AEES NEWSLETTER

September 2012

Contents

President's Report

I have just submitted the AEES annual report to Engineers Australia, reporting our activities in the year 2011/2012. Among other things, AEES has maintained an active and up-to-date website for its members and general public. I would like to especially thank the excellent work and great efforts put in by AEES Webmaster Adam Pascale in maintaining and updating the AEES webpage. If you visit the AEES webpage, you will find a lot of constantly updated information. I would also like to thank Bill Boyce who, with help from Kevin McCue, Sharon Anderson and others, collected all the previous newsletters, conference proceedings, the names of AEES scholarship winners, as well as the information relating to not only the previous AEES annual conferences, but also to the other conferences and workshops related to earthquake risks in Australia even before the birth of the AEES. All of these are now available on the AEES Webpage. Through reading the early newsletters and emails from Bill and Kevin, I have learnt a lot regarding the history of AEES. The materials are invaluable collections of our society. Without the great initiatives and tireless effort of Bill, some of these precious recordings might be lost forever.

46 abstracts have been received for the coming AEES annual conference in December. The full paper is due on the 1st of September. Many of us are busy preparing the full paper(s). In order to ensure a smooth review process of the full papers and preparation for the conference, I encourage all those who plan to submit a full paper to please do so on time. I am looking forward to another fantastic conference and meeting many of you again in December in Queensland.

With the information and suggestions from Kevin McCue, Helen Goldsworthy, Greg MacRae of NZSEE, Karine Bulger of Arinex and a few others, Mr. David McCarthy from the Melbourne Convention & Visitor Bureau has prepared a bid document to host the 16WCEE in Melbourne in 2016. On behalf of AEES I submitted the document on 15 August to the IAEE general secretary Prof. Manabu Yoshimura, which will soon be published along with the bid documents from other countries on the IAEE webpage. Please visit the IAEE Webpage at http://www.iaee.or.jp/ to have a look. You will find that Mr. McCarthy has done a fantastic job in putting together an excellent bidding document. It summarizes a strong case for Australia, and promotes AEES, Melbourne and Australia. This time we will be facing strong competitions from Chile, Indonesia and Japan who have also submitted their bids to host the conference. We will do our best on this endeavour. I will keep you informed about the outcome.

Despite a relatively strong economy and a boom in resources and construction engineering, especially in Western Australia, government funding on research seems to be decreasing. I was told that the first thing that the Australian Research Council (ARC) plans to cut is the funds for travelling. Since the ARC is the major or even the only funding source for many academics in Australia, this may prevent many academics from attending conferences, or affect their ability to support postgraduate students to do so. I hope our members will still put the AEES annual conference as their first priority when selecting conferences, and hope to see many academics and postgraduates attending the annual conference in December this year.

Funding cuts in research and tertiary education only partially reflects the economic situation. I personally believe it reflects more the viewpoints of many people and politicians in Australia. I am always astonished

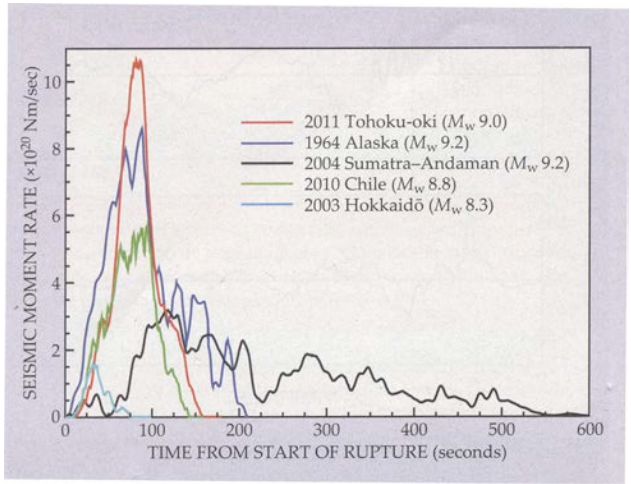
that tertiary education and research are considered as a revenue generating business instead of a long term investment that may not have monetary returns in the short term. One would wonder how many tonnes of iron ore need to be dug out to match the revenue generated by Microsoft which depends mainly on brainpower rather than natural resources. Without strong investment from government into higher education and research, not only applied but also pure research, the competitiveness and advantages that Australia has been enjoying in the last hundred years may diminish quickly.

Hong Hao
President AEES

Insights into the 2011 great Japan earthquake

The most readable summary article I have read about the Tohoki-oki earthquake of 11 March 2011 was in the December 2011 edition of Physics Today pages 33-39, the authors eminent seismologists Thorne Lay and Hiroo Kanamori. They discuss the physics at plate-boundaries, tsunami generation (making waves), the physics of the rupture and lesson learned. There are useful boxes explaining moment magnitude and tsunami and earthquake warning systems.
Some of their comments resonated with me:

- *Even relatively long seismological records are too limited to adequately assess the hazard from infrequent but devastating events.*
- *The complex variations of slip behaviour on the Japan megathrust highlight our ignorance of what controls fault behaviour.*
- *Our best prospect for coping with those event is to draw on our technologies, preparations and ability to respond when Earth delivers the unexpected, as it did on 11 March 2011.*



(Figure 5 from Thorne and Kanamori) Seismic Moment Rate plotted against time (seconds) for several recent great earthquakes. Note for structural engineers - compare the Tohoku-oki source-time function with that of the 2004 Sumatran earthquake, 2.5 minutes duration compared with more than 8 minutes duration, that's a lot of cycles.

IAEE Matters

Some 10 members of AEES led by President Hong Hao are travelling to Lisbon Portugal as this Newsletter hits the stands, to join colleagues from all over the world attending the 15th World Conference on Earthquake Engineering.

The latest research will be published on recent destructive earthquakes and on how such destruction can be minimised. The conference theme is the great Lisbon earthquake of 1755, though this was not the only destructive earthquake to strike Portugal.

A decision will be made at a meeting of National delegates and IAEE committee as to the venue for the next world conference in 2016, hopefully Melbourne Australia. Gary Gibson will vote as our national delegate, for the last time as his 8 year tenure expires at the conference.

Melbourne shaken - again

The town of Moe in central Gippsland Victoria was shocked by a magnitude 4.4 earthquake on 20 July 2012 at 11 minutes past seven in the evening. People reported minor shaking in Flemington, Docklands and North Melbourne as far as the suburb of MacLeod, more than 100km away.

This was the largest aftershock to late August of the magnitude 5.3 earthquake on 19 June that caused damage in the epicntral region and was felt throughout Melbourne. More than 200 aftershocks have been recorded since that earthquake, most of them too small to have been felt.

The epicentre was 15-20km southwest of Moe - a similar location to the epicentre of the June mainshock. Gippsland has a long history of earthquakes dating back to first settlement by Europeans, and smaller event shook the region in May 2012 and in March, April and July last year.

In Moe, picture frames and loose articles vibrated and dogs were set barking. Moe Police Acting Senior Sergeant Pat Hamilton said there had been no reported damage and the station only received one call. He said he was in a patrol vehicle at the time and felt nothing.

A useful set of accelerograms was obtained on aftershock recorders established in the epicentral region after the mainshock, by the ES&S Seismology Research Centre, Melbourne University and Geoscience Australia. The earthquake foci are in the middle crust at about 15km depth so the PGAs are not as strong as those recorded at Eugowra NSW (1994) or Tennant Creek NT (1988) during earthquakes there which were very shallow in the upper crust , 1 to 8km deep.

Urology conference honours earthquake's brave surgeons

At the Darwin Convention Centre in April 2012, the 65th Annual Meeting of the Urological Society of Australia and New Zealand held a ceremony to honour surgeons who had risked their lives to help others in the aftermath of the destructive February 2011 Christchurch earthquake.

Some 600 urological surgeons were attending the 64th Annual Conference in Christchurch in February 2011 when the second large and most damaging earthquake in the series occurred, killing 185 people as buildings collapsed upon them.

Surgeons helped rescue people trapped in the rubble and treated those who were badly injured – one surgeon amputated the leg of a man trapped beneath concrete using just a pen knife.

(Ed. - from the Darwin Convention Centre Newsletter, Vol 8, 2012)

New Royal Adelaide Hospital

Engineers Australia Civil Edition (not their uncivil edition) magasine vol 84 No 7 page 31 has a feature article by Theresa Tran about progress on construction of the new Adelaide Hospital.

Adelaide was damaged by earthquakes in 1902 and 1954, magnitudes 6.0 and 5.6 respectively, two people dying of heart attack in the earlier earthquake. Mention was made in the EA article of the earthquake design provisions for the hospital, though not that it was being built on or very close to the Para Fault (see information on the Para Fault below).

The design brief specified an event with a return period of 1500 years corresponding to a probability factor (k_p) of 1.5. The contractors also checked the servicability for the 500 year event. The current Australian Standard page 19 sets a Hazard Factor (Z) of 0.10 for Adelaide.

The design and construction contractor are installing 2000 piles to support the building so we assume the site would be classified sub-soil class D_e. A CFA piled foundation system was adopted to resist the earthquake and gravity loads. Pile caps up to 3.5m long were required.

The contractor apparently performed a dynamic analysis of the structure using the current Australian Standard for earthquake loading (AS1170.4-2007) but also incorporated the acceleration-displacement response spectra (ADRS) approach which, as they said, has rarely been used before and is not mentioned in the standard.

The earthquake resisting elements of the hospital are the reinforced concrete shear walls and lift/stair shafts.

We can only hope that the building performs as designed and constructed and that the owners insist it be instrumented with accelerographs to confirm that the designed and as–built structures are indeed the same. (Ed.)

The Para Fault

(Dr Dan Clarke, Geoscience Australia).

In the Adelaide CBD region borehole records indicate that the Pliocene (age 2-5 Ma) Hallett Cove Sandstone has been displaced across the Para Fault by <200 m (Sheard & Bowman 1996), implying long-term vertical slip rates of the order of 0.04 - 0.1 mm/a. The borehole records further indicate that the overlying Hindmarsh Clay (age >500 ka) is vertically displaced by 20-30 m across the Para Fault, suggesting an upper limit for the average vertical slip rate of 0.04 - 0.06 mm/a. A trench excavated by Geoscience Australia in late 2011 across the projection of the tip of the northern Para Fault identified a maximum of 0.5 m of vertical displacement across sediments older than Pooraka Formation age (> ca. 120 ka, Bourman et al. 1997). A vertical slip rate over the late Quaternary of <0.004 mm/a is indicated. The data suggest that the >20 m vertical difference in the base of the Pooraka formation across the fault near the CBD (Sheard & Bowman 1996) relates to drape of the formation over a pre-existing scarp, rather than to tectonic displacement. The fault may currently be in a relatively quiescent phase of its history.

BOURMAN, R.P.,MARTINAITIS, R., PRESCOTT, J.R. & BELPERIO, A.P. 1997. The age of the Pooraka Formation and its implications, with some preliminary results from luminescence dating. Transactions of the Royal Society of South Australia 121, 83-94.

SHEARD M. J. & BOWMAN G. M. 1996. Soils, stratigraphy and engineering geology of near surface materials of the Adelaide Plains. South Australia. Department of Mines and Energy. Report Book 94/9.

Ed. Note. Members at the 2011 AEES Conference were privileged to have a conducted tour of the two Para Fault trenches cut by GA's Dan Clark and Andrew McPherson.

Conferences/ Workshops

24-28 Sep 2012 15th World Conference on Earthquake Engineering. Lisbon Portugal.

http://15wcee.com/

7-8 Nov 2012 4th International Conference on Geo-Information technology for Natural Disaster Management. Colombo Sri Lanka.

http://e-geoinfo.net/git4ndm2012/

29 Nov 2012 Earthquake Loading (Actions) Workshop To AS1170 Part 4.

Melbourne Vic, Hotel Grand Chancellor. Speakers Paul Uno and Professor John Wilson

info@seminarservices.com.au

AEES Scholarships

AEES instituted an annual scholarship program at the instigation of then President Bill Boyce in 1999. A scholarship is not necessarily awarded in any year. Students and supervisers can apply for a scholarship at the beginning of the academic year and don't need to wait for an announcement from AEES.

Year	Applicants	Scholarships awarded to
2000	5	Amy Brown and Jason Chaytor
2001	3	No scholarship awarded
2002	5	Kittipoom Rodsin, Trevor Allen and Darren Andrews
2003	3	Dominic Dowling, Huang (Jack) and Yao Brzezniak et al
2004	No scholarship awarded	
2005	2	No scholarship awarded
2006	Applications not called	
2007	2	Jonathan Liang and Jaya Kashyap
2008	1	Maxime Claprood
2009	2	Hamid Reza Tabatabaiefar and Lawrence Anton
2010	1	Siva Sivanerupan
2011	Applications not called	
2012	Applications not called	

Note: If there are errors or omissions in this list please advise the editor and Sharon Anderson.

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The 2011 AEES Committee

President:	Prof Hong Hao UWA
Secretary:	Paul Somerville
Treasurer:	Mark Edwards
Committee members:	Gerhard Horoschun, Helen Goldsworthy
IAEE Representative:	Gary Gibson
Secretariat/Newsletter:	Sharon Anderson/ Kevin McCue
Webmaster:	Adam Pascale

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Victoria	Gary Gibson
Queensland	Russell Cuthbertson
New South Wales	Colin Gurley
Tasmania	Angus Swindon
ACT	Mark Edwards
South Australia	David Love
Western Australia	Hong Hao
Northern Territory	tba

An upliftable structure in the 2010-2012 Canterbury earthquake swarm

Nawawi Chouw[1] and Kevin McCue[2]

[1] *The University of Auckland, Auckland, New Zealand*
[2] *Australian Seismological Centre, Canberra, Australia*

Although research on structural uplift has been performed for more than a century, only a few structures designed to permit uplift have been constructed in the world, e.g. the South Rangitikei Bridge in New Zealand (Beck and Skinner, 1974). In past decades seismic design has been strongly shaped by capacity design where damage to the structure is tolerated and life safety is ensured. The damage to civil infrastructure in past major earthquakes indicates that this seismic design approach may result in severe damage that is too costly for retrofit solutions and possible lead to a large economic impact due to the long down time (e.g. Chouw and Hao, 2012). Incorporating the benefit of uplift in structural seismic design may provide a possible solution to reducing the structural down time.

On 15 April 2012, at the end of the annual conference of the New Zealand Society for Earthquake Engineering in Christchurch, the authors visited one of the very few structures in the world designed for uplift, an industrial chimney near the Air New Zealand hanger at Christchurch airport. The chimney, Figure 1, was built with accommodation for uplift at the base (see Sharpe and Skinner, 1983). Despite 4 large earthquakes and more than 10,000 aftershocks, including many strong aftershocks such as those on the 22 February 2011 and the 25 May 2012 magnitude 5.2, between the 4 September 2010 and our visit, no structural damage has been observed. Only light concrete spalling at the footing is visible (Figure 2).

Figure 1. Rocking chimney at Christchurch airport (car for scale).

At the airport the ground shaking was measured by a GNS recorder sited at the Aero Club. All 3 components have been filtered by GNS but still showed about 0.2g peak ground acceleration with the maximum ground velocity nearly 20cm/s horizontally and 12 cm/s vertically. Ground displacement exceeded 20cm horizontally and nearly 6cm vertically. The duration of strong shaking was about 10s on the accelerogram but note the strong resonance in the vertical velocity and displacement records (Figure 5).

To investigate the possible merit of structural uplift a series of shake table tests were performed at the University of Auckland. Figure 3 shows a model of a two storey steel structure with a surface footing on sand of finite stiffness. Figure 4 shows the top horizontal displacement due to a hard soil condition ground motions simulated based on Japanese design spectrum. The solid and dotted lines in the top figure show the displacement of a structure with and without a possibility of uplift on a rigid base, respectively. To simulate a possible plastic hinge development during the ground excitation, an artificial plastic hinge is constructed at the base of the column. Allowing the structure to lift reduces the residual top displacement from 6.44 mm to 1.05 mm. The result clearly shows that the uplifting structure suffers much less damage than the one with an assumed fixed base. When a flexible ground is considered a further reduction is possible. The solid and dotted in the lower part of Figure 4 are the top displacement when the upliftable structure is placed on a rigid and sand support. In this case, plastic hinge development can be completely avoided. More details of the investigations are given in the reference (Chouw and Qin, 2012).

Figure 2. Concrete spalling at base of chimney, (looking downward)

References:

Beck, J.L., and Skinner, R.I. (1974). Seismic response of a reinforced concrete bridge pier designed to step. *Earthquake Engineering and Structural Dynamics*, 2:4, 343-358.

Sharpe, R.D., and Skinner, R.I. (1983). The seismic design of an industrial chimney with rocking base. *Bulletin of the New Zealand National Society for Earthquake Engineering*, 18:2, 98-106.

Chouw, N., Hao, H. (2012). Pounding damage to buildings and bridges in the 22 February 2011 Christchurch earthquake. *International Journal of Protective Structures*, 3:2, 123-139.

Chouw, N., Qin, X. (2012). The benefit of upliftable structures in earthquakes. *Proceedings of the 12th International Symposium on Structural Engineering*, 17-19 November 2012, Wuhan, China,

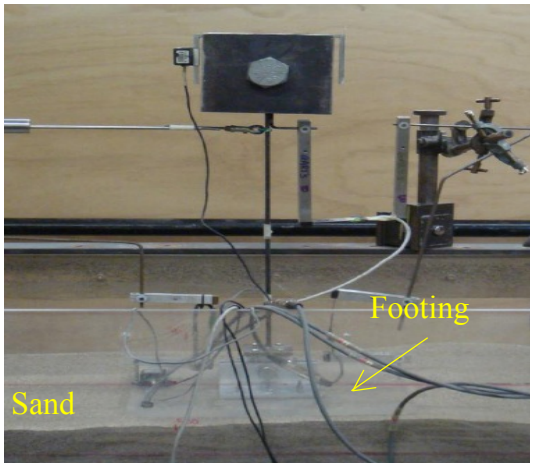
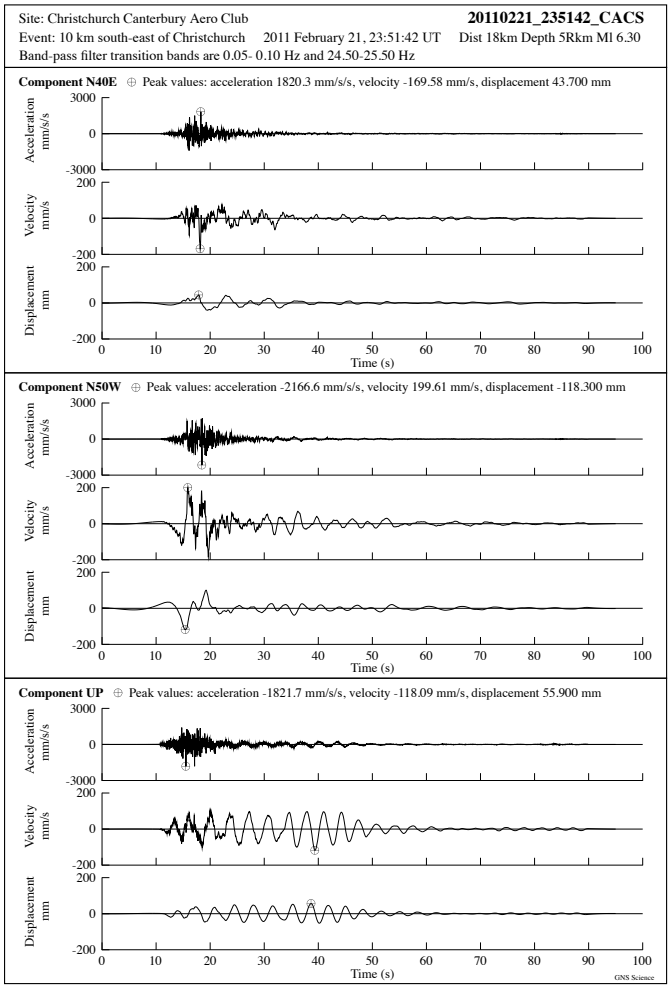


Figure 3. Shake table test setup



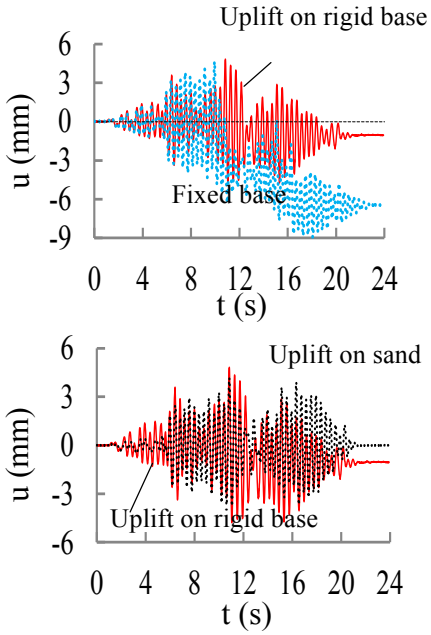


Figure 4 (above). Effect of uplift and support flexibility on structural response

Figure 5 (left). Filtered strong motion recorded at the Canterbury Aero Club during the February 2011 Christchurch earthquake, magnitude 6.2 (Geonet data).

Major World Earthquake June to August 2012

The only major earthquake worldwide in this quarter was a 625km deep magnitude 7.7 earthquake under the Sea of Okhotsk offshore northeast Russia on 14 August 2012. According to the USGS, the earthquake ruptured a fault in the interior of the subducting plate rather than on the thrust interface where the Pacific plate collides, at approximately 81 mm/yr towards the west-northwest, with the North America plate. This plate boundary here is divided into several microplates, including the Okhotsk and Amur microplates.
Since 1900, the largest earthquake along the Kuril-Kamchatka arc was the M9.0 1952 Kuril Island earthquake.

Australian Earthquakes June to August 2012

Table Earthquakes in the Australian region, magnitude 3.0 or greater, located by Geoscience Australia

UTC Date	UTC Time	Latitude °S	Longitude °E	Depth (km)	Mag	Approximate location
5/06/12	9:12:10	34.34	148.70	12	3.2	N of Boorowa, NSW.
8/06/12	11:32:39	30.75	150.40	0	4.1	NW of Tamworth, NSW.
8/06/12	11:31:00	30.76	150.41	0	4.2	NW of Tamworth, NSW.
16/06/12	19:46:02	35.07	149.08	10	2.7	N of Canberra, NSW.
19/06/12	14:37:34	38.29	146.18	10	3.1	SW of Moe, Vic.
19/06/12	11:14:47	38.35	146.20	4	3.1	SW of Moe, Vic.
19/06/12	10:53:29	38.30	146.20	10	**5.4**	SW of Moe, Vic.
22/06/12	9:16:03	34.11	148.64	14	3.7	N of Boorowa, NSW.
29/06/12	12:28:56	23.93	136.88	10	3.2	Simpson Desert, NT.
30/06/12	3:02:35	38.32	146.27	12	3.1	S of Moe, Vic.
8/07/12	10:27:33	38.34	146.18	14	2.9	Near Moe, Vic.
18/07/12	16:35:18	30.41	117.88	3	3.2	Beacon, WA.
18/07/12	9:20:55	30.43	117.79	2	3.5	Beacon, WA.
20/07/12	17:02:28	27.30	113.71	8	2.9	NW of Kalbarri, WA.
20/07/12	9:11:30	38.31	146.23	0	4.4	Near Moe, Vic.
30/07/12	17:28:26	37.81	150.58	17	3.2	SE of Mallacoota, Vic.
30/07/12	17:25:19	37.74	150.50	2	3.5	SE of Mallacoota, Vic.
31/07/12	1:06:58	37.84	150.43	0	3.1	SE of Mallacoota, Vic.
19/08/12	16:27:19	27.56	135.32	10	3.4	Near Oodnadatta, SA.

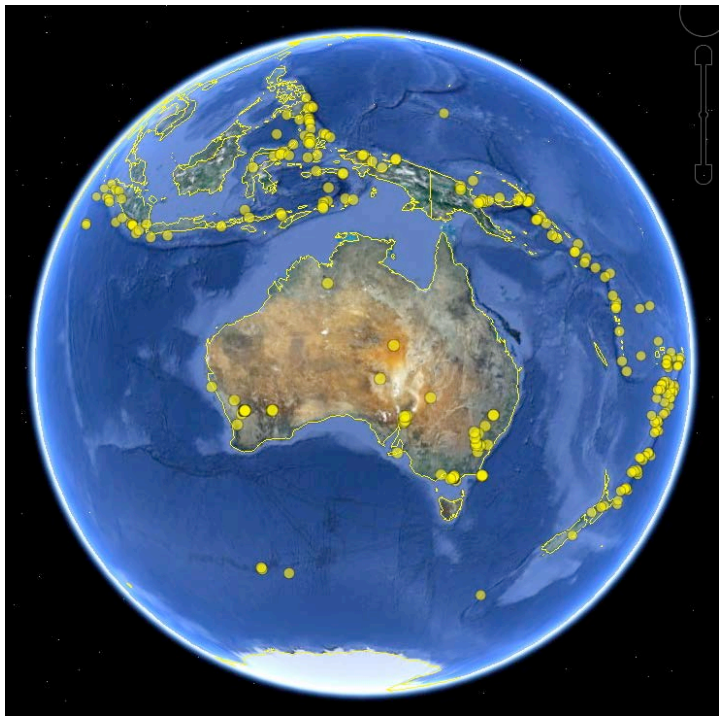


Figure Epicentres of earthquakes M≥3 in Australia and the region, June to August 2012, from Geoscience Australia.

The June 12 magnitude 5.4 Moe earthquake caused minor non-structural damage near the epicentre and was felt throughout Melbourne. Hundreds of aftershocks were recorded, the largest magnitude 4.4 on 20 July was also felt in Melbourne.

Two earthquakes occurred in rapid succession about 30 kilometres northwest of Tamworth near Keepit Dam in northern NSW. The first was followed a minute later by a similar sized earthquake. They were reported felt in Attunga, Bendemeer, Tamworth and Dungowan.

The small earthquake near Canberra is included because it was felt in the Capital's north-western suburbs.