Natural Hazard Risk Assessment in the Australasian Region: Informing Disaster Risk Reduction and Building Community Resilience

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Acknowledgments

- GA team
  - Jane Sexton, Nick Horspool, Adele Bear, Martin Wehner, Kriton Glenn
- External Collaborators
  - Indonesia - AIFDR, Badan Geologi, ITB
  - Philippines – Phivolcs
  - Australia – States/Territories
- Sponsors
  - AusAID, AGD

2004 Indian Ocean Earthquake and Tsunami

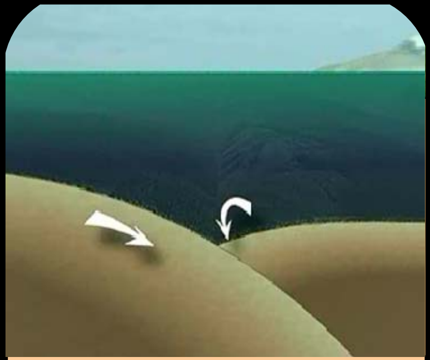
Problems versus Solutions

- We are good at assessing risk (defining the problem)
- We are not so good at reducing it (providing solutions)
  - Developing tools with clients and stakeholders
  - Working with them to develop response, recovery and mitigation plans
- Reducing risk, increasing resilience

Overview

- Risk assessment method
- Case studies
  - Tsunami (Australia and region)
  - Volcanic ash (Indonesia)
  - Vulnerability/exposure (Philippines)
  - Post-disaster damage (Indonesia)
- Conclusions

Risk Methodology



Hazard

Exposure

Vulnerability

$

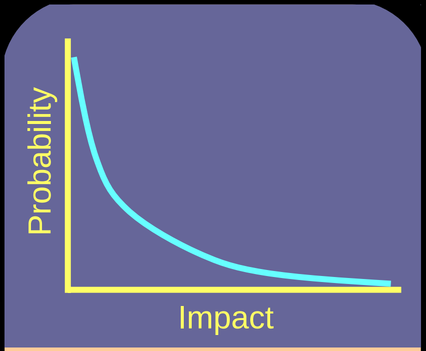
Impact

Methodology

Simulate
“All”
Earthquakes

Exposure

Vulnerability



Risk

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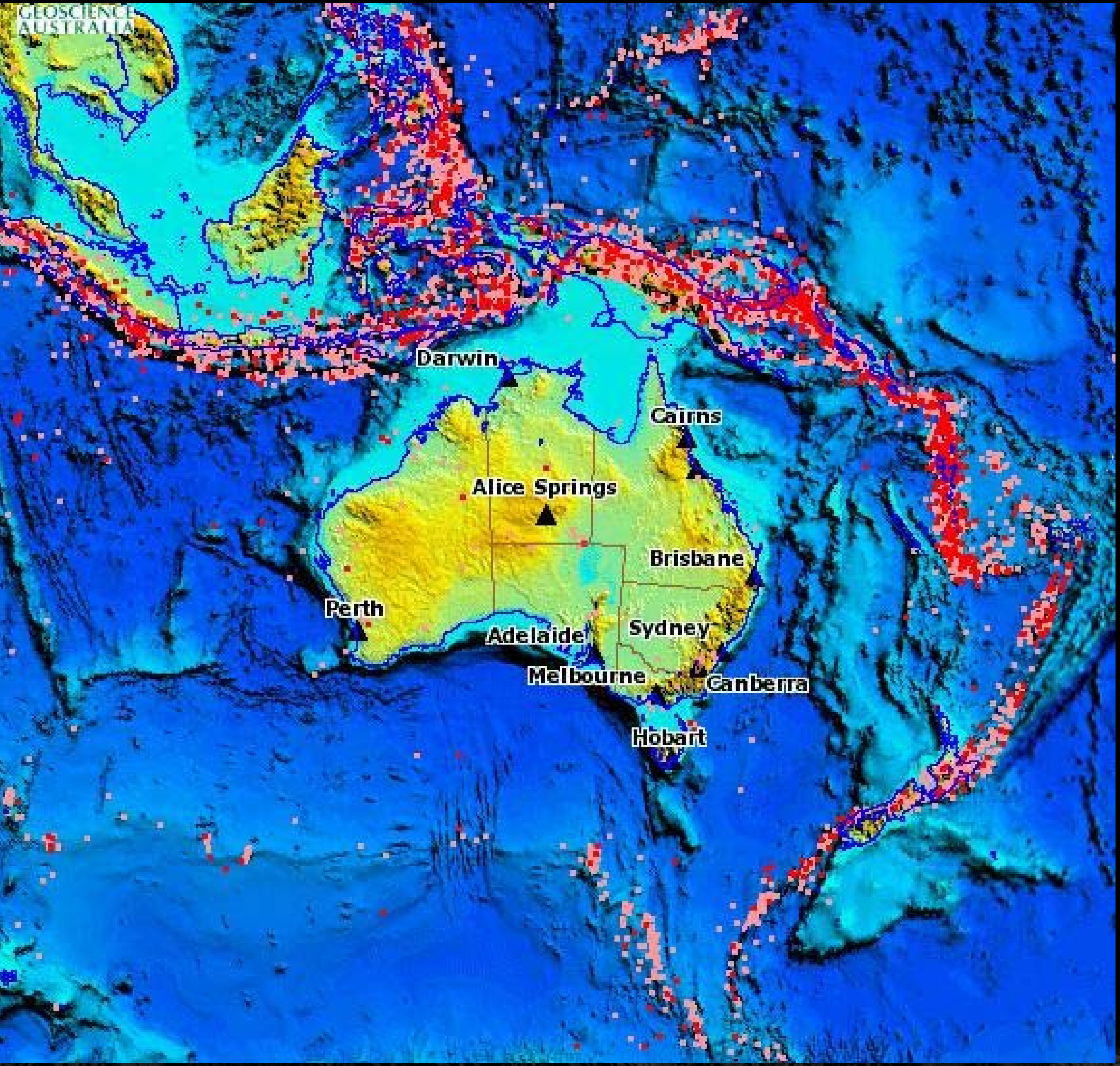
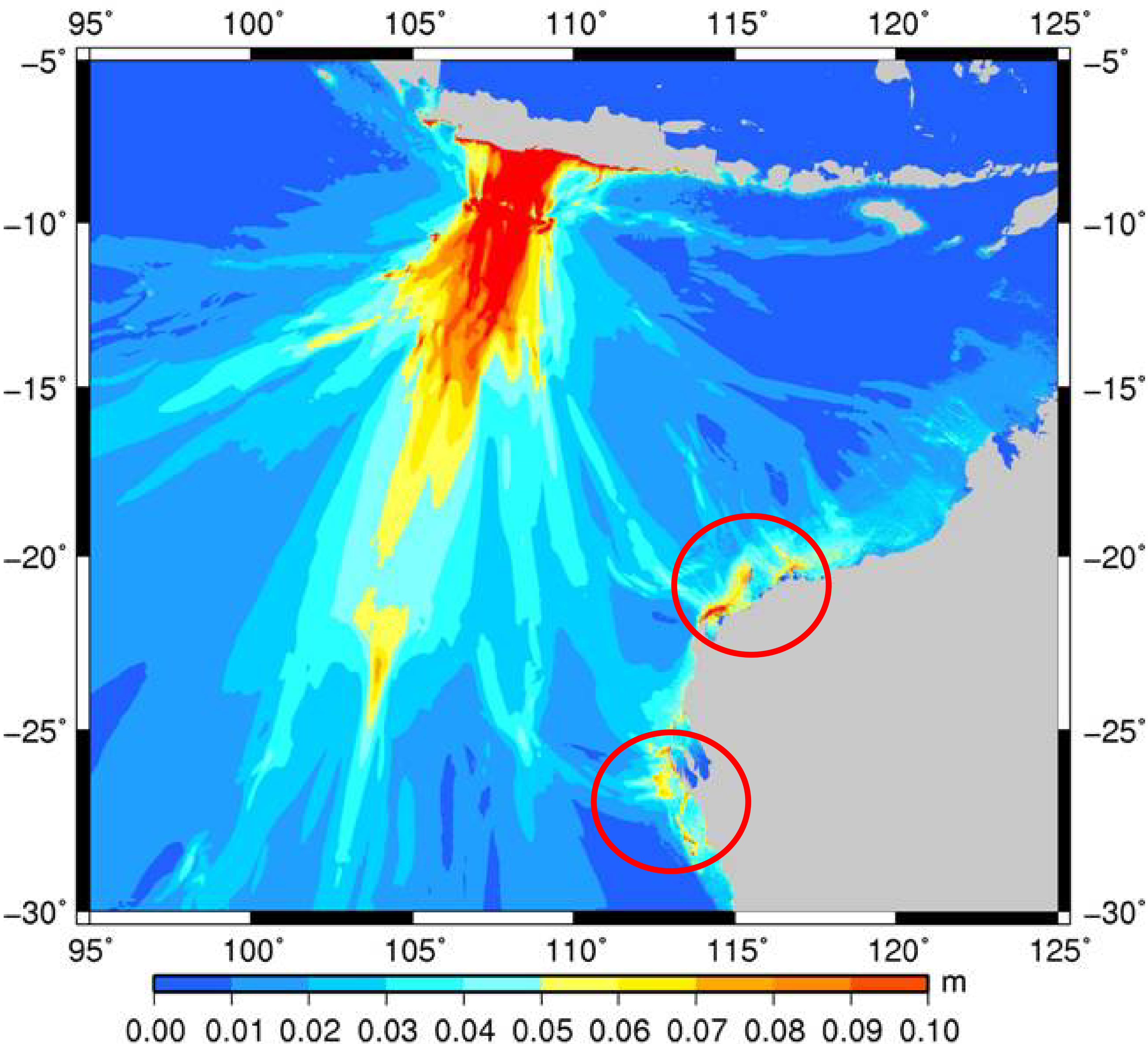
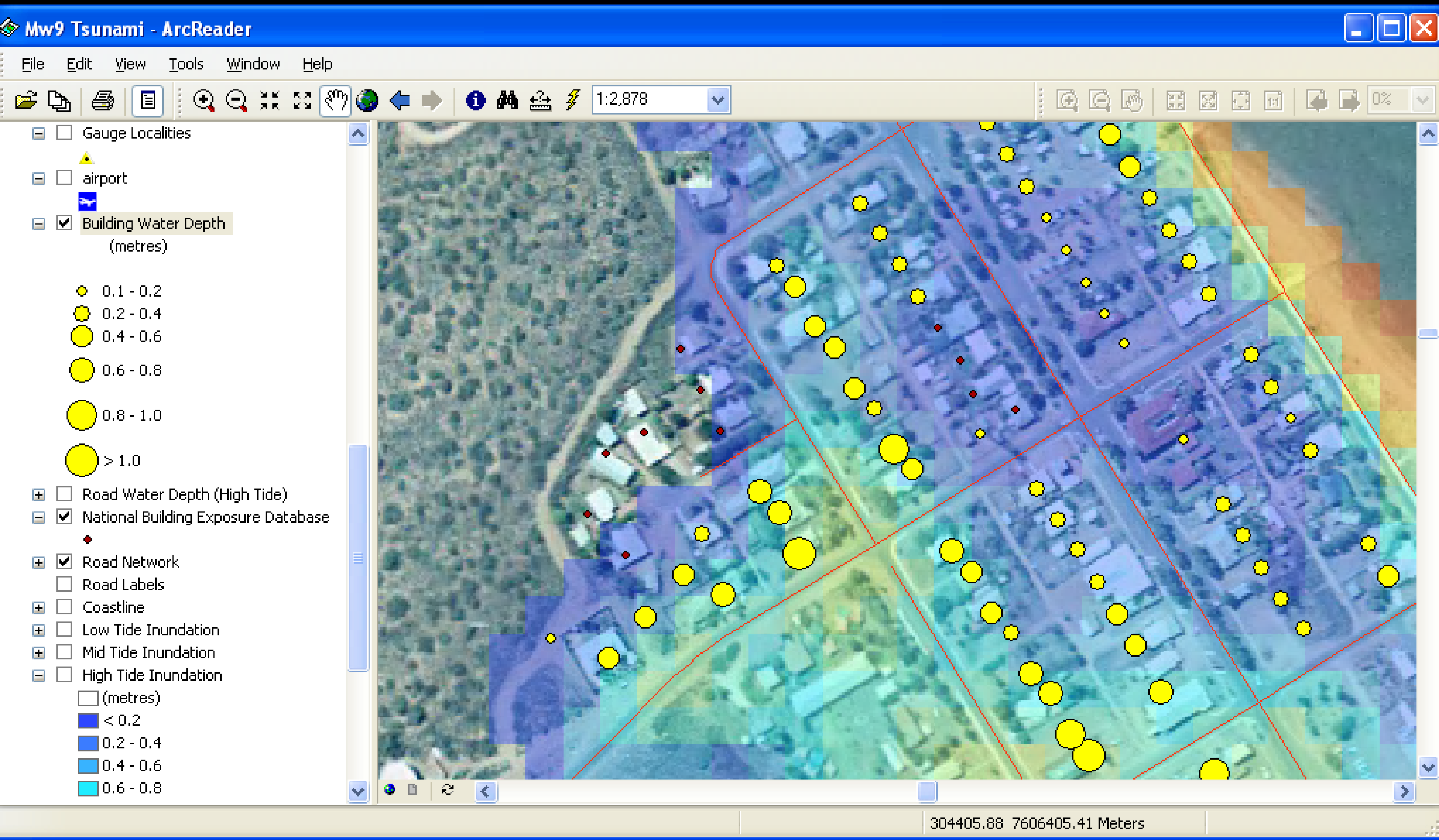
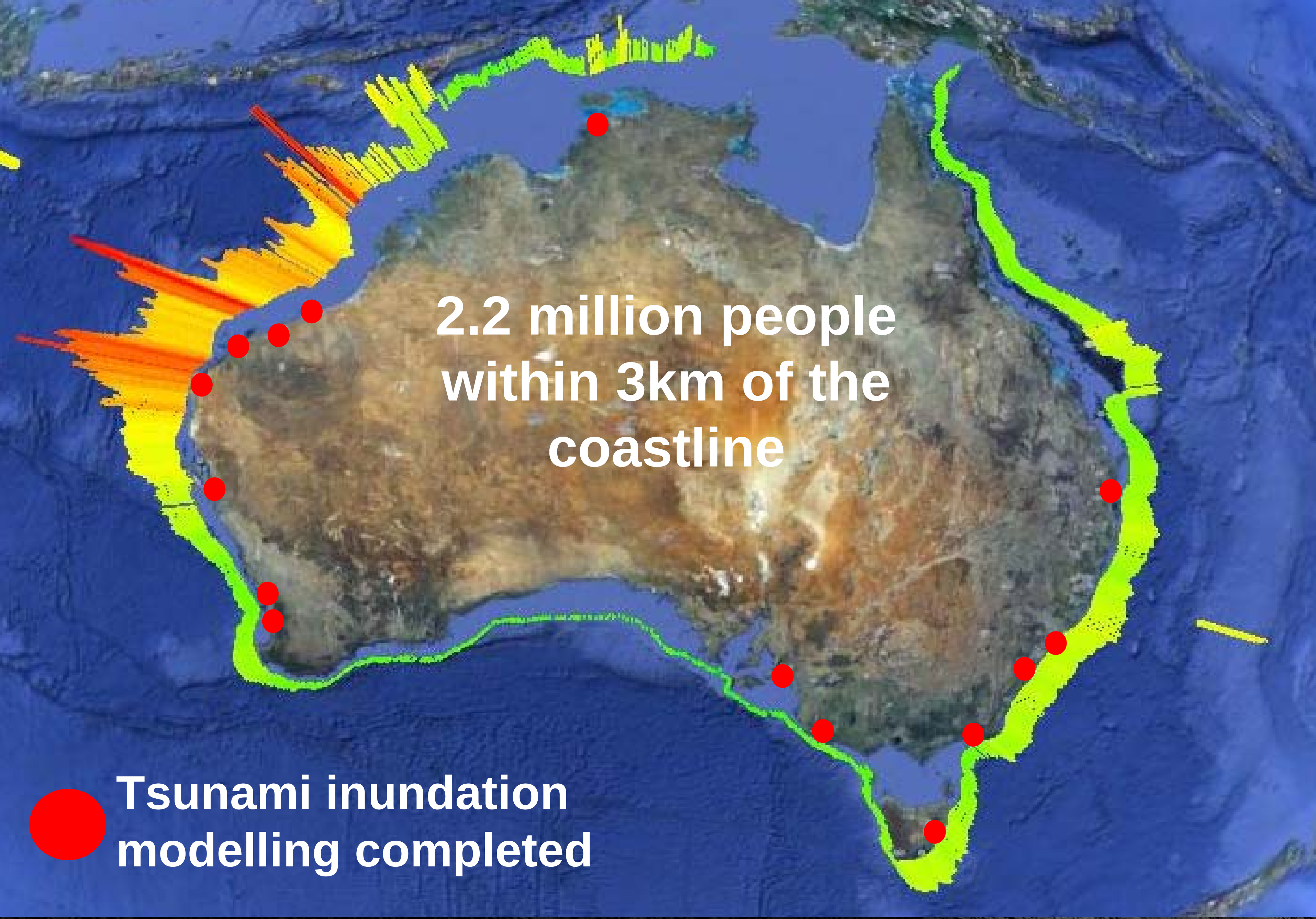


Earthquakes (tsunami sources) in and around Australia


95° 100° 105° 110° 115° 120° 125°
−5° −10° −15° −20° −25° −30°
m
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10

Impact Modelling




2.2 million people within 3km of the coastline
Tsunami inundation modelling completed

Understanding your tsunami risk:

tsunami inundation modelling and risk assessment workshop

Australian Government

Geoscience Australia

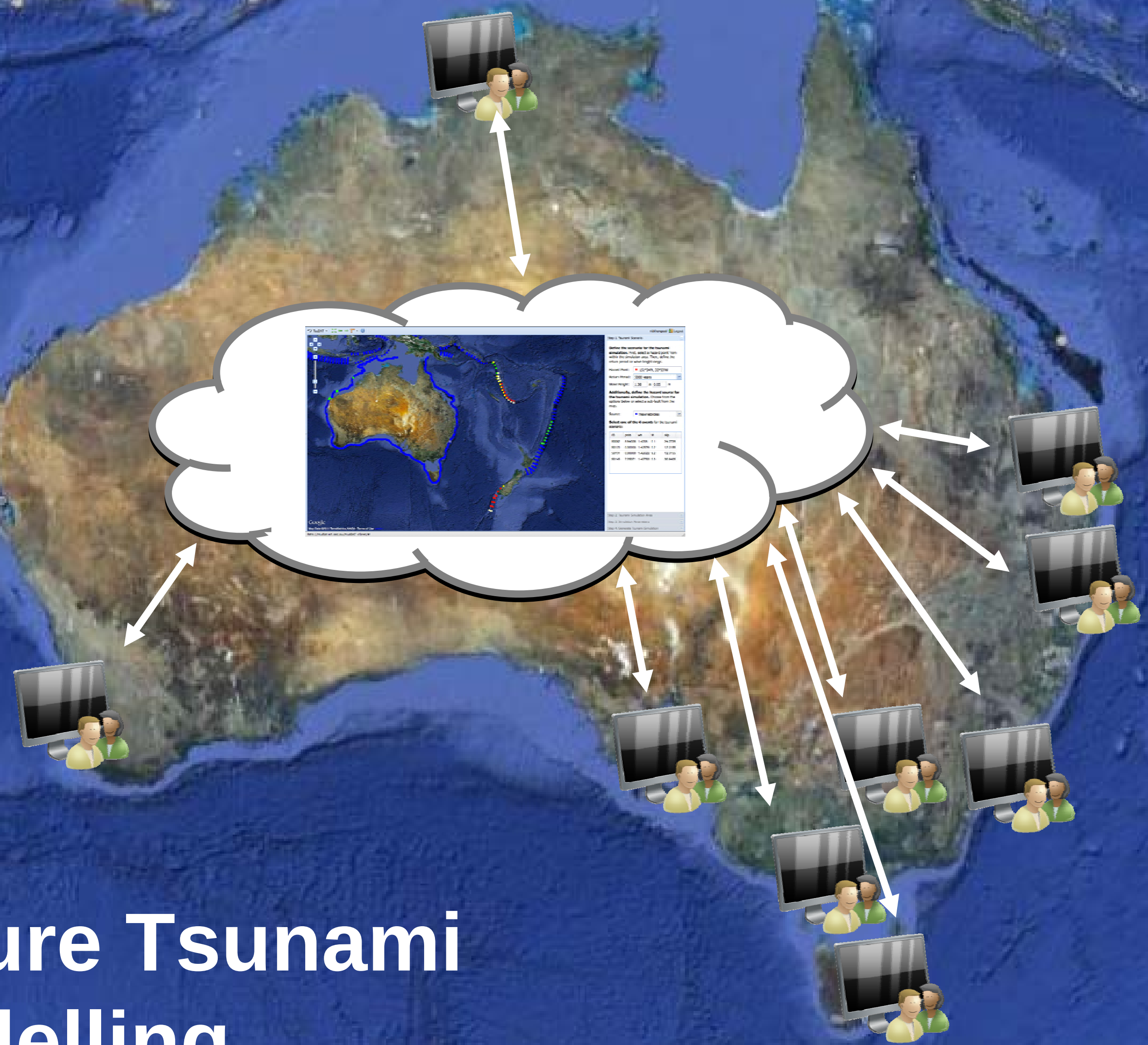
TsuDAT: Overview

In partnership with:

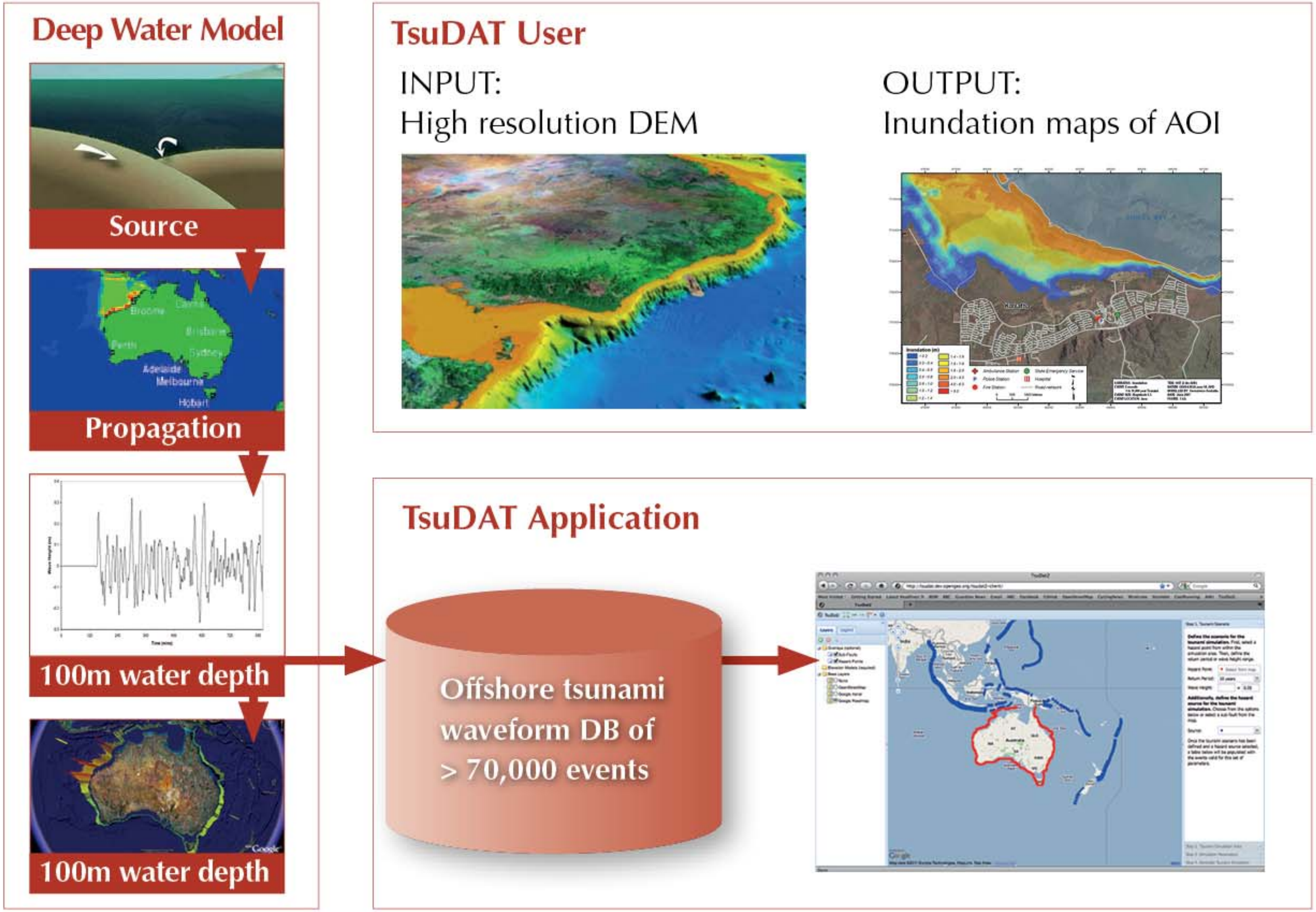
OpenGeo

NCI

AUSTRALIA-INDONESIA FACILITY FOR DISASTER REDUCTION

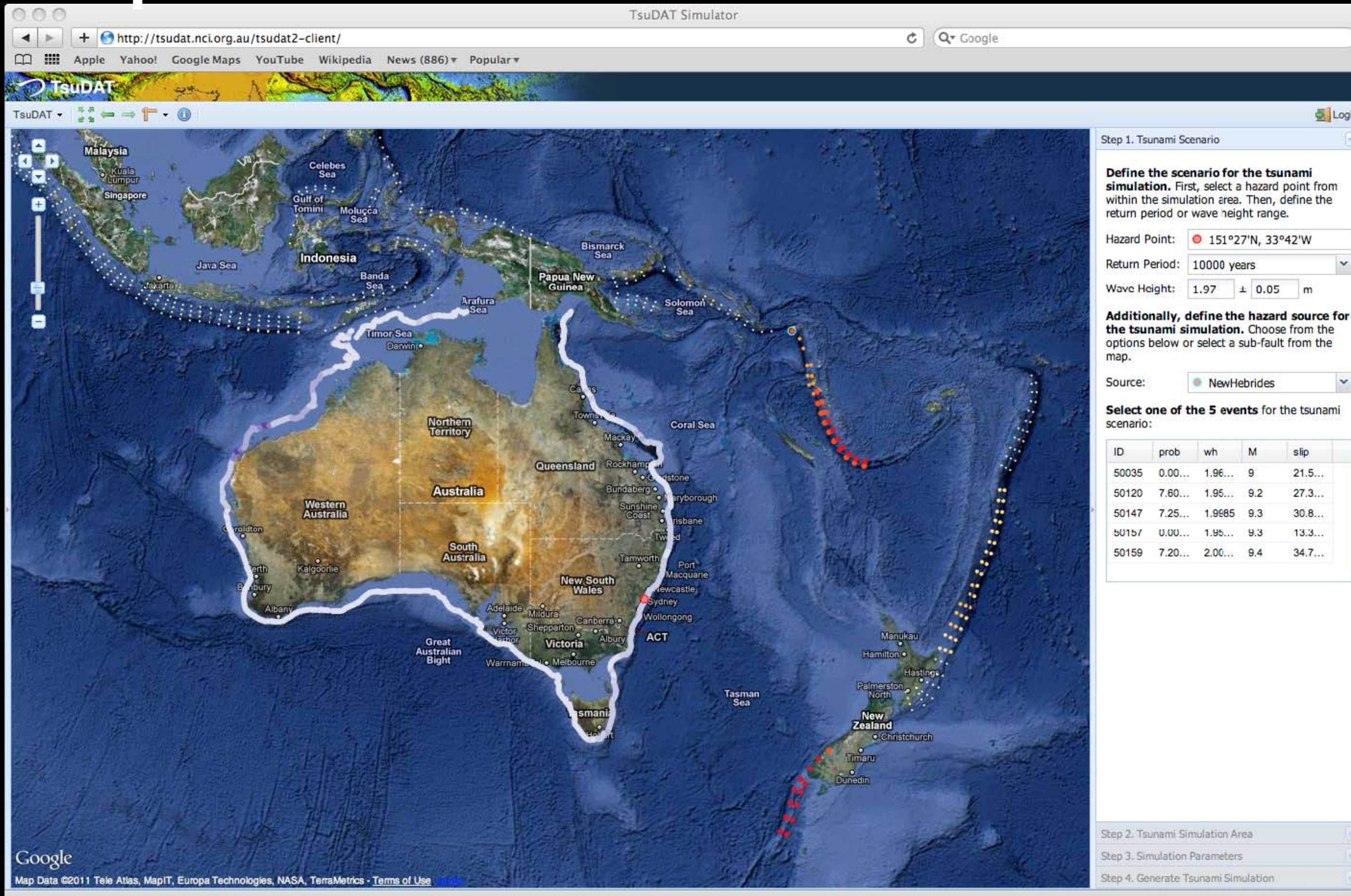


Future Tsunami Modelling Capacity

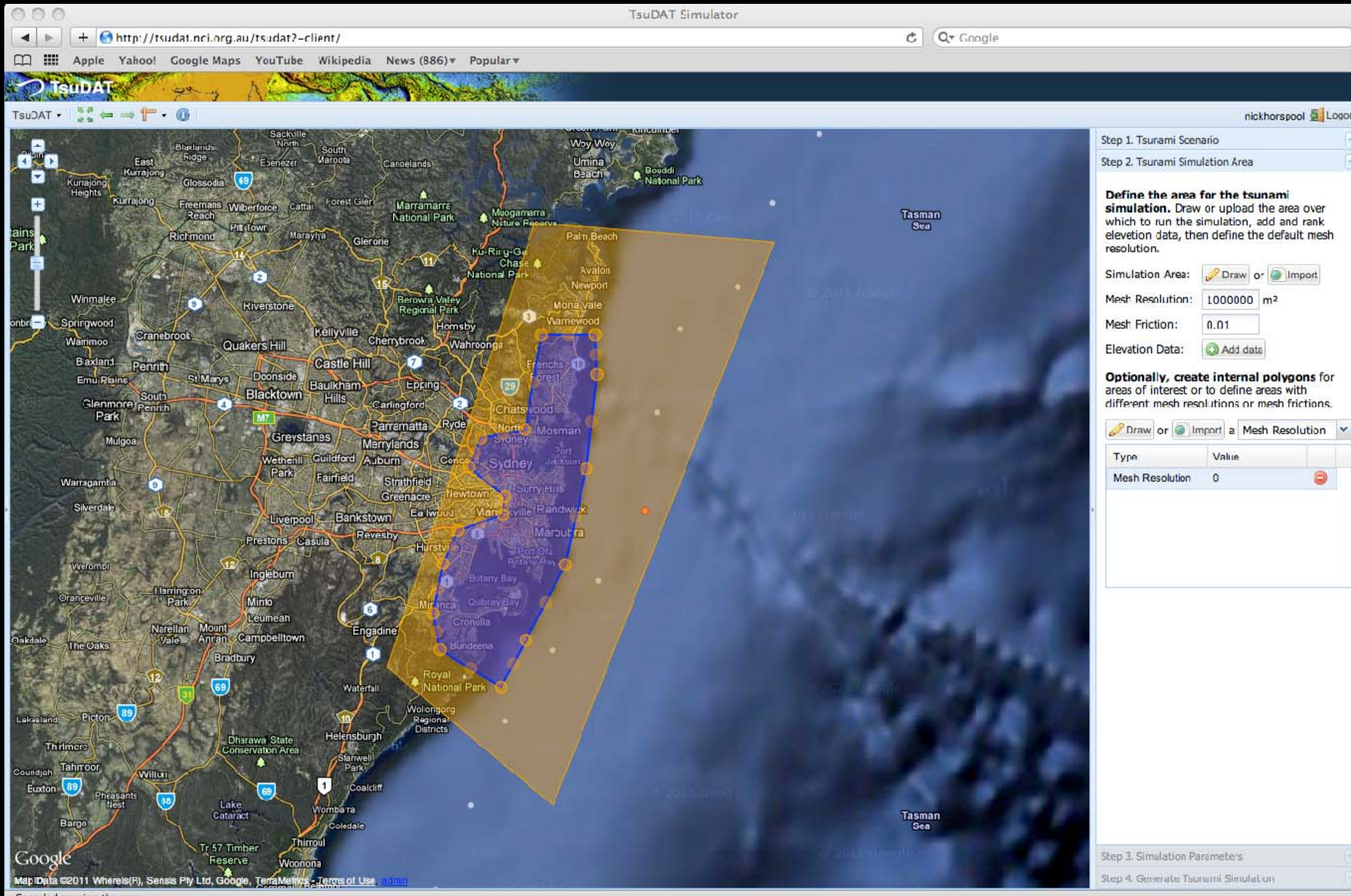


Deep Water Model
Source
Propagation
100m water depth
100m water depth
TsuDAT User
INPUT:
High resolution DEM
OUTPUT:
Inundation maps of AOI
TsuDAT Application
Offshore tsunami waveform DB of > 70,000 events

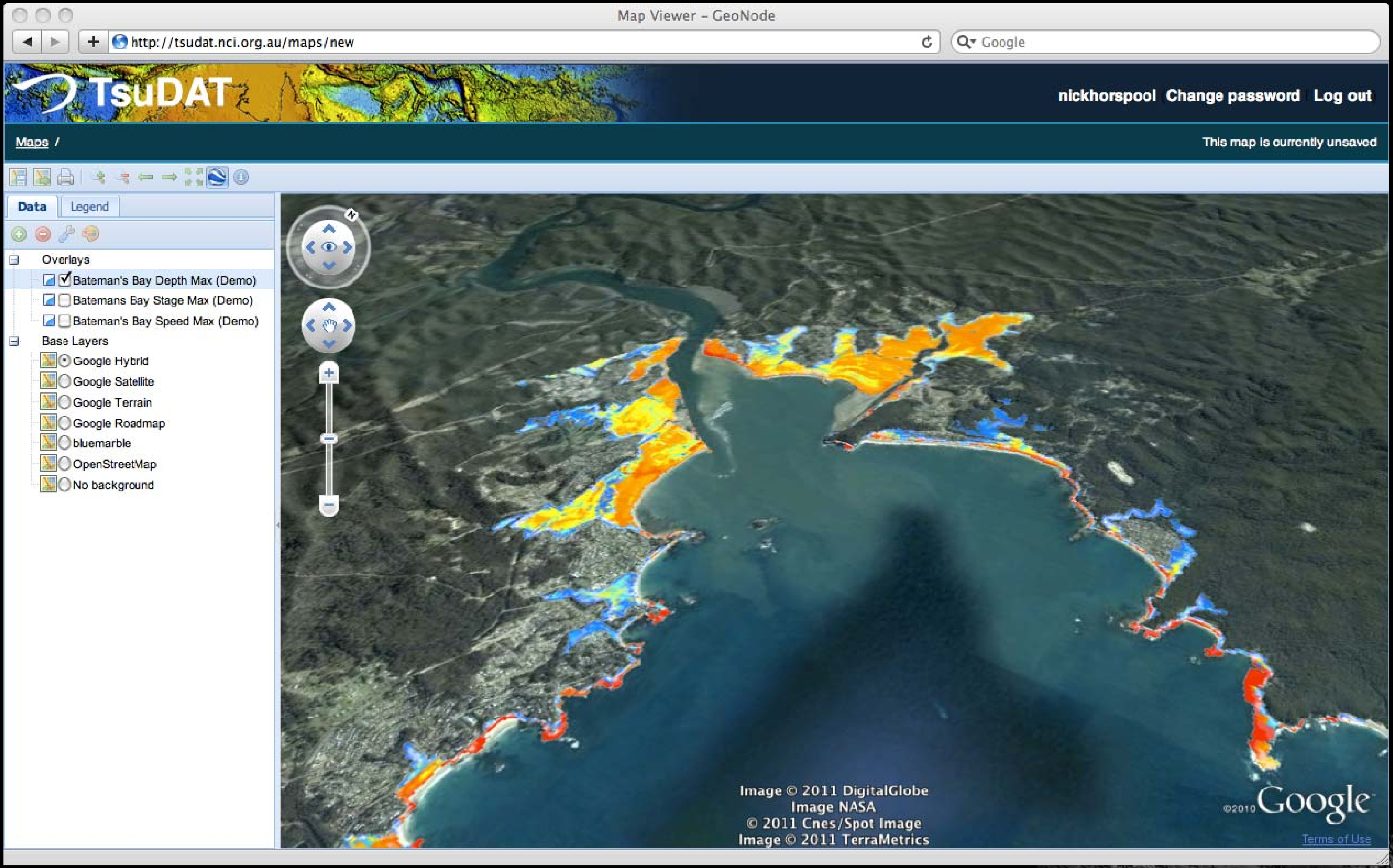
Explore Offshore Tsunami Hazard



Define Simulation Area



Create Maps of Results



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Workshop 4 - West Java Ash Risk

Update on development and application of python-FALL3D

Dr Adele Bear-Crozier

Geoscience Australia

PHIVOLCS DOST

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Indonesia

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Sinabung
Talang
Kerinci
Kaba
Krakatau
Papandayan
Slamet
Merapi
Bromo
Semeru
Batur
Rinjani
Sangeang Api
Rokatenda
Egon
Karangetang [Api Siau]
Lokon-Empung
Soputan
Ibu
Dukono
Gamalama
Volcano Watch List 24th Nov 2010
Normal (Level 1)
Siaga (Level 3)
Waspada (Level 2)
Awas (Level 4)
0
250
500
1,000
Kilometers

Volcanic Island Arcs

- Indonesia
- Philippines
- Japan

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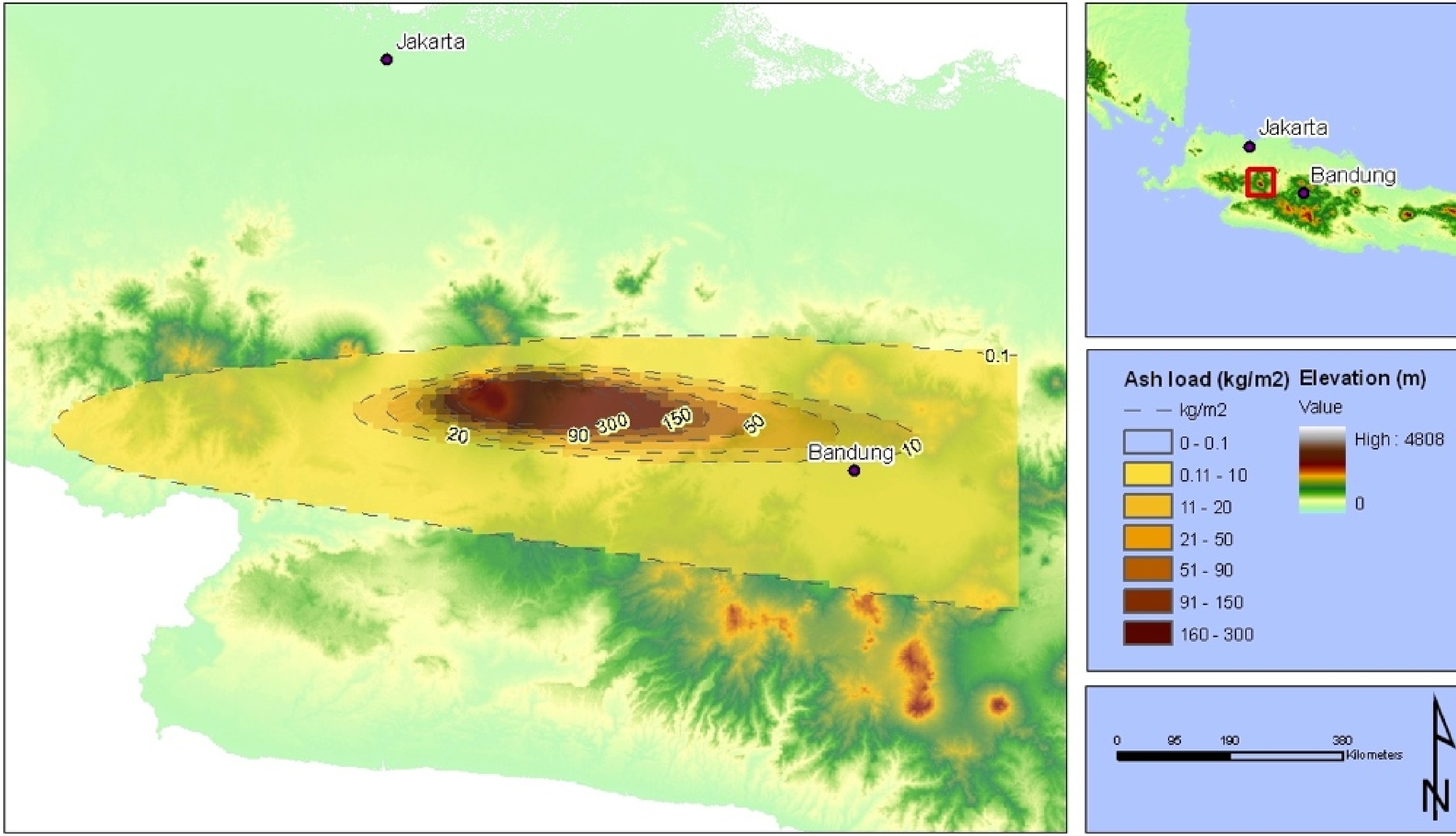
Impact of volcanic ash load

Volcanic Ash Load (kg/m)	Observed Impact*
0.1 - 90	Significant damage to crops, contamination of water supplies and disruptions to critical infrastructure (i.e. electricity)
90 - 150	Same as above as well as cosmetic damage to building exteriors
150 -300	Same as above as well as partial building collapse on flat roofs where ash is allowed to accumulate
>300	Same as above as well as total building collapse

* based on ash impact surveying at Rabaul in 1994; Blong (2003)

Ash Damage

Single scenario (deterministic) - ASH LOAD (kg/m2) - VEI4 eruption of G.Gede



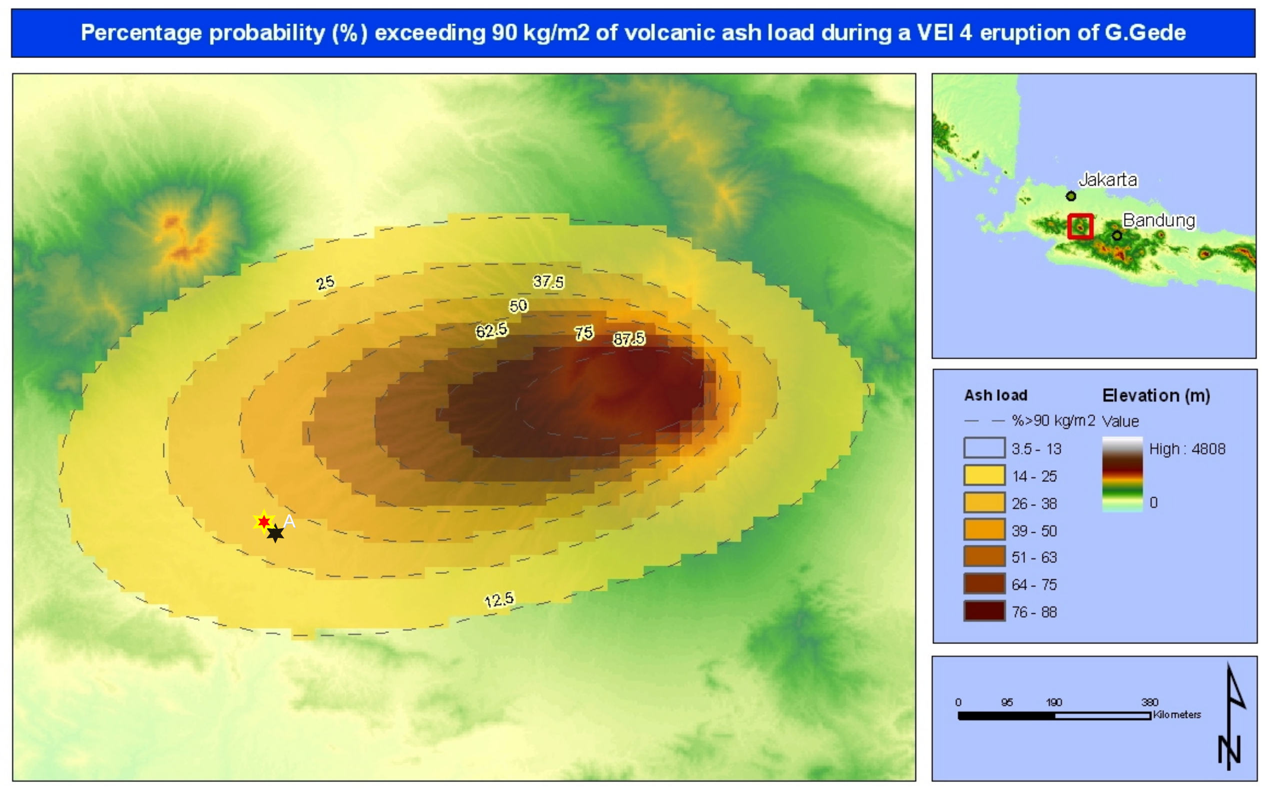
<u>python-FALL3D input parameters</u>

Eruption Column Height: 20,000m (20km)
Eruption Duration: 12
Post-eruptive settling duration: 0
Wind profile: 1 January 2009 (0:00) - 3 January 2009 (18:00)

Average grainsize: -1.43 phi
Minimum grainsize: 4 phi
Maximum grainsize -3.67 phi
Sorting: 1.56

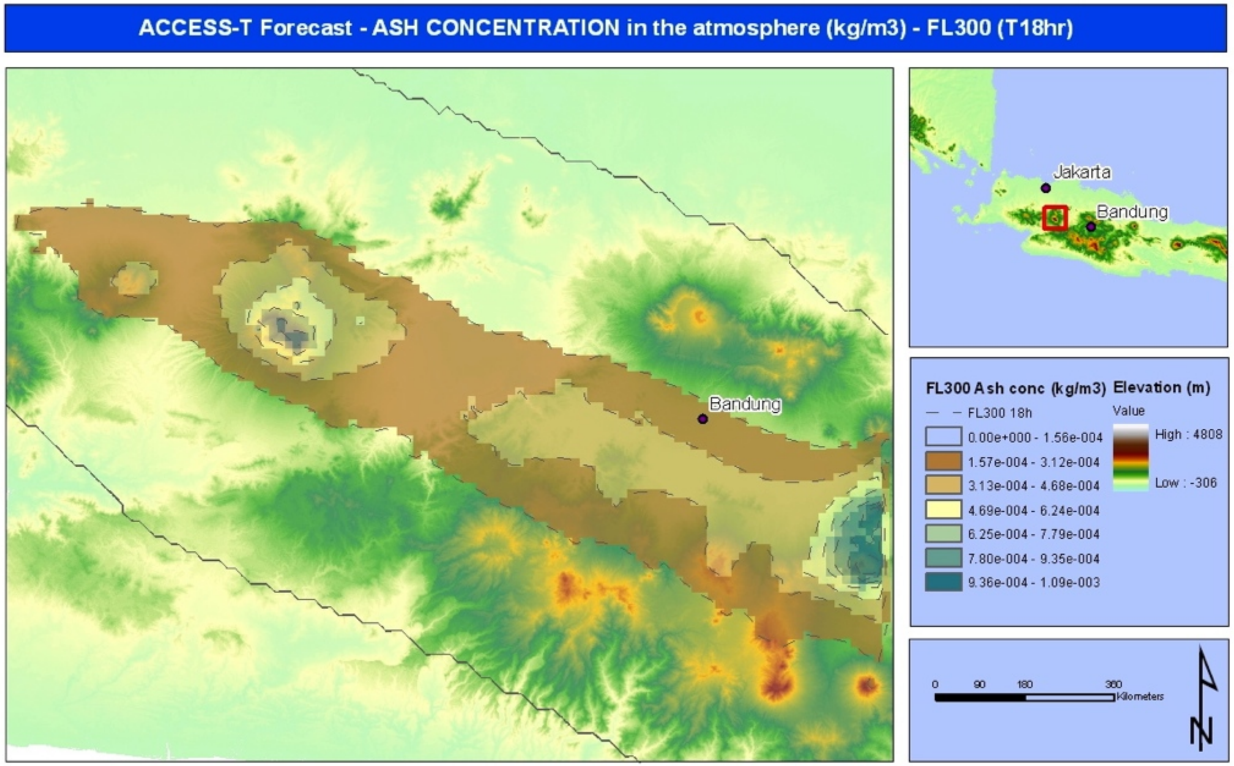
Probabilistic scenario (multiple wind)

Ash Load (kg/m^2)



Same as previous as well as cosmetic damage to building exteriors

Forecasting (ACCESS-T)



python-FALL3D input parameters

Eruption Column Height: 20,000m (20km)
Eruption Duration: 12
Post-eruptive settling duration: 6
Wind profile: ACCESS-T 18 hour forecast

Average grainsize: -1.43 phi
Minimum grainsize: 4 phi
Maximum grainsize -3.67 phi
Sorting: 1.56

Ash Concentration (kg/m^3)

procedure

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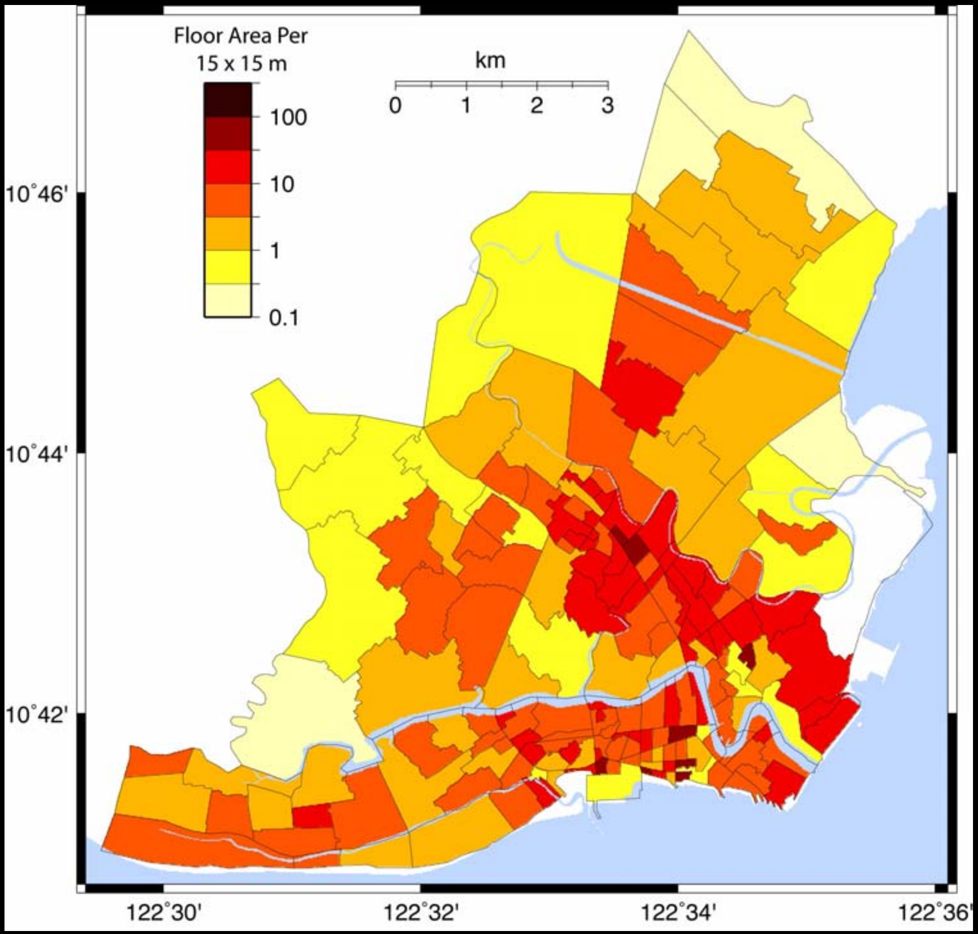
Strengthening Natural Hazard Risk Capacity in the Philippines

- GA and Philippine Institute of Volcanology & Seismology (PHIVOLCS) partnership to better understand and reduce the risks associated with natural hazards in the Philippines
- Aims:
  - develop earthquake impact scenarios to support disaster risk reduction initiatives in the local development planning process
  - enhance PHIVOLCS' Rapid Earthquake Damage Assessment System (REDAS) for use by disaster managers following earthquakes
  - undertake first-order earthquake impact assessments at any location in the Philippines

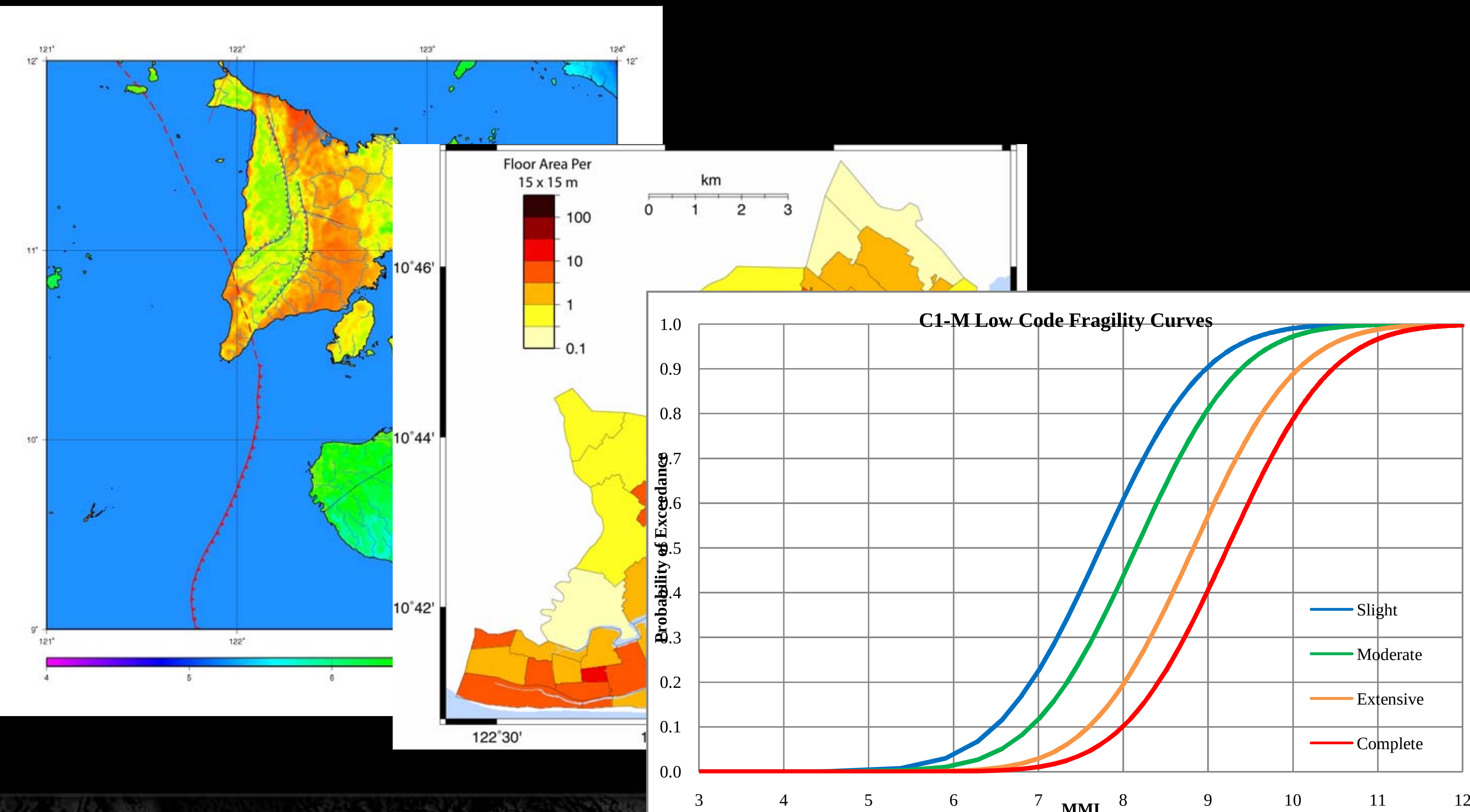
Development of Exposure Database



Use national census data combined with field observations to develop statistical relationships to distribute different building types across a spatial grid

using Generic Mapping Tools (http://gmt.soest.hawaii.edu/)

Combining Hazard, Exposure & Vulnerability



Preliminary Impact Results: Mw 6.3 Scenario

UP Building Type	No. Buildings Complete Damage (Pre-Code)	No. Buildings Complete Damage (High-Code)	Total Buildings in Iloilo City	Complete Damage Rate (High-Code)
C1L	800	800	5400	15%
C1M	110	60	1600	10%
CWS	1100	1100	9100	12%
W1	600	600	5100	12%

Outcomes of Iloilo Impact Study

Results of partnership:

- initiated the development of the first national building typology for the Philippines
- introduced a framework for the development of a building exposure database using National and Local Government data that can be systematically improved with time
- supported the development of earthquake vulnerabilities for key building types though engagement with local engineering expertise
- applied new exposure and impact modules in REDAS using open source software
- undertaken earthquake impact assessments for Iloilo City

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Australian Government
Geoscience Australia
AusAID

The 30TH September 2009 West Sumatra Earthquake

Padang Region Damage Survey

Record 2010/44

GeoCat # 70863

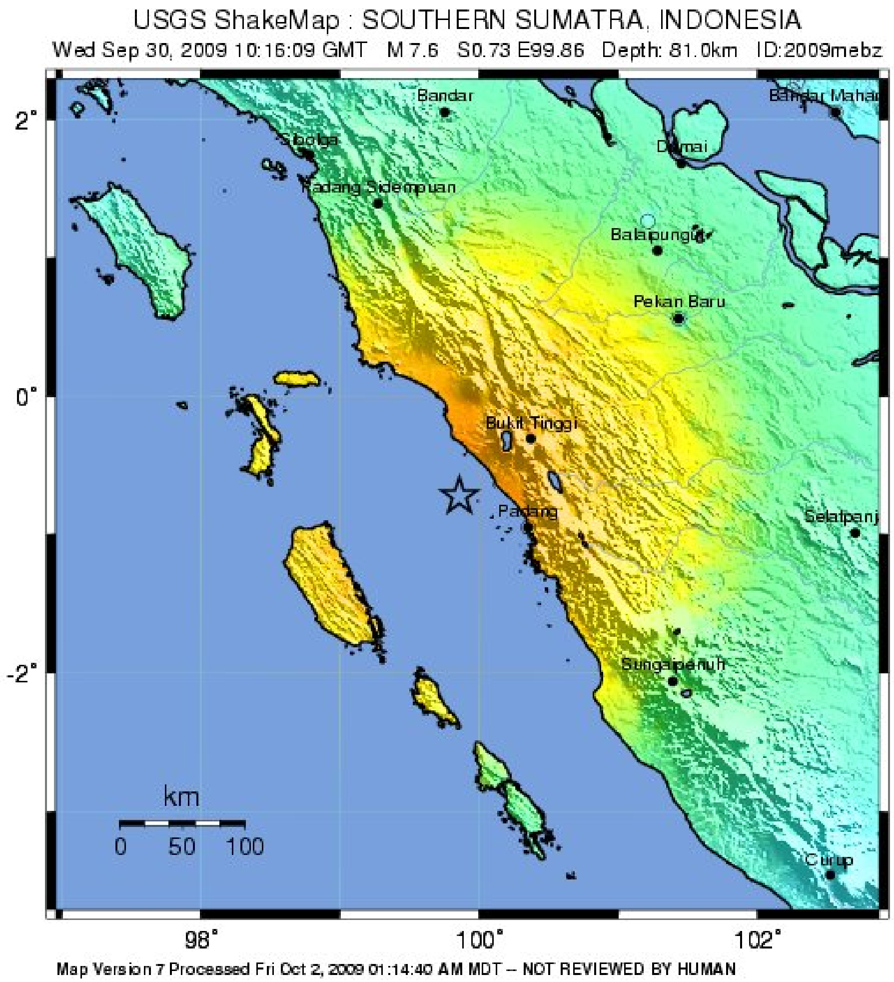
Sengara, I.W.; Suarjana, M.; Beetham, D.; Corby, N.; Edwards, M.; Griffith, M.; Wehner, M.; Weller, R.

AUSTRALIA-INDONESIA FACILITY FOR DISASTER REDUCTION

APPLYING GEOSCIENCE TO AUSTRALIA'S MOST IMPORTANT CHALLENGES

The Event

- 30 Sept 2009, M 7.6
- Depth 80 Km
- 60 km WNW of Padang
- Survey found mostly MMI VIII over survey area
- 1,117 lives lost
- 279,196 homes damaged



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Objectives

- Two objectives:
  - Detailed investigation that could inform recommendations regarding damage and improvements
  - Population survey that could produce statistically useful data to inform knowledge of the vulnerabilities of a wide range of Indonesian building types

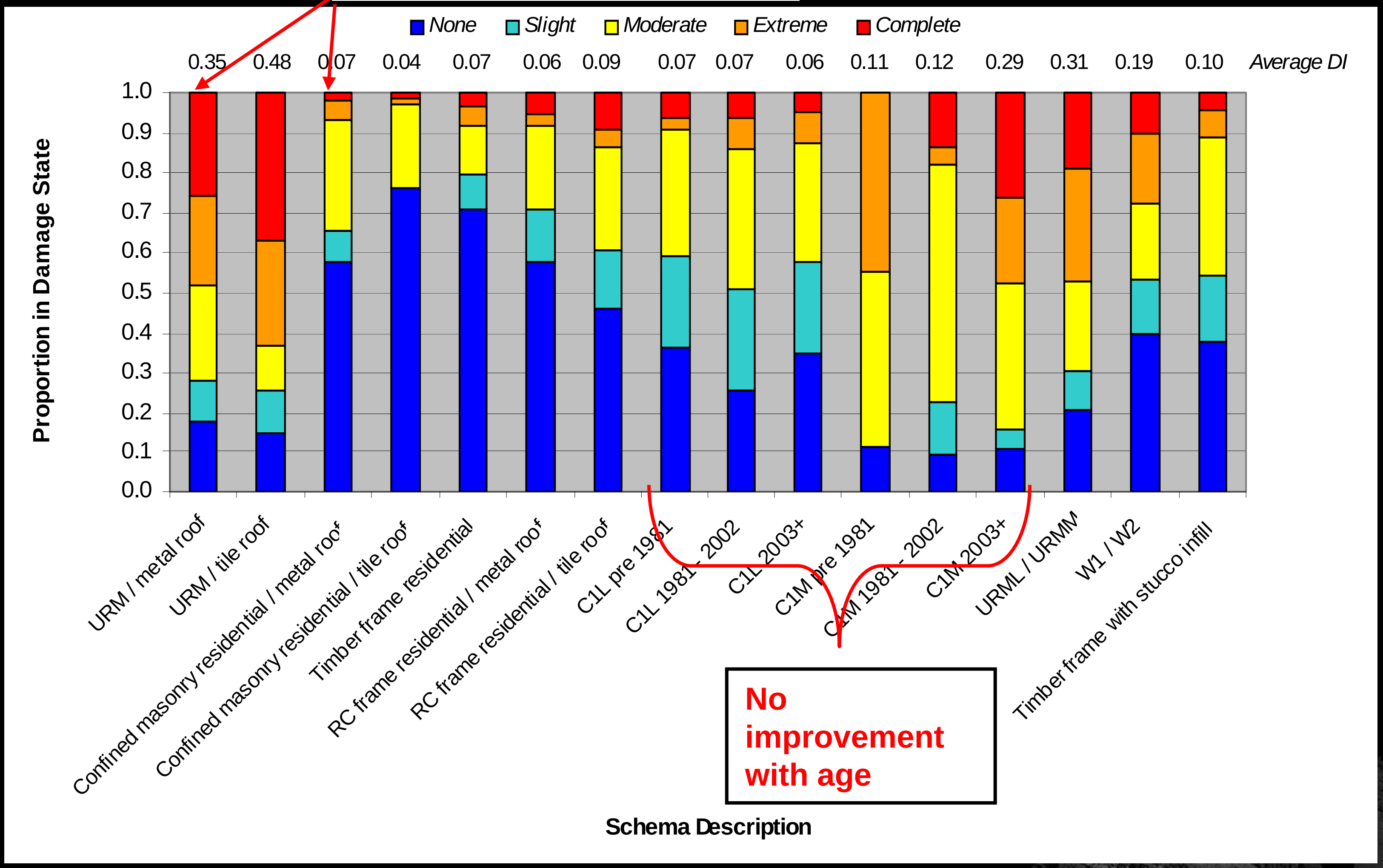
Survey Team (and our Hotel)

Results

- Detailed survey provided Draft West Sumatra Building Recommendations.
  - Specific recommendations covering Regulation, Enforcement and Engineering Design and Construction
- Population survey informed building vulnerability models for risk assessment

Results

Confined masonry performed significantly better than URM



LIA

Results

- The survey results informed a ‘Build Back Better’ campaign in Padang: an awareness campaign to help inform Indonesians about practical ways they can make their families and homes safer

http://www.rumahamangempa.net/

http://picasaweb.google.com/rumahamangempa2010

Conclusions

- Risk assessment is essential to informing risk reduction
- Science/engineering provides necessary knowledge base: data, tools, models
- Risk reduction begins with transfer of this knowledge to stakeholders in the community
- Partnerships in the Australasian region are leading to risk reduction activities (developing resilience)

Thank You