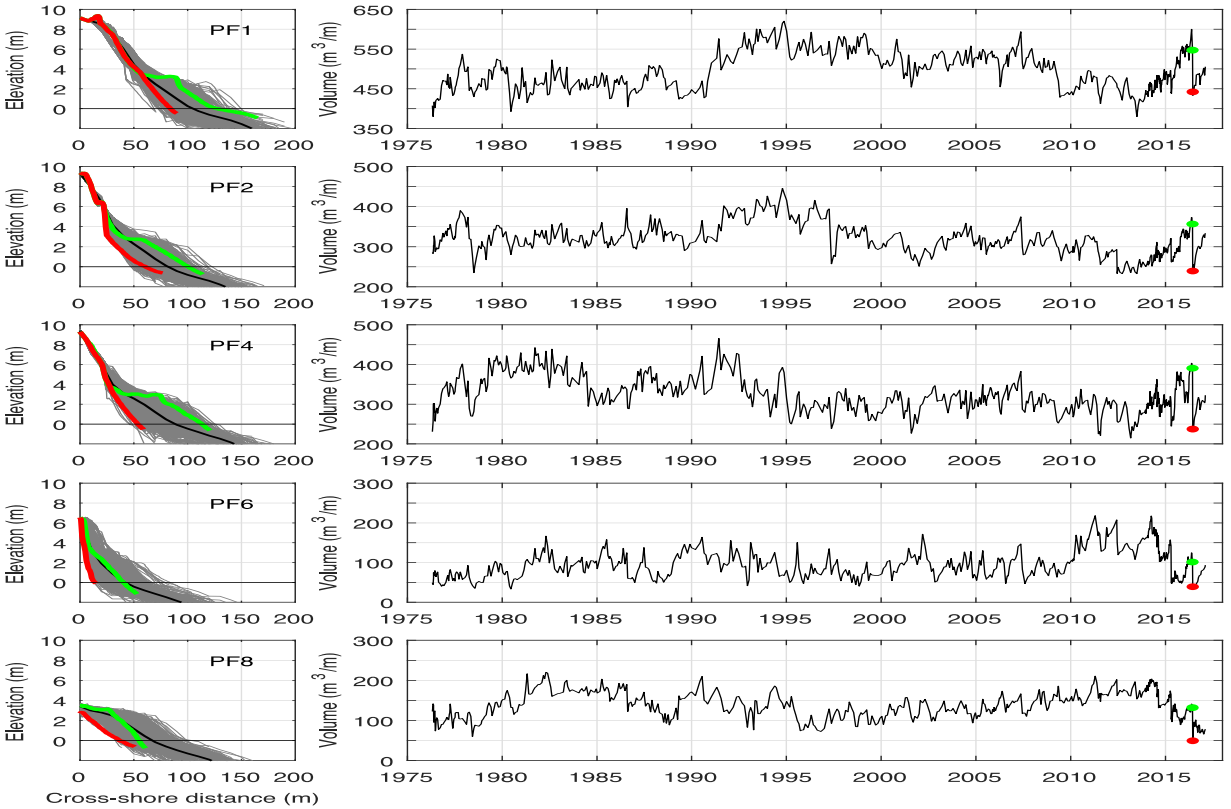
4 decades of coastline monitoring at Narrabeen-Collaroy



4 decades of monitoring: what does the data tell us?



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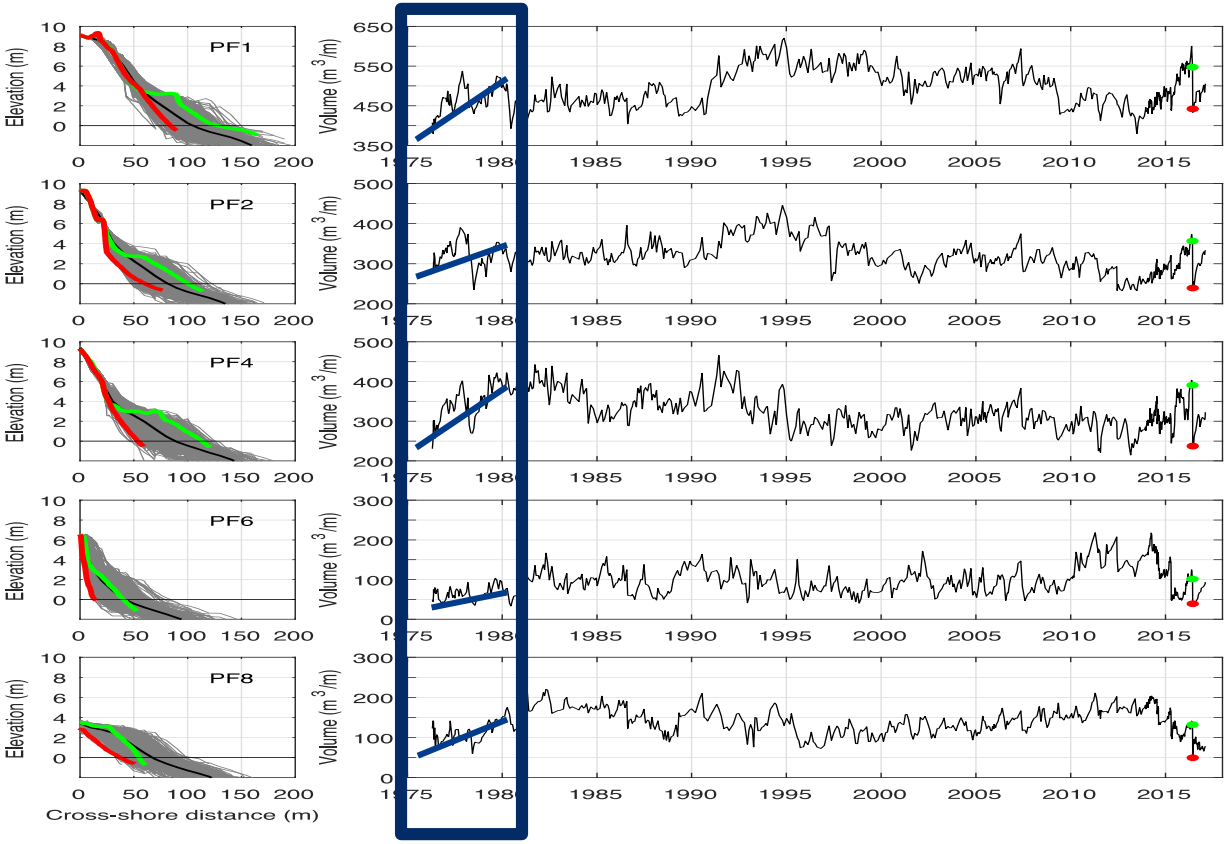

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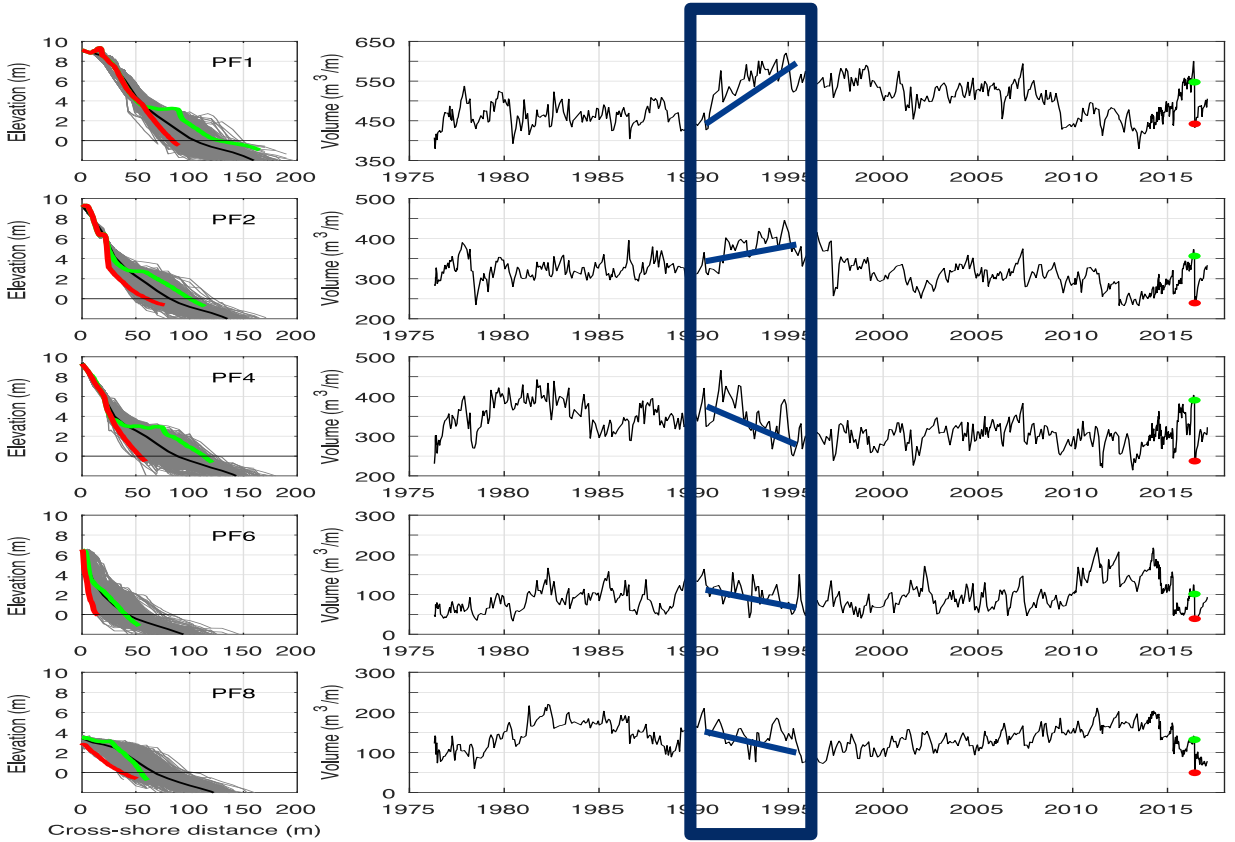

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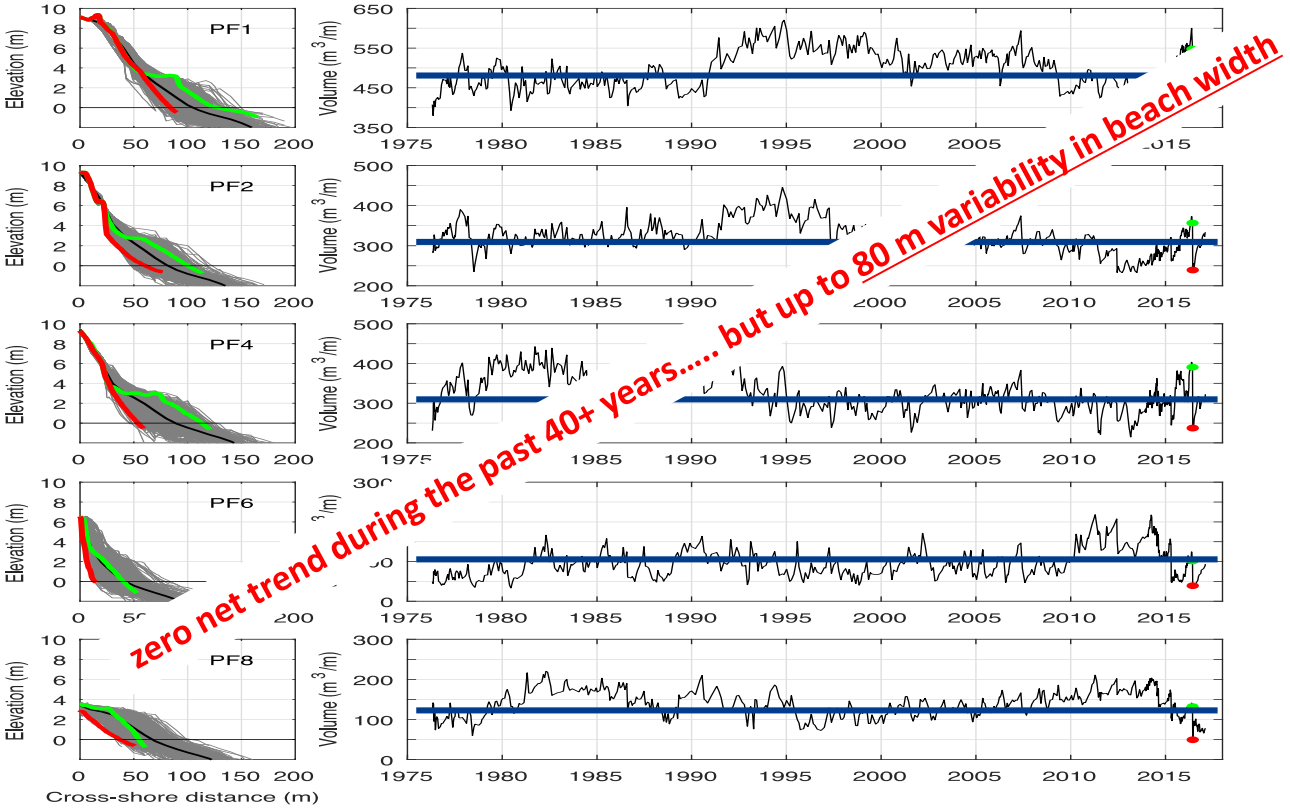


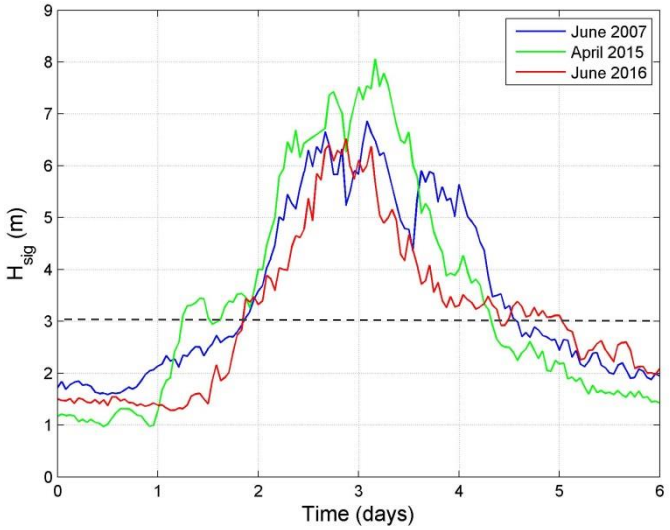
Historical perspective of the June 2016 event – storm erosion demand (1976 – 2016)*

Rank	Storm	Average (max.) storm demand‡ (m^3/m)
1	June 2016	**103 (151)**
2	May 1997	76 (137)
3	June 2007	73 (96)
4	April 2015	62 (95)
5	August 1986	58 (68)

* *Based on five historical profile lines only*

Narrabeen-Collaroy

Offshore wave measurements



Storm	June 2007	April 2015	June 2016
Peak H_{sig} (m)	**6.9**	**8.1**	**6.5** *
Average storm direction (° TN)	149	161	107 *
Duration (h)	65	72	74
Total storm energy (MJh)	**1.13**	**1.37**	**0.89**
Peak water level (m)	0.95	1.22	1.29

* 1 in 5 year event only

* the dominance of a subtle shift in wave direction

Lessons learnt for future disaster risk management

- A few university researchers knew the likely impact of this storm was coming a week in advance…. but the subtleties of a slightly different wave direction - rather than necessarily a ‘big’ storm - was understandably missed by the wider coastal management community and emergency services
- Most importantly, presently in Australia there is no nationally or state-coordinated COASTAL EROSION EARLY WARNING SYSTEM capability

Australian Government
Australian Research Council

The Project:

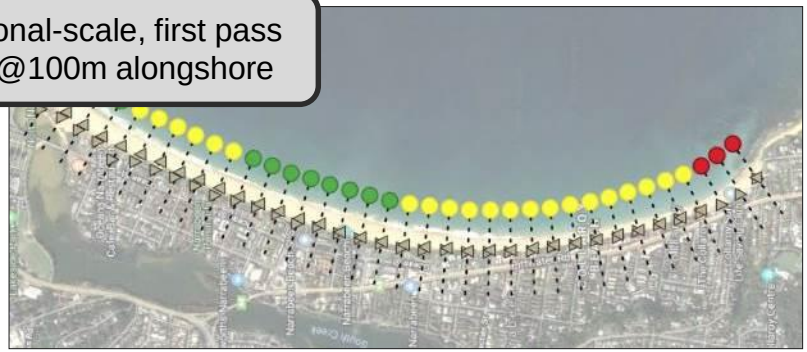
A new national research initiative to deliver the knowledge framework and practical guidelines for:

An Australian storm wave damage and beach erosion Early Warning System

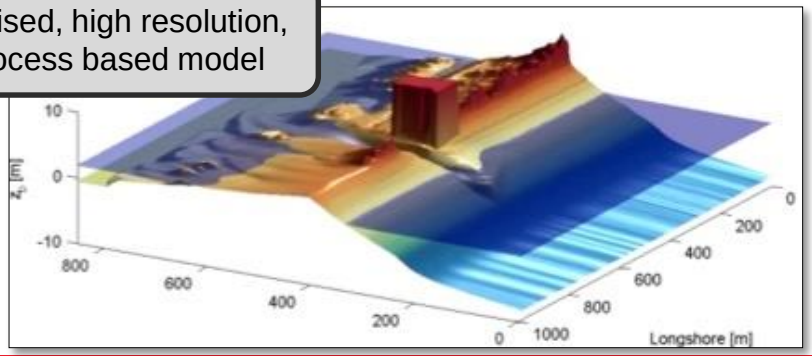
Recognising the significant diversity in coastal landforms around Australia's coast, this project is targeted at open ocean sandy shorelines

Two key components:

Tier 1: Regional-scale, first pass forecasting @100m alongshore



Tier 2: Localised, high resolution, hot spot process based model



Conceptual EWS framework:

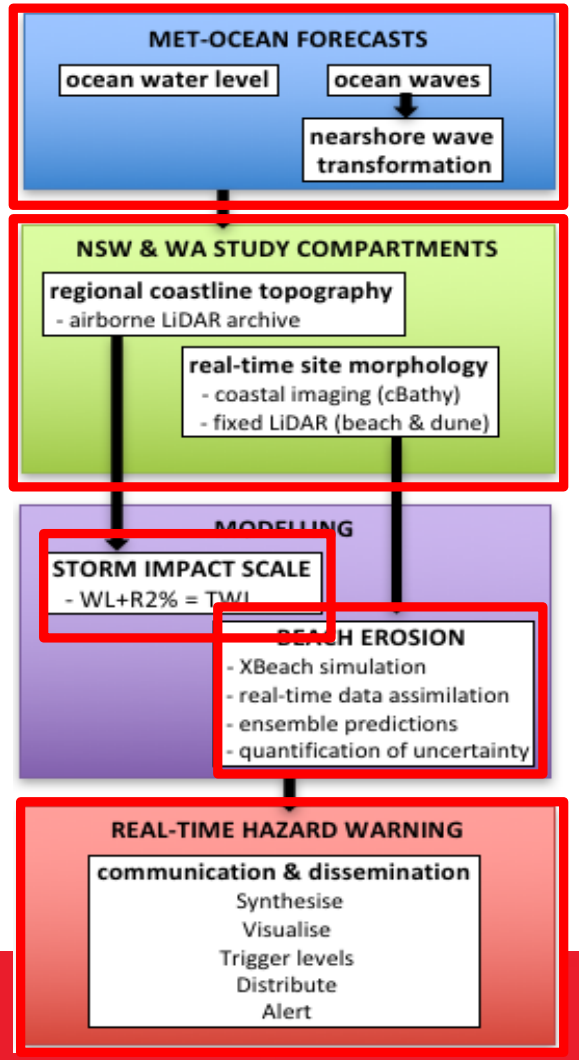
rolling forecasts of approaching (7 → 0 days) storm waves and water-levels

knowledge of localised pre-storm coastline conditions

rolling regional forecasts of the location and type of localise impacts

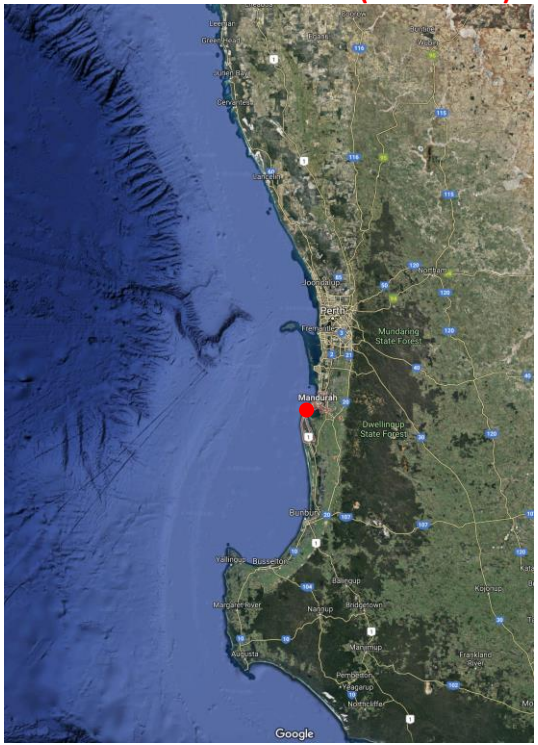
rolling ensemble site-specific forecasts of quantitative beach & dune erosion demand

effective and timely delivery of impact/erosion information, that addresses the needs of specific emergency services and coastal managers

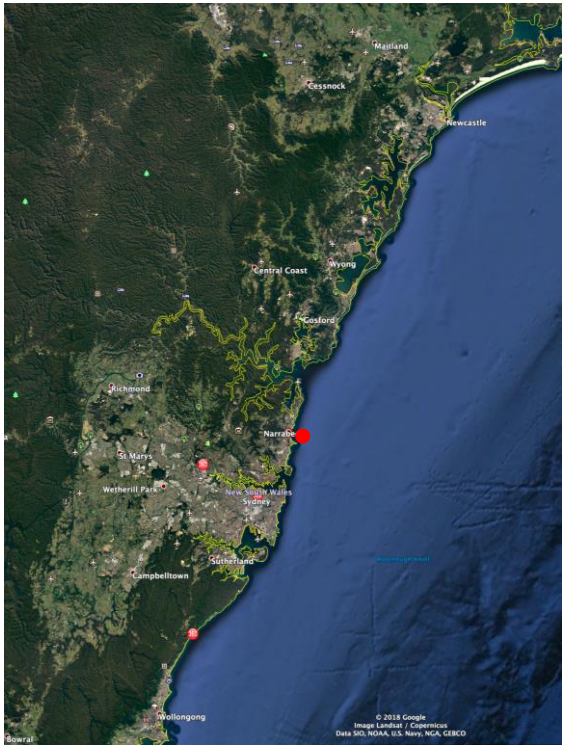


Two test-case regions and pilot ‘hot-spot’ sites in WA & NSW

~300 km of coastline in WA (Mandurah)



~ 300 km of coastline in NSW (Narrabeen)



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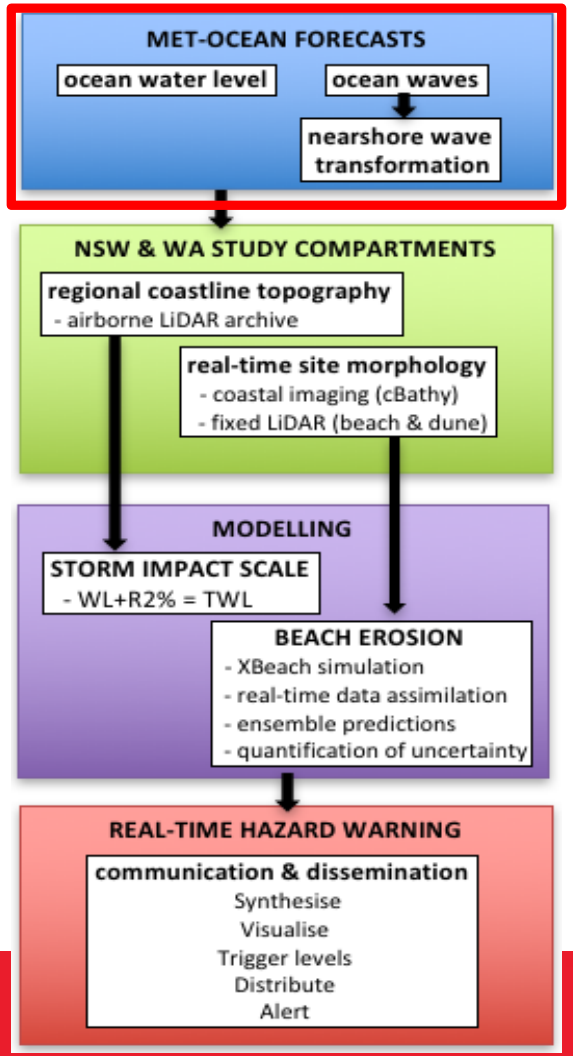
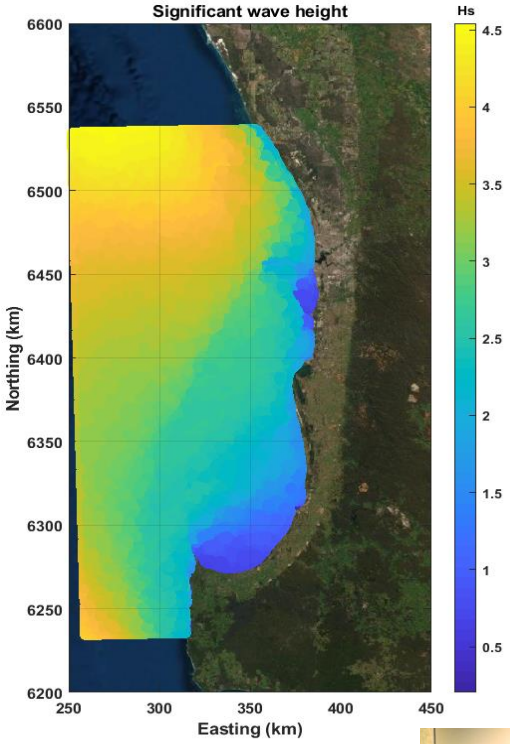


New variable-resolution wave modelling for coastal applications

- The Bureau of Meteorology's operational wave forecast system (AUSWAVE) is relatively coarse in spatial resolution (1/10^{o}) and is therefore not able to accurately represent the transformation of deep-water waves to the nearshore.
- To close this gap, a new high-resolution wave hindcast and forecast system is being developed and trialled to provide detailed wave information at the coast.
- The pilot system is an implementation of WAVEWATCH III® with variable resolution of up to 250 m in the coastal zone.
- The model is forced with surface winds from BOM's operational Numerical Weather Prediction (NWP) System.
- The coastal wave models are nested within a new global configuration of AUSWAVE that is initially being evaluated along two ~300km stretches of metropolitan coastlines in WA and NSW.



Further details: Stefan Zieger et el, Coasts & Ports 2019

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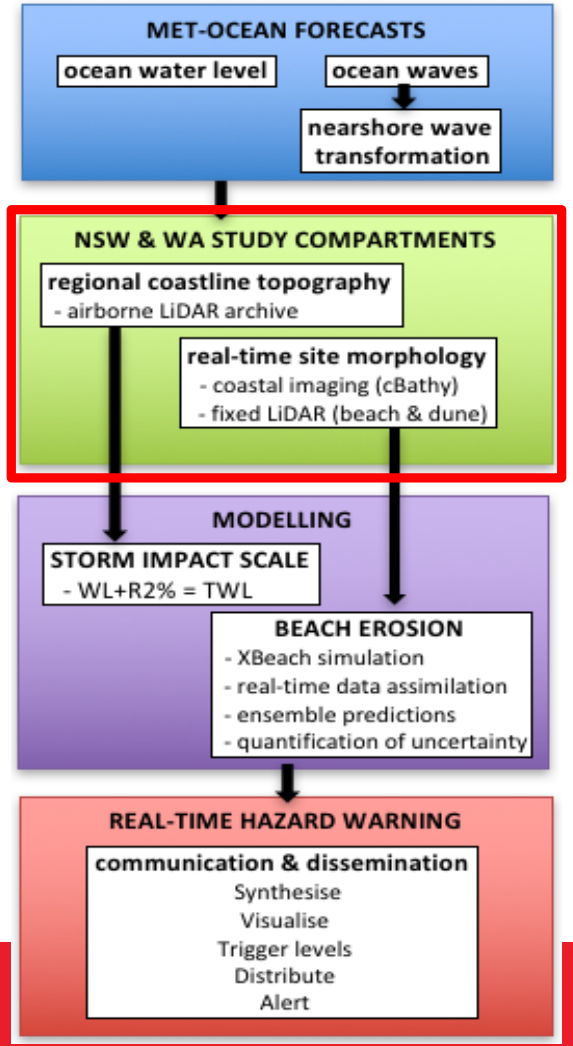
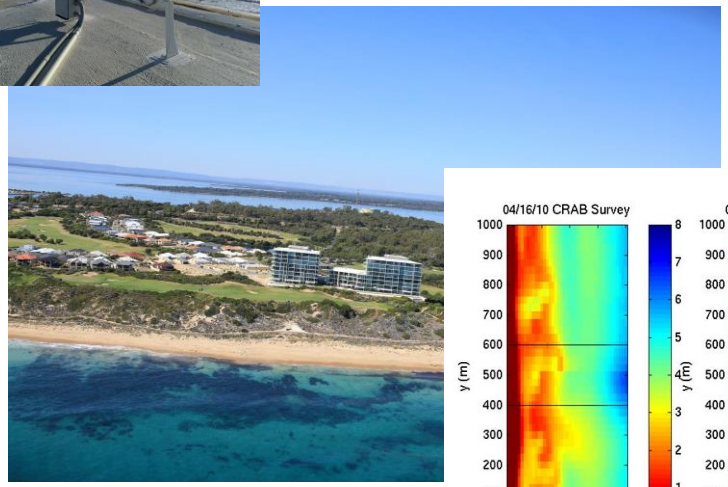
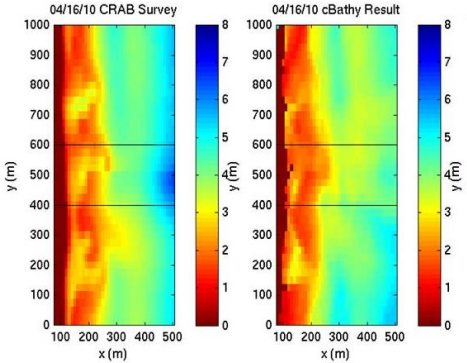
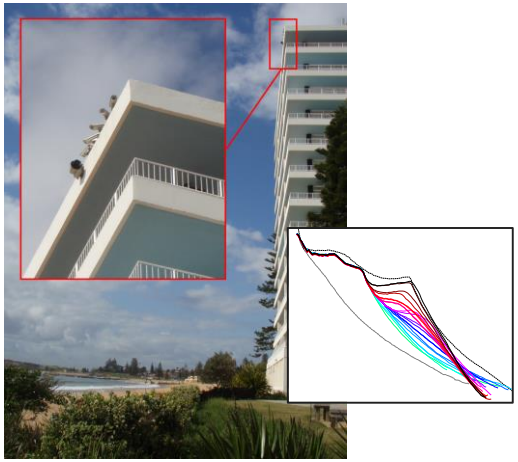


Pilot regions and test sites in UNSW & WA:

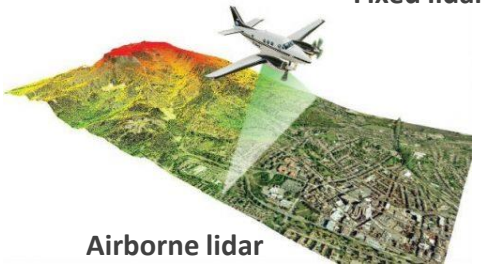




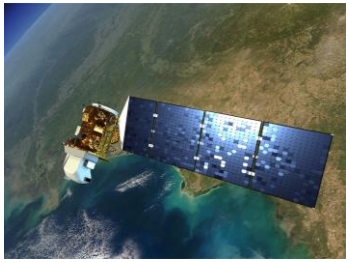
cBathy – 'real-time' video-derived bathymetry



Fixed lidar (continuous)



Airborne lidar



coastSat – automated assimilation of 'real-time' shorelines & beach slope

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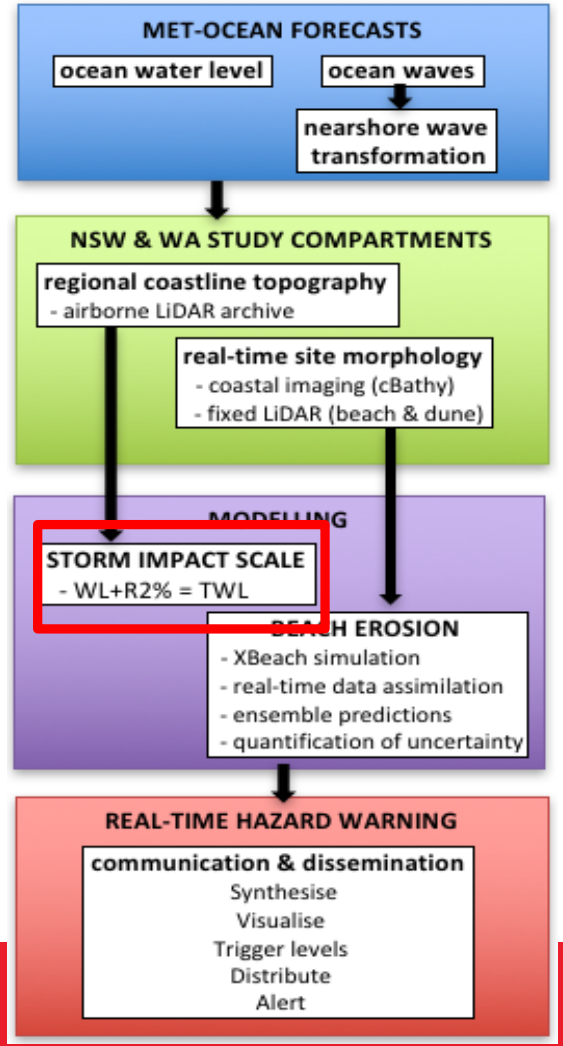
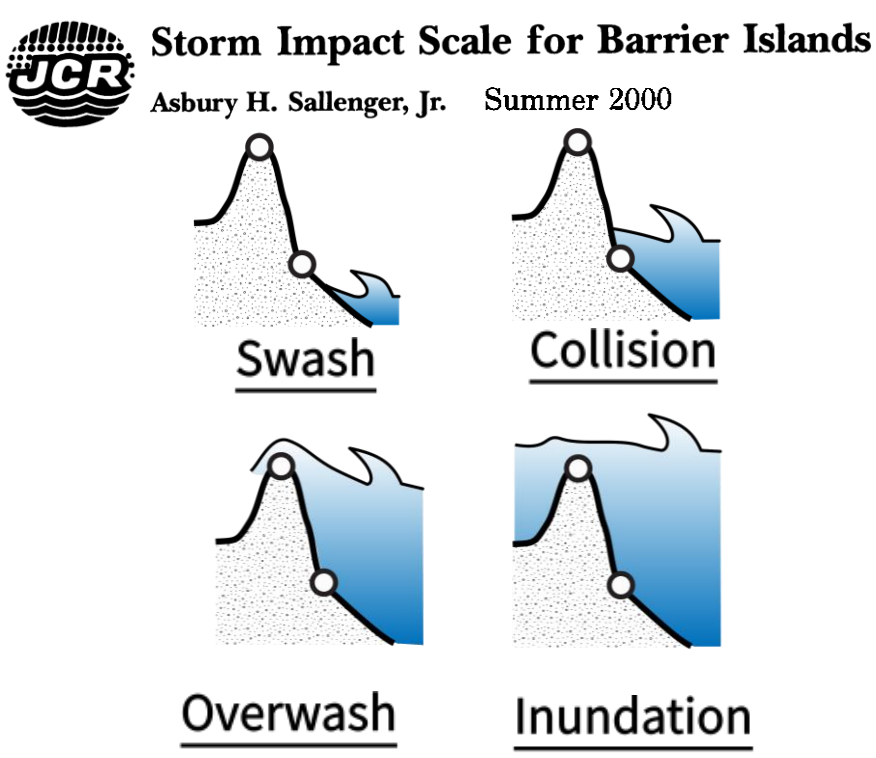
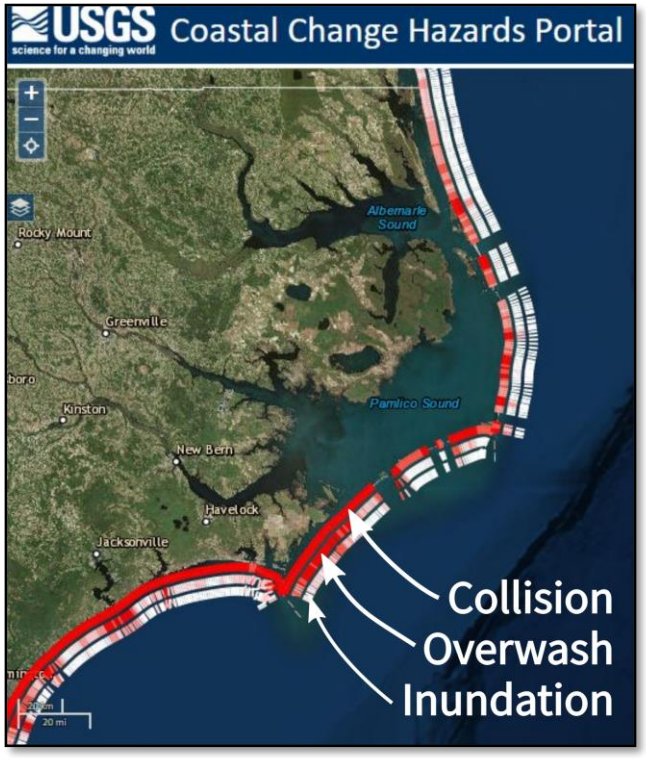


Of course, we are not the first to think about this…



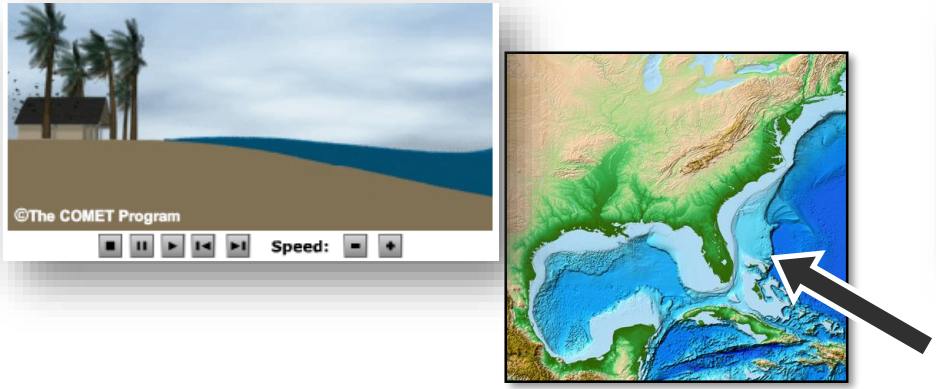


Sources: Sallenger, A. (2000). Storm Impact Scale for Barrier Islands. Journal of Coastal Research, 16(3).
https://marine.usgs.gov/coastalchangehazardsportal/

Is the Storm Impact Scale a useful framework in the Australian context?

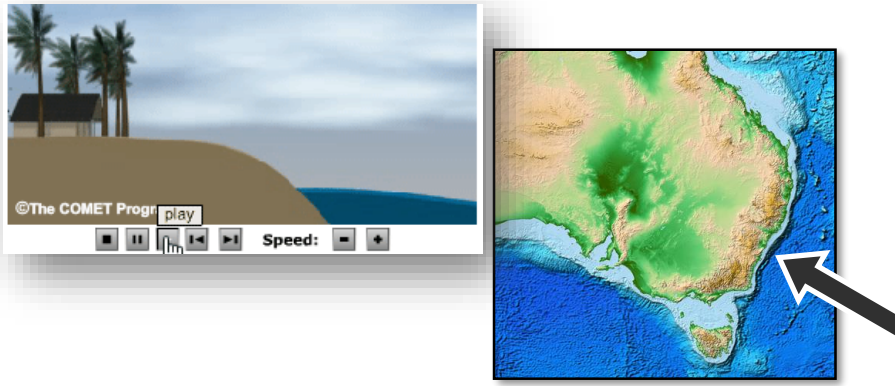
U.S. East Coast:

- **Wide continental shelf** generating large storm surge
- Hazards caused by **elevated water levels**



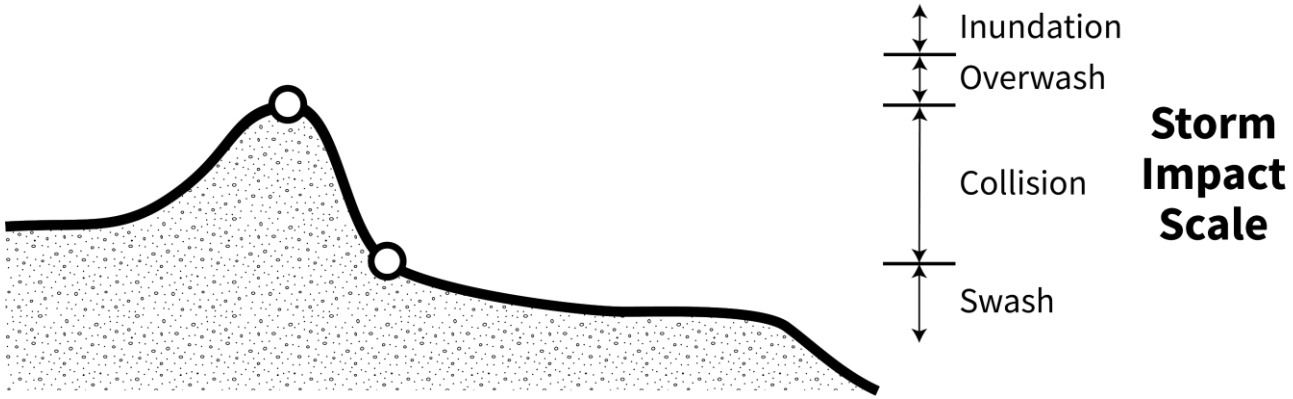
Large regions of Australia's sandy open coasts

- **Narrow continental shelf** allowing wave energy to reach coast
- Hazards caused by **wave energy**



Sources: NOAA ETOPO1 Global Relief Model, UCAR COMET Program

Is the Storm Impact Scale a useful framework in the Australian context?



Storm Impact Scale is only based on the **vertical dimension**

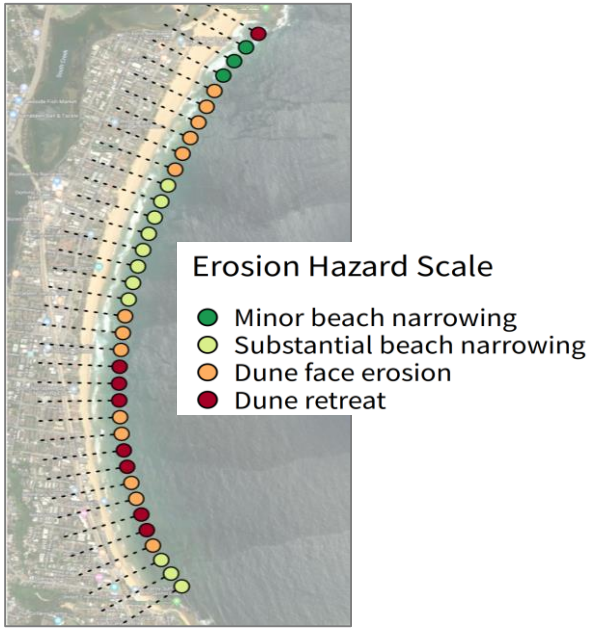
Is there a better framework?

Storm Impact Scale is only based on the **vertical dimension**

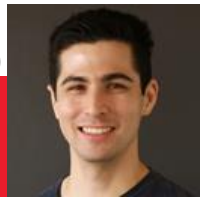
But around much of Australia's open sandy coastlines, erosion hazards should be primarily defined in the **horizontal dimension**

The development of a new storm impact matrix

Storm Impact Matrix for Natural Beaches		Erosion impact scale: Increasing erosion hazard → Minor narrowing	Substantial narrowing	Dune face erosion	Dune retreat
Flooding impact scale (Sallenger, 2000) ↑ Increasing flooding hazard	Inundation				Extreme
	Overwash				Severe
	Collision			High	Very High
	Swash	Low	Moderate	High	Very High



Further details: Chris Leaman et el, Coasts & Ports 2019



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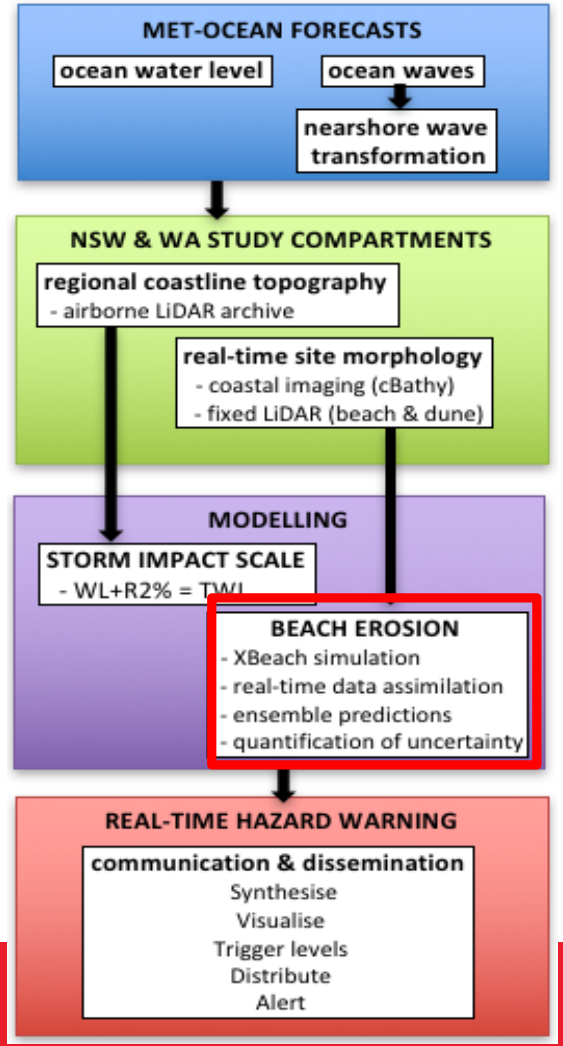
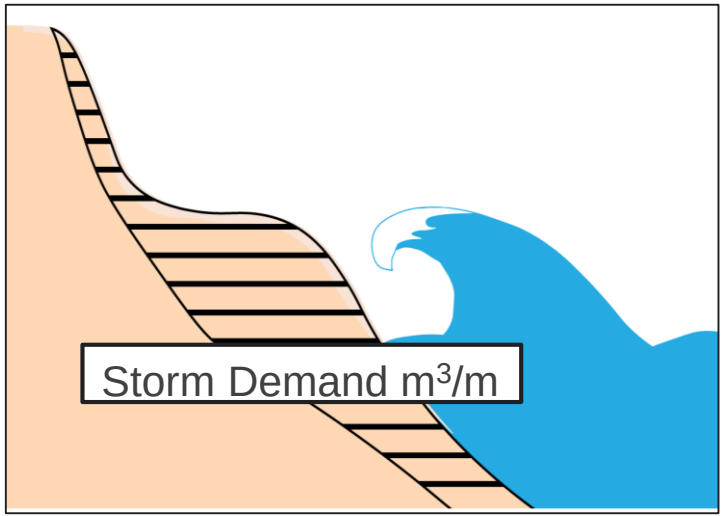


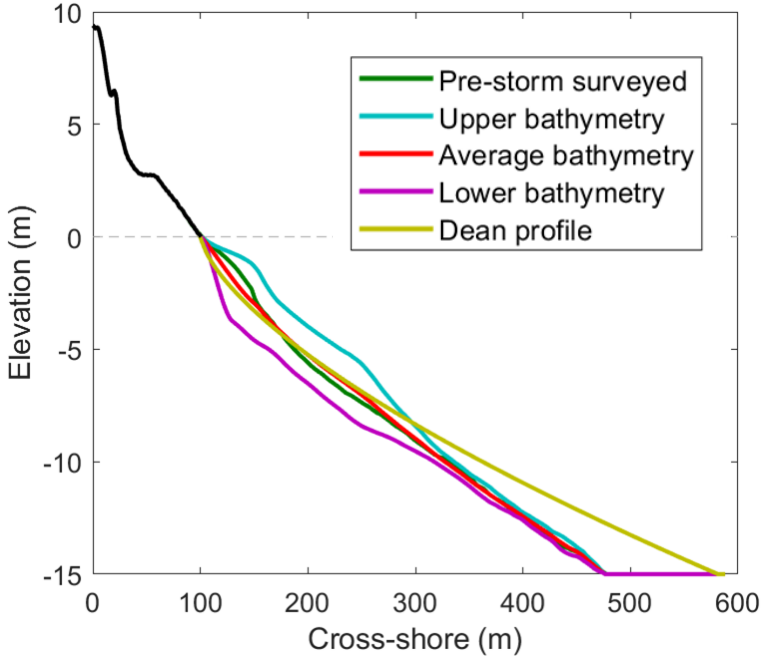
Quantitative ‘hot-spot’ erosion forecasting:



XBeach is currently the ‘best practice’ storm erosion modelling tool

But knowledge of pre-storm bathymetry is required as a boundary condition …..

Evaluating XBeach prediction sensitivity to pre-storm bathy



Preliminary conclusions:

- Use of measured pre-storm bathymetry generally results in the most accurate predictions of sub-aerial beach & dune erosion
- Average bathymetry and Dean-type profiles are the next best choice
- An accurate estimate of the typical surfzone gradient for a site is crucial – detailed and regularly updated bathmetry surveys of the surfzone may be of lesser importance

Further details: Nash Matheen et el, Coasts & Ports 2019

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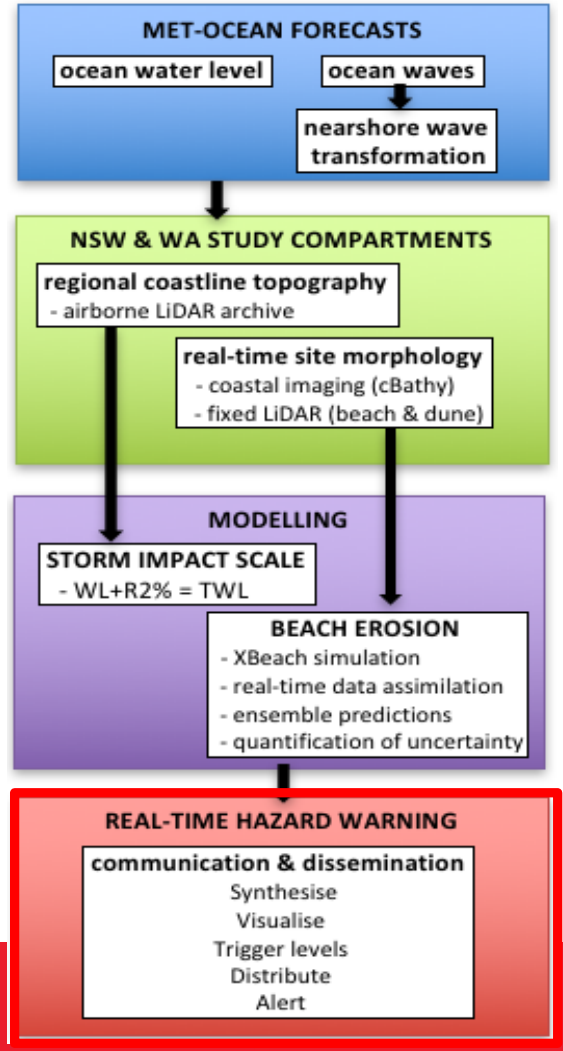
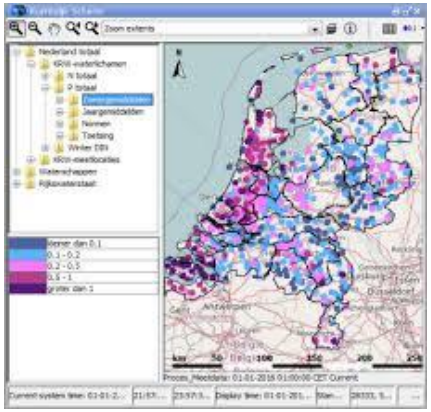


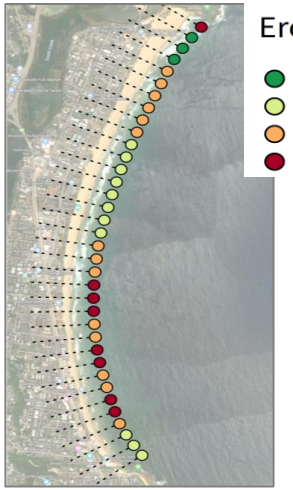
Key next steps:

Selection of a suitable data assimilation and EWS platform

Delft-FEWS



EWS communication and dissemination



Erosion Hazard Scale

- Minor beach narrowing
- Substantial beach narrowing
- Dune face erosion
- Dune retreat


...thanks