WATER, WATER EVERYWHERE

Improving Community Resilience to Flood and Extreme Water Levels along the Coast

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Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

Australian Government
Geoscience Australia

INTRODUCTION

1) Why do research in this space?
2) Developing better predictions for extreme water levels
    - Robert Schwartz – End User, Department of Science, Information Technology, Innovation and the Arts, QLD
3) Resilience to clustered disaster events at the coast: storm surge
    - James Guy – End User, Department of Environment, Water & Natural Resources, SA
4) Improving flood forecast skill using remote sensing data
    - Yuan Li – Researcher, Monash University
5) Big issues remaining



Images: Goldcoast

IMPORTANCE OF RESEARCH INTO COASTAL & FLOOD HAZARDS

- ~85% of Australia's population lives within 50km of the coast
- Constant change & adaptation of the coast
- Climate change impacts & increasing population increase Australia's vulnerability to coastal hazards
- Occurrence of extreme water levels can lead to loss of life & damage to infrastructure & buildings
- Mitigate the cost & damage caused by coastal hazards & floods

Images: Top – Sunshine Coast, Bottom: Byron Bay

FACTS AND FIGURES ON COSTS
Extreme water levels (meteotsunami, storm surge)

- Historically low economic cost per event, however potential for large losses:
  - A tropical cyclone crossing over one of the more densely populated parts of the coast at high tide can be devastating.
  - Cost largely in ongoing management of beaches due to coastal erosion.

PHOTO: At Tennyson, only sand replenishment keeps some coastal housing safe from high tide and storms. (ABC News)

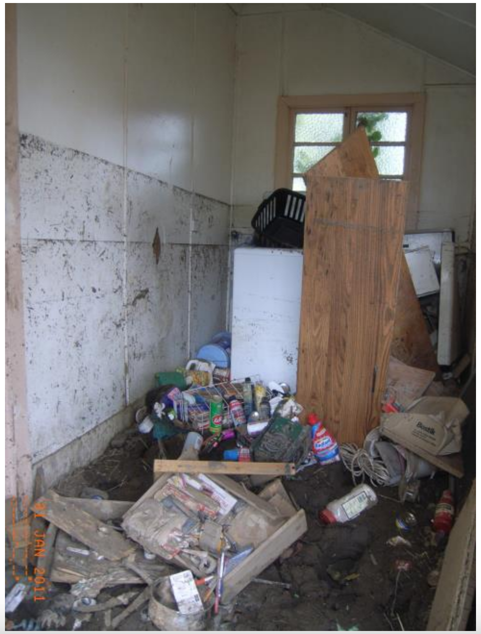
FACTS AND FIGURES ON COSTS

Extreme water levels (meteotsunami, storm surge)

- Fatalities:
  - Deaths at sea (e.g. boats capsizing)
  - 300+ people died in 1899 at Bathurst Bay, QLD when a cyclone crossed the coast causing a large storm surge
  - No confirmed deaths from meteotsunamis in Australia

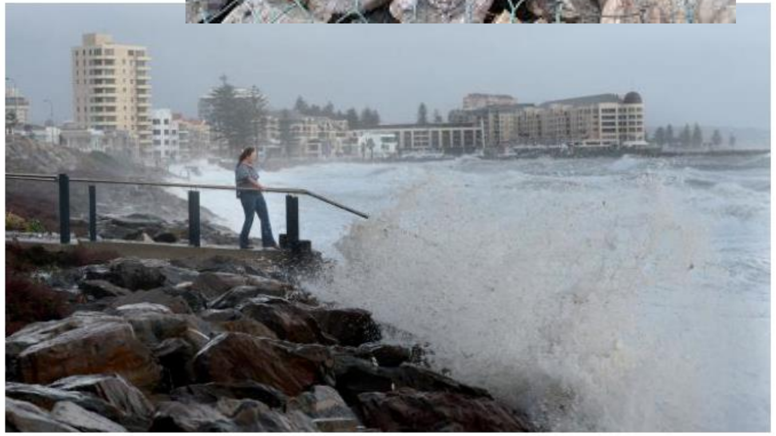
FACTS AND FIGURES ON COSTS
Floods

- Average annual cost for the last 40 years: $377M/year
- Many fatalities:
  - 1859 deaths from 1900 to 2015, of these 178 have occurred since 2000
  - 35 confirmed deaths, summer 2010-2011 floods, QLD ($2.38 billion damage)
  - 5+ deaths, June 2016 floods, QLD, NSW, TAS
  - 5+ deaths, March-April 2017 floods, QLD, NSW



IMPORTANCE OF MITIGATION

- Mitigation is imperative to reduce loss of life & property. Mitigation reduces the impact of disasters.



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

DEVELOPING BETTER PREDICTIONS FOR EXTREME WATER LEVELS

Robert Schwartz – End User
Department of Science, Information Technology & Innovation, Queensland

Research Team

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Asst/Prof Ivica Janekovic
Dr Yasha Hetzel
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End users

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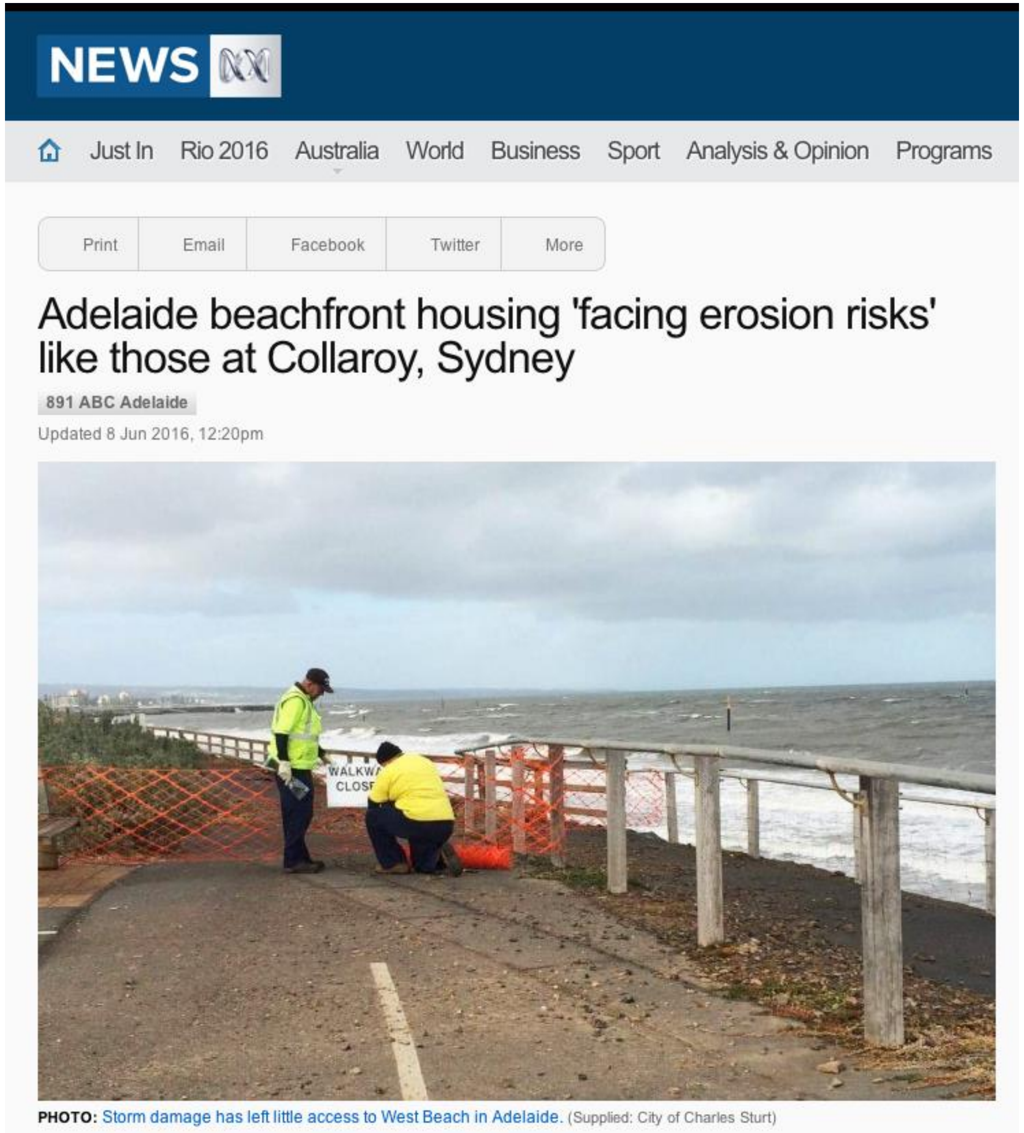
NSW Government Office of Environment & Heritage	David Hanslow
SES NSW State Emergency Service	Kaylene Jones
Government of Western Australia Department of Fire & Emergency Services	Steve Gray
Government of South Australia Department of Environment, Water and Natural Resources	James Guy

PROJECT IMPORTANCE

- Coastal communities & infrastructure **are at increasing risk** from the impacts of extreme water level events (e.g. tides, storm surges, meteotsunamis).
- To better prepare, coastal engineers, emergency managers & planners require accurate estimates of extreme water levels.


(source: DSITIA)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Adelaide beachfront housing 'facing erosion risks' like those at Collaroy, Sydney

891 ABC Adelaide

Updated 8 Jun 2016, 12:20pm

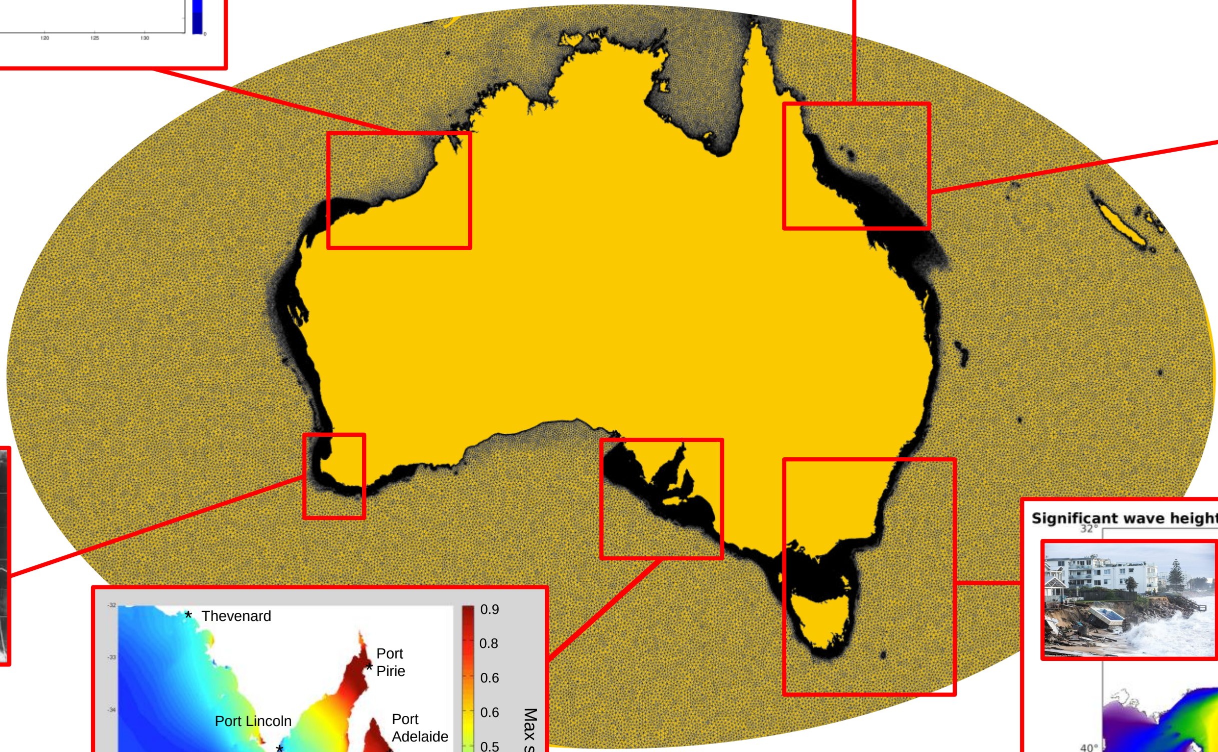
PHOTO: Storm damage has left little access to West Beach in Adelaide. (Supplied: City of Charles Sturt)

WHAT HAS IT ACHIEVED?

- An advanced coupled surge-wave model for the Australian coastline
    - Allows for estimation of wave setup over large areas
    - Output: 60 year time series of water levels
- Improved extreme sea level predictions

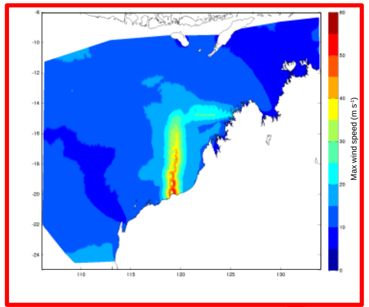
Damian Shaw Daily Telegraph

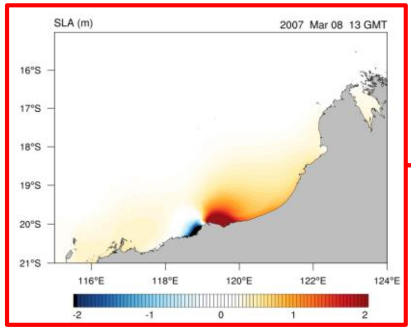
FIVE EVENTS - MODEL VALIDATION



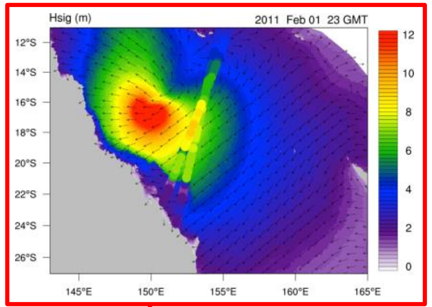
TROPICAL CYCLONE GEORGE

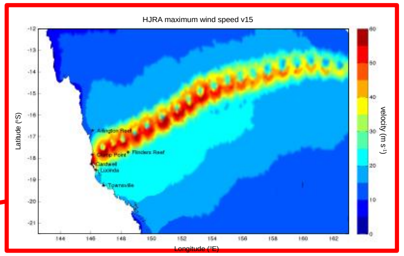
APRIL 2007

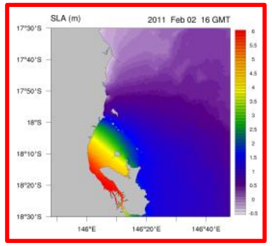




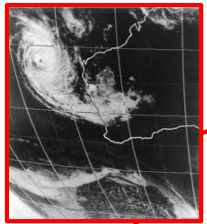
TROPICAL CYCLONE YASI FEBRUARY 2011

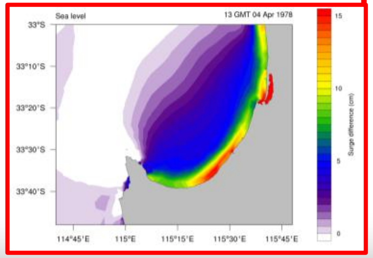


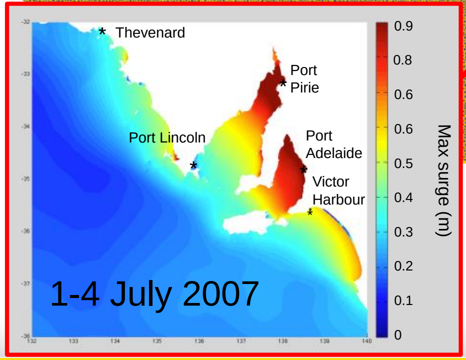




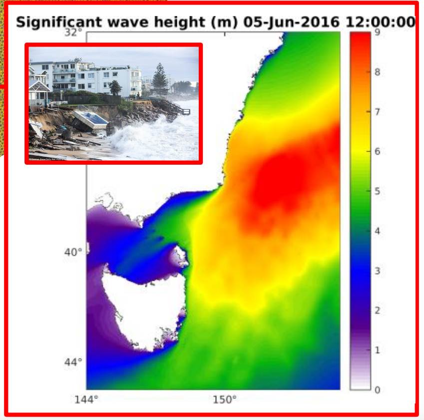
CYCLONE ALBY APRIL 1978







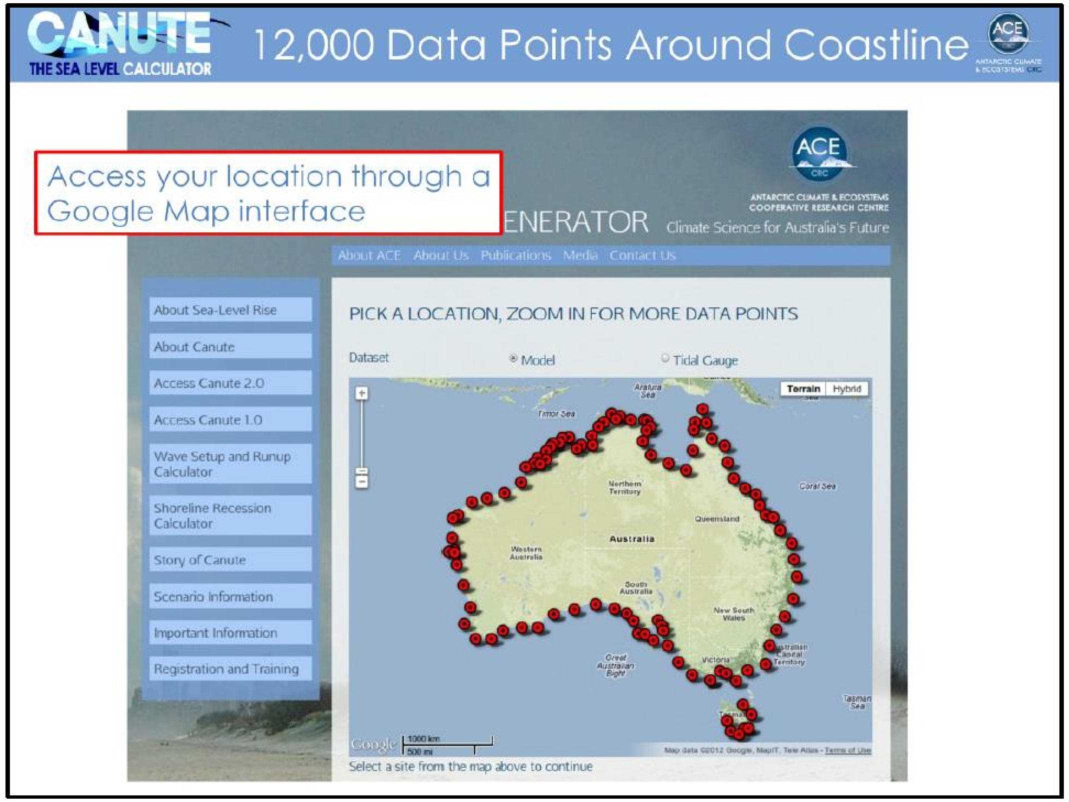
EXTRATROPICAL STORMS



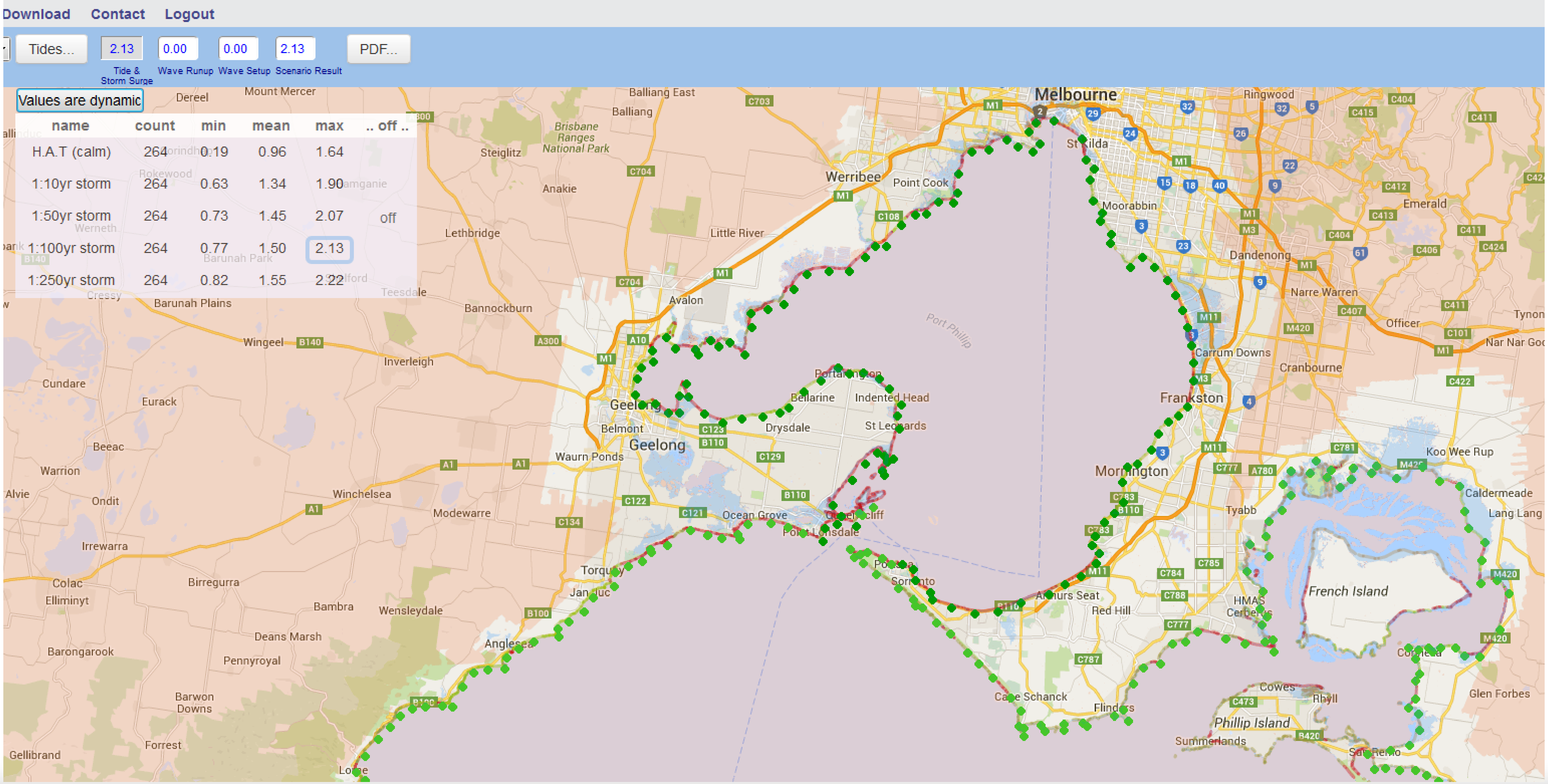
EAST COAST LOW JUNE 2016

WHAT ARE THE OUTPUTS/PRODUCTS?

- A web-based tool is being developed to disseminate results of the study – includes ~100,000 coastal 'stations' around Australia & estimates of likelihood.



WHERE HAS THE WORK TAKEN US?



RESILIENCE TO CLUSTERED DISASTER EVENTS AT THE COAST: STORM SURGE
Leading to improved knowledge in the coastal zone

James Guy – End User
Department of Environment, Water & Natural Resources

Research Team

Dr Scott Nichol (Leader)
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Floyd Howard
Duncan Moore
Dr Jane Sexton (Manager)

Professor Tom Baldock
Dr David Callaghan
Dr Uriah Gravois

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Geoscience Australia

The University Of Queensland
AUSTRALIA

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NSW Government – Office of Environment & Heritage: Dave Hanslow

Queensland Government: Robert Schwartz, Paul Boswood

Government of South Australia – Department of Environment, Water and Natural Resources: James Guy

PROJECT IMPORTANCE

- Coastal communities & infrastructure **are at risk** from the impacts of storm surge
- Clustered surge events **reduces time for recovery** of the coastline
- Not accounting for the impact of clustered events **underestimates the risk** to coastal assets

Coastal managers require information & tools to better understand coastal erosion → **Where? How much? Why?**

Images:
- TC Debbie March 2017 – Shute Harbour
- Ex-TC Debbie April 2017 – Gold Coast (Surf Life Saving QLD)
- Storms May 2016 - Adelaide
- East Coast Low June 2016 - Collaroy Beach, Sydney

WHAT WILL IT ACHIEVE?

Hazard Assessment – Existing Development:

- Improved assessment of existing hazard

Protection of Future Development:

- Improved assessment of erosion buffers

Improved management of Adelaide's Beaches

IMPROVING FLOOD FORECAST SKILL USING REMOTE SENSING DATA

Yuan Li – Researcher
Monash University

Research Team

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Australian Government
Geoscience Australia

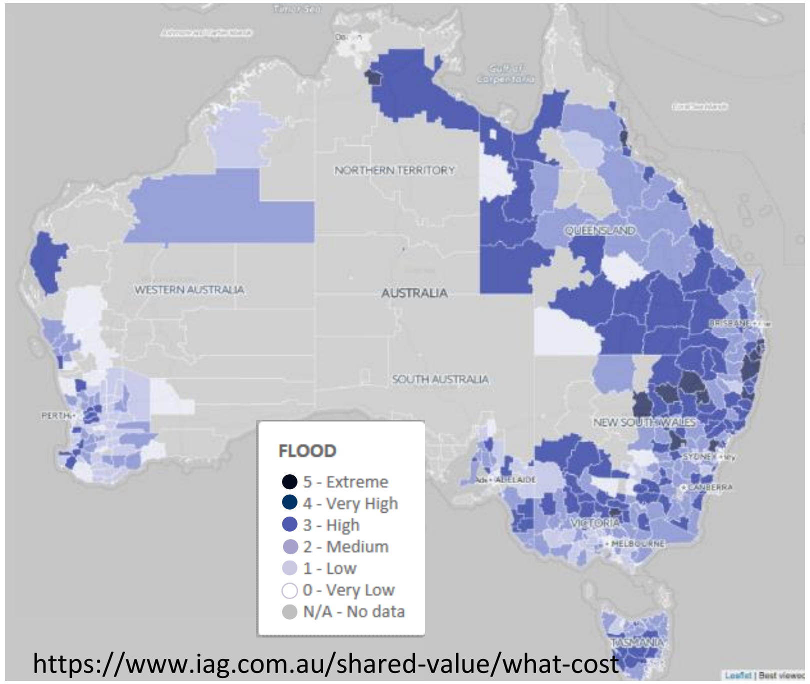
Dr David Hudson
Dr Norman Mueller

SES
NSW STATE EMERGENCY SERVICE

Caroline Ortel

PROJECT IMPORTANCE

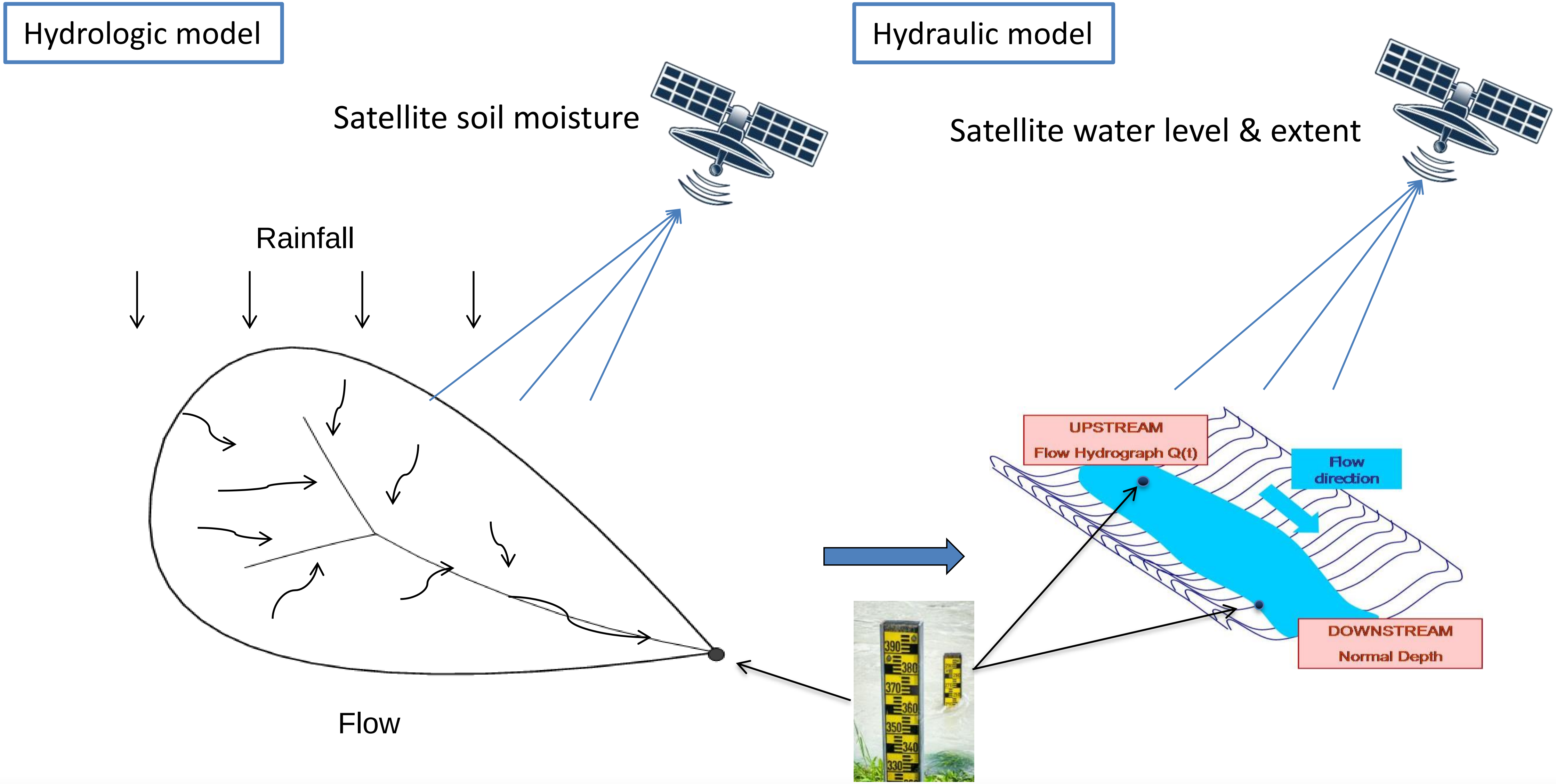
- **28.4% of GDP** & **24.9% of the population** live in areas at high to extreme risk of flood.
- Improving flood predictions, including accurate estimates of flood peak, depth & velocity **will help to reduce flood related deaths & damages.**
- Satellite data **offers new opportunities** to improve flood forecasting.



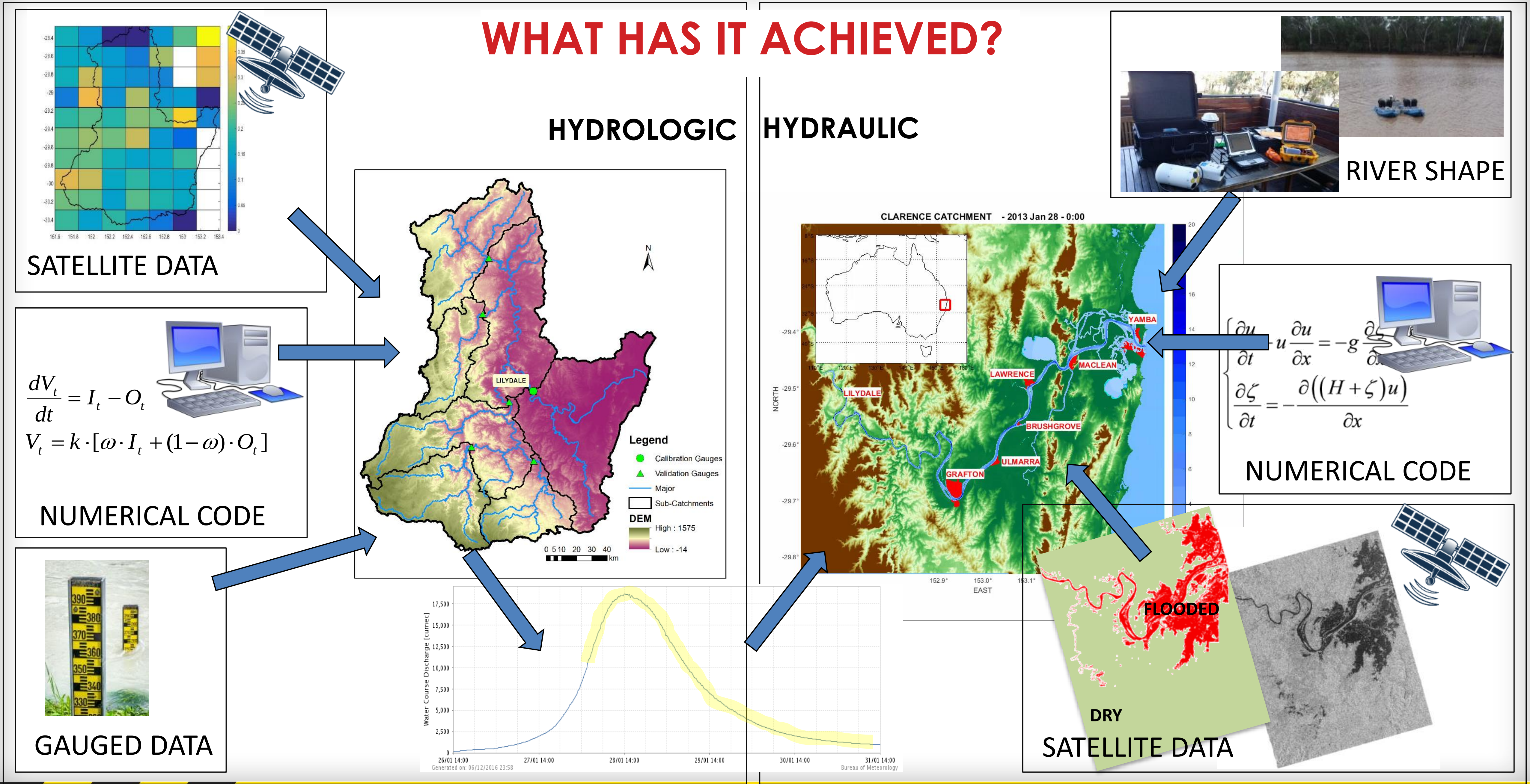
https://www.iag.com.au/shared-value/what-cost

St. George (QLD), 2010 March 5th, http://www.abc.net.au

FLOOD FORECASTING SYSTEM



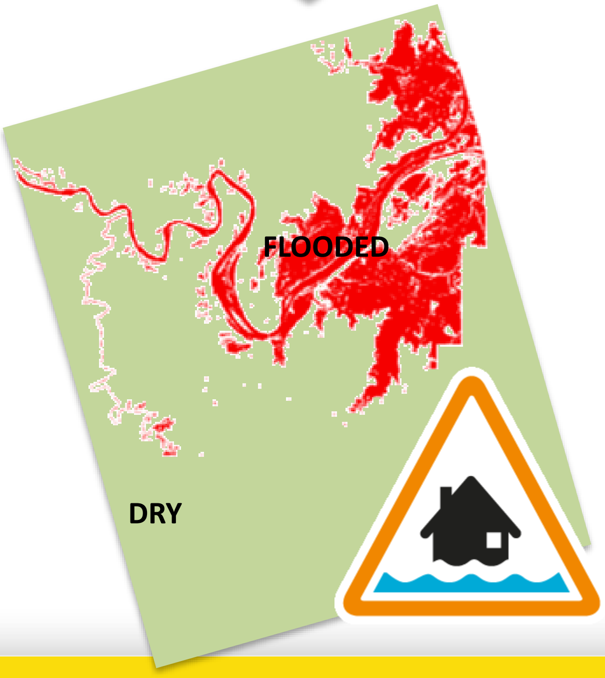
WHAT HAS IT ACHIEVED?



WHAT ARE THE OUTPUTS/PRODUCTS?

- An integrated forecasting system that consists of:
  - A coupled hydrologic-hydraulic model
  - A satellite data integration module

- Capability to deliver flood inundation warnings



WHERE HAS THIS WORK TAKEN US?

"This research will enable Geoscience Australia to ***better target satellite image acquisitions****. It will also* ***fill the gaps*** *in flood extent determination where satellite images are unavailable".*

Norman Mueller, End User, Emergency Response Coordinator, Geoscience Australia

"The remote sensing constrained hydrologic & hydraulic modelling capacity being developed will ***complement the current*** *flood forecasting capabilities of the Bureau of Meteorology".*

Soori Sooriyakumaran, End User, Manager Flood Policy Unit, Bureau of Meteorology

BIG ISSUES REMAINING – COASTAL PROJECTS
Science

- Model coastal processes at longer time scales (decades & longer) to fully understand coastal behavior
- Translate/communicate the science to decision makers so that effective mitigation strategies are adopted
- Impact of climate change

BIG ISSUES REMAINING – COASTAL PROJECTS
Implementation challenges for national application

- Availability of national datasets
  - Coastal infrastructure
  - Wave & sea level observations that are of sufficiently long time history
  - High resolution bathymetry & elevation
- Highly technical methods that relies on data & capability of users
- Collection of site specific data
- Construction of coastal inundation maps for extreme water levels including climate change effects

BIG ISSUES REMAINING – FLOOD PROJECT

- Forecasting of flood inundation (over the river bank)
  - Forecasts are limited to water level/amount forecasts at specific river locations
- The forecasting system does not use any satellite data, which has a potential to improve the forecasting skill especially at areas with limited flow gauges
- There is a need to develop an integrated forecasting system, which can make use of the satellite data & provide both water level/amount & flood inundation forecasts

CONCLUSION