The 2012 Australia National Seismic Hazard Model

The 2012 Australia national seismic hazard model is described in the reports by Burbidge (2012) and Leonard et al. (2013). We present here a description of the OpenQuake-engine implementation of the model.

The Seismic Source Model

The seismic source model consists of three different layers of seismic sources: continental-scale background zones, regional-scale area sources, and small-scale (hot spots) zones describing localized seismic sequences. Background zones (which contain holes where regional scale sources are defined) are implemented as gridded seismicity models, which are collections of NRML pointSource objects. Regional-scale sources and hot-spot zones are instead modeled as NRML areaSource objects.

The whole source model is divided into the following sub-models:

- Background and regional cratonic model
- Background and regional not-cratonic model
- Hot spots cratonic model
- Hot spots non-cratonic model

The map below depicts the annual occurrence rate per source (between minimum and maximum magnitudes) for the different source models included in the hazard model. Click the *show map layers* icon to view different source models and base layer maps.

Total occurrence rate
(number of events / year)

- < 1e-6
- 1e-6 - 1e-5
- 1e-5 - 1e-4
- 1e-4 - 1e-3
- 1e-3 - 1e-2
- 1e-2 - 1e-1
- 1e-1 - 1
- 1 - 10
- >= 10

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width: 30px; margin-right: 5px; margin-left: 0; border: 1px solid #999; } .my-legend .legend-source { font-size: 70%; color: #999; clear: both; } .my-legend a { color: #777; }

The Ground Motion Model

The ground motion model distinguishes between two main tectonic regions:

- Cratonic
- Non-cratonic

For each tectonic region, the model considers multiple ground motion prediction equations organized in a logic tree structure.

Cratonic	Weight
Allen 2012	0.3
Atkinson and Boore 2006	0.3
Chiou and Youngs 2008	0.1
Somerville et. al. 2009 (for Yilgarn Craton)	0.3

Non-cratonic	Weight
Allen 2012	0.25
Atkinson and Boore 2006	0.25
Chiou and Youngs 2008	0.25
Somerville et. al. 2009 (Non-cratonic)	0.25

Reference site condition

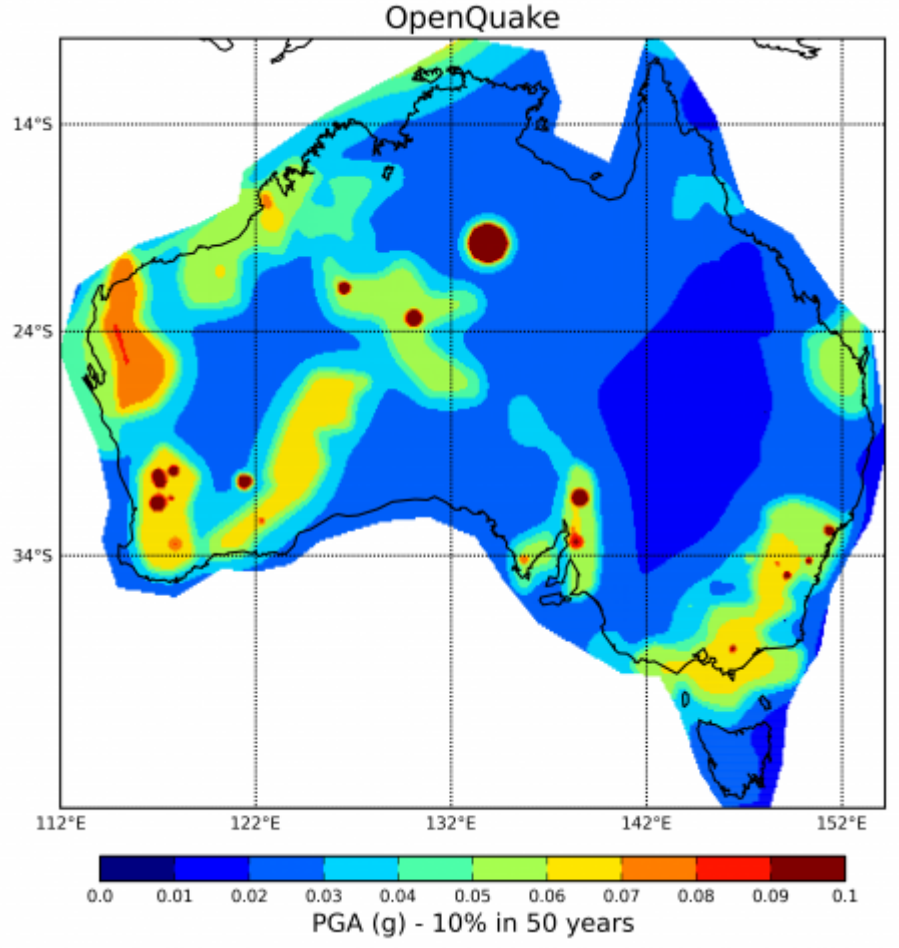
The reference site condition for the 2012 Australia national seismic hazard map is defined as generic rock assumed to have a Vs30 = 760 m/s. The Atkinson and Boore 2006 and the Chiou and Youngs 2008 GMPEs accept Vs30 as a prediction variable. The Allen 2012 and Somerville et. al. 2009 models are instead calibrated for Vs30 equal to 820 m/s and 865 m/s, respectively. For calculation purposes, the default site conditions are assumed consistent with the generic rock conditions.

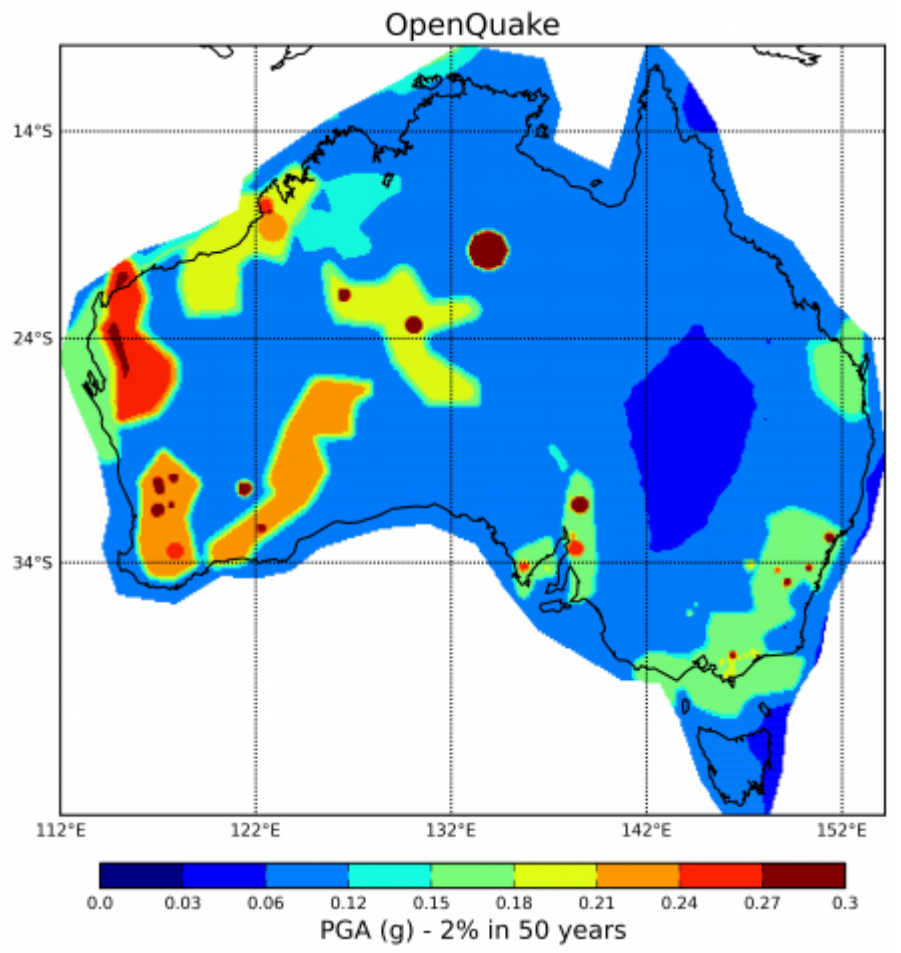
Hazard Results

Hazard maps

The figures below represent hazard maps for peak ground acceleration, for 10% and 2% probability of exceedance in 50 years, as computed by the OpenQuake-engine. Hazard maps are computed

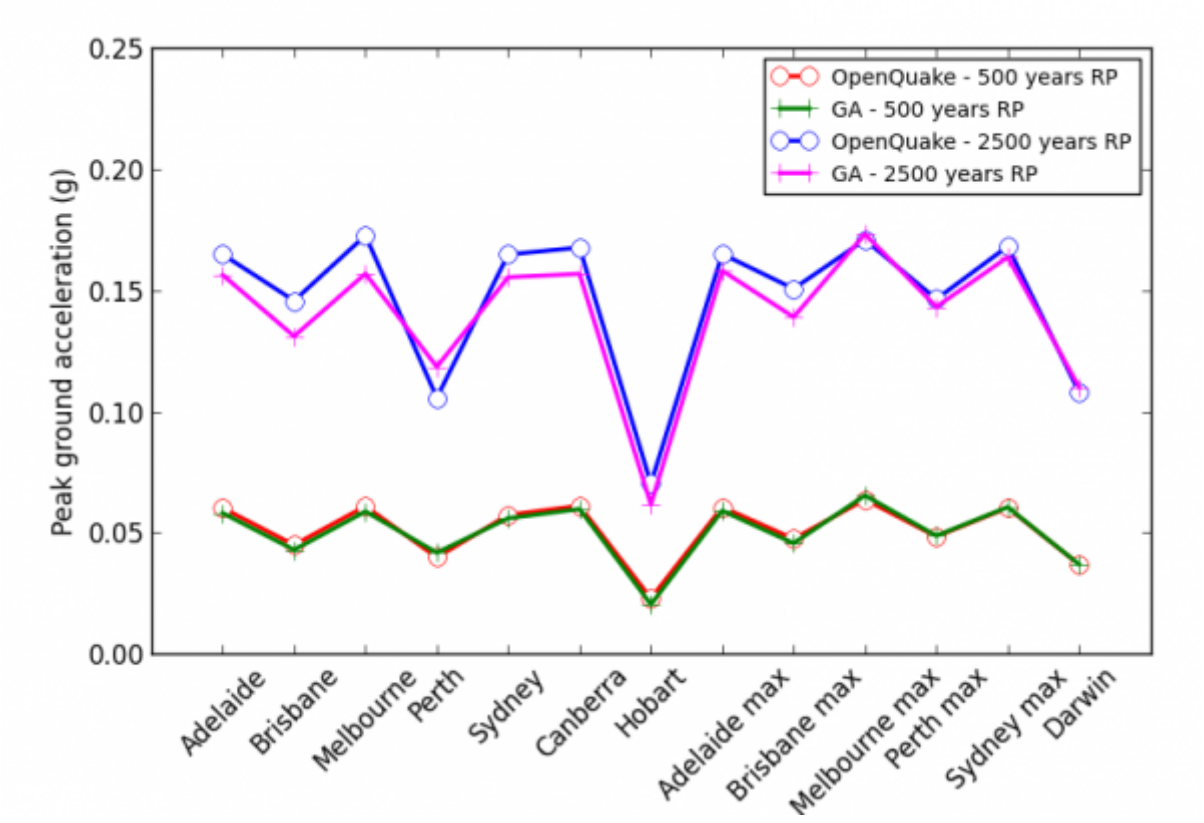
following the methodology described by Burbidge (2012). Separate hazard calculations are done for the background and regional model and for the hot spots model. Where the hot spots model predicts higher hazard level than the background and regional model, the mean of the two is taken.





Comparison against Geoscience Australia (GA) hazard results

The figure below shows the comparison between hazard map values for two return periods (RP) of 500 and 2500 years for the capital cities of Australia. GA reference values were taken from table 2, page 36 in Leonard et. al. (2013).



References

- Burbidge, D. R. (2012). The 2012 Australian Earthquake Hazard Map. Record 2012/071. Geoscience Australia. Canberra.Download .pdf
- Leonard, M., Burbidge, D. and Edwards, M. (2013). Atlas of seismic hazard maps of Australia: seismic hazard maps, hazard curves and hazard spectra. Record 2013/41. Geoscience Australia: Canberra. Download .pdf
- Leonard, M. (2010). Earthquake Fault Scaling: Self-Consistent Relating of Rupture Length, Width, Average Displacement, and Moment Release. Bulletin of the Seismological Society of America, 100(5A), 1971–1988. doi:10.1785/0120090189. Journal website
- McPherson, A.A. & Hall, L.S., 2007. Development of the Australian National Regolith Site Classification Map. 1 ed. Record 2007/007. Geoscience Australia, Canberra. Link

Model Summary Table

This table summarises the main characteristics of the original implementation of this model

1	**Datasets availability**	
1.1	Earthquake catalogue	Not available. The procedure used to create the catalogue is well described in Chapter 2 of Burbidge (2012)
1.2	Geological database	A database of faults is available but this hazard model does not include fault sources.

1.3	Strong-motion database	Not available. In Chapter 5 of Burbidge (2012) there is a comprehensive comparison between candidate GMPEs and recorded data.
1.4	Site characterization database	We assume the Regolith map of McPherson et al. (2007) has been used
Notes		
2	**Methodology for model development**	
2.1	Scientific participation (SSHAC levels) and review process	Level 2
2.2	Documentation describing model preparation	See Burbidge (2012)
2.3	Codes used for model preparation	Not available
Notes		
3	**PSHA input model**	
3.1	**Seismic Source Model**	
3.1.1	Area sources	Included
3.1.2	Grid sources	Not included
3.1.3	Crustal faults	Not included
3.1.4	Subduction faults	Not included
3.1.5	Non-parametric ruptures	Not included
3.1.6	Magnitude-area scaling relationships	Leonard (2010)
3.2	**Ground Motion Model**	
3.2.0	Tectonic regionalisation	The model defines two tectonic provinces: cratonic and non-cratonic.
3.2.1	Models for active shallow seismicity	Not explicity included
3.2.2	Models for subduction interface	Not included
3.2.3	Models for subduction intraslab	Not included
3.2.4	Models for stable continental regions	Included
3.2.5	Models for deep non-subduction sources	Not included
3.2.6	Models for volcanic areas	Not included
3.3	**Site Response Model**	
3.3.1	Based on GMPEs	Yes, hazard is computed for a reference soil condition corresponding to NEHRP B/C boundary (Vs30=760 m/s)
3.3.2	Based on site-response analysis	No
3.4	**Epistemic uncertainties**	
3.4.1	Seismic Source Model	Not explicitly included (Mmax determined by weighted average of three studies).
3.4.2	Ground Motion Model	Included using a logic tree (see the ground motion model section)
3.4.3	Site Response Model	Not included
Notes		
4	**Hazard Input Description**	
4.1	Hazard input document	Not avaliable
4.2	Input files	Not available
Notes		
5	**Calculation**	

5.1	Software	GA's Earthquake Risk Model (EQRM)
Notes	The EQRM sofware can be downloaded here	
5.2	**Results**	
5.2.1	Hazard curves	Available for the major cities
5.2.2	Hazard maps	Available
5.2.3	Uniform hazard spectra	Available for the major cities
5.2.4	Disaggregation	Not available
5.2.5	Stochastic event sets	The methodology adopted for the calculation of hazard uses stochastic event sets but these are not presented as results of the analysis
5.2.6	Ground motion fields	As per "stochastic event sets"
Notes		

Download The OpenQuake-engine Input Model

The OpenQuake-engine input model (NRML format) can be downloaded at the link provided below - Please read the license and disclaimer attached to the model.

N.B. This is a model adapted by GEM Hazard Team to the OpenQuake-engine from the original model developed by Geoscience Australia. This explains minor differences you might encounter between the results presented in the OpenQuake platform and those disseminated by the original Organisation.

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