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# RESILIENCE TO CLUSTERED DISASTER EVENTS AT THE COAST: STORM SURGE

## Annual project report 2015-2016

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# EXECUTIVE SUMMARY


What is the problem?

Coastal communities in Australia are particularly exposed to clustered disaster events, due to the impact of cyclones and extra-tropical storms when there can be coincidence of severe wind damage, storm surge, coastal flooding and shoreline erosion. Because the climatic drivers of cyclones and severe storms are stronger during or across specific years (e.g. during La Niña periods), these events often repeatedly impact the coast over periods of weeks to months. The consequences of individual events are therefore exacerbated with little or no opportunity for recovery of natural systems or communities.

The storm events that occurred on the southeast coast of Australia during 1974 are the most significant and recent in memory in terms of coastal impact associated with clustered events. The clustering in that year occurred as a series of at least 10 storms between January and June. Not all of these events led to coastal erosion, but the sequence likely played some role in setting the pre-conditions of the beach that ultimately led to the erosion towards the end of this six month period. The question therefore is to determine the beach response to clustered event sets and the nature of how those events ultimately lead to erosion.

The problem is complex as the response to the forcing will vary – there will be a spectrum from inundation to erosion, and further, there will be varying factors that drive the erosion (e.g. long-shore, cross-shore) that are functions of the location and the event.

Why it is important?

Australia's population is concentrated along the coastline, with over 85% within 50 km of the coastline (Australian Bureau of Statistics 2001). In New South Wales for example, the NSW Government has identified 15 erosional hotspots (Kinsela and Hanslow 2013), along its 2000 km of coastline. Of the approximately 1000 km of erodible sandy beaches (open coast only), 28% is within 220 m of property. The storm event that impacted the southeast coast of Australia on the weekend of 5 May 2016 has served as a dramatic reminder of the damage that storm surge can produce, with significant beach erosion and property damage at a number of high profile locations in Sydney including Collaroy and Coogee. Any subsequent storm(s) will potentially worsen the situation at these locations, particularly if they occur before the beaches have had time to rebuild naturally.

How are you going to solve it?

The study will quantify the risk of these clustered events by determining the nature of the hazard, the elements that are exposed to this hazard and their resultant vulnerability. Combining the frequency of the hazard with its impact will enable the risk to be quantified. This risk can then be managed through the coastal and disaster management processes of all stakeholders.

The study is focused on two case studies, Old Bar beach in NSW and the beaches of metropolitan Adelaide. These sites were selected in consultation with the project end-users on the basis that they are actively being managed as erosion

'hotspots'. The physical setting of each site also presents an opportunity to advance our understanding of shoreline processes. The project has adopted the coastal compartment framework as the functional unit for understanding shoreline response at a range of spatial scales, and detailed geomorphological site investigations are being used as input to the beach response modelling.

Together, the risk and coastal compartments framework are powerful in terms of situating the assessment at local, regional and national scales.

# END USER STATEMENT

**Martine Woolf,** *Geoscience Australia, ACT*

This project is a collaborative effort between Geoscience Australia and the University of Queensland. At the end of its second year, the project has made good progress with the technical components (e.g. statistical modelling and geophysics). The first year focused on project planning, fieldwork and data collection, with preliminary modelling already underway. By the end of the second year, the modelling has significantly matured with high quality modelling of beach response to storms being conducted. As for all CRC projects, engagement between end-users and researchers is a key component of the CRC philosophy. This project has capitalised on the early productive end-user engagement with end-users involved in driving the requirements for the modelling (i.e. including climate variability into the wave climate). The project aims to implement a utilisation step with end-users to translate the project work to the coastal management framework at the state level. The focus of this utilisation will be to transfer knowledge and approach with those end-users with responsibility for areas where storm surge is a significant issue (i.e. east coast of Australia). End-user engagement will help ensure that the outputs of this work are relevant for different practitioners throughout Australia.

# INTRODUCTION

Coastal communities in Australia are particularly exposed to clustered disasters, due to the impact of cyclones and extra-tropical storms when there can be coincidence of severe wind damage, storm surge, coastal flooding and shoreline erosion. These effects were again demonstrated in May 2016 when a slow moving East Coast Low generated a storm surge that coincided with Spring high tide to cause significant beach erosion and property damage, particularly in Sydney. Because the climatic drivers of cyclones and severe storms are stronger during or across specific years (e.g. during La Niña periods), these events often repeatedly impact the coast over periods of weeks to months. The consequences of individual events are therefore exacerbated with little or no opportunity for recovery of natural systems or communities.

The processes that drive the coincidence or clustering of natural disasters are reasonably well understood. However, there is as yet no clear methodology in use to quantify the elevated risk to communities from clustered or coincident events. Typically, risk assessments are based on individual hazards against a long-term frequency baseline. This is potentially misleading as it underestimates the true impacts of coincident or clustered events on the resources and resilience of communities.

While clustering of events can add significant impact to all natural hazards, coastal communities are particularly sensitive to clustering because of the dynamic nature of the coast. Coastal landforms are not static, and themselves are vulnerable to the impact of the hazards. Coastal landforms provide the physical foundation of coastal communities, as well as potentially forming natural protection to those communities. Inadequate techniques that do not take a holistic approach to the dynamic response of coastal landforms and communities to clustered events can lead to inappropriate decision-making or funding allocation.

This study will demonstrate how a methodology developed for storm surge events can be applied to better inform decisions around resource investment in terms of disaster mitigation, planning and response and thereby optimise the resilience of the communities involved. Case studies will apply this methodology to coastal communities at selected areas in eastern and southwest Australia.

This project will provide a powerful combination of two conceptual frameworks: firstly, the framework that quantifies risk as the product of severity and frequency of impact defined by hazard, vulnerability and exposure, and secondly the framework of the coastal sediment compartment as the functional unit for modelling shoreline response to storm surge. The sediment compartment framework spans a hierarchy of spatial scales, and provides a basis to enable robust and consistent modelling of shoreline response. Furthermore, the conceptual framework places local studies into a regional context for improved coastal risk management. Geoscience Australia recently developed a national classification of coastal compartments for the entire Australian coast, and this study will build and extend that work to integrate with the risk assessment framework, supporting outcomes with applications at a national, regional and local level.

## PROJECT BACKGROUND

The aim of this project is to develop a new methodology to quantify the impact and risk of coincident and clustered disasters on the coast, with an initial focus on storm surge, associated erosion and reshaping of the coastline and the resulting inundation and damage to buildings and infrastructure.

As a basis for risk management at a range of scales suited for use by National, State and Local Government agencies, the objectives of this project are to:

- Examine the physical characteristics of coastal landforms at study sites that are vulnerable to storm surge erosion, as identified by end-users;
- Develop and validate an approach to model the frequency and severity of storm surge events, incorporating clustered events;
- Critically assess available conceptual and numerical models describing and quantifying physical responses of coastal landforms to storm surge;
- Demonstrate the value of an integrated methodology to quantify the impact of clustered storm surge events on coastal assets (buildings and infrastructure);

To meet these objectives, the project will be undertaken through a number of phases:

1. Project planning (completed during 2014/15)
    a. Engage State and Territory end-users to revise and refine the project plan
    b. Select study sites to ensure the utility of outputs for emergency management and land-use planning. Study sites based on the following criteria:
        i. Availability of data, including:
            1. Elevation – access to LiDAR derived elevation surfaces is key, both topographic and bathymetric.
            2. Geomorphology – including datasets such as the NSW Coastal Geomorphology Classification.
            3. Stratigraphy – subsurface studies to help inform estimates of sediment volumes in beach-barrier systems
            4. Access to previous local studies – where available. In particular, any sediment transport or process modelling studies in the region.
        ii. Areas that are of interest to end-users – particularly sites where a better understanding of shoreline response to coastal storms, and impacts on infrastructure is needed for land use planning.
        iii. Representative of a common coastal (beach-barrier) morphotype – this will ensure applicability of developed approach to other locations. Morphotype(s) that are more likely

to experience significant erosion and damage to infrastructure will be selected.

iv. Where storms, and in particular, sequences of storms have occurred and where we have some understanding of the metocean drivers of these events.

v. Political sensitivity/iconic sites – these issues may need to be considered when selecting a site.

2. Model coastal susceptibility/vulnerability to hazards for the Case Studies (completed during 2014/15)
    a. Work with the end-users to establish a lexicon of scientific nomenclature to describe coastal landforms across a predetermined hierarchy of scales, applicable to all coastal regions around Australia;
    b. Describe the study sites in terms of their location in the Primary/Secondary and Tertiary Compartment level and where possible the Sediment Compartment.
    c. Identify landforms on unconsolidated sedimentary coasts in each case study region, and assess their context in terms of the characteristics of the Secondary and Tertiary Compartment level.
    d. Rate the indicative vulnerability/susceptibility of coastal landforms to inundation and erosion hazards.
3. Critical assessment and development of conceptual and numerical shoreline response models (underway)
    a. Identify and critically evaluate conceptual and numerical models used to describe inundation and erosion and their impact on the developed coast;
    b. Develop a set of modelled storm surge 'events' that reflects the full range of historical and potential events at the study regions;
    c. Develop and implement a methodology that reflects the impact of clustering on the distribution of severity and frequency of storm events.
    d. Reconstruct historical shoreline responses to storm surge inundation based on existing databases and identify key data gaps;
    e. Fill any essential data gaps using field investigations in collaboration with existing State, Territory and Commonwealth Government, and University programs.
4. Assess the impact and risk of hazards (underway)
    a. Categorise exposure (buildings/infrastructure/coastal defences) on each sedimentary coast morphotype in the study area;
    b. Determine management problems specifically related to coastal infrastructure which were encountered during historical storm passage; relate the historical events to the frequency/severity distribution developed above;

   c. Develop site-specific vulnerability models to inundation based on empirical data and existing vulnerability models;
   d. Resolve the magnitude and rate of shoreline change and determine the impact zone for each event/cluster of events in the modelled event set;
   e. Quantify the risk on coastal communities (including infrastructure and habitats) in terms of probability of (economic) impact and loss.

5. Synthesis (focus for 2015/16 and 2016/17)
   a. Apply results to coastal hazard planning at local and regional scales by evaluating the effectiveness of a range of adaptation/mitigation responses. Adaptation/mitigation responses could include e.g. retreat, beach nourishment, zoning, and improved infrastructure, and would be scoped in collaboration with end-users.
   b. In consultation with end-users, develop communication material to include:
      i. Identification how the results from this study can be incorporated into a comprehensive assessment of the resilience of coastal communities and infrastructure to natural hazards.
      ii. Recommendations for a national approach to the acquisition of coastal data and recommend to be considered by COAG to minimise the impacts of coastal risks.

The outcomes of this project include:

- Support for an improved ability of coastal managers and planners to make informed decisions and prioritise resource investment, based on appropriate, quantitative information regarding clustered storm surge events;
- A conceptual framework for integrating coastal studies across a range of spatial scales (local/regional/national);
- A demonstrated methodology for quantifying the impact of clustered events on coastal infrastructure;
- Recommendations for a national approach to the acquisition of coastal data and recommend to be considered by COAG to minimise the impacts of coastal risks;
- The development of a nationally consistent methodology to assess the potential impact of coastal hazards.

# WHAT THE PROJECT HAS BEEN UP TO

The first year of the project focused on the selection of study sites in consultation with end-users, desktop data collection and analysis, field work at Old Bar (NSW) and Adelaide, and selection of the shoreline response modelling tool. During year two, the project has progressed to modelling the response of beaches to storm events, including producing a statistically robust dataset of storm wave parameters. The project also completed the analysis of data collected during field work at the two study sites and the public release of the coastal sediment compartment data.

## WORKSHOPS AND SITE VISITS

The project participated in the coastal cluster workshop in conjunction with the BNHCRC Research Advisory Forum (17-18 November 2015). During the workshop, the collection of exposure data necessary for the impact and risk assessment component of the project was discussed. Following the workshop, a short summary report outlining the planned approach was circulated to end-users in December 2015.

The project plan had aimed to assess risk based on buildings and infrastructure in the coastal zone, with the expectation that the exposure (due to coastal recession and storm tide inundation) would be of the order of 10s to 100s of buildings and associated infrastructure (e.g. roads etc). The project has assessed that the likely exposure will be limited to beach access paths and stairs, coastline protection elements and storm water outfalls. Old Bar may have some limited building impact, perhaps up to 10 buildings.

Given this assessment, the exposure analysis will take on a more localized approach which will involve the creation of building footprint polygons digitized from imagery based on simulated coastal recession and storm tide inundation. Exposure will also be classified according to the sedimentary landform type. Vulnerability assessment will assume that buildings would require replacement based on the coastal recession hazard.

Collection of exposure data will be determined once preliminary shoreline response models are available. The project is aware that databases of coastal infrastructure assets in SA for example are not readily available.

During AFAC 2015, GA and UQ researchers conducted a site visit to the Adelaide Metropolitan Beaches. The visit was instructive to the researchers to get a first-hand view of the site and speak with the local end-user on how the beach front is currently managed.

The project has also conducted visits with stakeholders and end-users:

- UQ researchers visited the Queensland Government Hydraulics Laboratory in March following an invitation from the QLD end-user at the RAF (November 2015). Whilst the project's study sites are not in QLD, the QLD end-user has provided valuable feedback on the approach adopted by the project.

- Several visits have been made to the BMT WBM[1] Brisbane Office to ensure that the EVO software has been installed and to receive guidance on its application.

## DATA RELEASES

The coastal sediment compartments data (Figure 1) was published by Geoscience Australia in the Quarter 1 of 2015-16 in various geospatial file formats (ESRI geodatabase and Google Earth kml[2]) and then in Quarter 3 as webservices (WMS and WFS[3]). An accompanying GA record[4] outlines the methods used to generate the data. This nationally-consistent data and classification provides a mapping framework to support coastal management at a range of scales, and guide the selection of approaches for modelling shoreline response.

Users can now ingest the data directly into their own analysis systems thereby ensuring that any updates of the data will be seamlessly available to them. Users will also be able to discover and access this data through the CoastAdapt tool developed by NCCARF[5].

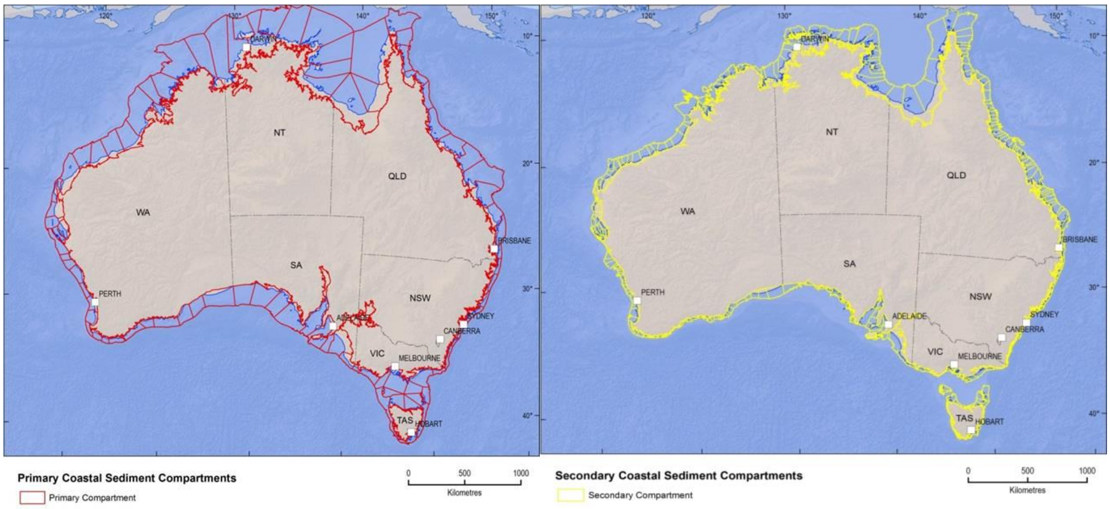


FIGURE 1: PRIMARY AND SECONDARY COASTAL SEDIMENT COMPARTMENTS.

## SHORELINE RESPONSE MODEL PREPARATION

The second year of the project has resulted in significant progress on the shoreline response modelling. Key activities include:

- Storm event set established for Old Bar and Adelaide study sites (Figure 2).
  - The method used to determine the storm event time series has been published in "Statistical modelling of extreme ocean climate

[1] http://www.bmtwbm.com.au/markets/water-and-environment/climate-change/shoreline-responses/
[2] http://www.ga.gov.au/metadata-gateway/metadata/record/84574
[3] http://services.ga.gov.au/gis/rest/services/Australian_Coastal_Sediment_Compartments/MapServer
[4] http://www.ga.gov.au/metadata-gateway/metadata/record/87838
[5] https://www.nccarf.edu.au/content/coastal-tool-overview

with incorporation of storm clustering" as part of the MODSIM 2015 conference proceedings. The work was also presented at MODSIM2015.

- The method has been discussed with: (1) researchers who will integrate this data with the shore-line response modelling; (2) end-users during the development of the data set (predominantly NSW OEH) and; (3) end-users at the RAF in Brisbane 17-18 November 2015.

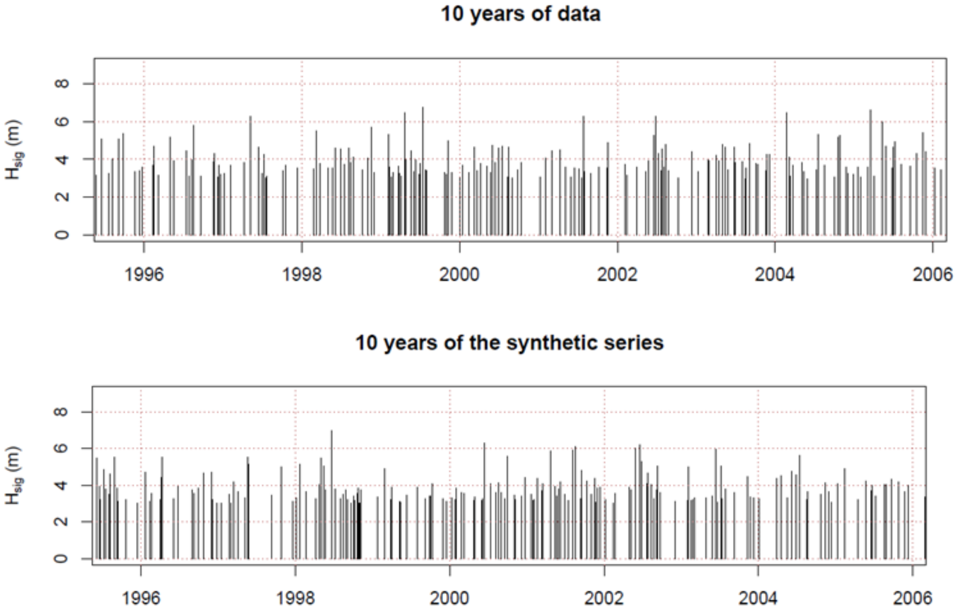


FIGURE 2: EXAMPLE OF OBSERVED AND MODELLED WAVE DATA FOR OLD BAR, SHOWING SIGNIFICANT WAVE HEIGHT

- The method requires an input data set which is different for each study site.
  - For the Old Bar study site, the project used observational wave data from an offshore wave-rider buoy as the record is sufficiently long (1985-2014) and representative of the wave climate at Old Bar.
  - For the Adelaide study site, observational wave data was not sufficiently long (10 years) and sourced from a location on the ocean side of Kangaroo Island that does not represent the wave climate within Gulf St Vincent. Therefore, a modelled hindcast data set was used (CAWCR) that covered a sufficiently long period (1979-2013) and represented wave conditions affecting the Adelaide shoreline. The relative importance of locally-generated waves and ocean swell-waves was also analysed for this hindcast data set.
  - The different input data sets used for each study site will provide some potentially useful lessons for end-users in terms of observed versus modelled data.

        - The statistical analysis has been further extended to account for the impacts of ENSO and seasonality on storm wave properties and storm frequency, as recommended by NSW Office of Environment & Heritage. The analysis has found that on average, storm wave properties (height, duration, period, surge, Mean Sea Level) are of greater magnitude in winter than summer. In addition, during La-Nina the Mean Sea Level is higher and frequency of storms increased higher, and the wave direction becomes more easterly, compared with El-Nino. This work has implications for our modelling of beach response and forms the basis for the draft submission "Resolving confidence limits and thresholds in probabilistic modelling of storm wave climate".

- Shoreline response modelling well advanced:
    - All components are now complete to commence sediment transport modelling at Old Bar with additional data sourced from SA for modelling the Adelaide beaches (e.g. wave measurements and sand pumping volumes):
        - Curvilinear grid for EVO model constructed from Old Bar digital elevation model (DEM). The DEM was developed by merging multi-beam, LIDAR, photogrammetry, beach profile, terrestrial survey, benchmarks, and aerial photographs
        - NETCDF wave model look-up table, and
        - offshore wave parameter time series.
    - Data collected from the field work conducted in March 2015 is being incorporated into the modelling:
        - Grain size analysis of beach samples was completed at the University of Queensland (Figure 3 - Figure 5). Grain size is believed to be related to the "A" parameter in the y=A*x(2/3) shape of the profile and may also relate to parameters that defines the time scale for the erosion and accretion in the cross shore direction.
        - The Ground Penetrating Radar (GPR) data will be useful to define the underlying bedrock or non-transportable material and the overlying sediment thickness. Inclusion of this data in the model set up will be discussed with the software developers (BMT WBM) as the model does include seawalls, groynes and headlands with offshore reefs and bedrock yet to be developed.
        - Importantly, this data will be discoverable and accessible to all users; the Marine Sediments (MARS) database[6] (for the grain size) and via GA (GPR data).

[6] The MARine Sediment (MARS) database contains detailed information on seabed sediment characteristics for samples collected from Australia's marine jurisdiction, including the Australian Antarctic Territory. It is an important scientific resource that includes survey and sample information

- Physical modelling of the effect of storm sequences on beach profile evolution and beach erosion:
  - This activity was not planned as part of the project however it will add significant value to inform and verify the modelling results. This student project is using UQ's hydraulics flume which was set up to replicate the Old Bar study site (Figure 6).


FIGURE 3: THE SIEVE SET AND MECHANICAL SHAKER AT THE UNIVERSITY OF QUEENSLAND LABORATORY.

such as locations, water depths and sample descriptions. Data are also provided from quantitative analyses of the sediments, such as grain size, mud, sand, gravel and carbonate concentrations, mineralogy, age determinations, geochemical properties, and physical attributes for down-core samples including bulk density, p-wave velocity, porosity and magnetic susceptibility. http://dbforms.ga.gov.au/pls/www/npm.mars.search

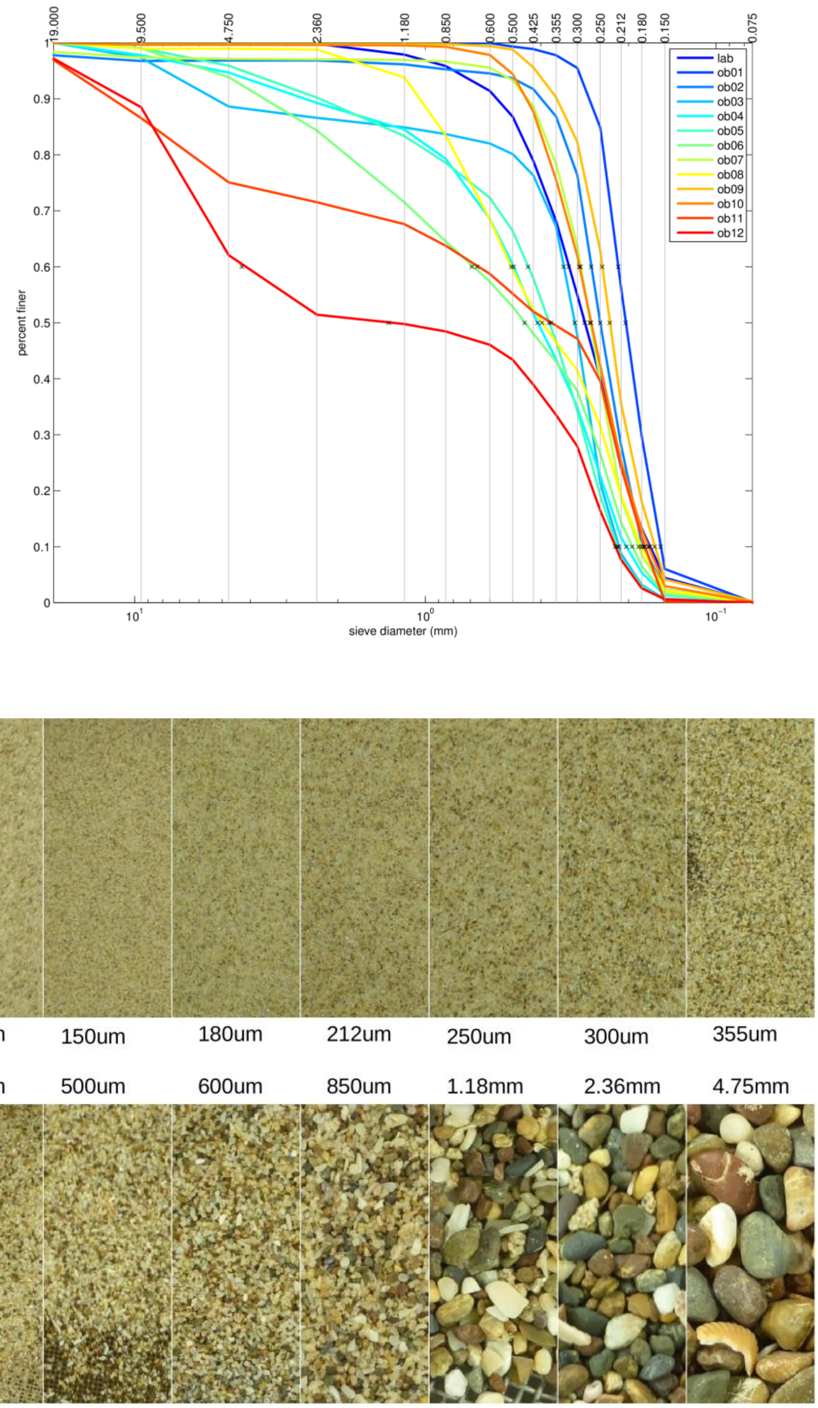


FIGURE 4: SEDIMENT ANALYSIS OF OLD BAR, NSW SAMPLES.

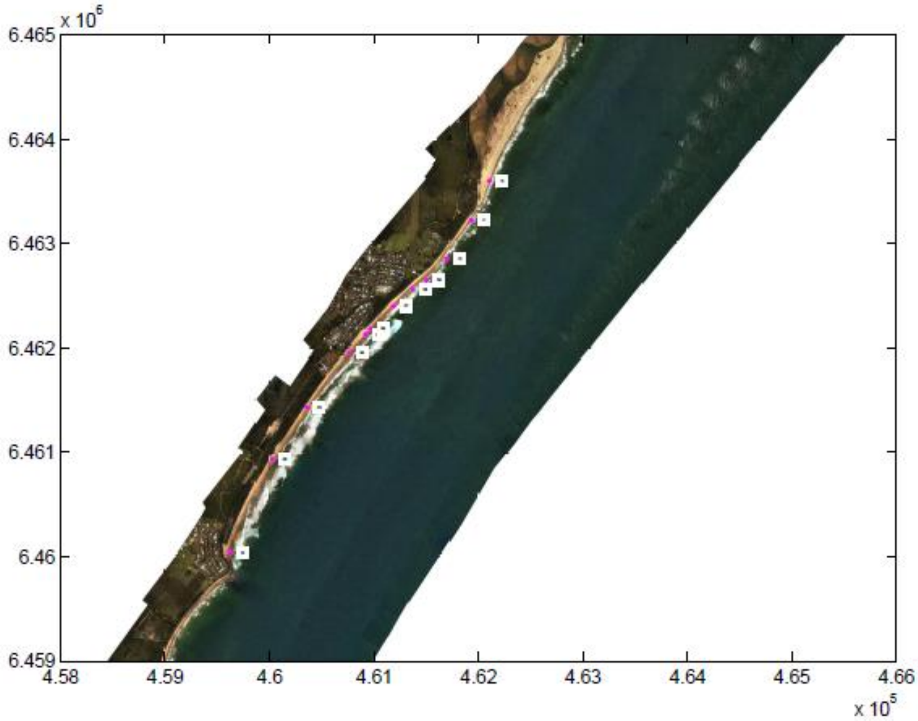


FIGURE 5: LOCATIONS OF SEDIMENT SAMPLES FROM OLD BAR, NSW.

FIGURE 6: UNIVERSITY OF QUEENSLAND RESEARCHER AND STUDENTS WTH THE UNIVERSITY OF QUEENSLAND HYDRAULIC FLUME USED FOR THE PHYSICAL MODELLING EXPERIMENT OF CLUSTERED STORMS. FROM LEFT TO RIGHT: URIAH GRAVOIS, CARLOS GOMEZ (VISTIING FROM IMPERIAL COLLEGE LONDON) AND SEAN HSIEH (VISITING FROM UNIVERISTY OF TORONTO).

## INSIGHTS FROM STORMS IN 2016

The southeast coast of Australia was impacted again by damaging storms in June 2016 with the passage of an east coast low on the weekend of 4-5 June. The project contacted the Greater Taree City Council to determine the impact of the storm at Old Bar. Photos showing the beach in June 2015 and June 2016 (following the June 5 storm) show minor erosion of the upper beach and dune face at Old Bar, resulting in damage to an access stairway. To the north of this stairway, a wall of sand bags remained in place following the storm. Clearly, the storm surge at Old Bar was less than on some Sydney beaches where property loss was significant (e.g. Collaroy and Coogee).

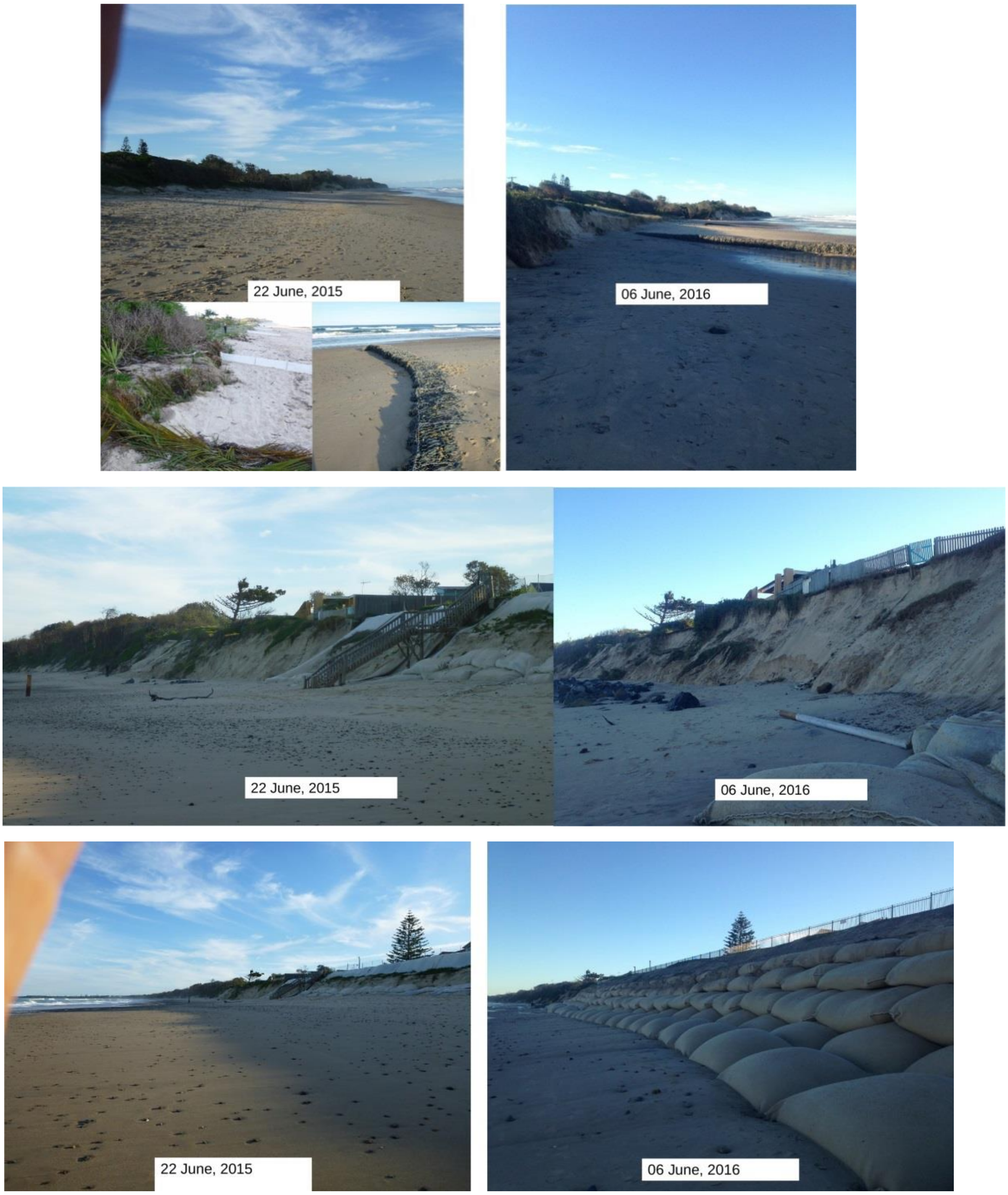


FIGURE 7: OLD BAR FOLLOWING THE STORMS IN APRIL 2015 (LEFT) AND JUNE 2016 (RIGHT).

The beaches of metropolitan Adelaide were also impacted by a storm surge on 9 May 2016, resulting in significant beach and dune erosion and localized damage to infrastructure (e.g. roads and seawalls at West Beach and Brighton; Henley jetty). A report on the storm event from the Department of Environment, Water and Natural Resources to the SA Coast Protection Board noted that the impacts from similar events in the past had been more extensive and that the erosion and damage during this storm was reduced due to the beach nourishment program managed by the Board and Department. This event also provides an opportunity for this project to 'calibrate' shoreline response modelling results with measured storm surge heights and resultant erosion.

## LINKS TO OTHER RESEARCH PROGRAMS

The project is collaborating with the University of Wollongong on a three year ARC Discovery Grant 'Sedimentary processes on sandy coasts in southern Australia' that commenced in January 2015. The ARC project team completed their first field work campaign in early December 2015 in Gippsland, Victoria. This involved reconnaissance Ground Penetrating Radar surveys of the coastal barrier systems in Gippsland with participants from University of Wollongong and University of Melbourne. Additional fieldwork on the NSW south coast was undertaken in March-April 2016, with collection of sediment cores from low lying barriers. This information will be of value to the BNHCRC project in adding to the overall understanding of coastal sediment compartments, particularly those characterised by shoreline progradation. Results from field work completed to date were presented at a project workshop on 28 June 2016.

In collaboration with CSIRO and the ANU, GA has developed the Australian Geoscience Data Cube (AGDC) that contains the historical archive of Landsat satellite data for Australia. While the spatial resolution of the Landsat archive is not sufficient to map coastal erosion in detail, new satellites such as Sentinel 1 will present opportunities to explore this issue in the future. The AGDC has also been used to produce the National Intertidal Extents Model (ITEM). This is a continental-scale model that maps the spatial extents of the exposed intertidal zone at various stages of the tidal cycle[7] and will be of value for understanding nearshore wave processes and sediment dynamics (erosion and accretion) at the scale of primary and secondary coastal compartments.

## PAPERS AND CONFERENCES

- MODSIM 2015, Gold Coast, November 2015 (extended abstract and presentation)
    - W Jiang, G Davies, D Callaghan, T Baldock and S Nichol. Statistical modelling of extreme ocean climate with incorporation of storm clustering.
- 14th International Coastal Symposium, Sydney, March 2016 (published in conference proceedings)

[7] http://www.ga.gov.au/metadata-gateway/metadata/record/100600

  - S Nichol, A McPherson, G Davies, W Jiang, F Howard, U Gravois, D Callaghan and T Baldock. A Framework for Modelling Shoreline Response to Clustered Storm Events: Case Studies from Southeast Australia.
  - It is worth noting that there were no presentations at this international conference that was taking a modelling approach to estimate shoreline response, particularly in a risk framework. Many of the related presentations were focused on field measurements, and the collection of data pre- and post disaster.
- 35th International Conference on Coastal Engineering, Istanbul, July 2016 (accepted as extended abstract for July 2016 conference however due to travel restrictions to Turkey the work was not presented)
  - U Gravois, T Baldock, D Callaghan, G Davies, W Jiang and S Nichol. Investigating Site Specific Directional Wave Measurement Bias Using Ray Tracing.
- AFAC 2016 (accepted as poster)
  - U Gravois, T Baldock, D Callaghan, G Davies, W Jiang and S Nichol. Improving resilience to storm surge hazards: assessing risk through wave simulations, shoreline modelling and field observations.
- 25th NSW Coastal Conference, Coffs Harbour, November 2016 (abstracts submitted)
  - U Gravois, T Baldock, D Callaghan, G Davies, W Jiang and S Nichol. Blue water waves: Inverse wave ray tracing of waverider measurements to deep water and comparison with global climate models.
  - G Davies, U Gravois, W Jiang, D Hanslow, D P Callaghan, T Baldock and S. Nichol. Probabilistic modelling of storm wave clustering at Old Bar, NSW, including the impacts of seasonal and ENSO cycles.
  - T Baldock, C Gomez, U Gravois and D Callaghan. Physical modelling of the effect of storm sequences on beach profile evolution and beach erosion.
- Coastal Engineering Journal (Q4 milestone, to be submitted in July)
  - G Davies, D Callaghan, U Gravios, W Jiang, D Hanslow, S Nichol and T Baldock. Resolving confidence limits and thresholds in probabilistic modelling of storm wave climate.

## LINKS TO GOVERNMENT POLICIES

The NSW State Government has recently announced a Coastal Reform program[8], including significant investment in data collection and science. Linked to this, the coastal science program in NSW Office of Environment & Heritage has advanced the national scale coastal sediment compartment framework used in

[8] http://www.environment.nsw.gov.au/coasts/coastreforms.htm

this project to the tertiary (beach) scale that is required to support state-wide coastal management.

QLD has recently made changes to planning policy, including amendments to the Coastal Protection and Management Act that relate to inclusion of maps showing coastal resources[9]. It is noted here that these resources could include offshore sand reserves and that the coastal sediment compartment framework would be relevant to defining these.

The SA end-user briefed the SA Coastal Protection Board on 4 Dec 2016 on the two projects in the coastal cluster of the BNHCRC. The Board noted the potential implications of this project for the target "sand buffer volumes" that they use for managing sand on Adelaide's metro coast. Implications from the other coastal project (led by UWA) relate to the 100 year ARI flood levels that are used to assess development proposals against the Board's flood hazard policy.

At the national level, National Climate Change Adaptation Research Facility (NCCARF) is developing the CoastAdapt tool[10]. As mentioned earlier, the coastal sediment compartment will also be discoverable and accessible via this tool given GA's release of the data as webservices. The tool will host a range of information, data and tools to provide practical guidance on how to manage the risks from climate change and seal-level rise around Australia.

## UTILISATION

A project is being scoped with NSW Office of Environment & Heritage that will blend the probabilistic shoreline response modelling approach developed through the BNHCRC project with the existing state-wide approach adopted by NSW. It is anticipated that the method will be initially tested at the Old Bar case study site.

9 http://www.dilgp.qld.gov.au/planning-reform
10 https://www.nccarf.edu.au/content/coastal-tool-overview

# CURRENT TEAM MEMBERS

Researchers:

*Geoscience Australia*

- Scott Nichol
- Andrew McPherson
- Floyd Howard
- Wenping Jiang
- Gareth Davies
- Duncan Moore
- Katherine Owens
- Jane Sexton (project manager)

*University of Queensland*

- Tom Baldock
- David Callaghan
- Uriah Gravois

End-users:

- David Hanslow (NSW Office of Environment and Heritage)
- Kaylene Jones (NSW State Emergency Services)
- Robert Schwarz (QLD Department of Science, Information Technology, Innovation and the Arts)
- James Guy (SA Department of Environment, Water and Natural Resources).