



Australian Government
Geoscience Australia



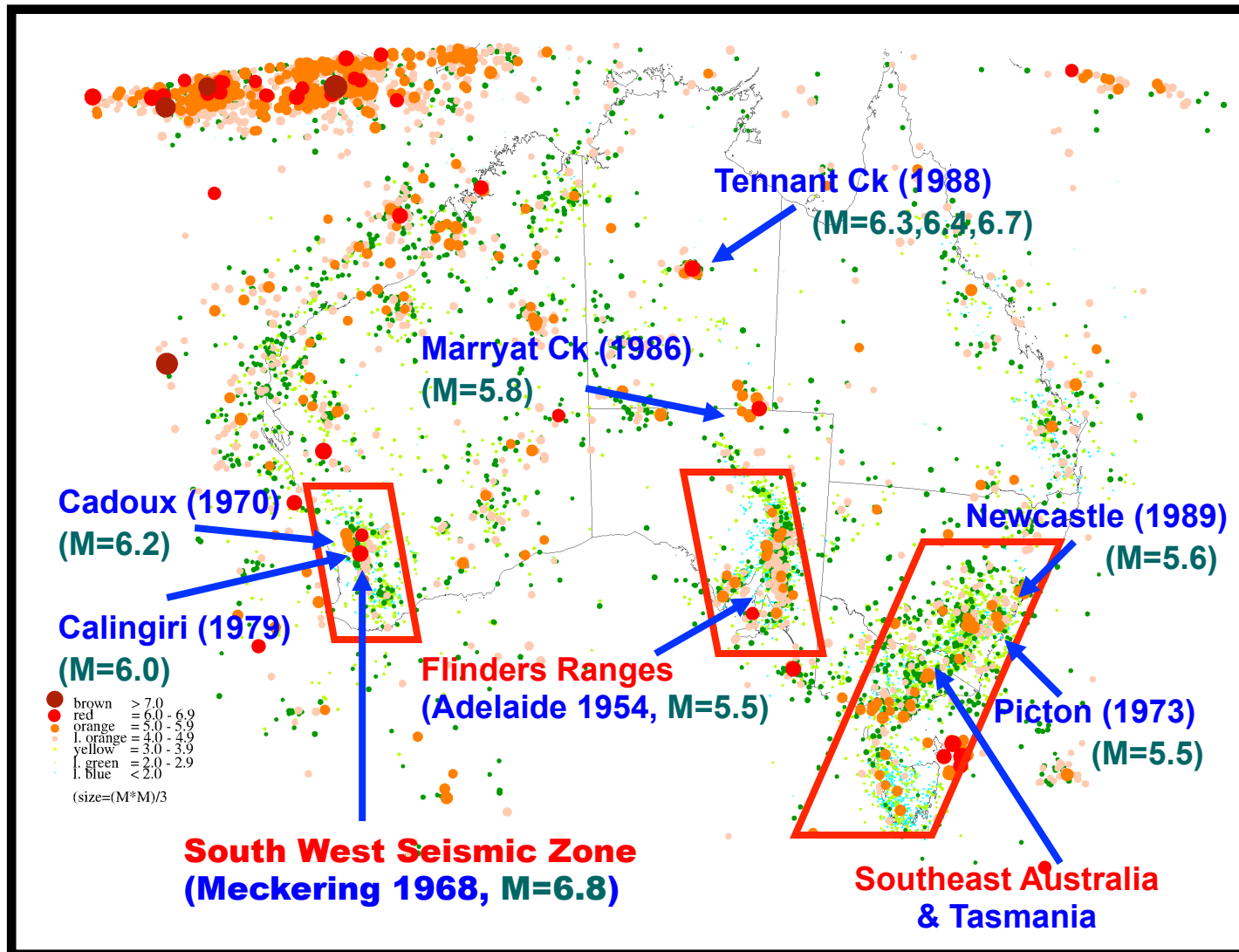
Earthquake Alert Centre and Joint Australian Tsunami Warning Centre Geoscience Australia

Dan Jaksa

Section Leader of the ATWS Section
Earth Monitoring and Hazards Group
Minerals and Natural Hazards Division

Co-Director of the Joint Australian Tsunami Warning Centre

Earthquakes in Australia



Adelaide 1954, magnitude 5.4



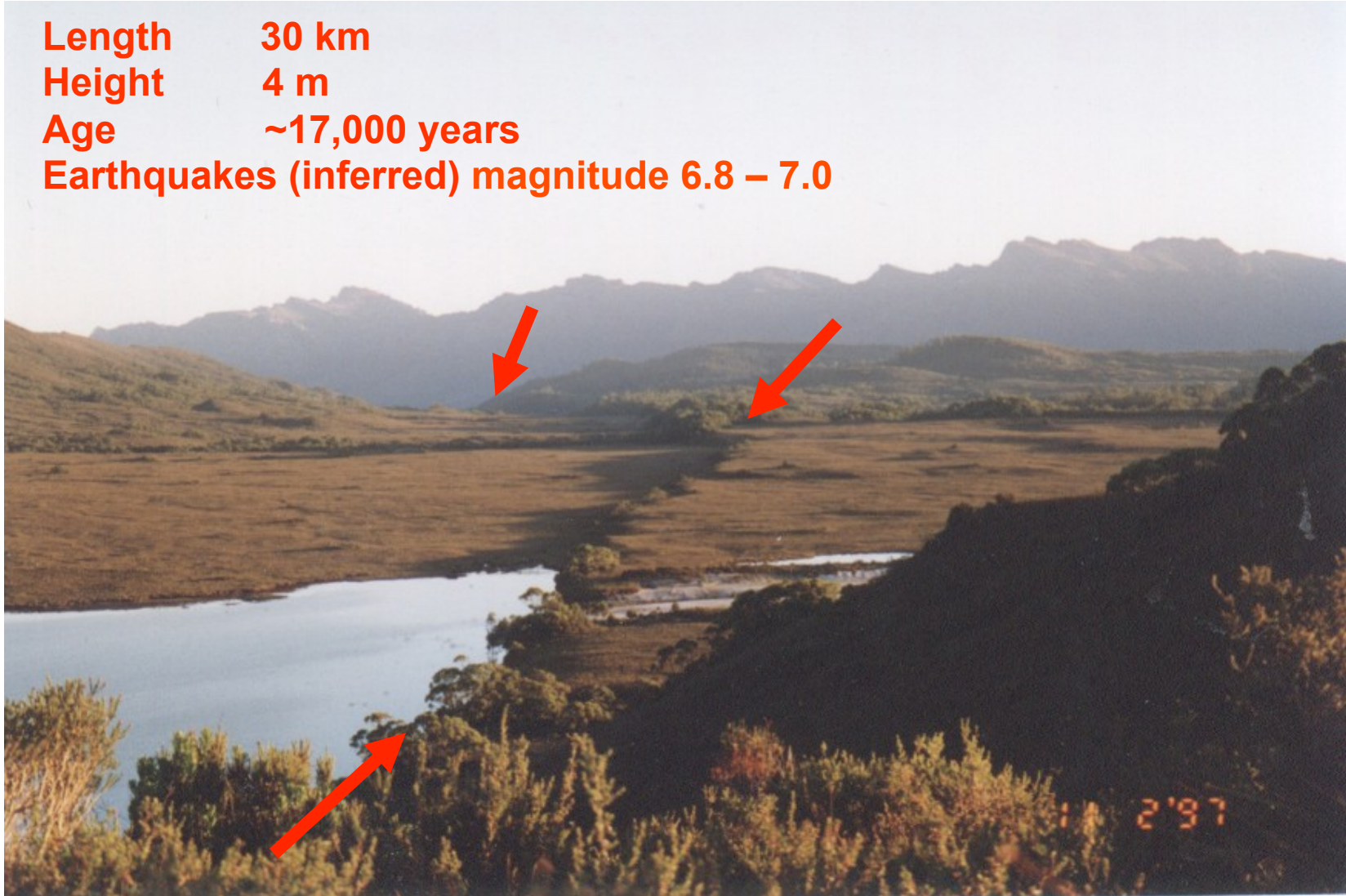
Meckering 1968, magnitude 6.9



Pre-historic earthquakes, Lake Edgar, Tasmania

Approximate magnitude 7 earthquake

Length 30 km
Height 4 m
Age ~17,000 years
Earthquakes (inferred) magnitude 6.8 – 7.0



Meckering 1968, magnitude 6.9



Meckering 1968, magnitude 6.9

Main East-West rail line



Meckering 1968, magnitude 6.9



Newcastle 1989, magnitude 5.6



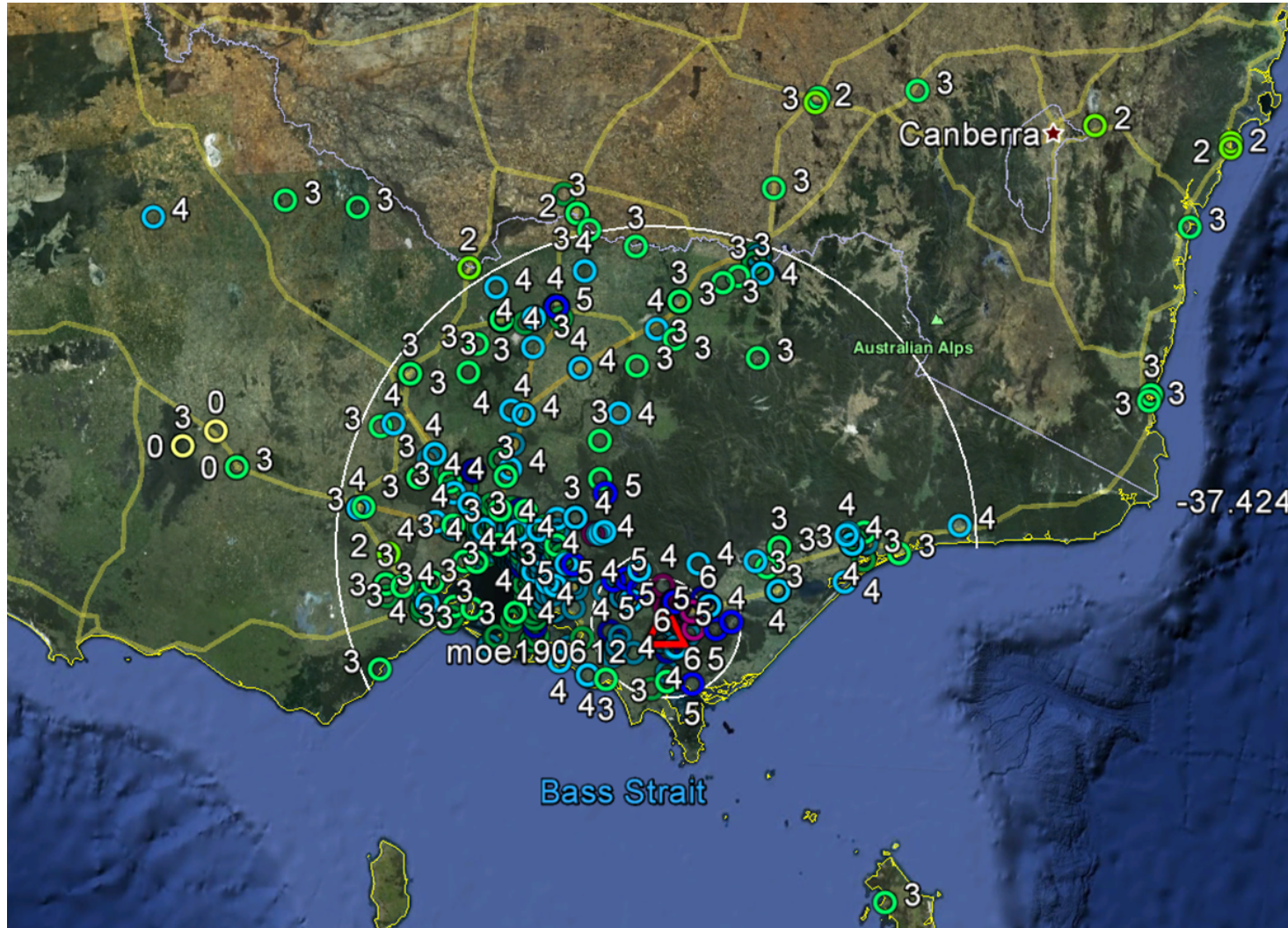
Newcastle 1989, magnitude 5.6



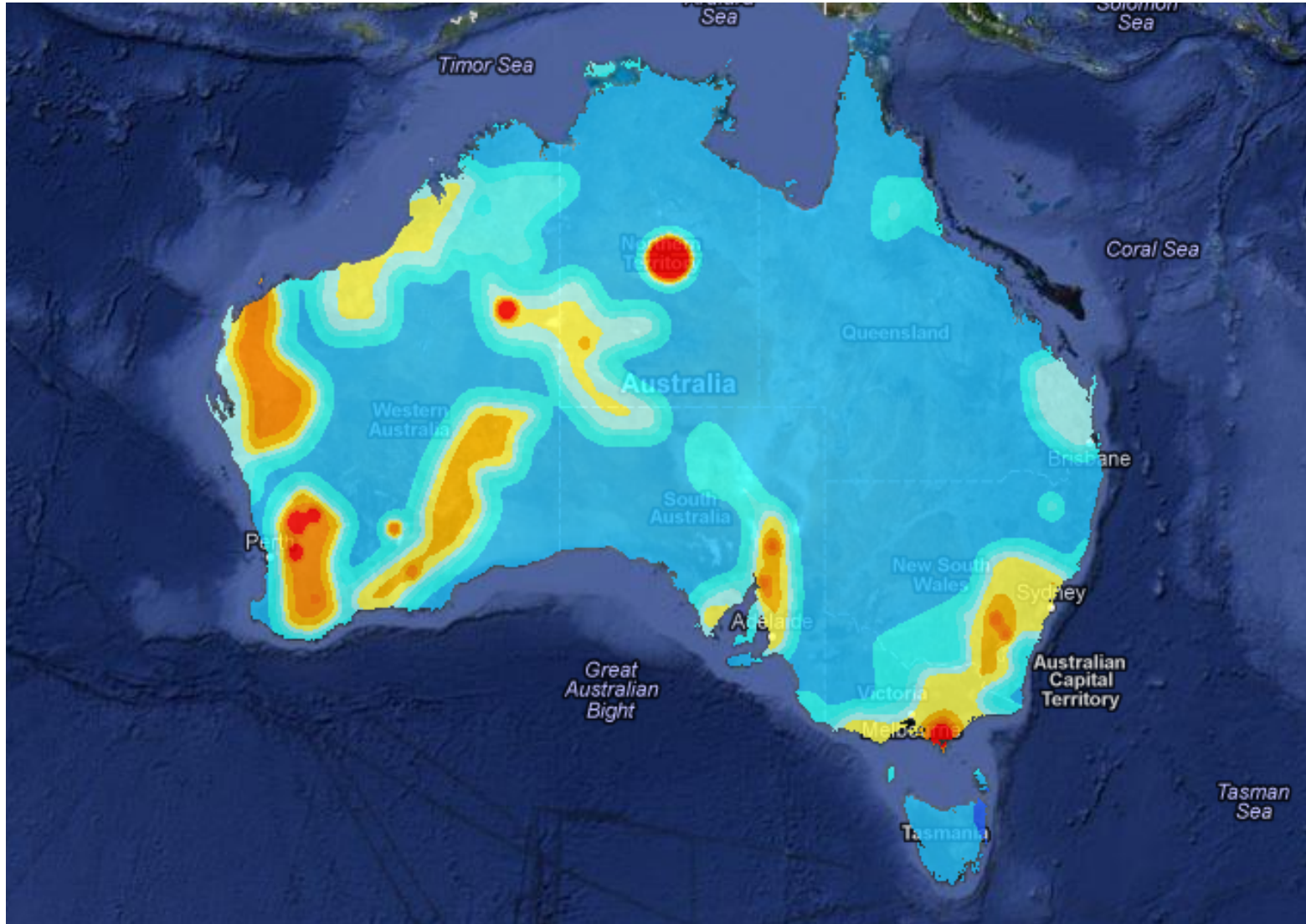
Kalgoorlie 2010, magnitude 5.0



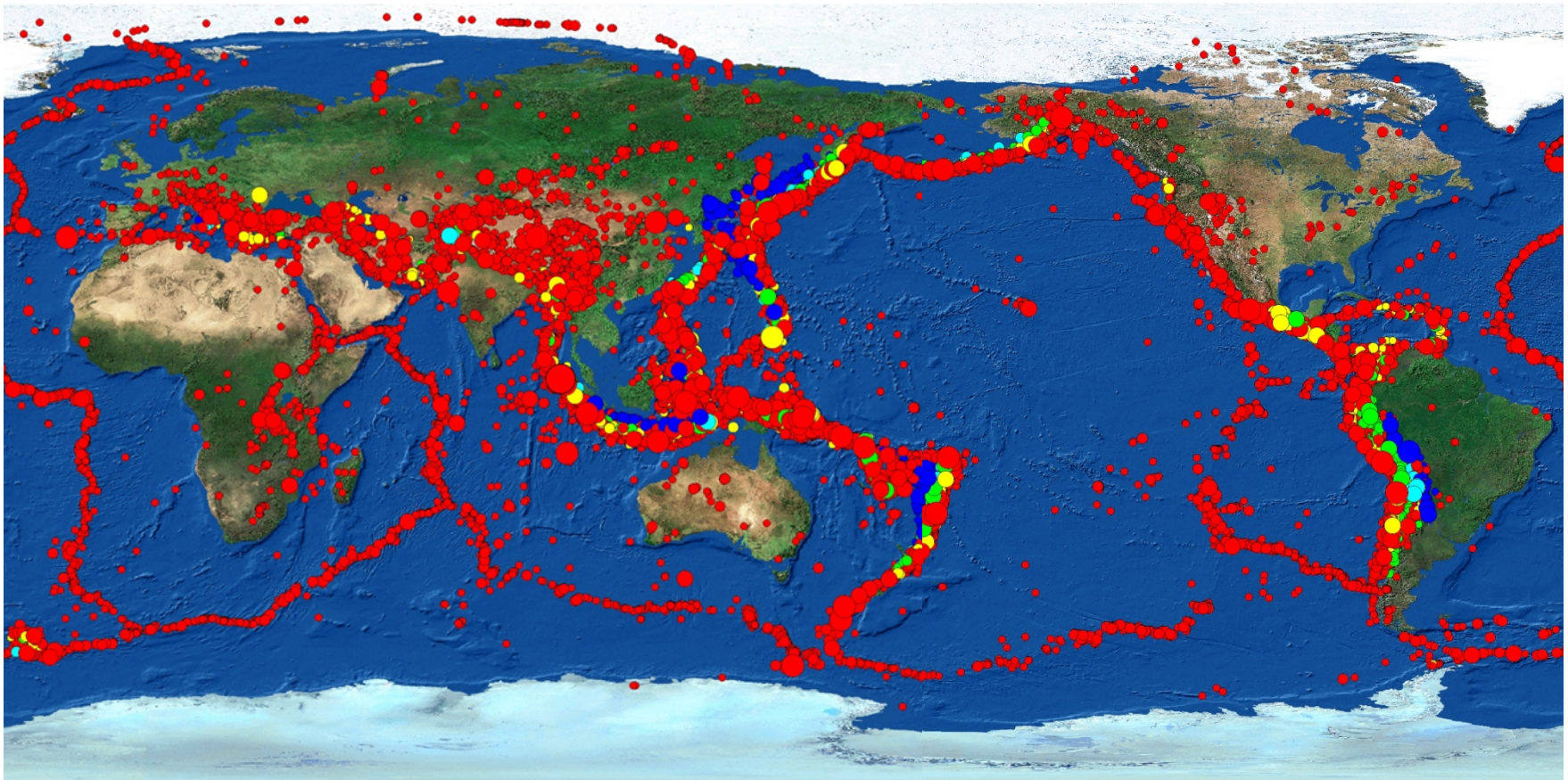
M5.4, Moe, Victoria, 19 June 2012



Australian Earthquake Hazard Map



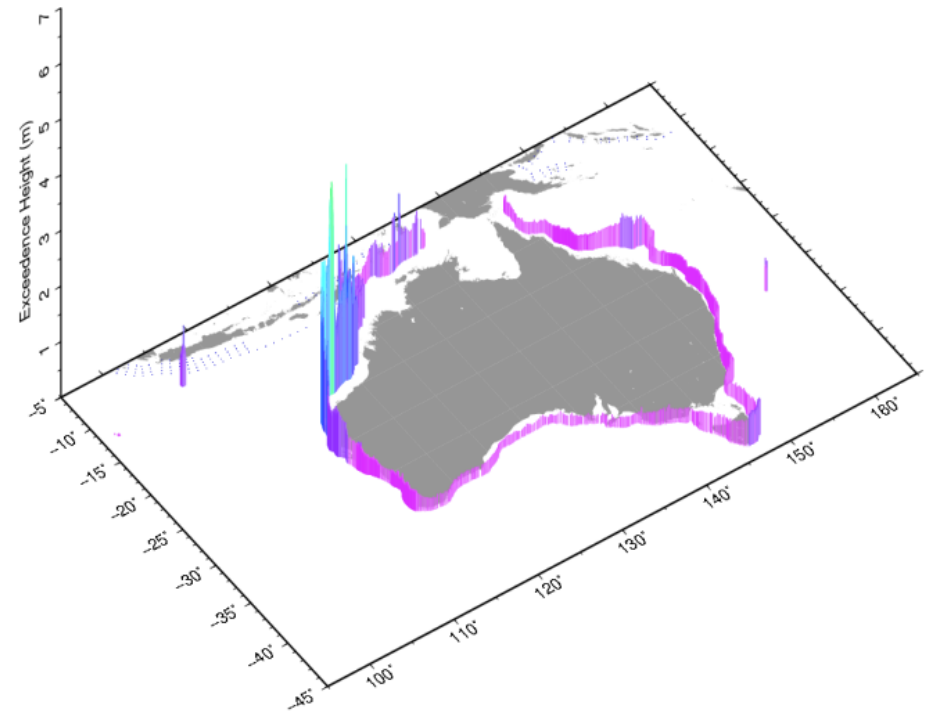
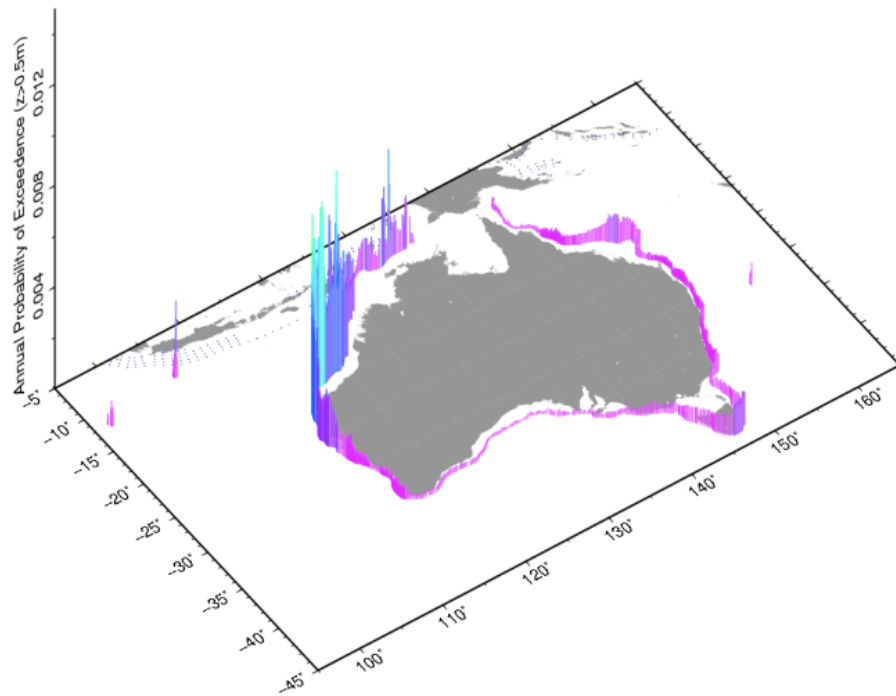
Global Earthquakes Magnitude ≥ 5



Tsunami Hazard Mapping

Annual Probability of Exceeding 1m

Wave Height with a 1 in 1000 year annual probability of being exceeded



Australian Tsunami Warning System

The ATWS is defined as an end-to-end system:

- from understanding the hazard and risk to community awareness and preparedness;
- earthquake and tsunami monitoring;
- detection and analysis;
- through to public warnings; and then onto
- evacuation and response.

As the constitutional responsibility for all these components exist within all levels of Government, the Australian Government, State and Territory Governments and some Local Governments are all involved in the ATWS to varying capacities.

Three Australian Government Agencies Responsible for the ATWS

Geoscience Australia

JATWC

- Seismic Monitoring & Earthquake Advice

Bureau of Meteorology

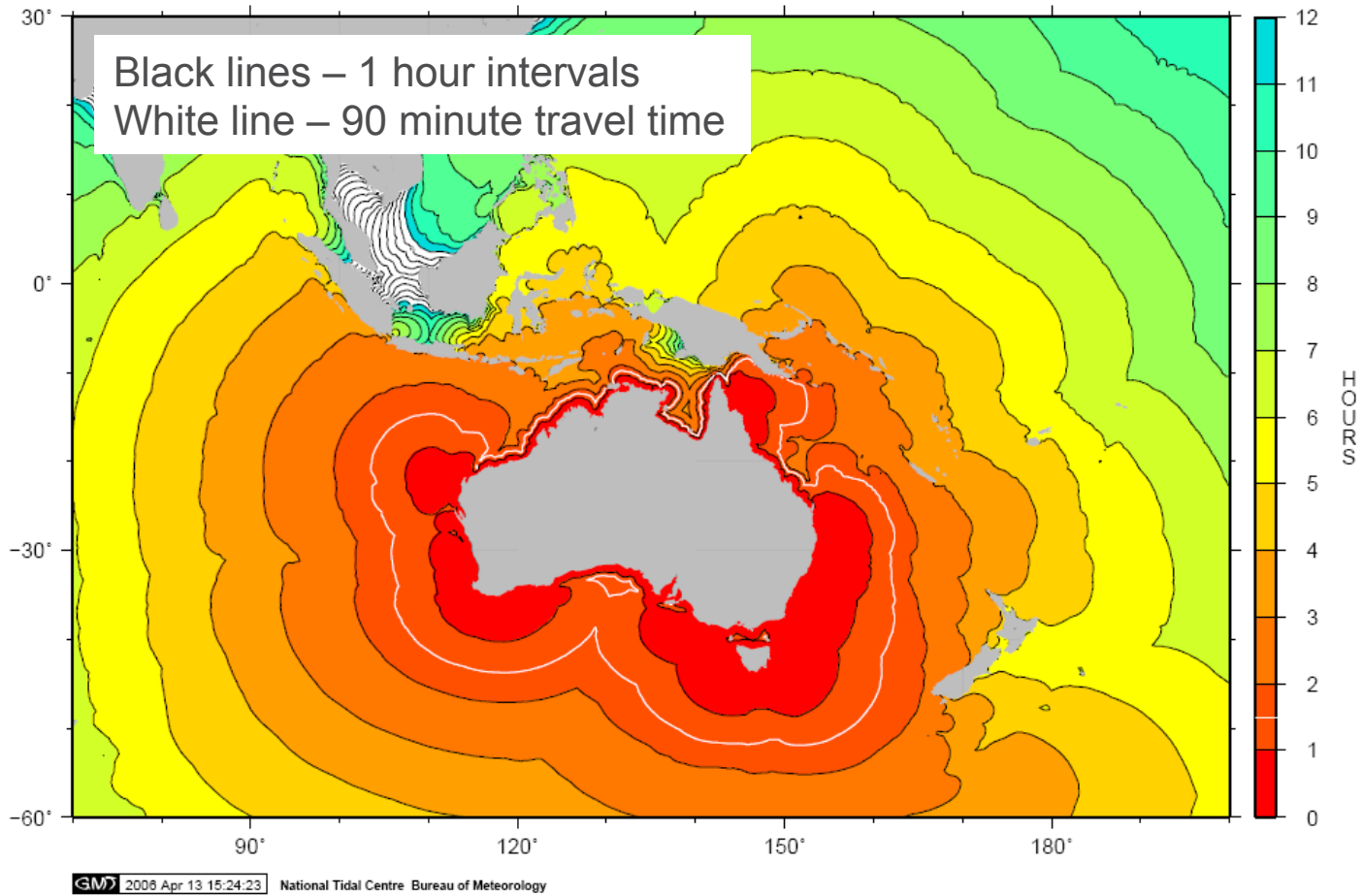
- Sea Level Monitoring & Warnings

Attorney-General's Department

- Community Awareness & Preparedness
- Situational Awareness to all levels of Government

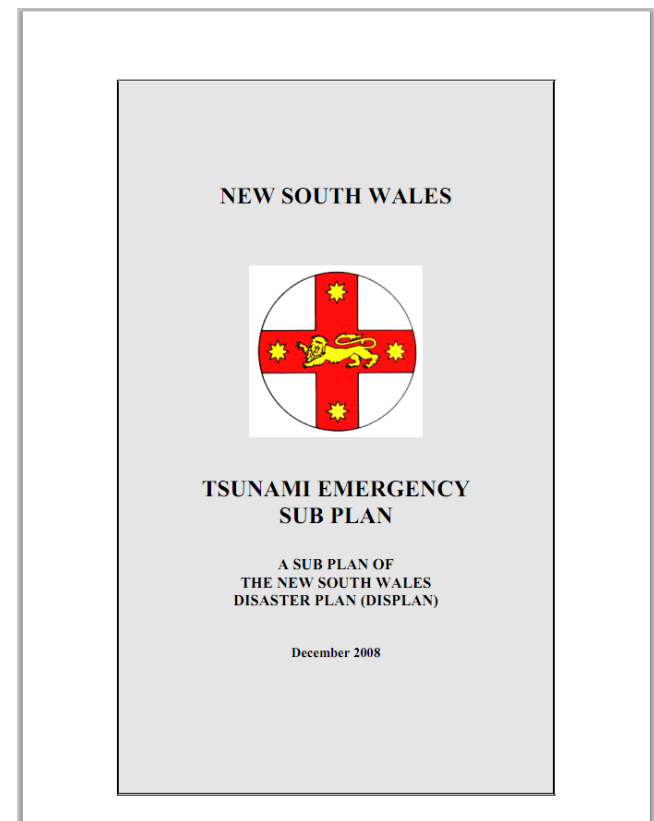
Tsunami Warning Lead Times

Inverse tsunami travel times from the Australian Mainland



State Emergency Management

The screenshot shows the NSW Government website's State Emergency Service (SES) page. At the top, it says "For emergency help in floods and storms CALL 132 500". The navigation bar includes "Home", "News", "Volunteering", "Community Safety", and "About". The main content area is titled "Tsunami" and includes a sidebar with links to StormSafe, FloodSafe, Home Emergency Kit, Schools, Coastal Erosion, Tropical Cyclones, TsunamiSafe, Fact sheets, Community Language Resources, and 132 500. The main text explains that the SES is the designated combat agency for tsunamis and lists four causes: vertical movement of the sea floor, submarine or coastal volcanic eruptions, meteor impacts, and coastal landslides and slumps. It also mentions that the NSW coast has been affected by over 30 tsunamis in the past 200 years, with the largest occurring in May 1960. A quote describes the damage caused by the 1960 tsunami in Sydney. A "Current Information" section highlights that Strathfield SES volunteers were highly commended in the NSW Volunteer of the Year Awards on 8:00AM AEST / 11 November 2011.

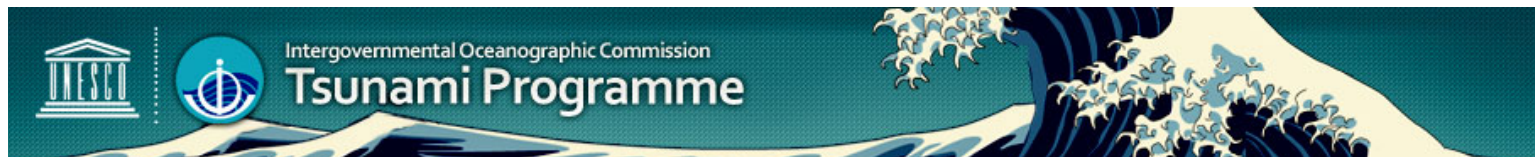


International Coordination

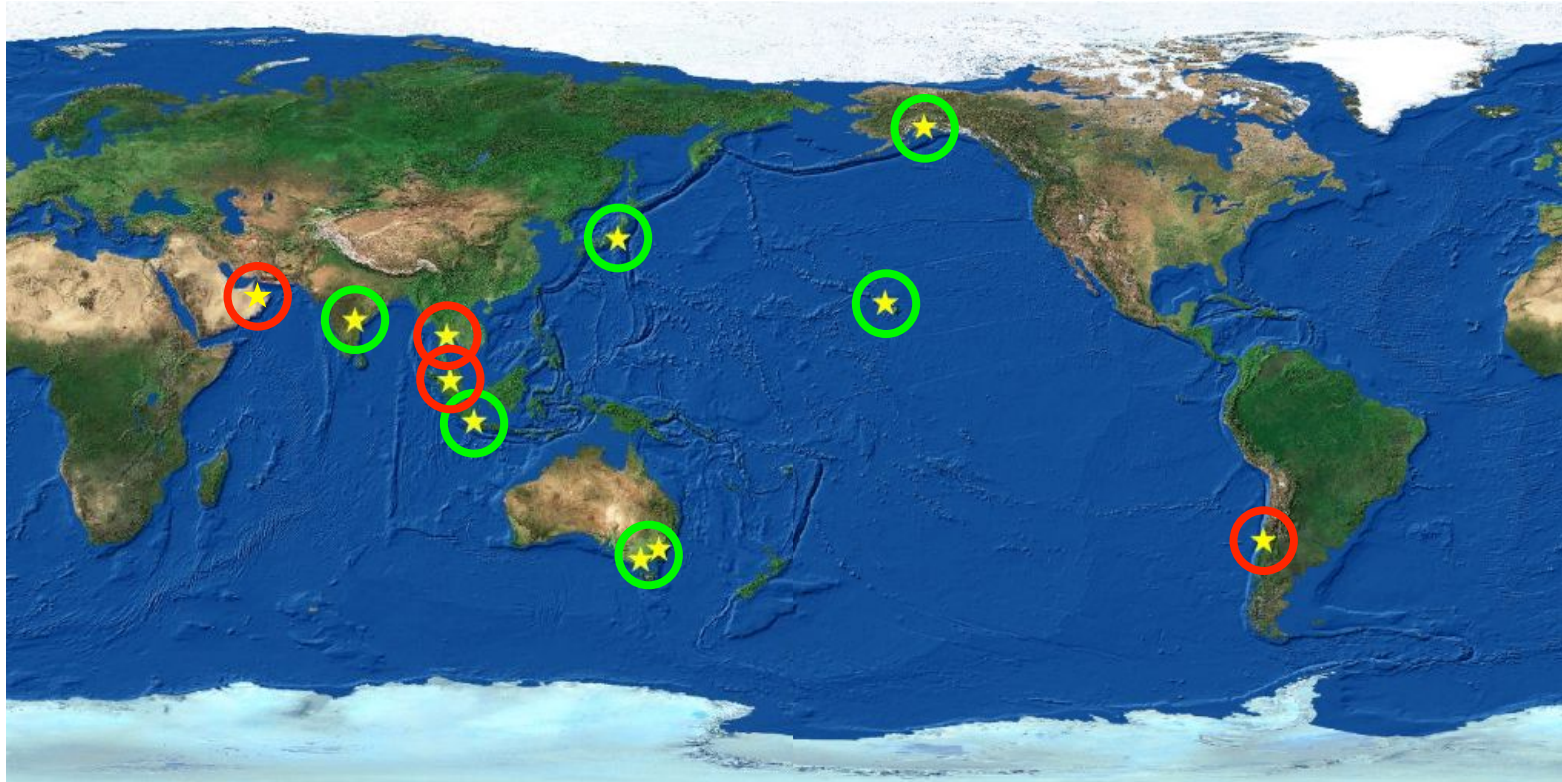
The body responsible for coordinating international efforts in tsunami warning and mitigation is the Intergovernmental Oceanographic Commission of UNESCO. The IOC General Assembly XXIII in Paris held in June 2005 confirmed the need to establish an **interim tsunami warning system** in the Indian Ocean. This would be provided through the existing **Pacific Tsunami Warning Center** in Hawaii and the **Japan Meteorological Agency** in Tokyo.

The Paris meeting also adopted resolutions to create three regional Intergovernmental Coordination Groups (ICGs)—for the Indian Ocean, the North-East Atlantic and Mediterranean, and the Caribbean—to establish basin-wide tsunami warning systems.

The first session of the **Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System** was held in Perth in August 2005. A key resolution of the meeting was that the IOTWS would be **a coordinated network of national systems** and capacities. It was agreed that each Member State would have responsibility for issuing warnings within their respective territories.



Tsunami Warning Centres ...



Regional Tsunami Service Provider

RTSP Australia - Regional Tsunami Service Provider for the Indian Ocean

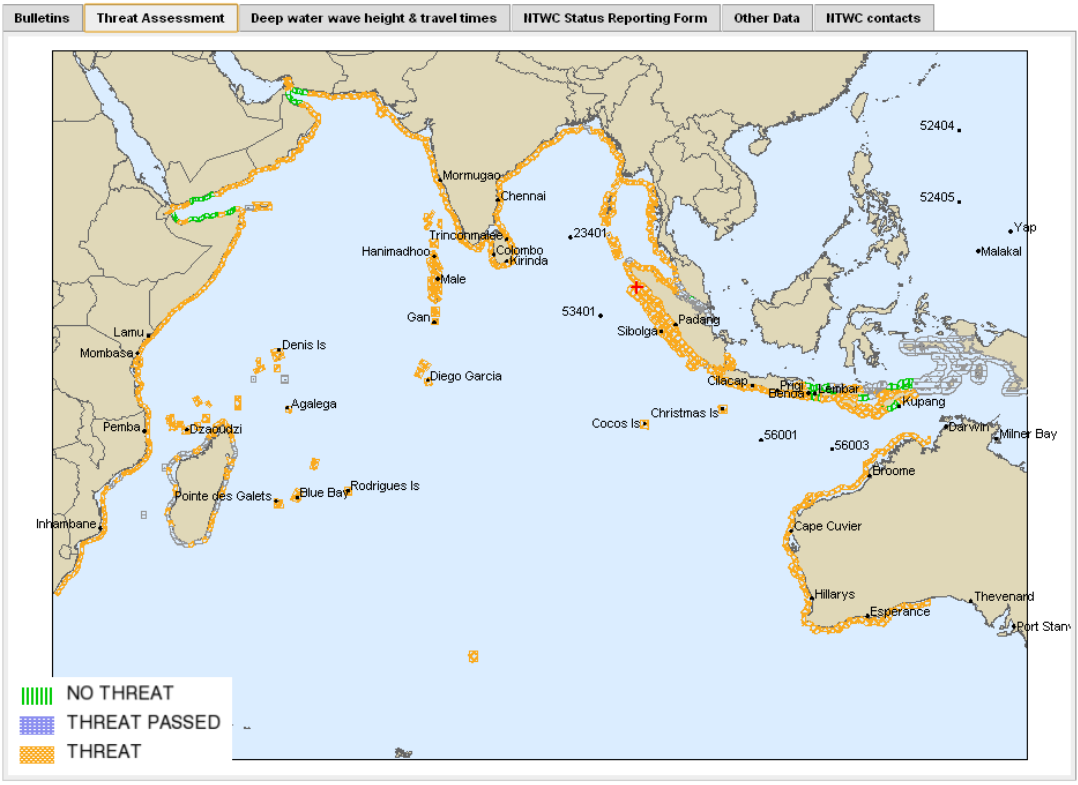
A service provided by the Joint Australian Tsunami Warning Centre (JATWC), operated by the Australian Bureau of Meteorology and Geoscience Australia

[* Disclaimer *](#)

Recent Events

- 04:05 UTC 14 November 2011 Mag 6.6**
SOUTHERN MOLUCCA SEA
2.No Threat Bulletin 04:21UTC 14 Nov 2011
1.Earthquake Advice 04:15UTC 14 Nov 2011
- 22:00 UTC 09 November 2011 Mag 8.4**
VANUATU * PACWAVE11 TEST EVENT *****
6.No Threat Bulletin 23:49UTC 09 Nov 2011
5.Earthquake Advice 22:08UTC 09 Nov 2011
4.No Threat Bulletin 22:48UTC 09 Nov 2011
3.Earthquake Advice 22:08UTC 09 Nov 2011
2.No Threat Bulletin 22:11UTC 09 Nov 2011
1.Earthquake Advice 22:08UTC 09 Nov 2011
- 02:59 UTC 08 November 2011 Mag 7.0**
NORTHEAST OF TAIWAN
1.Earthquake Advice 03:11UTC 08 Nov 2011
- 12:32 UTC 01 November 2011 Mag 6.5**
REVILLA GIGEDO ISLANDS REGION
1.Earthquake Advice 12:45UTC 01 Nov 2011
- 18:55 UTC 28 October 2011 Mag 6.9**
NEAR COAST OF PERU
1.Earthquake Advice 19:02 28 OCT 2011
- 17:57 UTC 21 October 2011 Mag 7.3**
KERMADEC ISLANDS REGION
1.Earthquake Advice 18:07UTC 21 Oct 2011
- 03:35 UTC 14 October 2011 Mag 6.5**
EASTERN NEW GUINEA REG., P.N.G.
1.Earthquake Advice 03:46UTC 14 Oct 2011
- 03:16 UTC 13 October 2011 Mag 6.3**
SOUTH OF BALL, INDONESIA
2.No Threat Bulletin 03:34UTC 13 Oct 2011
1.Earthquake Advice 03:30UTC 13 Oct 2011
- 01:00 UTC 12 October 2011 Mag 9.2**
Northern Sumatra, Indonesia **TEST**
14.Final Bulletin 11:57UTC 12 Oct 2011
13.Threat Bulletin 10:59UTC 12 Oct 2011
12.Threat Bulletin 10:01UTC 12 Oct 2011
11.Threat Bulletin 08:59UTC 12 Oct 2011
10.Threat Bulletin 07:58UTC 12 Oct 2011
9.Threat Bulletin 06:53UTC 12 Oct 2011
8.Threat Bulletin 05:53UTC 12 Oct 2011
7.Threat Bulletin 04:58UTC 12 Oct 2011
6.Threat Bulletin 03:57UTC 12 Oct 2011
5.Threat Bulletin 02:45UTC 12 Oct 2011
4.Threat Bulletin 01:57UTC 12 Oct 2011
3.Earthquake Advice 01:45UTC 12 Oct 2011
2.Threat Bulletin 01:12UTC 12 Oct 2011
1.Earthquake Advice 01:10UTC 12 Oct 2011
- 23:07 UTC 22 September 2011 Mag 6.2**
TONGA ISLANDS
Earthquake Advice 23:19UTC 22 Sep 2011

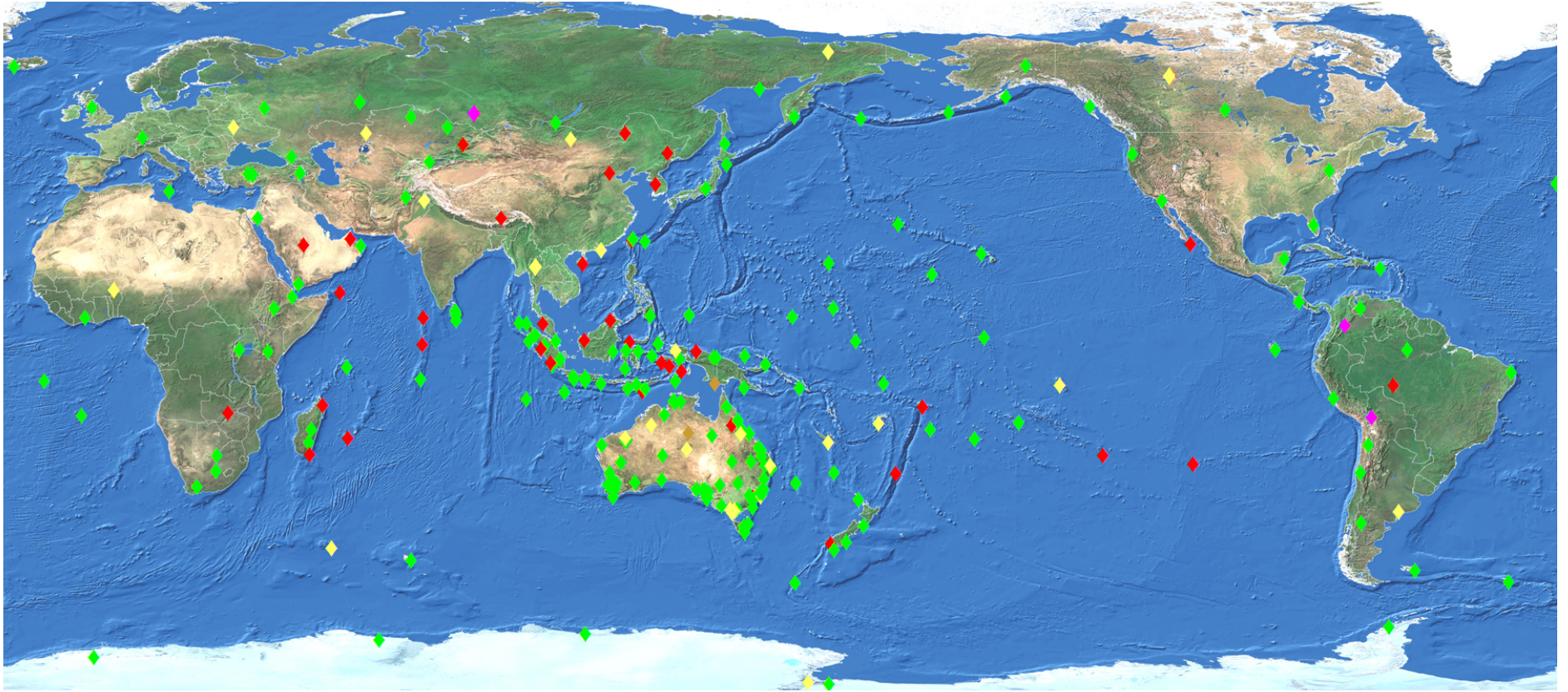
Northern Sumatra, Indonesia **TEST** 01:00 UTC 12 October 2011 Mag 9.2



Earthquake Alert Centre



JATWC Real-time Seismic Network



Seismic Stations (Lord Howe Island)





Alerts at 19 Jun 8:58:23 PM : Adjust alert display for: Retweet % Unique users Common words

#earthquak .#melbourn .an .anyon .did .earth .earthquak .els .everyon .feel .felt .fuck .happen .holi .hous .in .just .melbourn .mini .move .must .omg .room .scari .second .shake .shit .shook .someone .that .thought .tremor .wa .whole .wow .wtf .yep

Topic clusters for red alert 'earthquak':

1st Earthquake I Felt in Australia - Actually Felt - Biggest Earthquake I've ever Felt - **Earthquake Felt** - Earthquake Felt Strong in Wandin - Earthquake Felt in Mornington - **Earthquake Melbourne** - Earthquake OMG - Earthquake Wtf - FUCKING Huge Earthquake OMG so Scared - **Feel that Earthquake** - Felt Big - Felt Like - Felt Like an Earthquake in Leongatha - Felt a Small Earthquake - Felt in Melbourne - Felt in Mt - Felt the Earth - Ive never Felt - **Just Felt** - Longest Earthquake I've ever Felt - Mini Earthquake Just - OMG Earthquake Guys - OMG I Felt - OMG I Shat - OMG I Think - OMG Just Felt an Earthquake - OMG so Scary - **Other Topics** - RT 1DSwaggg - RT 3AW693 - RT ABCEnvironment - RT AUS_WANTS_1D - RT Adam86Valentine - RT Angiestarwebb - RT Anthonyalsop - RT BGIbbsy4 - RT BenBirchall - RT BradGreen18 - RT BrendanFevola25 - RT Dancejudgejason - RT DavidZaharakis - RT Emmasq - RT Firstdogmoon - RT Frezned - RT Hot30Countdown - RT Insomnius - RT Itsblackers - RT JLLLOW - RT JackLScanlan - RT James_Yammouni - RT JedKnight_ - RT Jessmatilda - RT JordanPSmith18 - RT Jordy3392 - RT JustLetMalikYou - RT Katreeena - RT Kiraajadex - RT LetMalikZayn - RT Lilithia - RT Luk3yyyy - RT MeeMeep_com - RT Nicole_r - RT Ricky_Fandrich - RT Steph_n - RT Y7News - Shaking OMG - Swear I Felt an Earthquake - Think there was an Earthquake - Thought I Felt

Displaying 3456 tweets for red alert 'earthquak'

Most recent timestamp: 2012-06-19 20:58:22

Oldest timestamp: 2012-06-19 20:53:46

Hide Retweets Reverse Tweet Order Save Tweets As CSV

Retweets: 12.33% Geo Spread: 3.63

	@Jstav Great night for an earthquake I reckon!! Lol Location: Australia	19 Jun 8:58:22 PM
	@Shadowofadream no baby that wasn't an earthquake, it's just me rock'n your world! - #melbournequake Location: Perth, Australia	19 Jun 8:58:22 PM
	@BellaJonas1D Why's my entire TL filled with caps lock and everyone talking about an Earthquake? hahaha WHAT'S HAPPENING Location: Sydney, Australia	19 Jun 8:58:22 PM
	@Tessaasimpson @trangandgam HAHAAHAHAHAHAH SUCH A GOOD SYSTEM :) OH WUT WAS THERE JUST AN EARTHQUAKE THERE?!?!? Location: Perth, Australia	19 Jun 8:58:22 PM
	@benjya85 @a13x earthquake in Melbourne Location: Tugun, QLD, Australia	19 Jun 8:58:22 PM
	@cnarinli @isellenquyen Was there an earthquake? In Melb? Location: Sydney, Australia	19 Jun 8:58:22 PM
	@nana_na_ayeeee RT @jessmatilda: EARTHQUAKE!! IN MELBOURNE! Location: Australia	19 Jun 8:58:21 PM

Data CC-BY-SA by [OpenStreetMap](#)

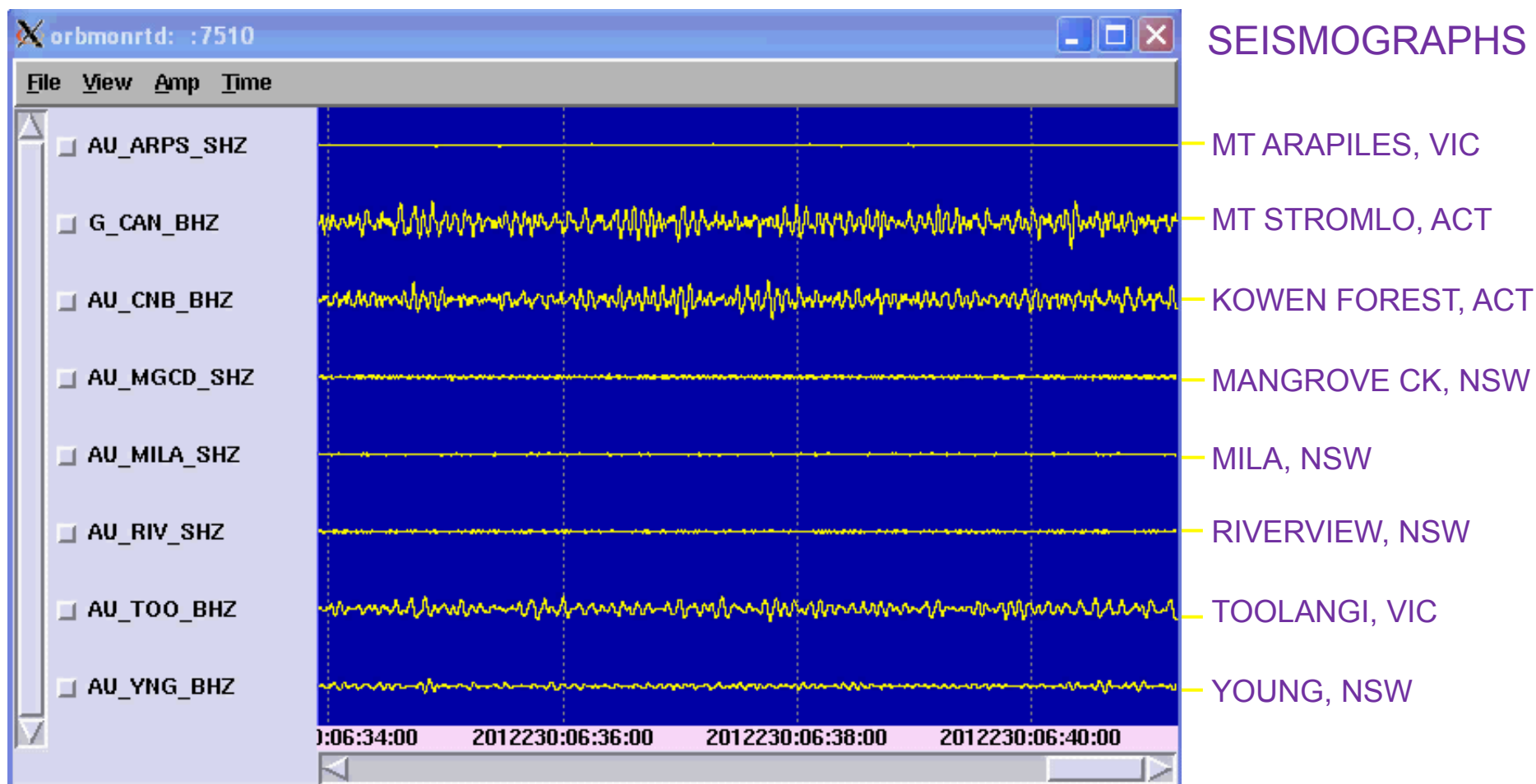
Cluster Alert Set Clear

OR AND

Alert Set:
earthquak

Wee Jasper earthquake, April 2012

5:00 am

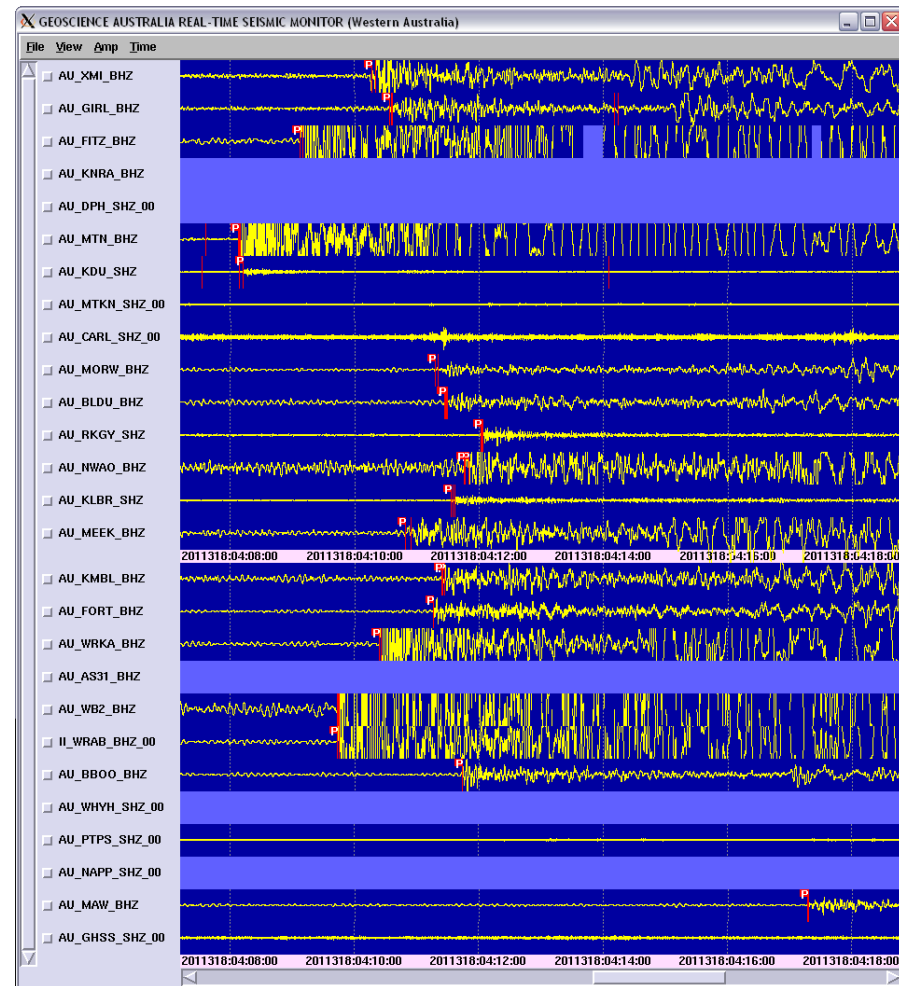


Real-time Seismic Waveform Displays

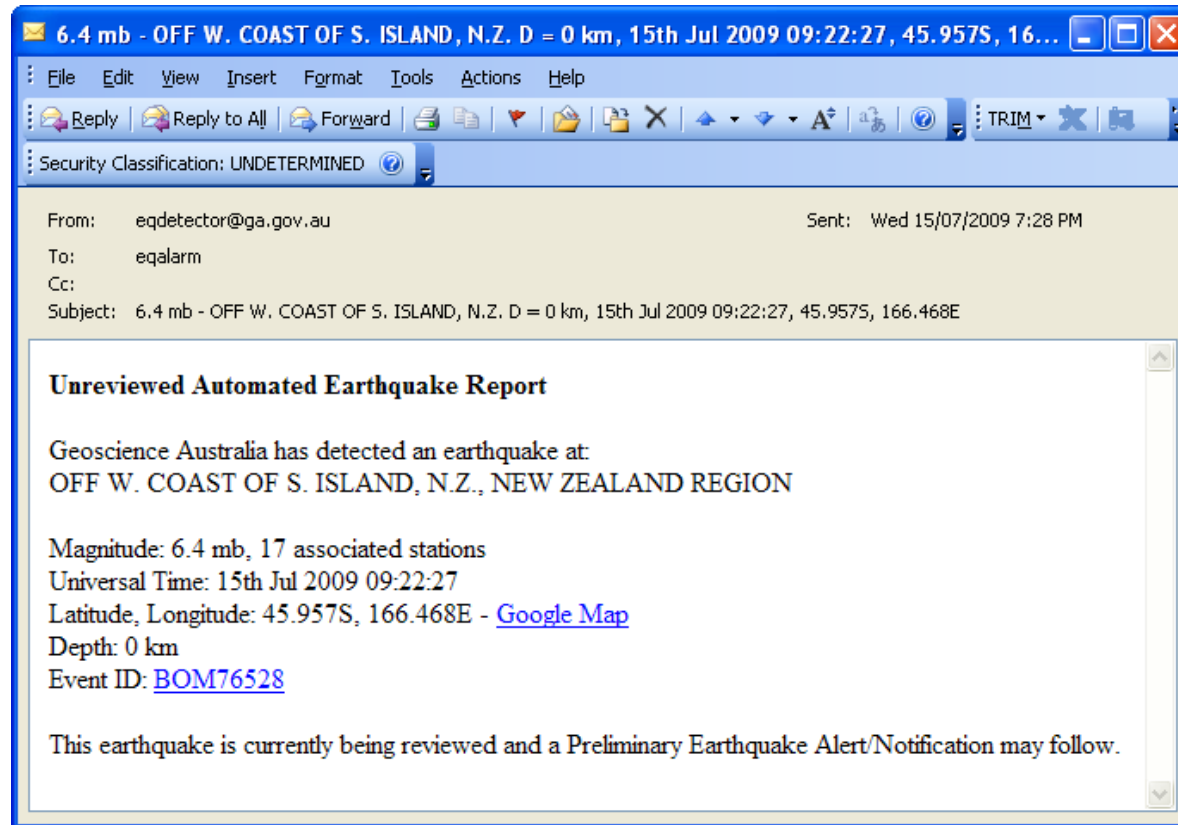
Visual display only.

With experience, the Duty Seismologist can approximate location and magnitude.

Duty Seismologist waits for earthquake solution before analysis can be made – about 3 to 6 minutes in our region.



Seis-alert (automatic solution)



Cordless phone rings, control desk alarms activate,
Backup BlackBerry sounds, XML sent to Bureau JATWC &
email alerts to GA staff

Decision Support System

ORBEVENTS

File View Filters

Calc Mwp Run Mwp Follow Events Zoom In Zoom Out

Current UTC Time: 1st Sep 2009 05:42:42

NOTIFY ALERT

Map

Mwp

Waveforms

Test Display

Events	Assoc	Logs			
Evid	Orid	Time	mb	NASS	AUTH
> 103995	107749	04:52:48	3.70	13	rega
> 103999	107746	04:34:06	5.83	13	rega
> 103983	107737	03:55:23	5.00	14	rega amb
> 103981	107733	02:21:27	5.03	19	rega
> 103971	107718	01:14:37	3.53	17	rega ms
> 103953	107706	00:18:00	5.00	22	rega amb
> 103934	107692	23:22:44	4.74	17	rega amb
> 103916	107657	22:28:01	5.18	27	tele amb
> 103894	107656	22:04:12	4.04	20	rega dbg
> 103886	107648	21:51:35	5.40	26	tele amb
> 103882	107629	21:30:54	3.54	10	rega
> 103857	107618	20:45:03	4.72	26	rega dbg ms
> 103855	107600	19:03:57	3.12	11	rega
> 103843	107598	17:52:30	3.21	19	rega
> 103816	107579	17:35:00	4.69	31	rega dbg ms
> 103817	107563	17:09:14	3.19	10	rega dbg
> 103798	107542	14:20:52	4.83	24	rega amb
> 103771	107523	10:41:52	5.07	25	tele amb
> 103743	107506	10:15:38	5.83	17	tele amb

Orid	Time	Type	Action
107742	04:46:02	ATWSAlarm	Created
107742	04:46:03	ATWSAlarm	XML Message to 134178.6.1
107742	04:46:03	ATWSAlarm	XML Message to 134178.6.5
107742	04:46:04	ATWSAlarm	Sent Email
107742	04:46:58	ATWSAlarm	Ring Phones

DATE	TIME	Latitude	Longitude	Depth	Stations	mb	msx
01/09/2009	04:34:06	-45.67	160.14	200.00	13	5.83	4.56

Time Since Event: 1:09 hours

Map Tool

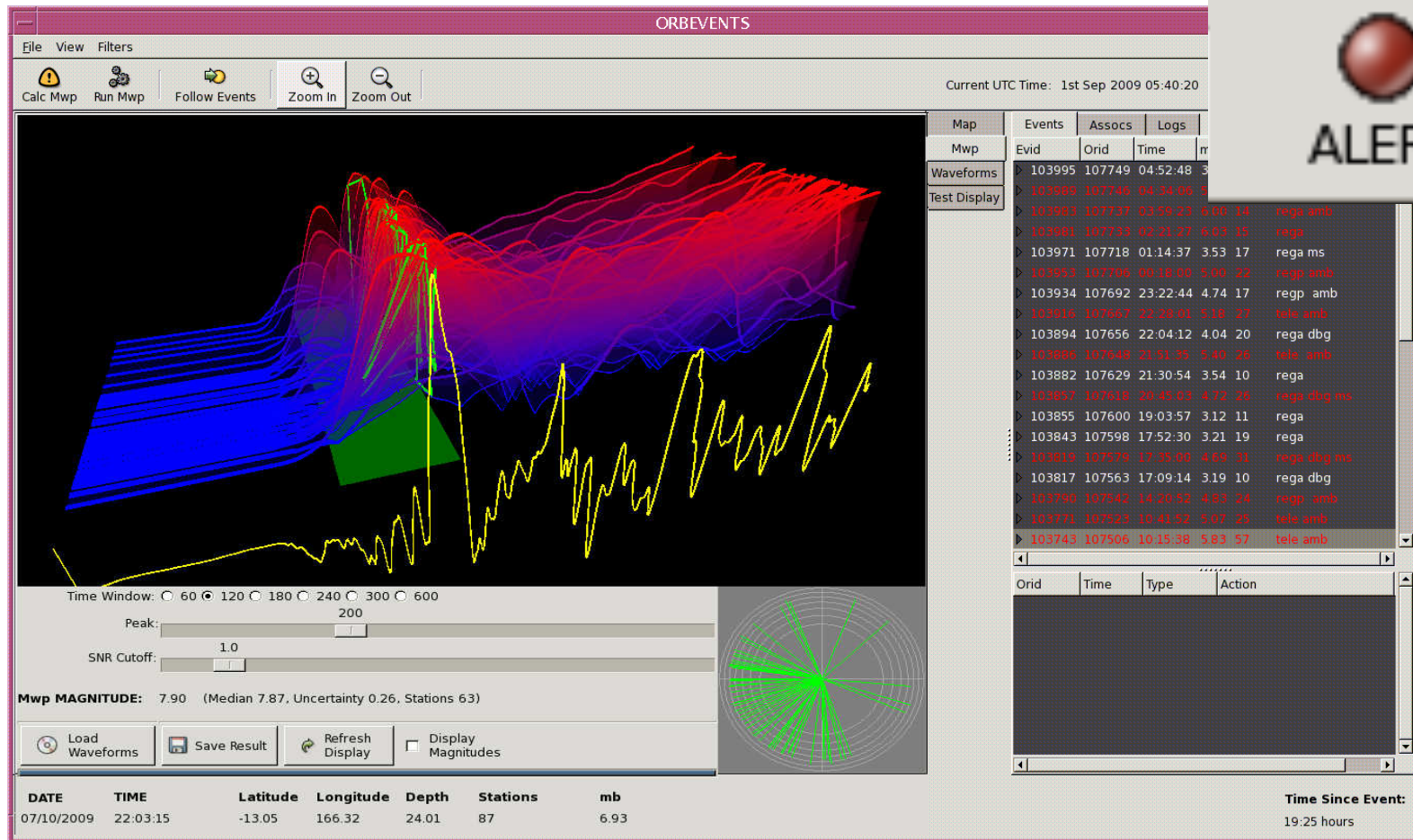
Mwp Magnitude

$$M_{wp} = \frac{\log M_0 - 9.1}{1.5}$$

$$M_0 = \max \left(\int u_z(x_r, t) dt \right) \frac{4\pi\rho\alpha^3 r}{F^P}$$

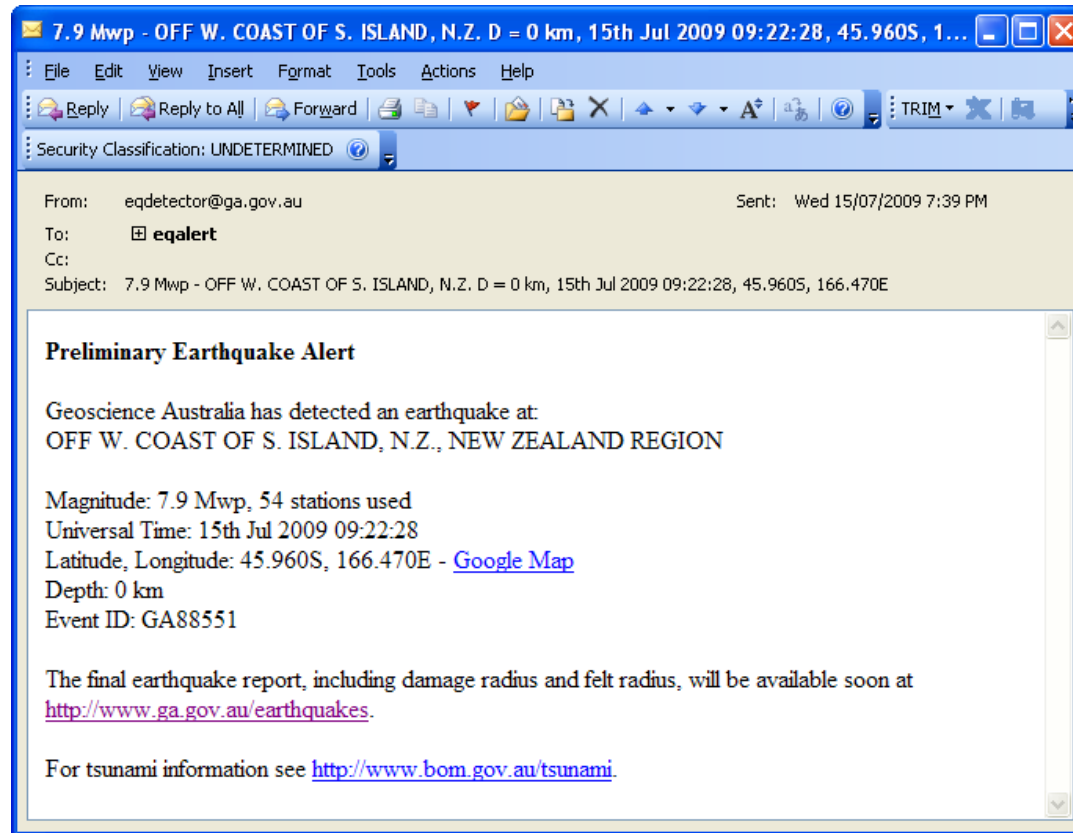
where $u_z(x_r, t)$ is the vertical component of far-field P -wave displacement at receiver, x_r ; ρ and α is the average density and average P -wave velocity along the propagation path; r is the epicentral distance between the source and the receiver and F^P is a radiation pattern due to the double-couple source mechanism. (Tsuboi, et al, 1995)

Decision Support System



Mwp Tool

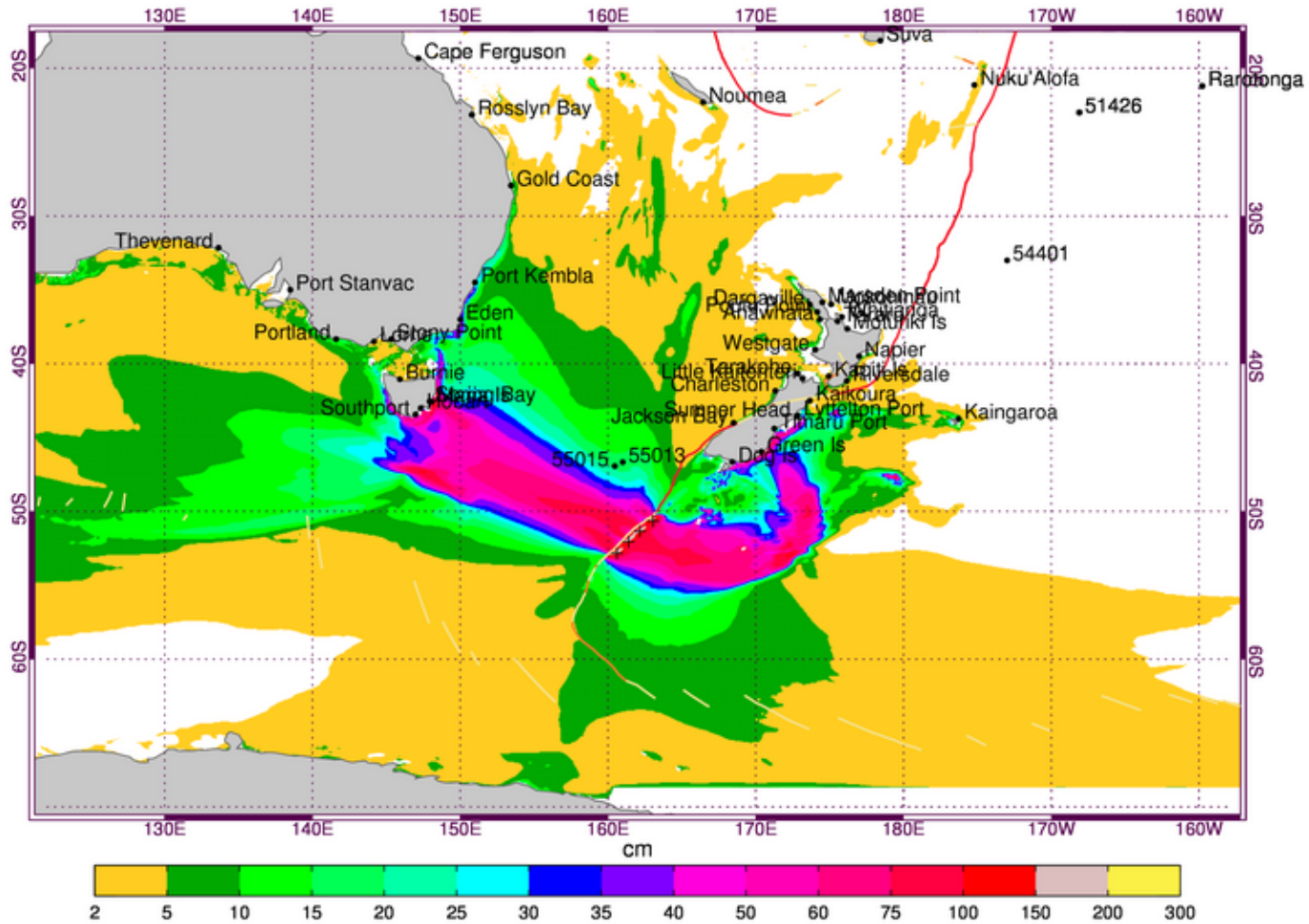
Manual Solution Email Alert



Control desk email alarm sounds, Backup BlackBerry sounds, XML sent to Bureau JATWC & email alerts to RTSP, GA staff & AGCCC, website, RSS, CAP, Twitter

Tsunami Scenario Selected

Scenario number = 212 Position = 161.80E 51.72S Mag = 8.5



JATWC at the Bureau of Meteorology

Australian Government
Bureau of Meteorology

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[Bureau Home](#) > [Joint Australian Tsunami Warning Centre](#)

Joint Australian Tsunami Warning Centre

Need Emergency Advice? Please listen to your local radio and TV announcements or call **1300 TSUNAMI (1300 878 6264)** for latest warning information. For emergency assistance, call your local emergency authority on **132 500**

*****No Tsunami Currently Affecting Australia*****

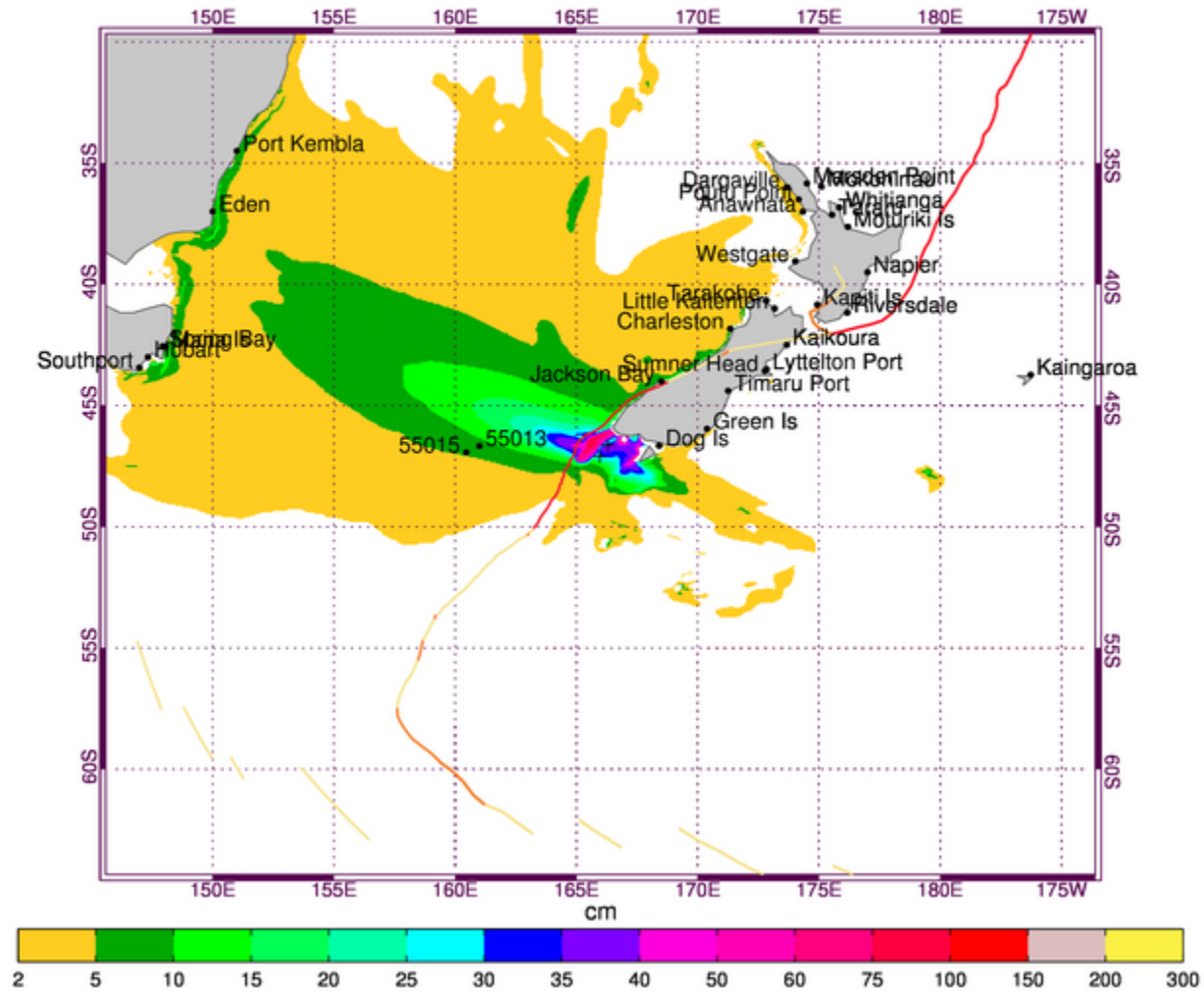


National Tsunami Bulletins
No tsunami bulletins current

State/Territory Warnings
No tsunami warnings current

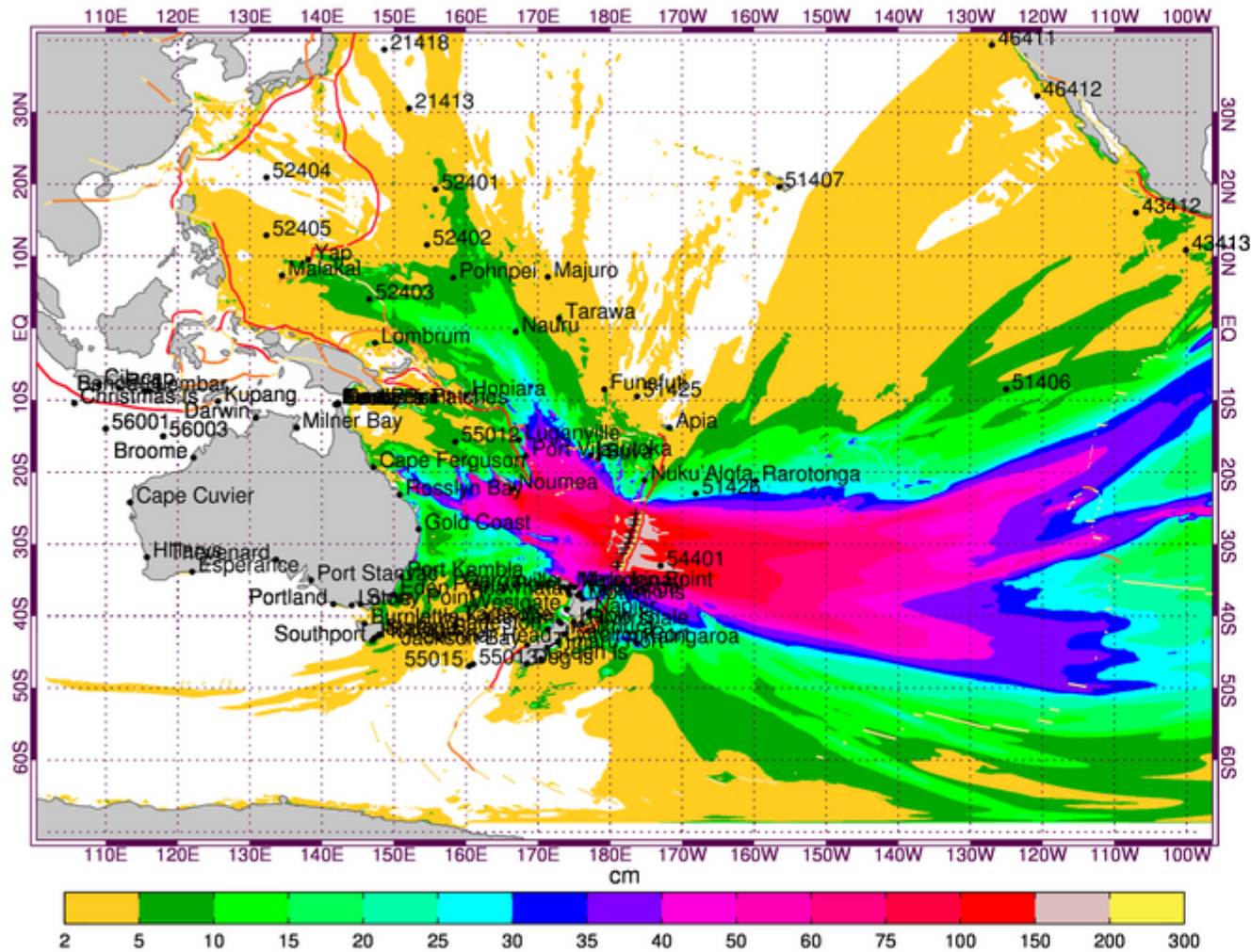
The [Joint Australian Tsunami Warning Centre](#) is operated by the Australian Bureau of Meteorology and [Geoscience Australia](#)

Tsunami Scenario Selected

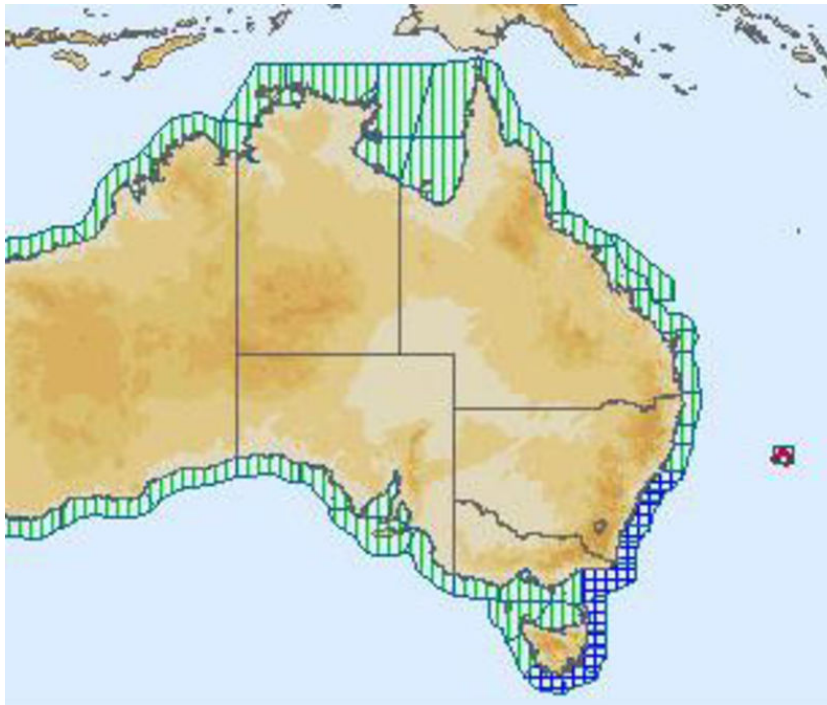


Tsunami Scenario Selected

Scenario number = 235 Position = 182.42E 29.43S Mag = 9.0



Tsunami warning prepared and published



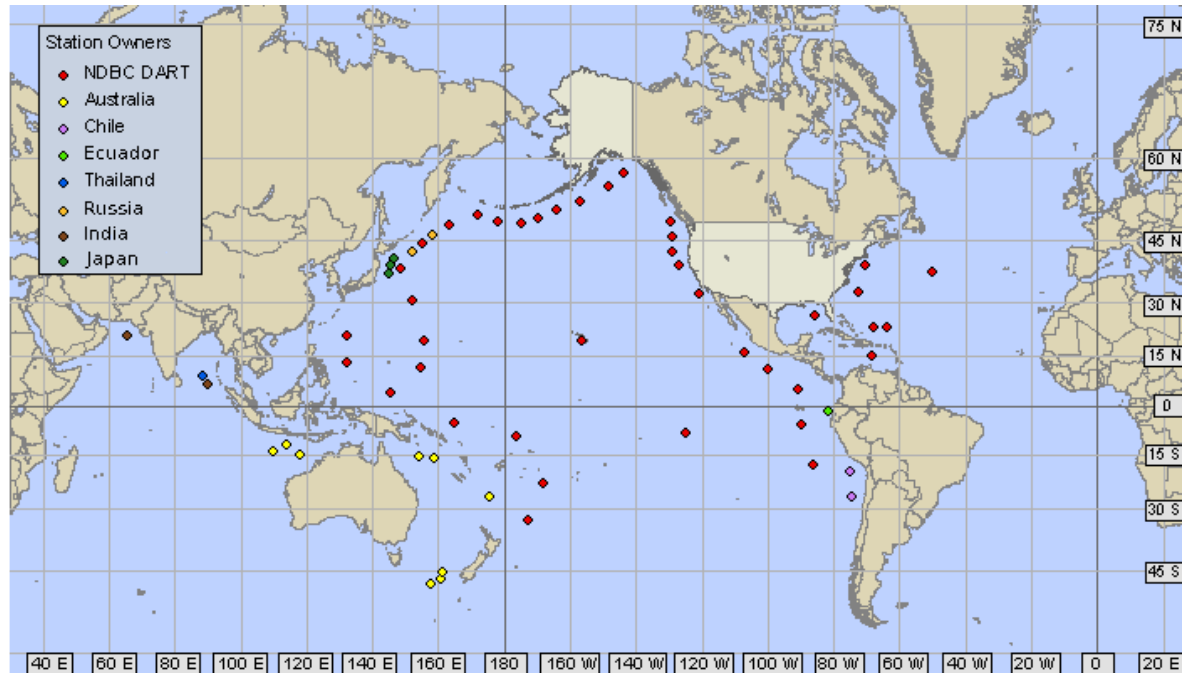
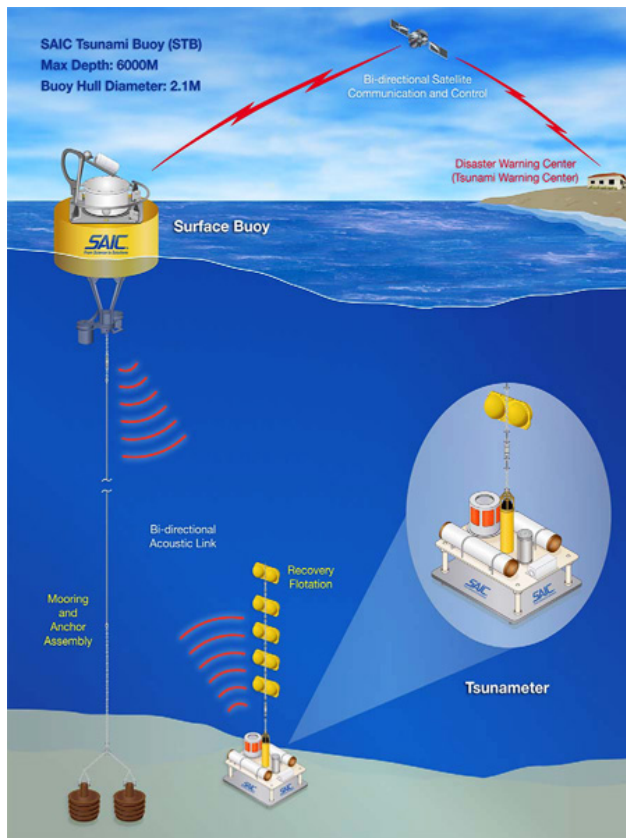
Categories of Threat Levels within Tsunami Warnings

No threat An undersea earthquake has been detected, however it has not generated a tsunami, or the tsunami poses no threat to Australia and its offshore territories.

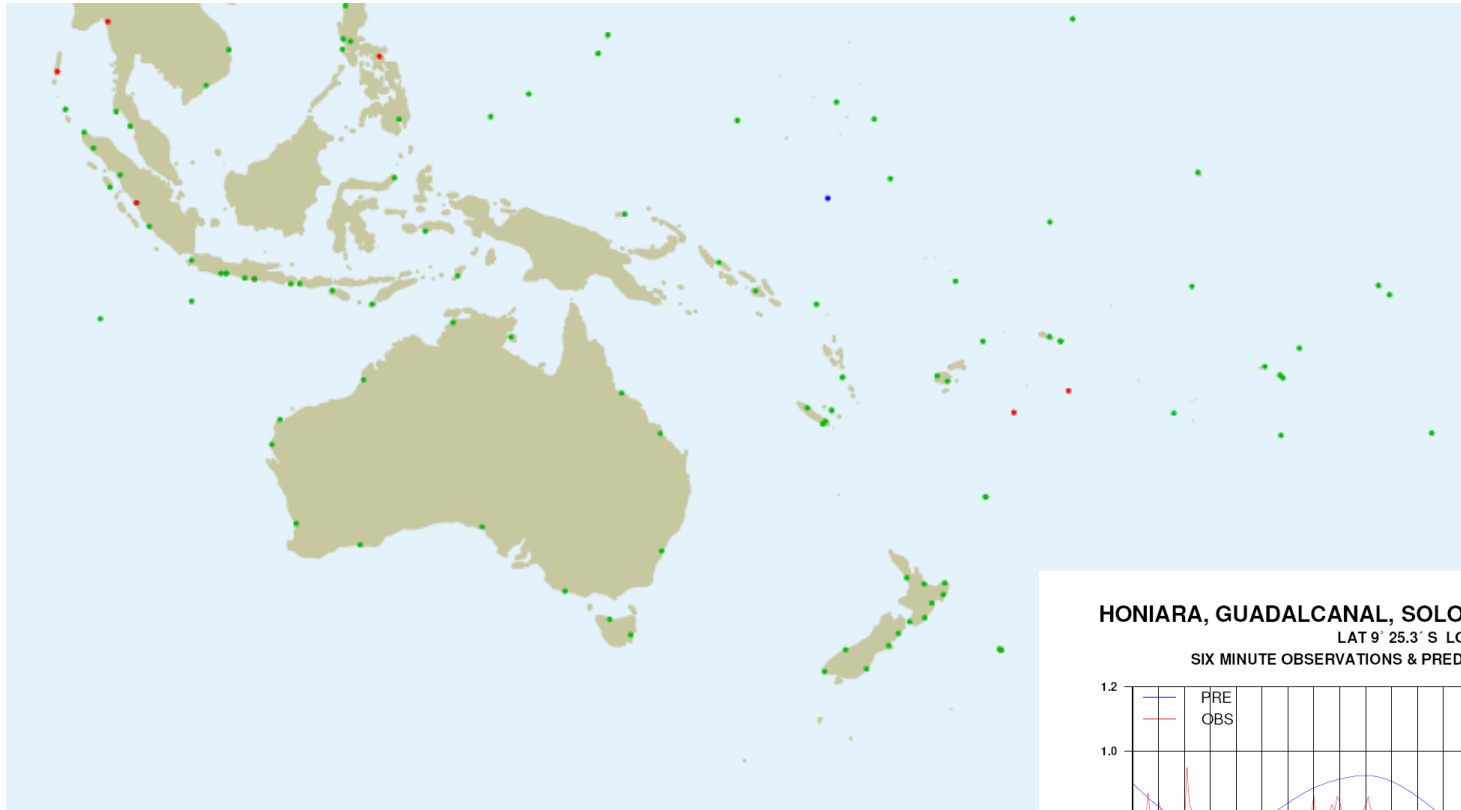
Marine and immediate foreshore threat Warning of potentially dangerous waves, strong ocean currents in the marine environment and the possibility of only some localised overflow onto the immediate foreshore.

Land inundation threat Warning for low-lying coastal areas of major land inundation, flooding, dangerous waves and strong ocean currents.

JATWC Sea Level Monitoring Bottom Pressure Sensors



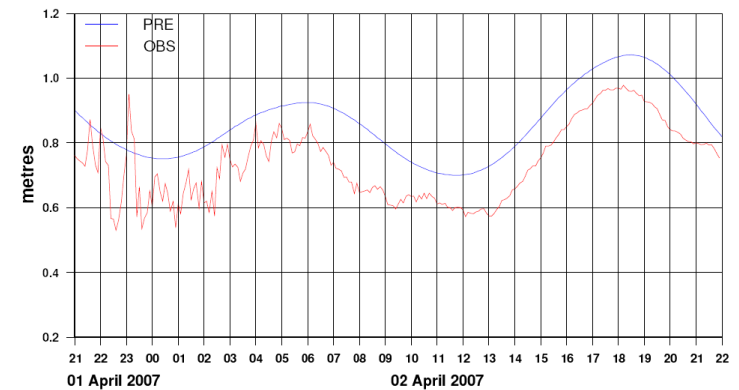
JATWC Sea Level Monitoring Tide Gauge Network



HONIARA, GUADALCANAL, SOLOMON ISLANDS - LAST 24 HOURS

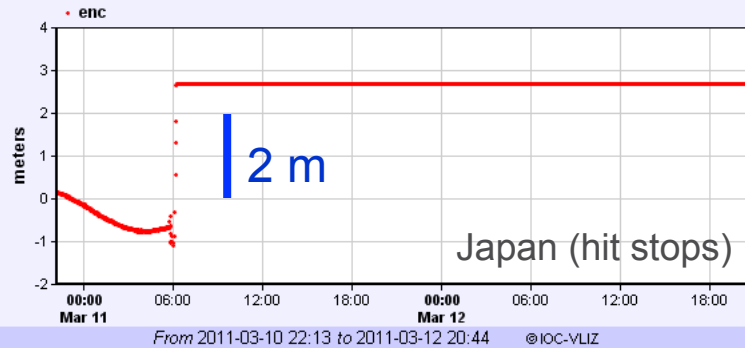
LAT 9° 25.3' S LONG 159° 57.3' E

SIX MINUTE OBSERVATIONS & PREDICTIONS TO 21:54 02 APR 2007 UTC

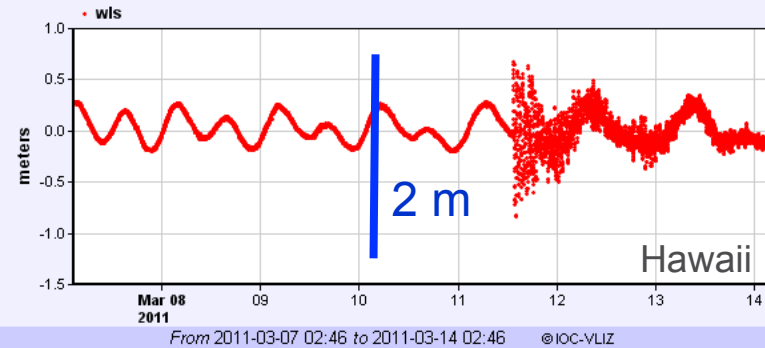


Sea Level Gauges

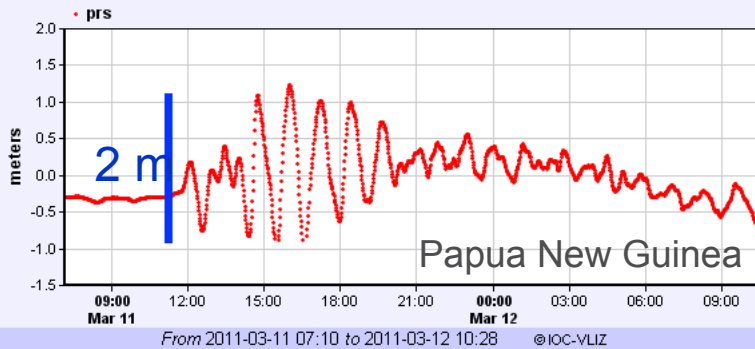
Sealevel at Ofunato station - (1.1095 m)



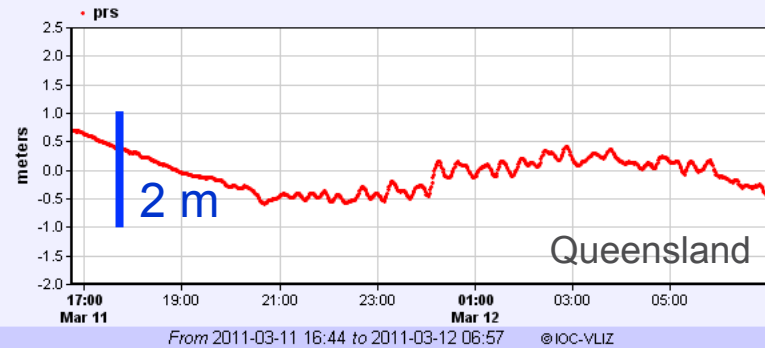
Sealevel at Honolulu,Oahu station - (-3.184 m)



Sealevel at Lombrum_Manus_Is_PG station - (0.887 m)



Sealevel at Rosslyn_Bay_AU station - (2.618 m)



Rupture Animation

M9.2 Northern Sumatra, Indonesia

26 Dec 2004

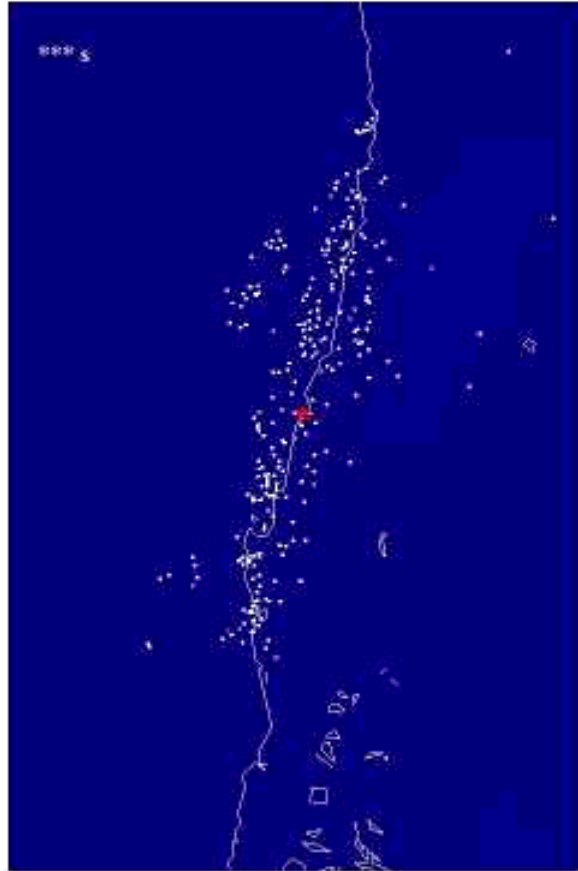


Rupture time was approximately 9 minutes

Rupture Animation

M8.8 Southern Chile

27 Feb 2010

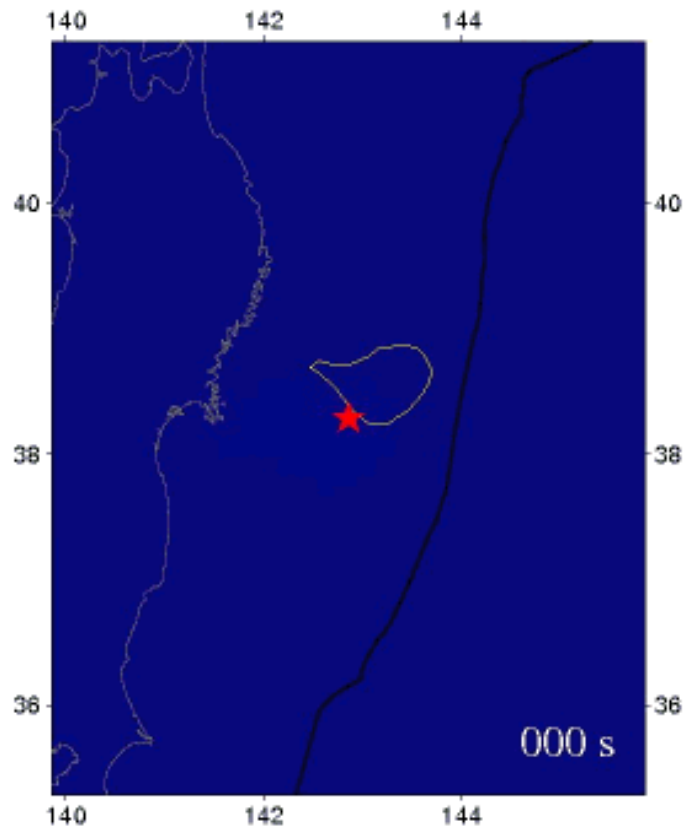


Rupture time was approximately 2½ minutes

Rupture Animation

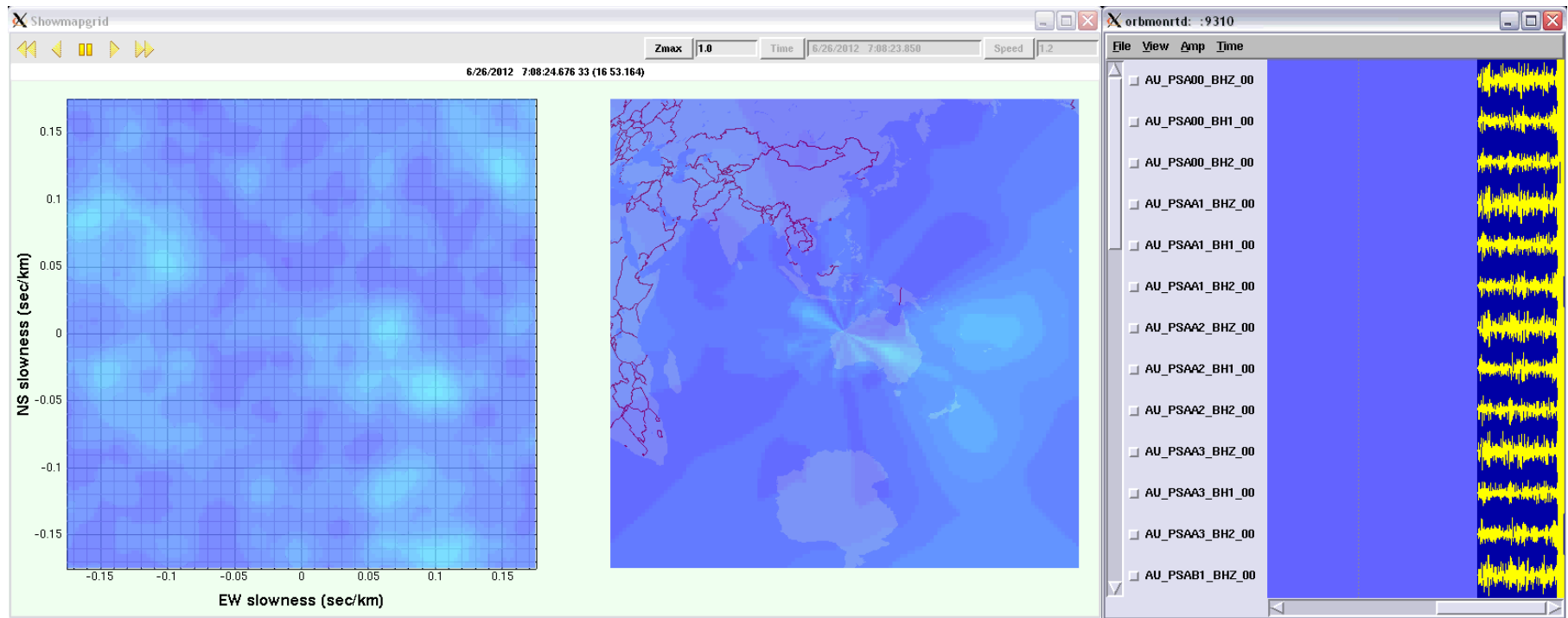
M9.0 East of Honshu, Japan

11 March 2011



Rupture time was approximately 3½ minutes

Australian Real-time Seismic Array Processing





Australian Government
Geoscience Australia



Thanks for your attention

www.ga.gov.au/earthquakes
twitter.com/EarthquakesGA

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