USING REALISTIC DISASTER SCENARIO ANALYSIS

To understand natural hazard impacts and emergency management requirements

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WHY DISASTER SCENARIOS

Risk = Hazard x Elements at-risk x Vulnerability

Scenarios enable the combination of these risk attributes to be analysed and ultimately achieve a fuller understanding of the risk.

Enables what if questions to be realistically answered?

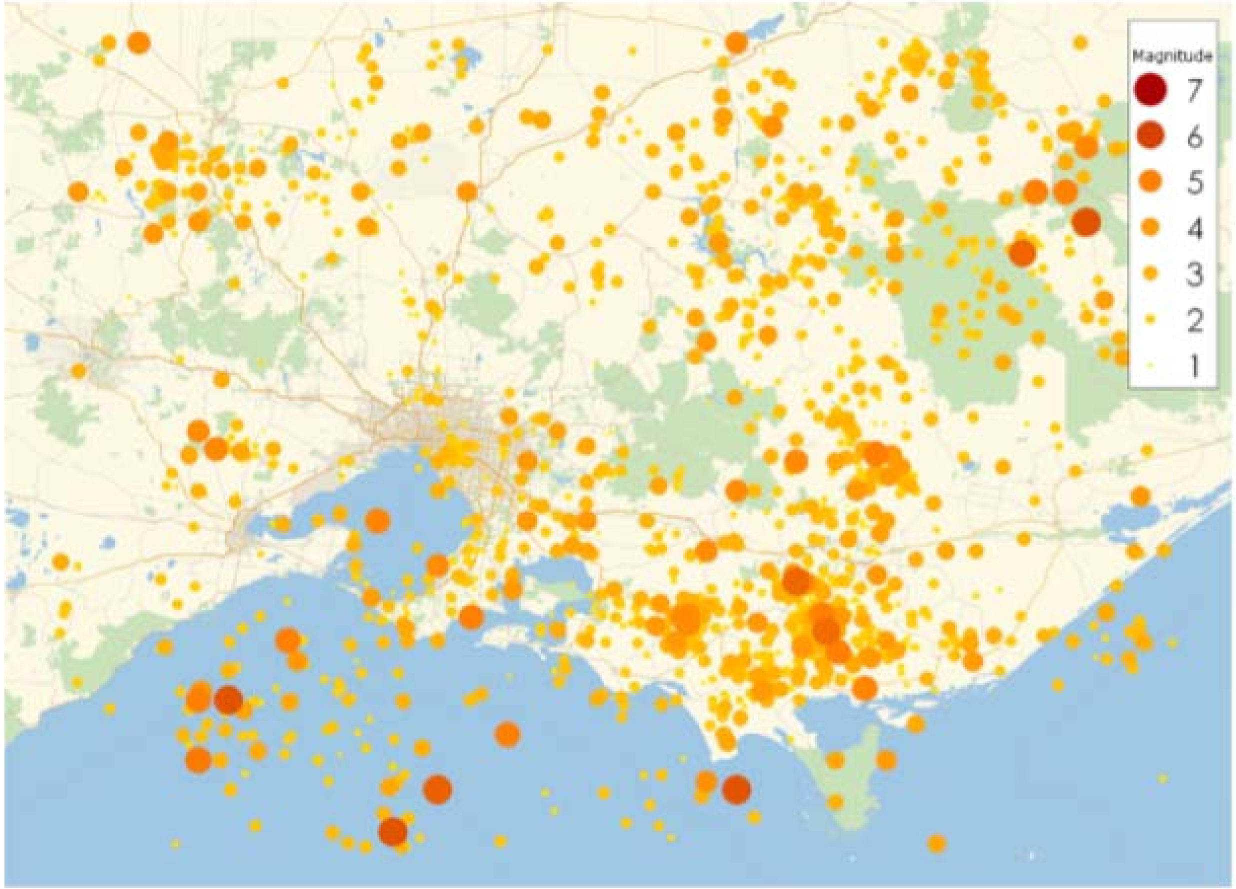
HOW CAN THEY BE USED

- Enhance planning:
  - Basing planning assumptions upon realistic consequences of a disaster.
  - Moving beyond planning based upon administrative boundaries.
  - Improving our understanding of the indirect consequences of a disaster, economic losses, possible fatalities and recovery priorities.
- Assist to identify gaps in our understanding
- Enhance resource allocation modelling
- Provide realistic tools for engaging with communities

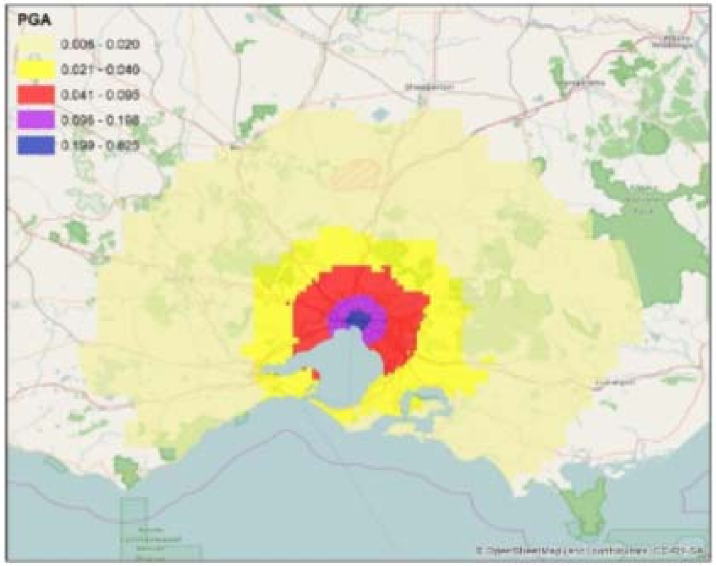
ULTIMATE BENEFITS IF UTILISED

- Improved knowledge of the risk
- Establishment of priorities for mitigation
- Enhanced planning to manage consequences and apply resources effectively
- Overcome cross boundary issues
- Enhanced engagement with community and political leaders

MELBOURNE EARTHQUAKE



Historical earthquake epicentres



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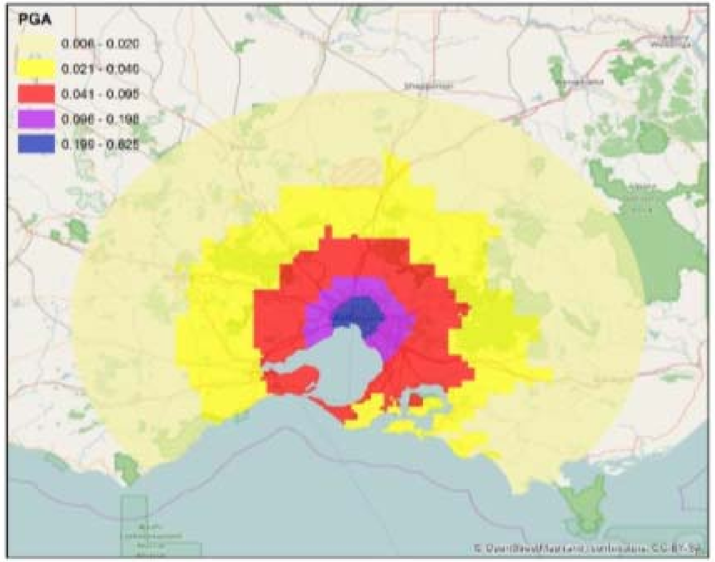

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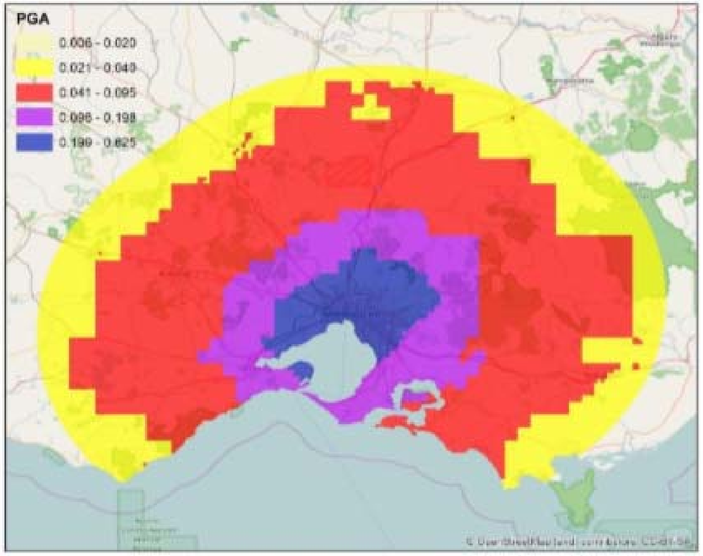

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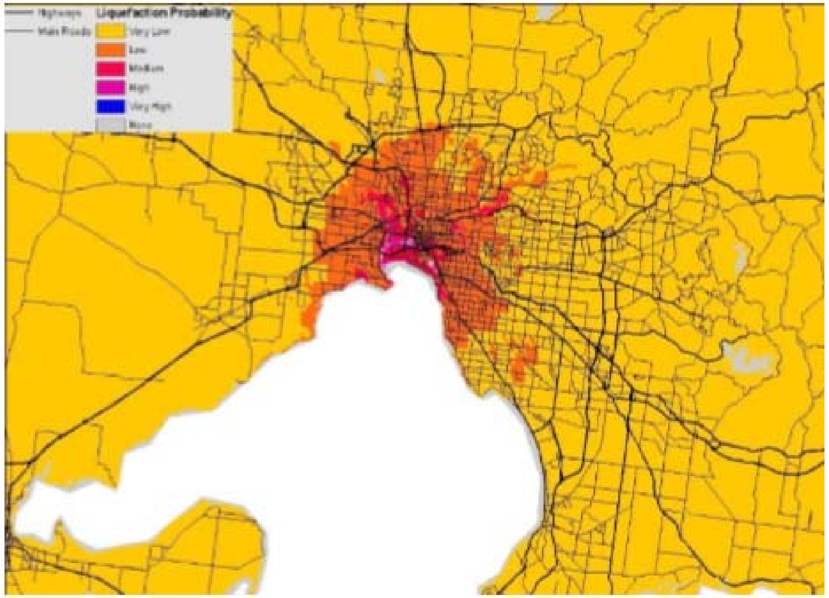

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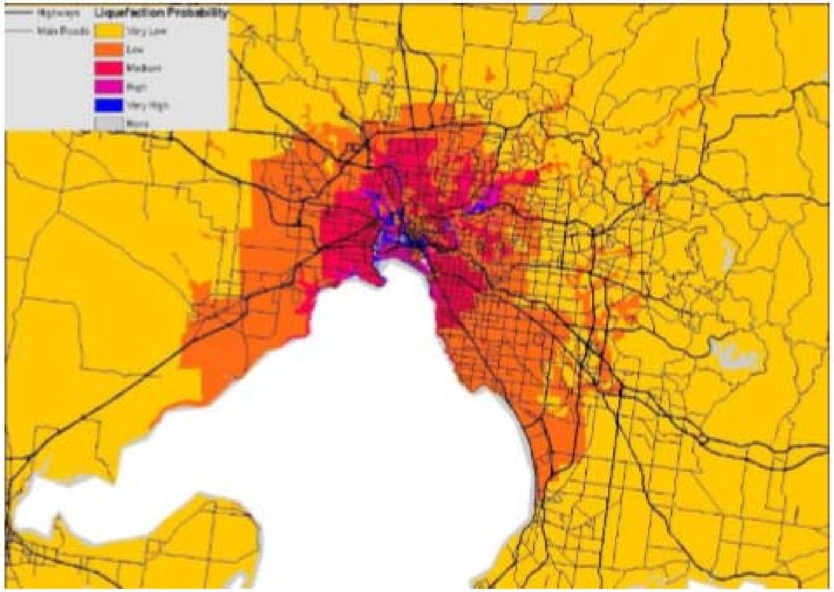

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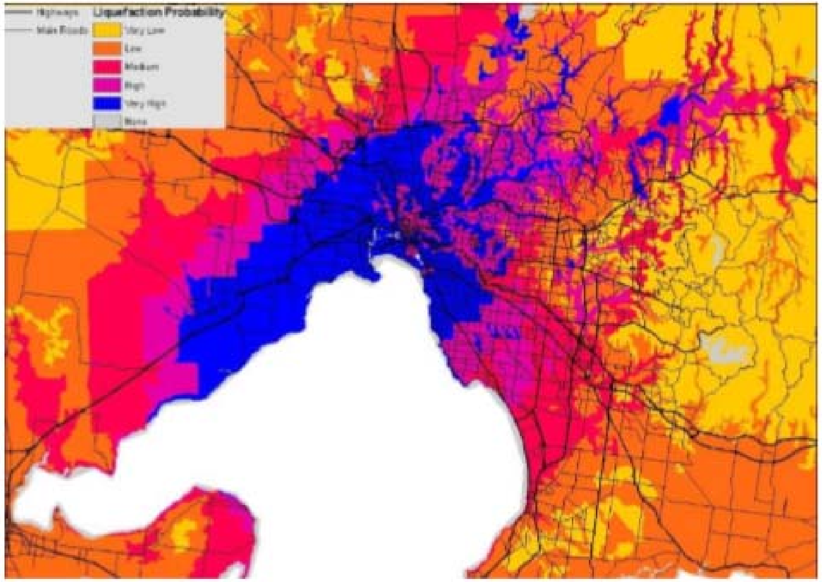

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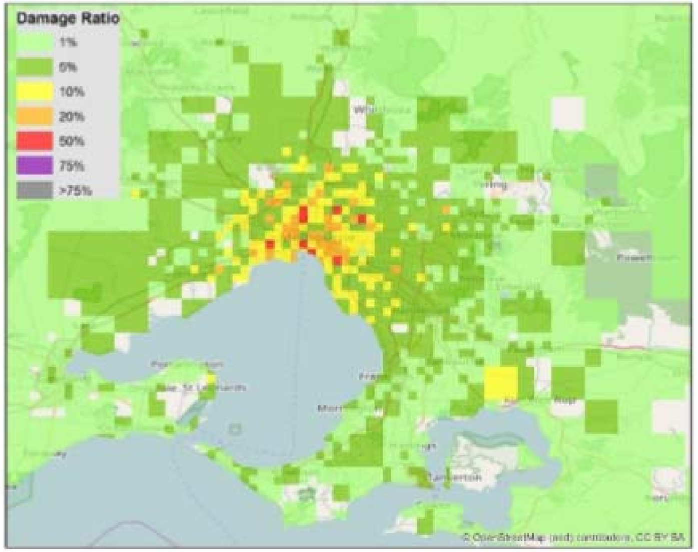
DAMAGES

Event	Number of Addresses
1	63,452
2	126,955
3	609,138

Number of equivalent addresses destroyed



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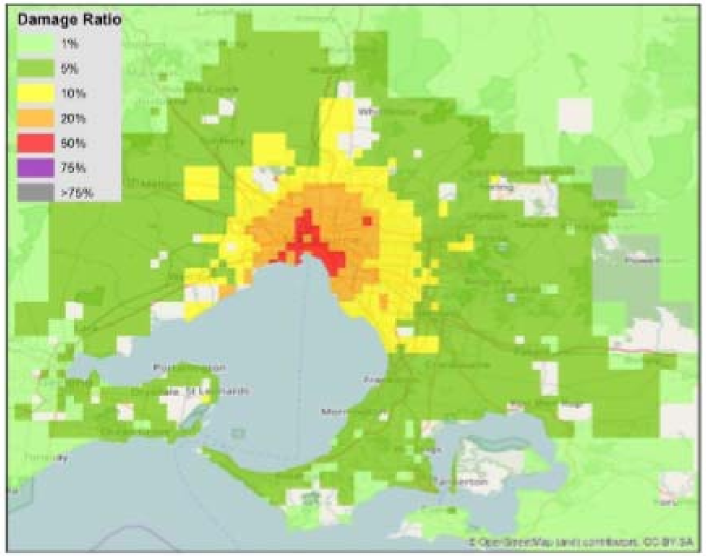

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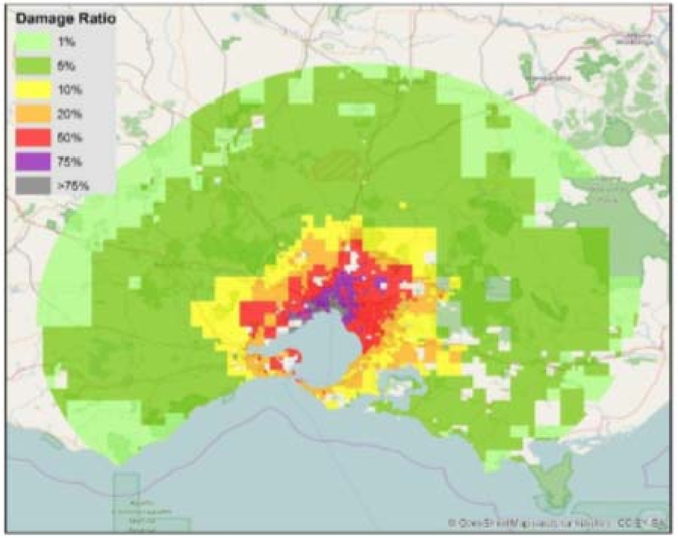

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Building damage distribution - % of replacement value

DAMAGES

	Event 1		Event 2		Event 3	
Severity	Day	Night	Day	Night	Day	Night
1	4,039	4,037	12,581	12,875	101,947	103,937
2	1,252	1,285	3,741	3,860	31,576	31,412
3	104	93	412	381	4,631	4,190
4	197	181	779	744	8,690	8,159

Median fatalities, by severity night and day

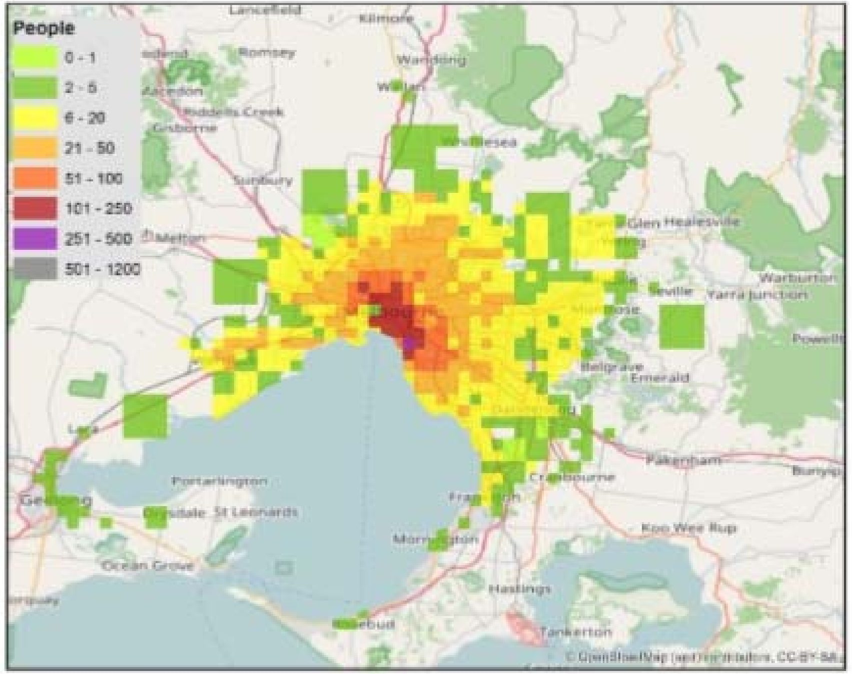
- **Severity 1:** Injuries requiring basic medical aid that could be administered by paramedics.
- **Severity 2:** Injuries requiring a greater medical care and medical technology or surgery, but not expected to be life threatening.
- **Severity 3:** Injuries that pose an immediate life threatening condition if not treated expeditiously.
- **Severity 4:** killed or mortally injured.

DAMAGES

Facility	Event 1	Event 2	Event 3
Hospitals	0	2	110
Schools	4	24	941
Fire Stations	1	2	119
Police Stations	0	4	79
SES Stations	0	3	31
Ambulance Stations	0	2	74

Damage to essential services to experience > 10%

DAMAGES



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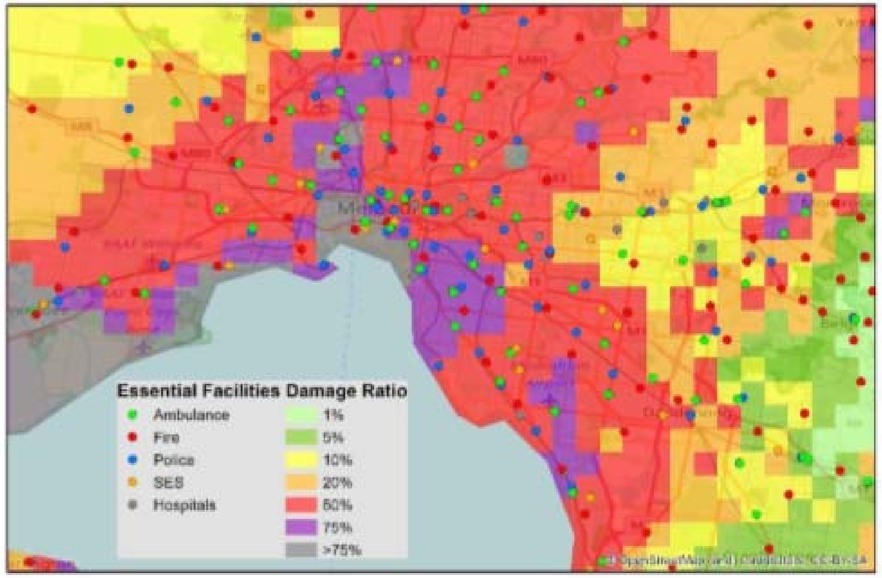

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Distribution of fatalities and injuries

Distribution of essential services damage

SIMILAR PAST EVENTS

Parapets

... the scene of the greatest damage to any building in Newcastle. 9 deaths occurred there and many others were injured.

Localised liquefaction of soft soil near rivers

Local and foreign events

- Casualties
- Building damage
- Services disruption (Hospitals, Schools...)
- Utilities disruption (Power, Sewage, Fresh Water...)
- Transport disruption (Airports, Roads, Rail...)

INFRASTRUCTURE DAMAGE

- Transport
- Electricity
- Water Supply
- Waste Water
- Communications

YEAR 3 - MODELLING SCENARIOS

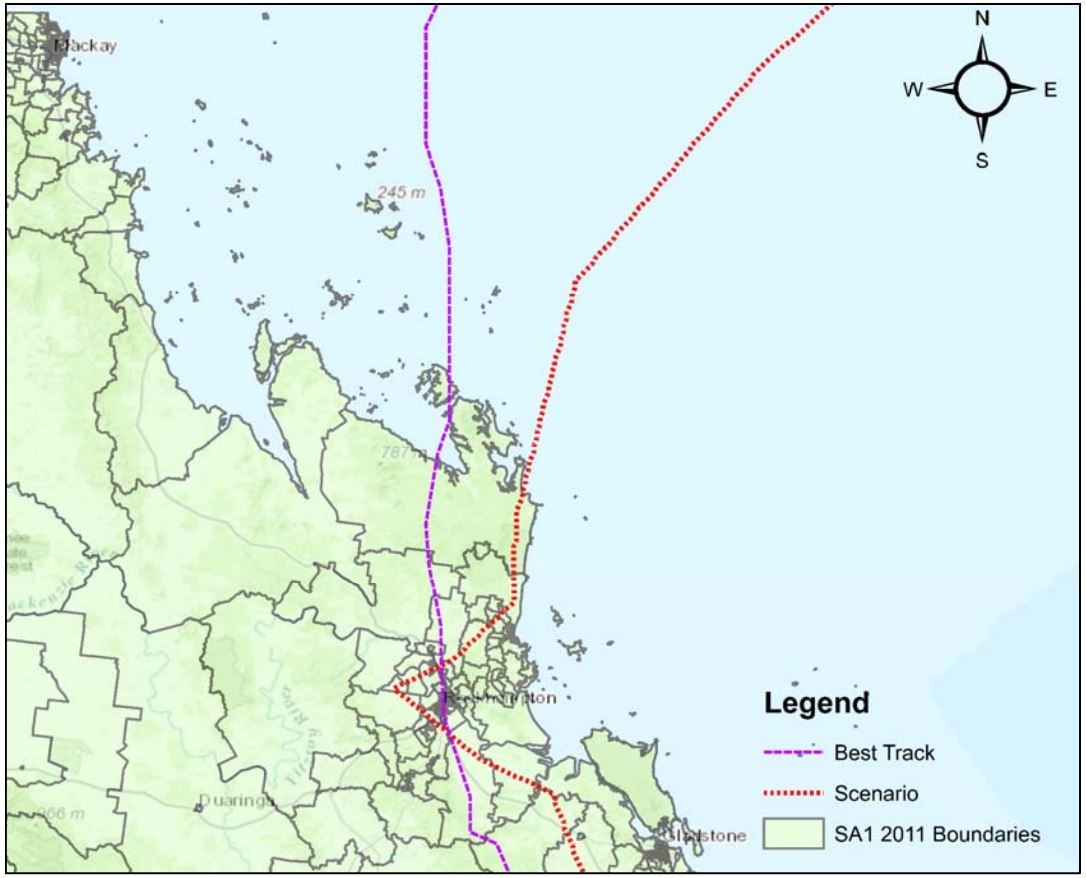
1) Tropical Cyclone, QLD Rockhampton/Yeppoon

- *University of Queensland* in association with Queensland Fire and Emergency Services (QFES) and Livingstone Shire Council
- Hazards: storm surge, rain and wind

2) East Coast Low, NSW Greater Sydney region

- *Risk Frontiers* in association with State Emergency Services (SES) New South Wales
- Hazards: river and surface water flooding and storm surge

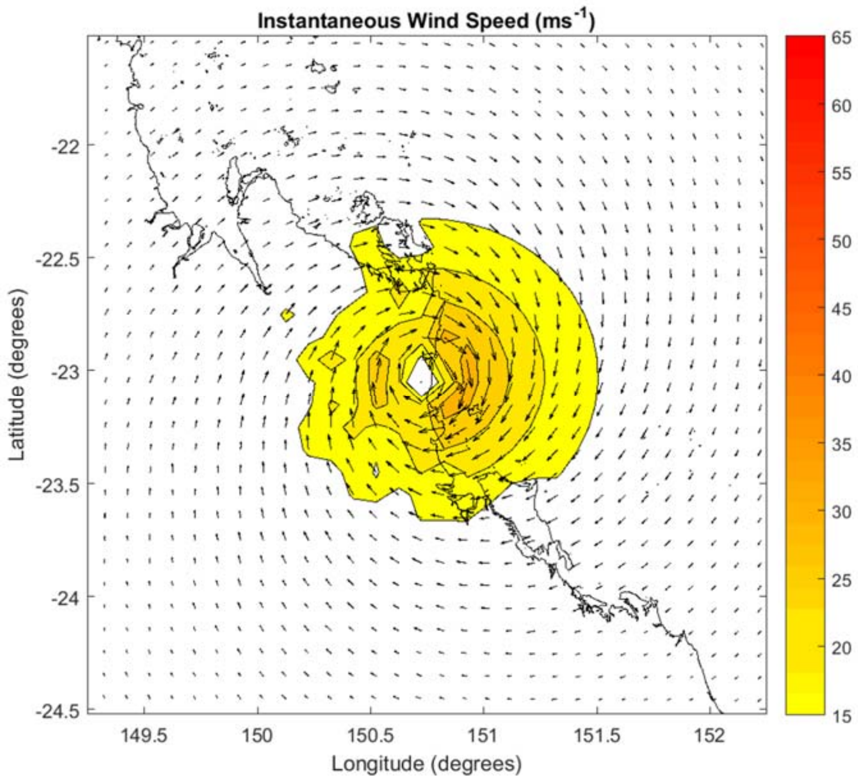
1. TROPICAL CYCLONE - QLD



- Modified Tropical Cyclone Marcia (2015)
- Scenario based on a modification of actual track for 'worst-case' planning
- Scenario makes landfall east of Shoalwater Bay as a very strong Category 5 cyclone with slow forward speed and at high tide
- Impacts Rockhampton and Yeppoon region

1. TROPICAL CYCLONE - QLD

- Three components: 1) **wind model**, 2) rainfall model and 3) storm surge model



- **Wind model:** a wind field for the modified Martia track has now been completed
- 1 x 1 km grid resolution
- Geoscience Australia Dynamic Land Cover Data (DLCD) has been used to simulate over land mean and gust wind speeds.
- Geoscience Australia wind speed multipliers used to compute maximum three-second gust wind speeds to assess **building damage**

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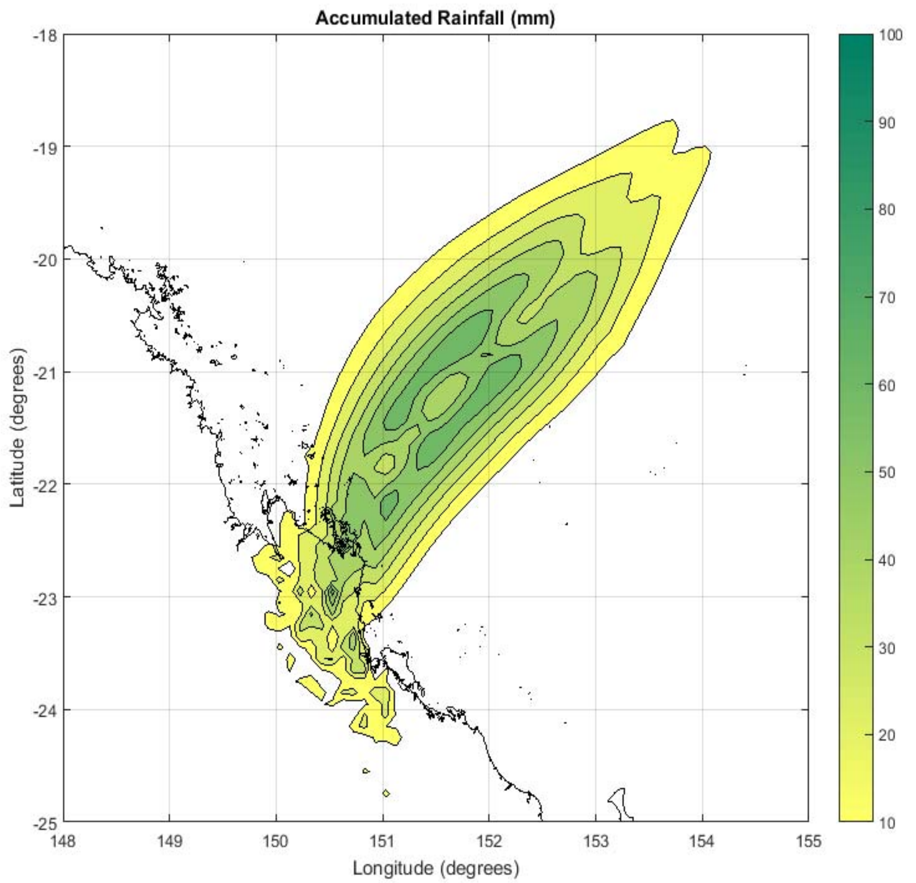

- **Rainfall model:** uses wind field and storm radius to derive rainfall totals by empirical relations based on US cyclone data
- Rainfall rates are adjusted based on near-surface terrain conditions
- 1 x 1 km grid resolution like wind model

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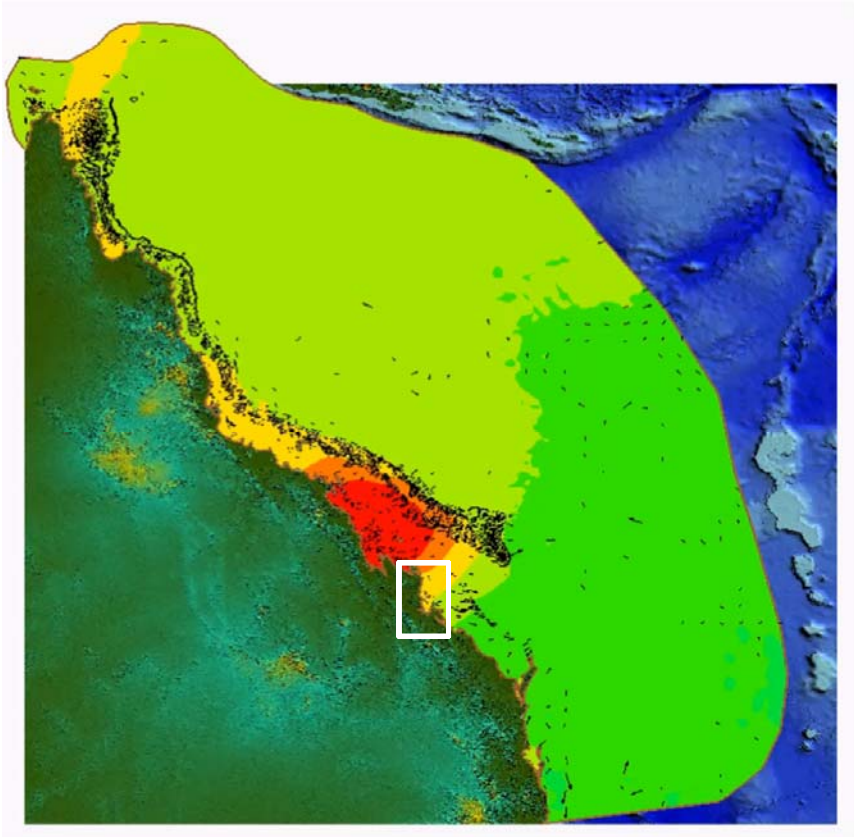
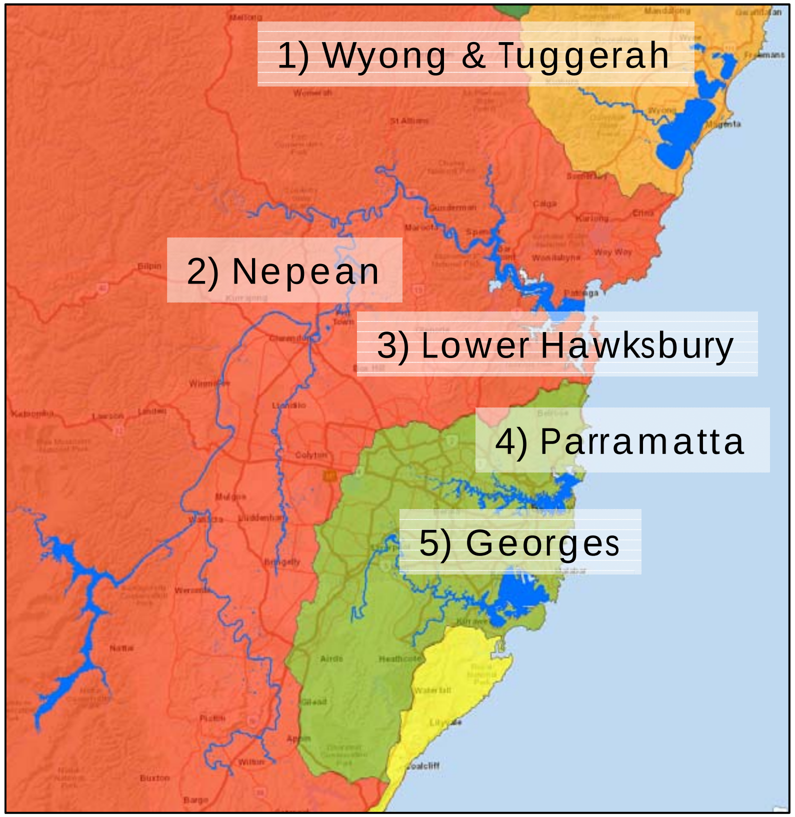


- **Storm surge model:** uses BMT WBM's TUFLOW surge model
- Model is driven using background tides and cyclone wind field from wind model over wider region
- Storm tide heights will be converted to **inundation hazard maps** using high-res land elevation data within the focus area (white box)

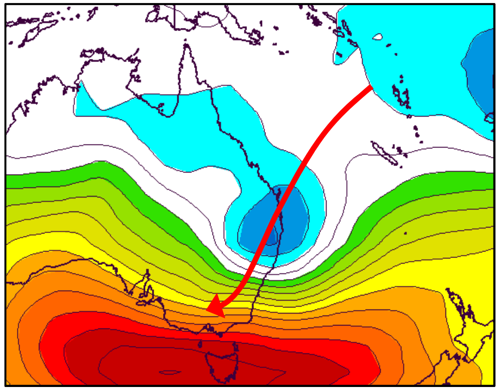
2. EAST COAST LOW - NSW

- Focus on **river flooding**, but also includes **surface water** and **storm surge flooding** where applicable

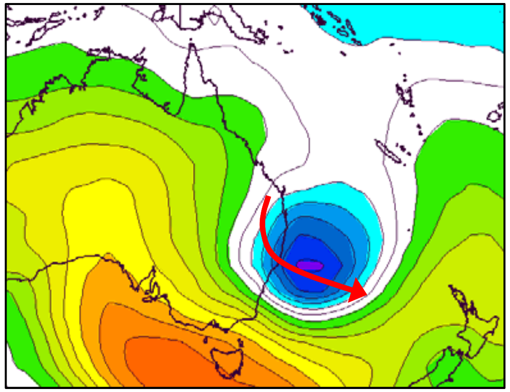


- After consultation, flood modelling is of most use to end user if it is **regional** and **time-variant** (i.e. cross-catchment and 3-hrly flood surfaces throughout the storm)
- Covers five rivers across Sydney West, Sydney CBD and Central Coast NSW
- Modelling underpinned by high-resolution (1 m2) coastal lidar data and river and rainfall gauge network

2. EAST COAST LOW - NSW



- **17 - 21 Mar 1978** – severe flooding of the Hawksbury, Georges rivers
- Not really an East Coast Low, but an extra-tropical transition of a Tropical Low, with a slightly more inland flood footprint

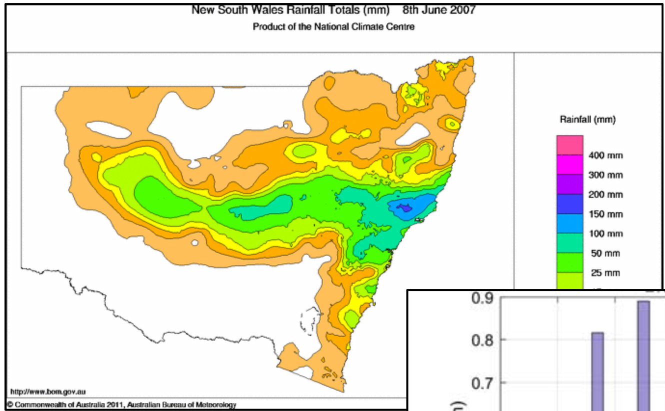


- **5 – 8 Aug 1986** – severe flooding of the Nepean, Hawksbury, Georges rivers
- A fairly stationary East Coast Low on the Central NSW coast

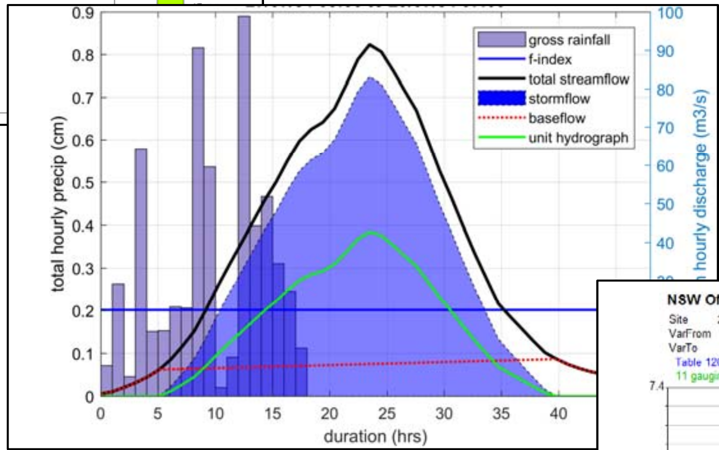
2. EAST COAST LOW - NSW

STEP 1: Develop relationship between **rainfall and river heights** on a reach-by-reach basis

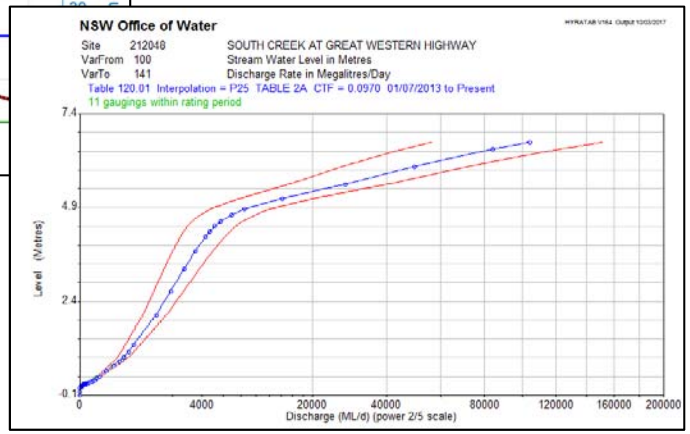
Accumulated rainfall maps



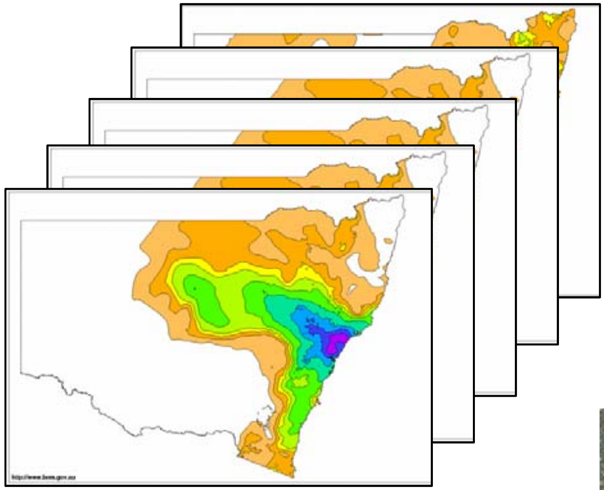
Rainfall to streamflow



Streamflow to river height

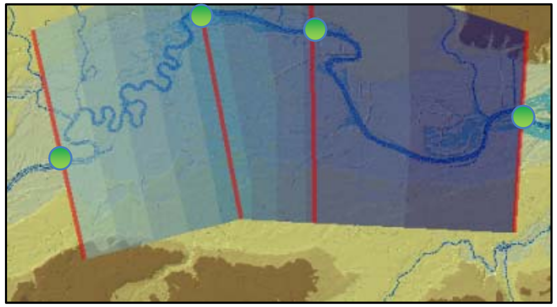


2. EAST COAST LOW - NSW



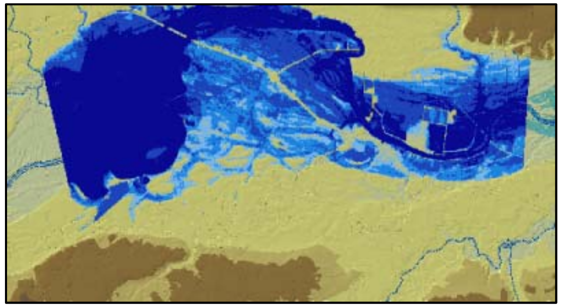
STEP 2: Convert **river heights to flood extents** on a reach-by-reach basis

Convert river heights to a sloped flood surface over the floodplain



OVERALL: **Rainfall maps** converted to **river flood maps**

Extract all terrain underneath flood surface



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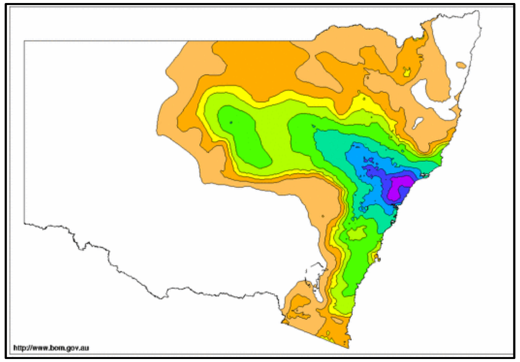
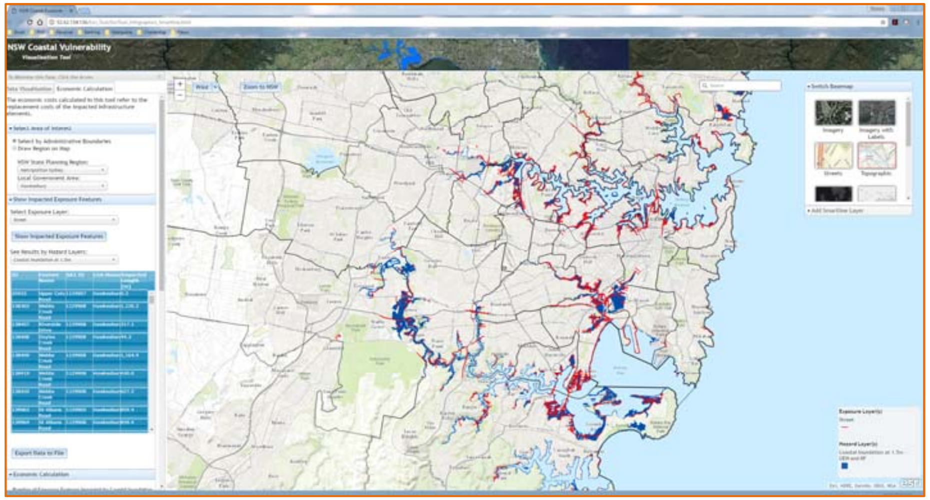


Forecast or historical rainfall maps

Pre-processed database of flood extents

Rapid viewing of first-pass inundation extents at 3-hr intervals through the storm



Flood layers intersected with geo-located assets and infrastructure data

SUMMARY YEAR 3 MODELLING

- **Tropical Cyclone** scenario for Rockhampton/Yeppoon that includes wind, rain and storm surge

- Development and calibration of the storm surge model has delayed the final outcomes and report. The final scenario results will be delivered in report form by the ***end of April 2017***.

- **East Coast Low** scenario for Sydney region that includes river and surface water flooding and storm surge

- Delayed consultation with key end-user means extension has been requested. The final scenario results will be delivered in report form by the ***mid-May 2017***.

Further information, contact Rich Krupar (r.krupariii@uq.edu.au) for Tropical Cyclone or Thomas Mortlock (thomas.mortlock@mq.edu.au) for East Coast Low