Australian Government

Geoscience Australia

Ground-motion attenuation modelling in Australia

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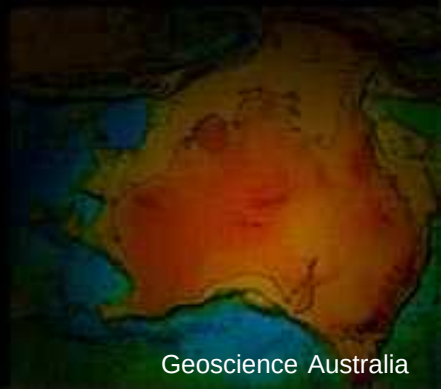
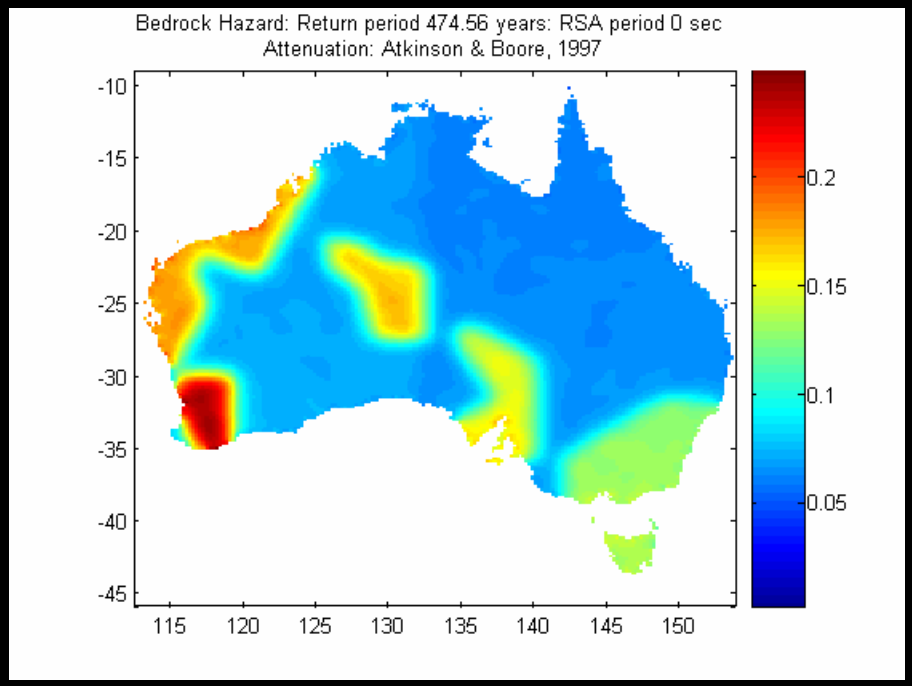
Risk Research Group

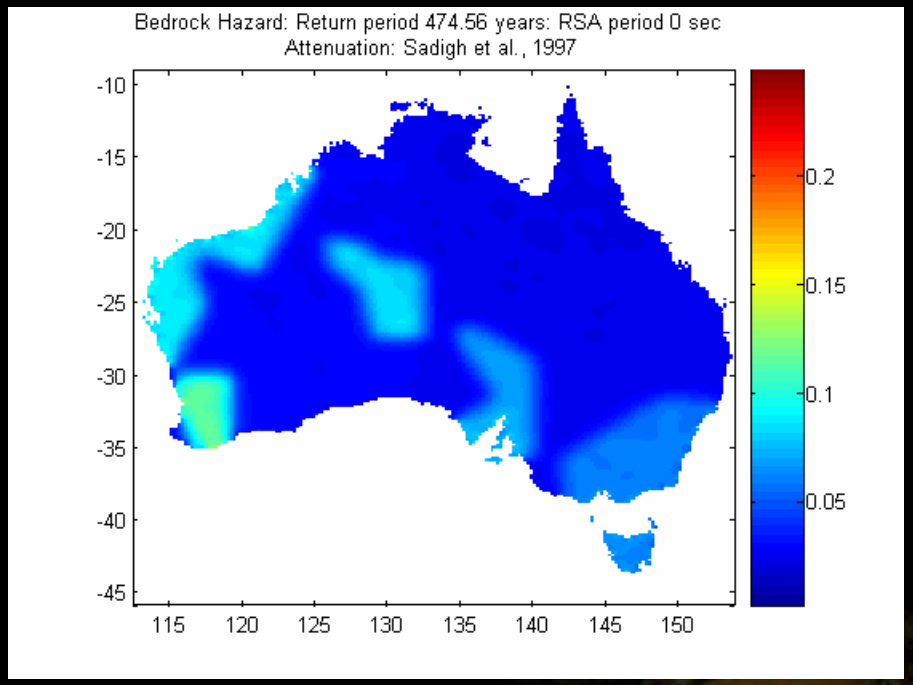


Which Attenuation Model to Choose?

***T* = 0 sec**

(PGA)

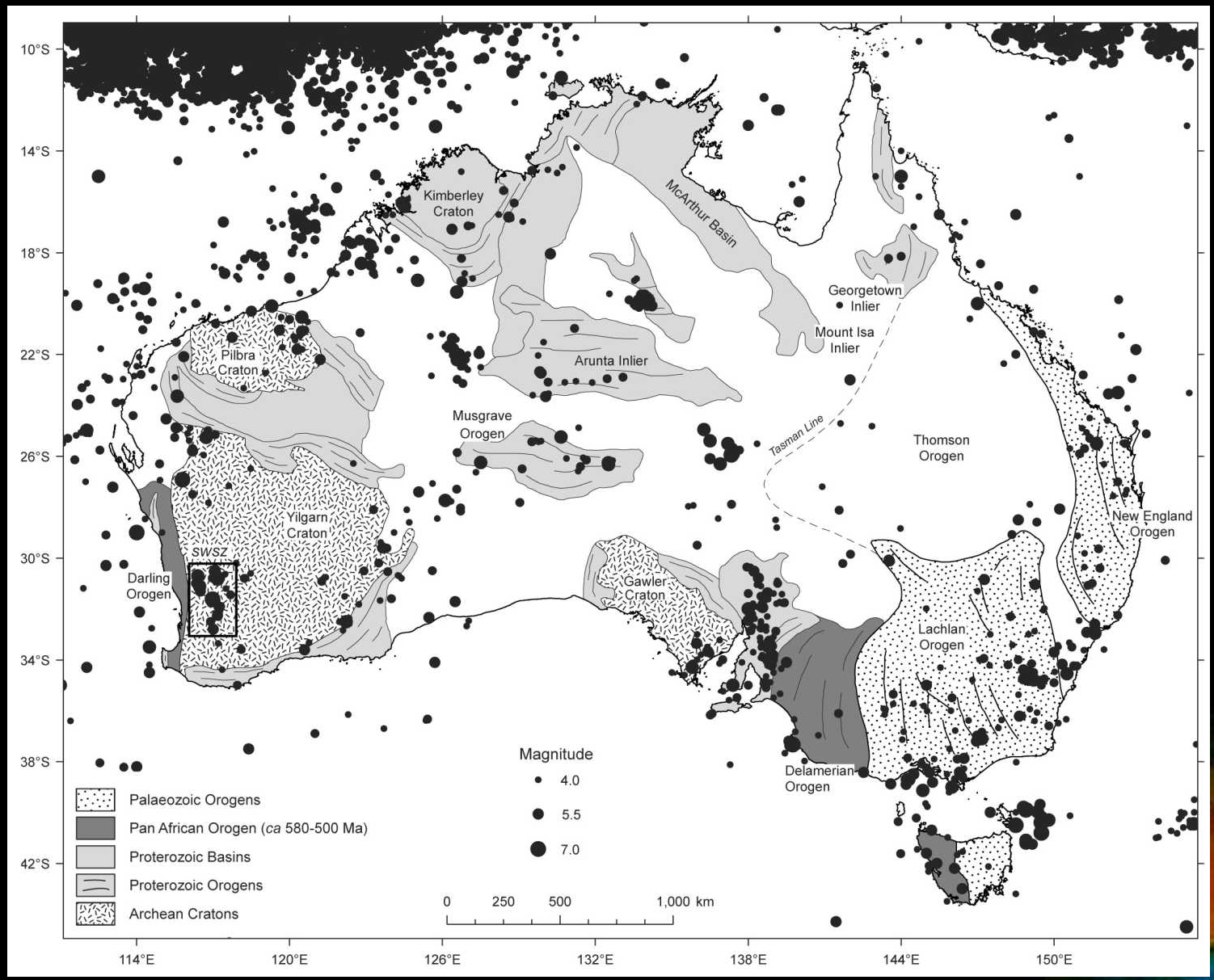




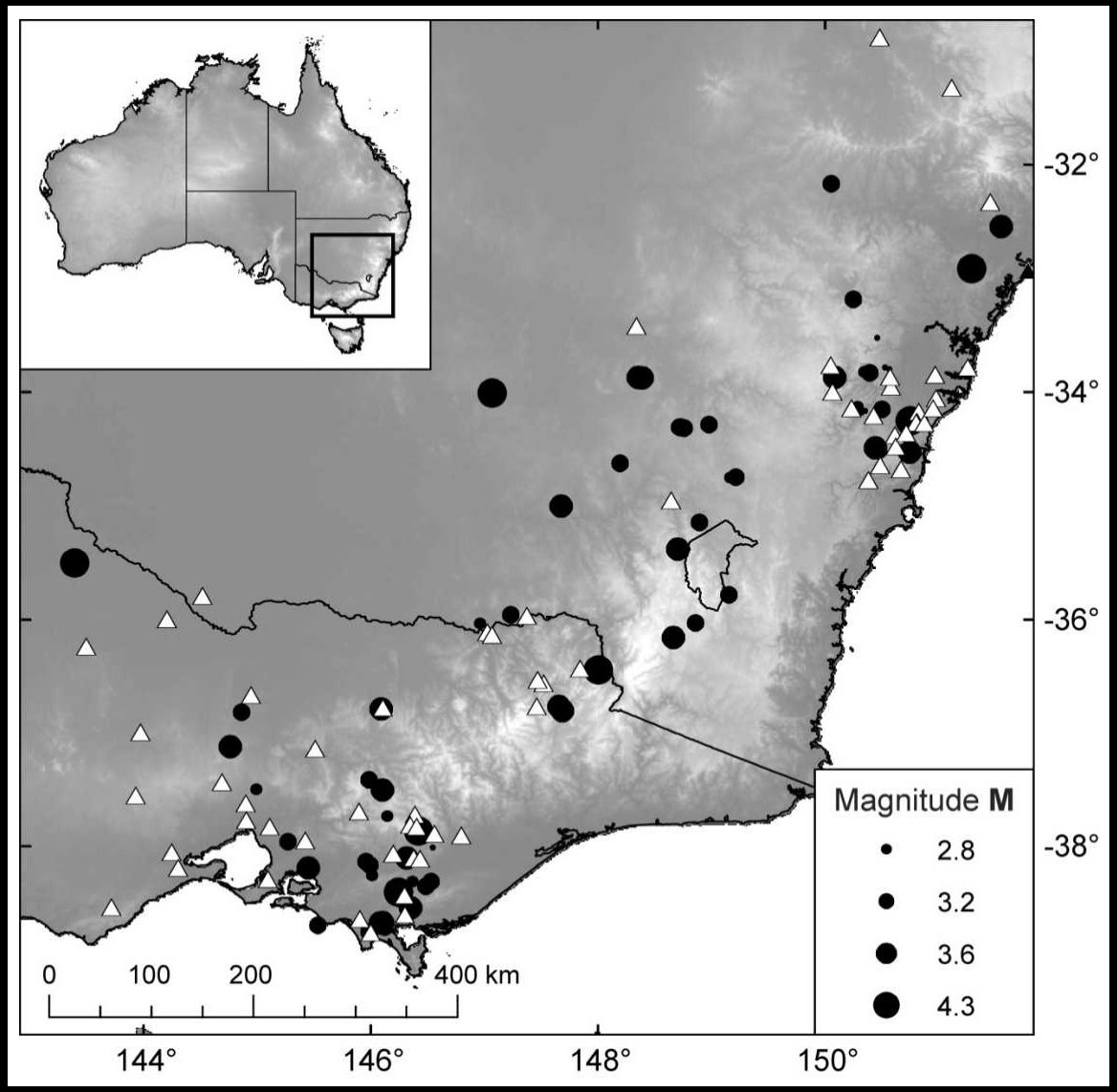
Eastern North America

California

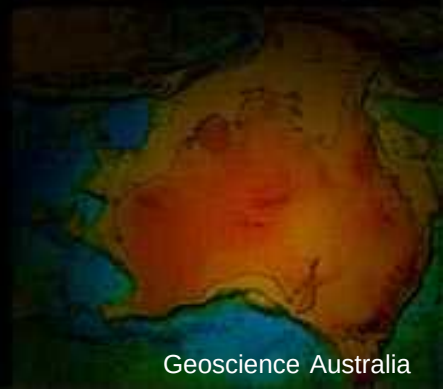
Major Geologic Domains



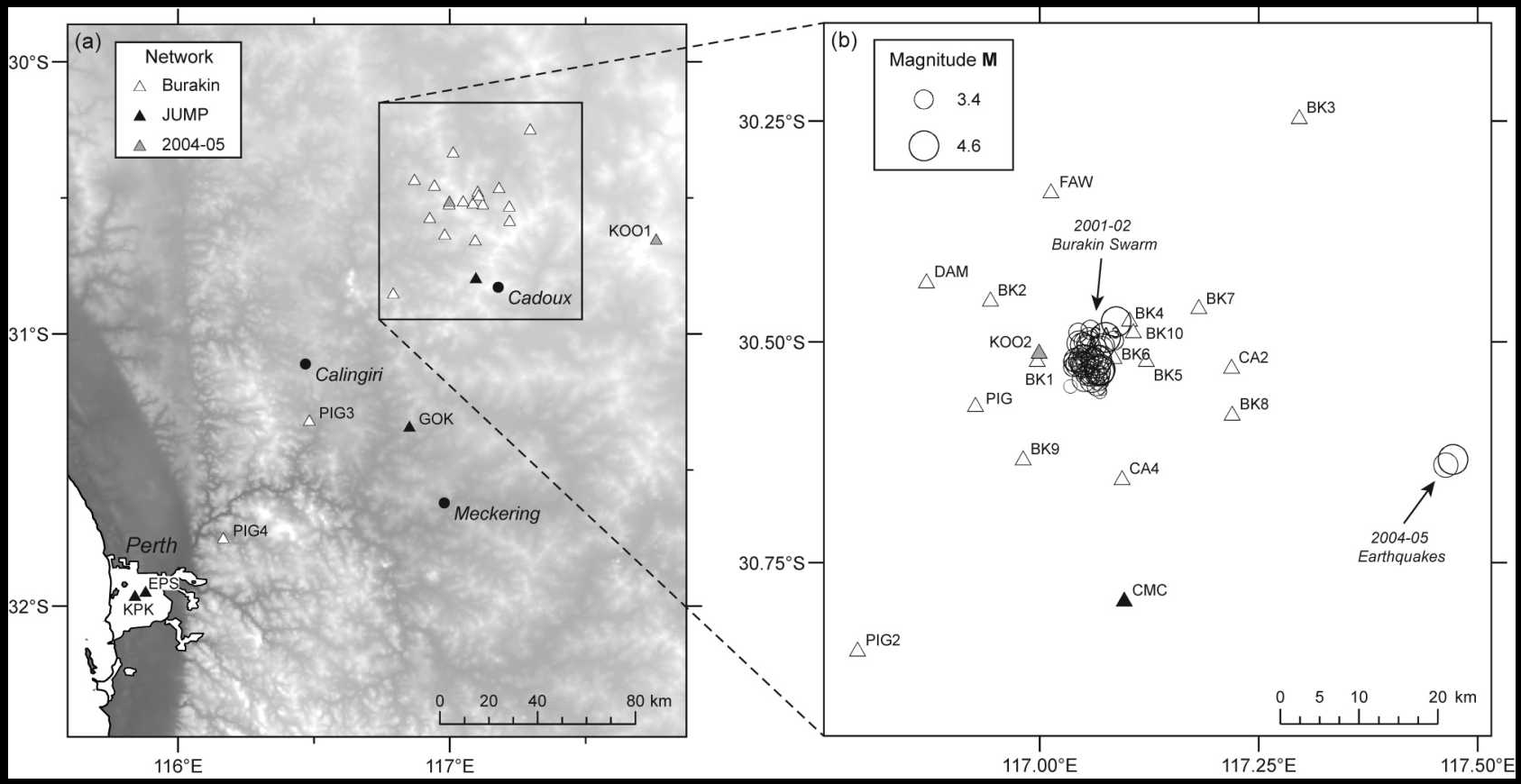
Data #1: Southeastern Australia



- Data recorded by Environmental Systems & Services
- Magnitudes ranged between $2.2 < M_W < 4.6$
- Good spatial distribution to approx. 700 km



Data #2: Southwestern Western Australia



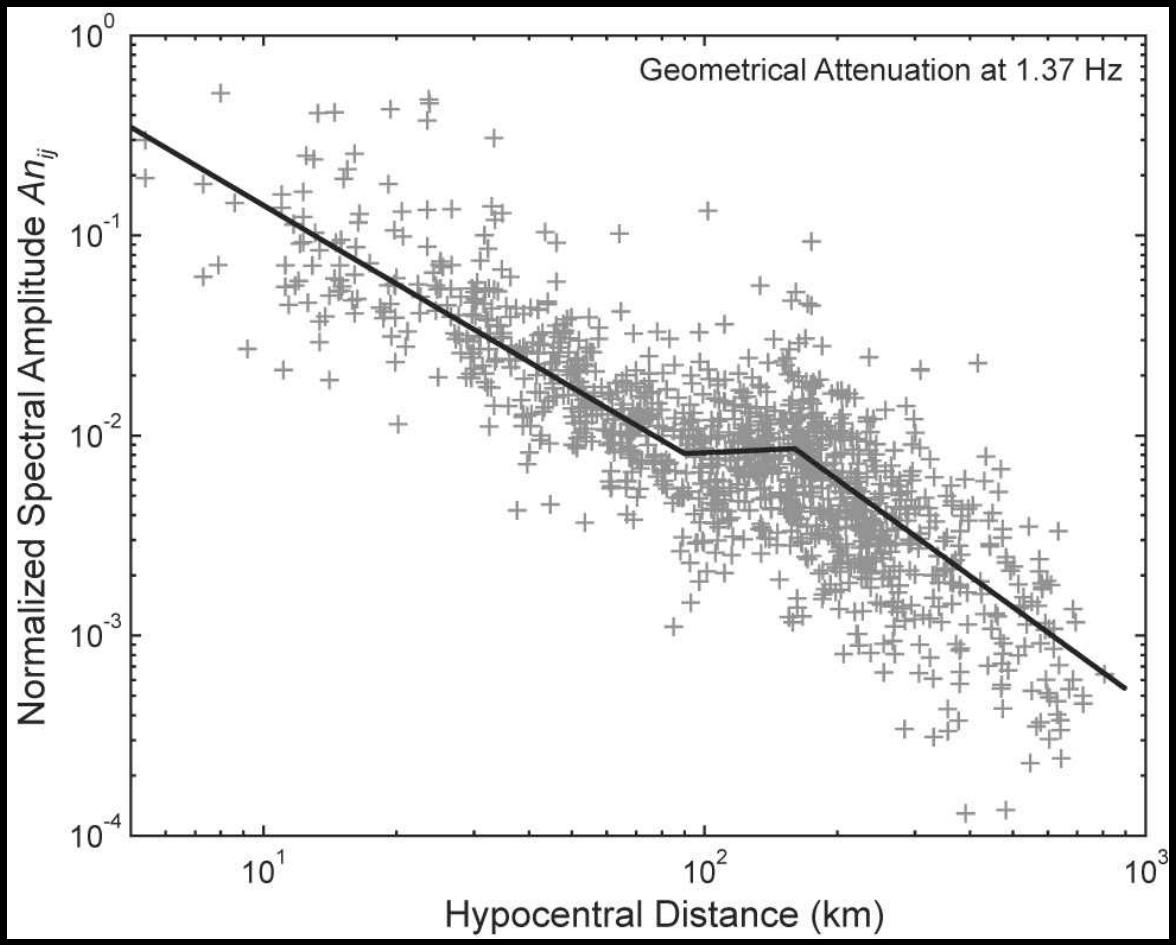
- Recorded during the 2001-02 Burakin earthquake sequence
- Approximately 70 events
- Very shallow events

- Magnitudes ranged between $2.2 < M_W < 4.6$
- Low stress drop
- Spatially clustered data

The Empirical Method

- Follow the methods adopted by Atkinson (2004)
- Estimate geometrical attenuation
- Estimate anelastic attenuation [i.e. $Q(f)$]
- Calculate M_W and regress
- Compare with Atkinson's empirical model for ENA
- Cannot be extrapolated reliably beyond the magnitude range of the dataset

Geometrical Attenuation

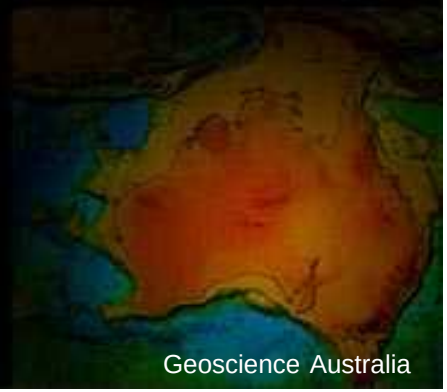


Normalised spectral amplitudes at 1.37 Hz

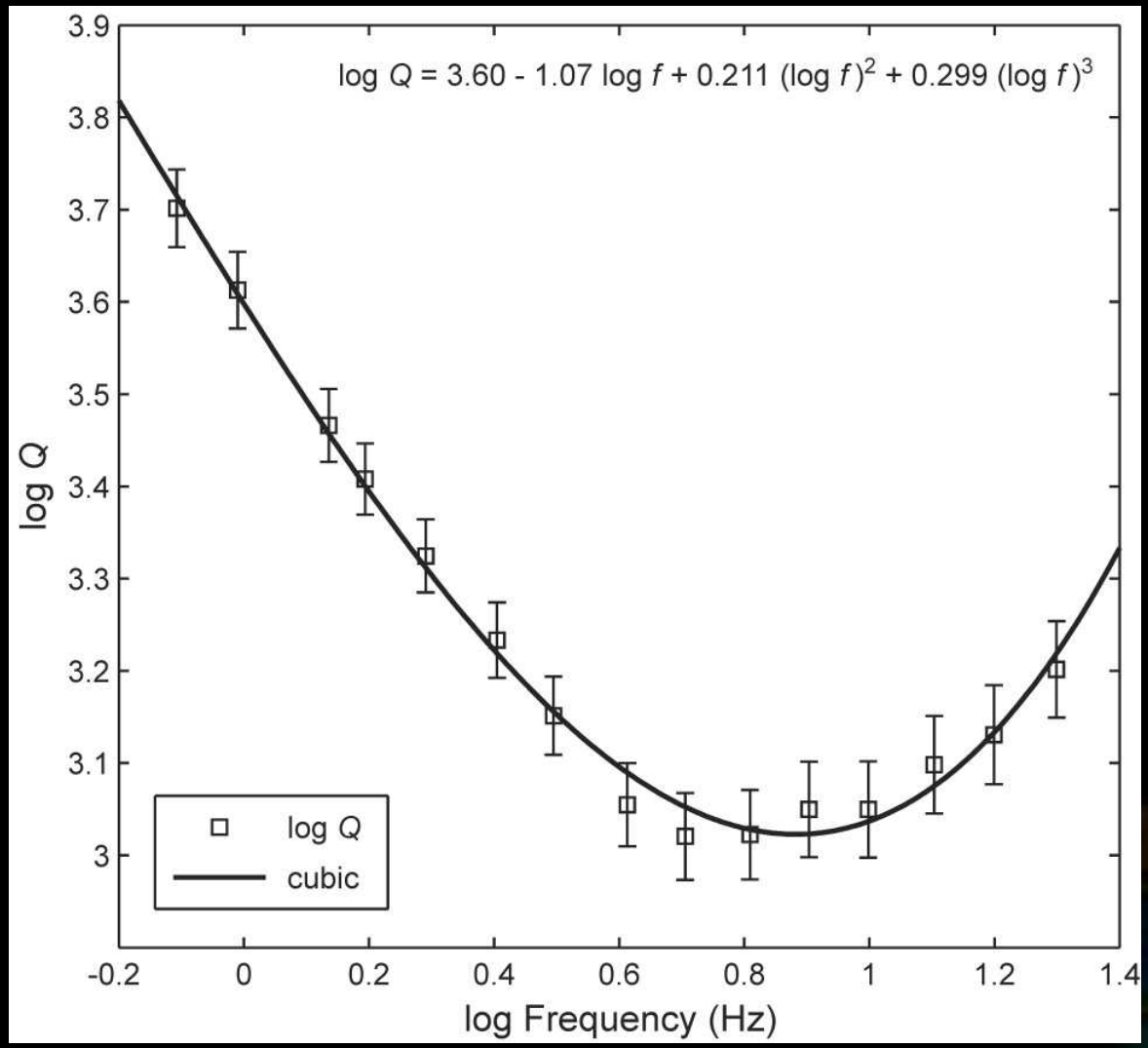
$G(R) = R^{-1.3}$ for $R < 90$ km

$G(R) = R^{+0.1}$ for $90 < R < 160$ km

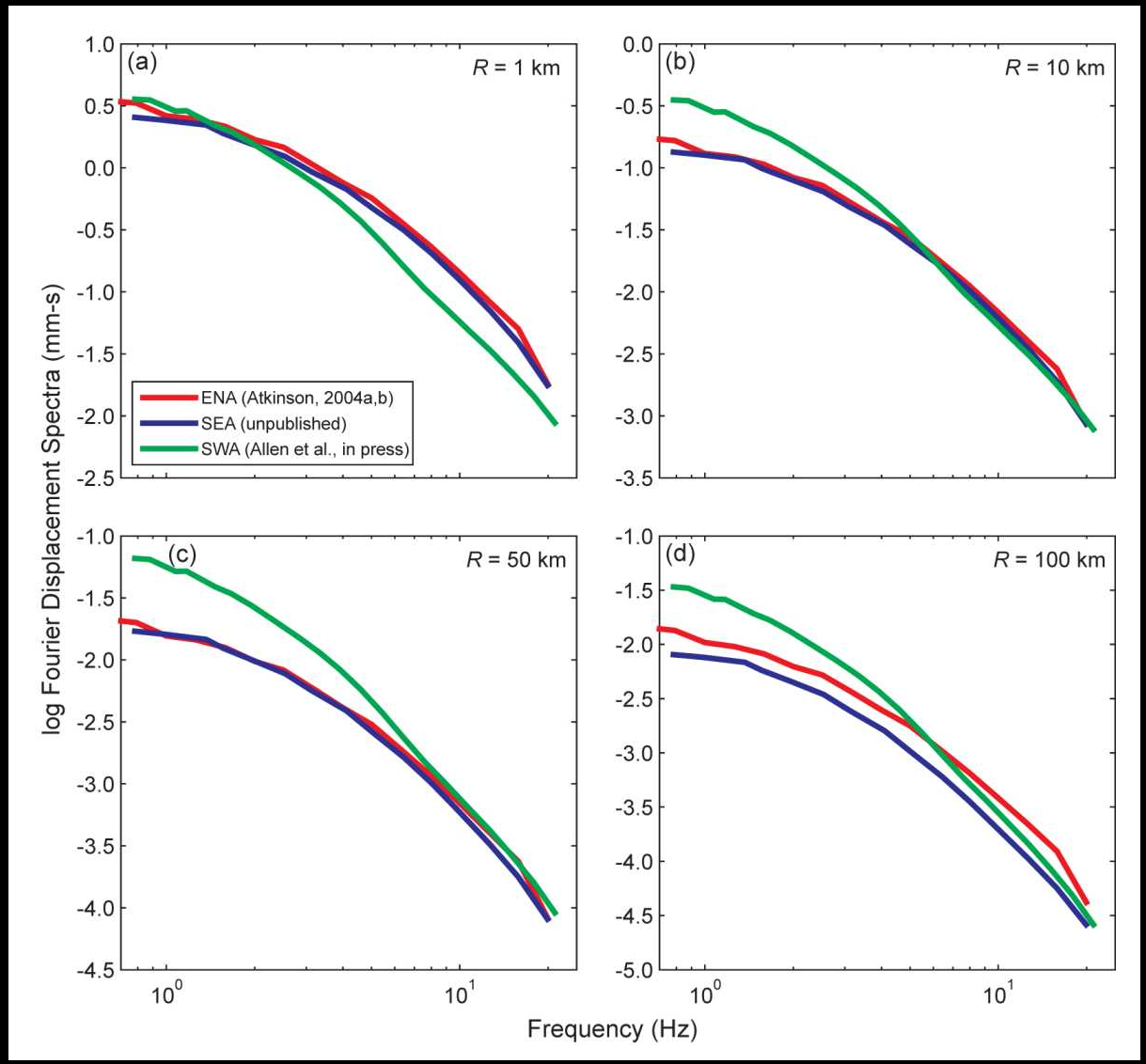
$G(R) = R^{-1.6}$ for $R > 160$ km



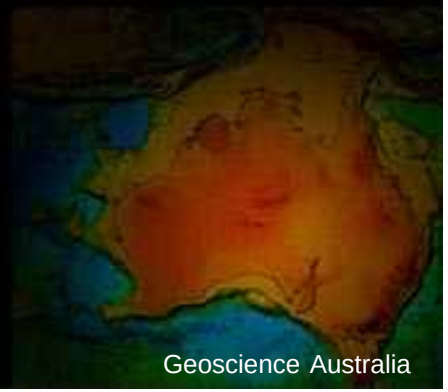
Seismic Quality Factor $Q(f)$



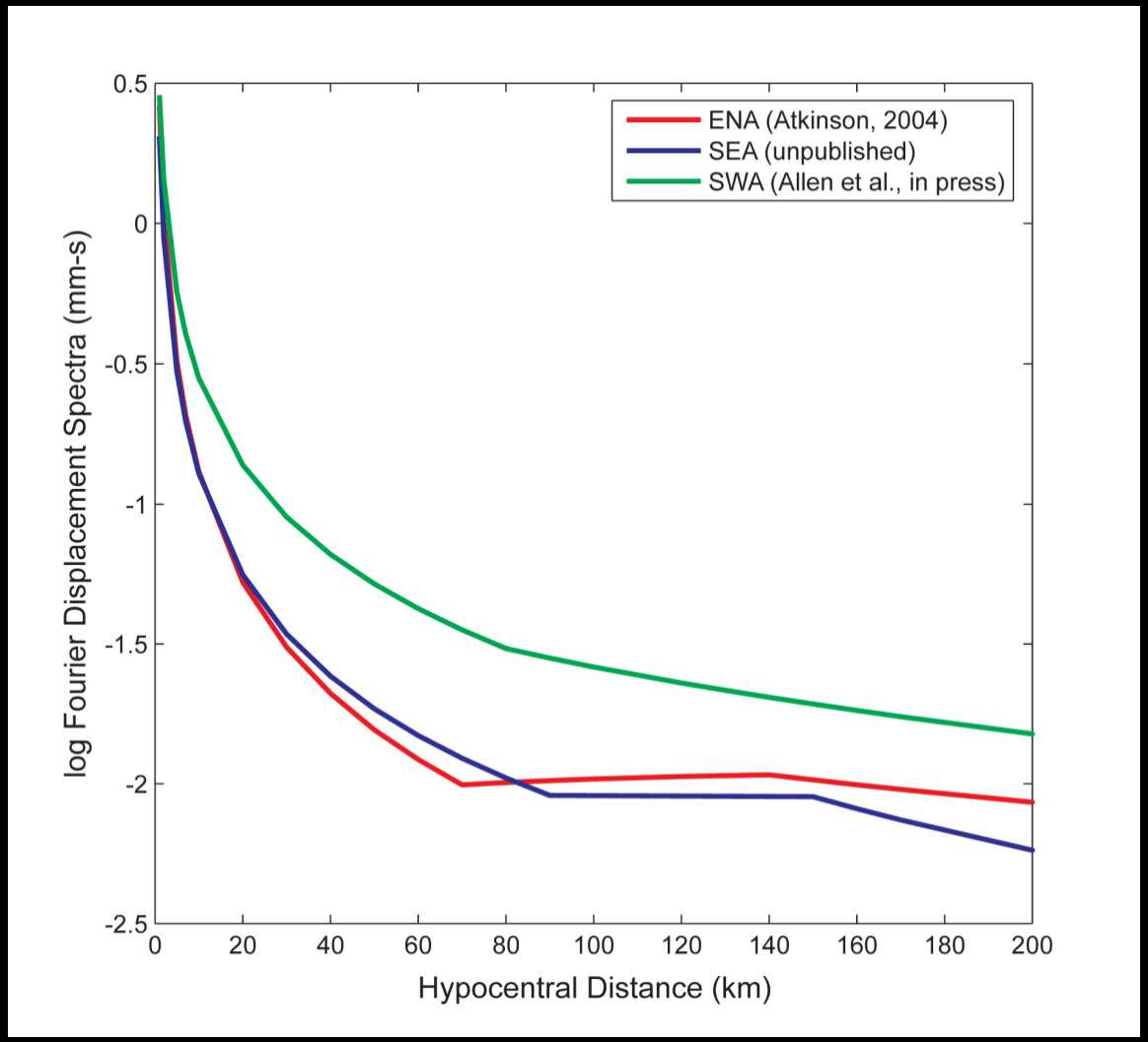
The Empirical Method



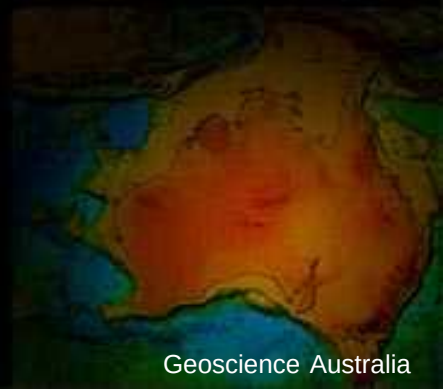
Predicted spectral amplitudes for an event of Mw 4.5



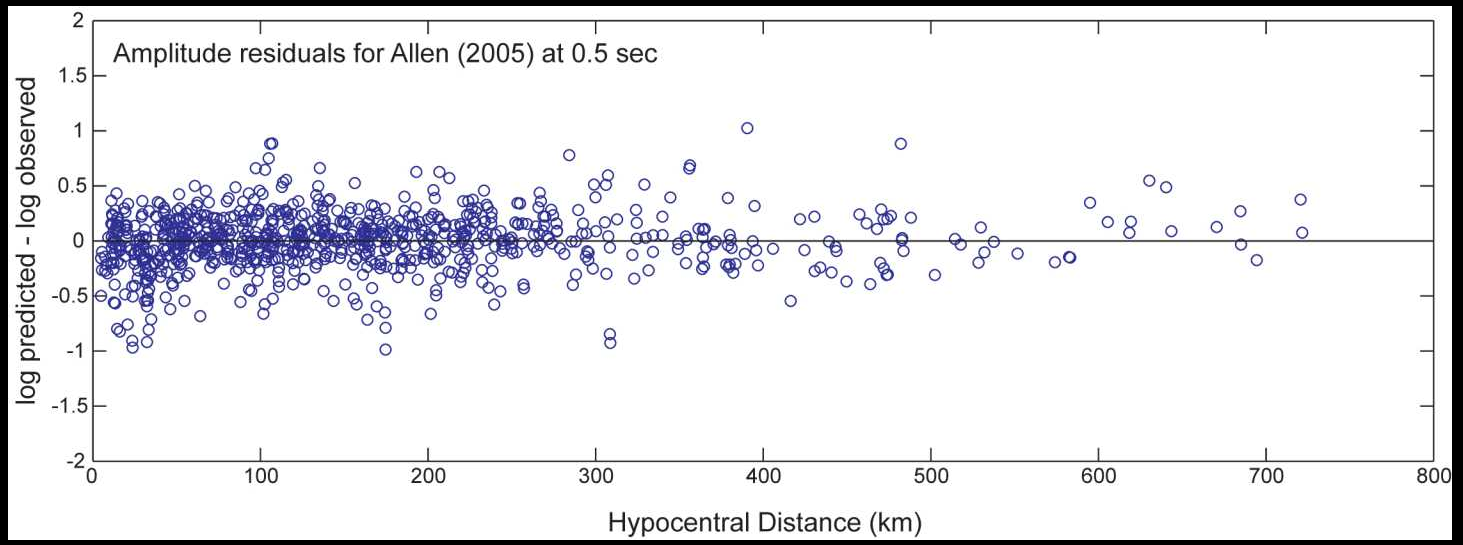
Modelling Ground-Motion



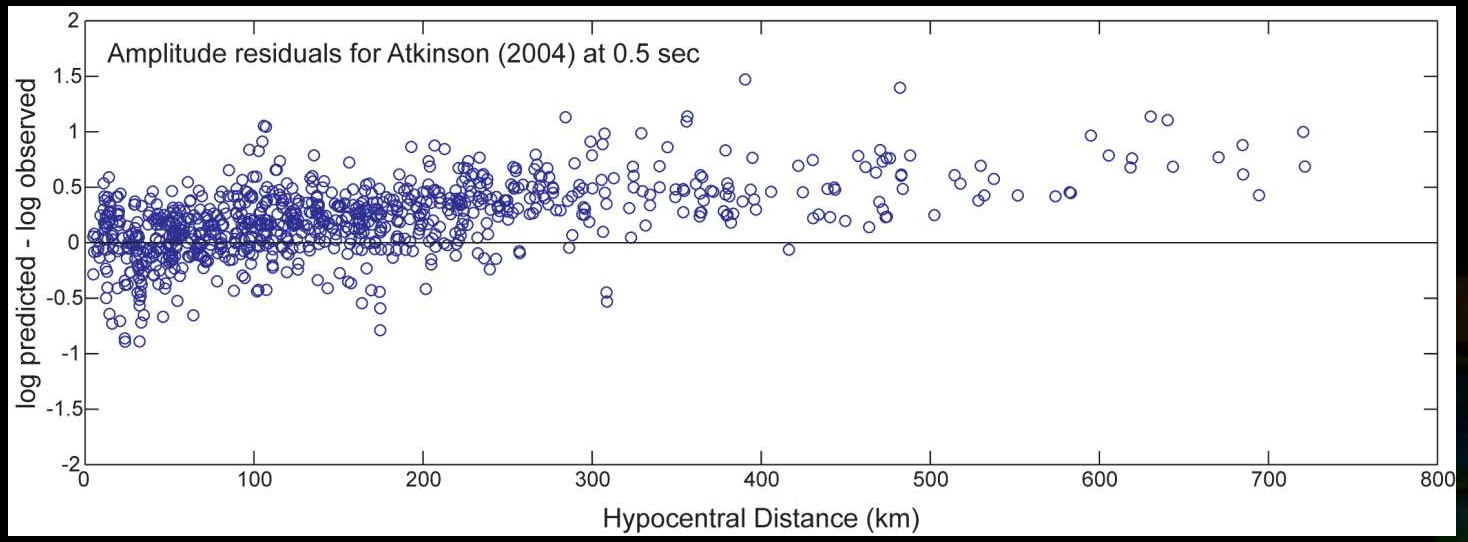
Predicted spectral amplitudes at 1 sec for and earthquake of Mw 4.5



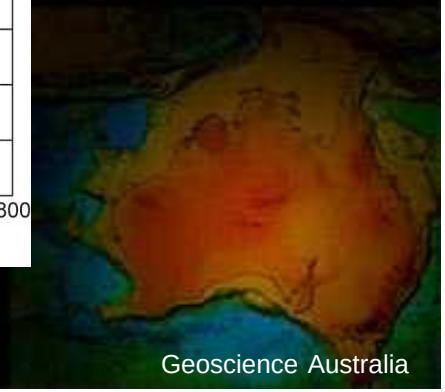
Modelling Ground-Motion (SEA data)



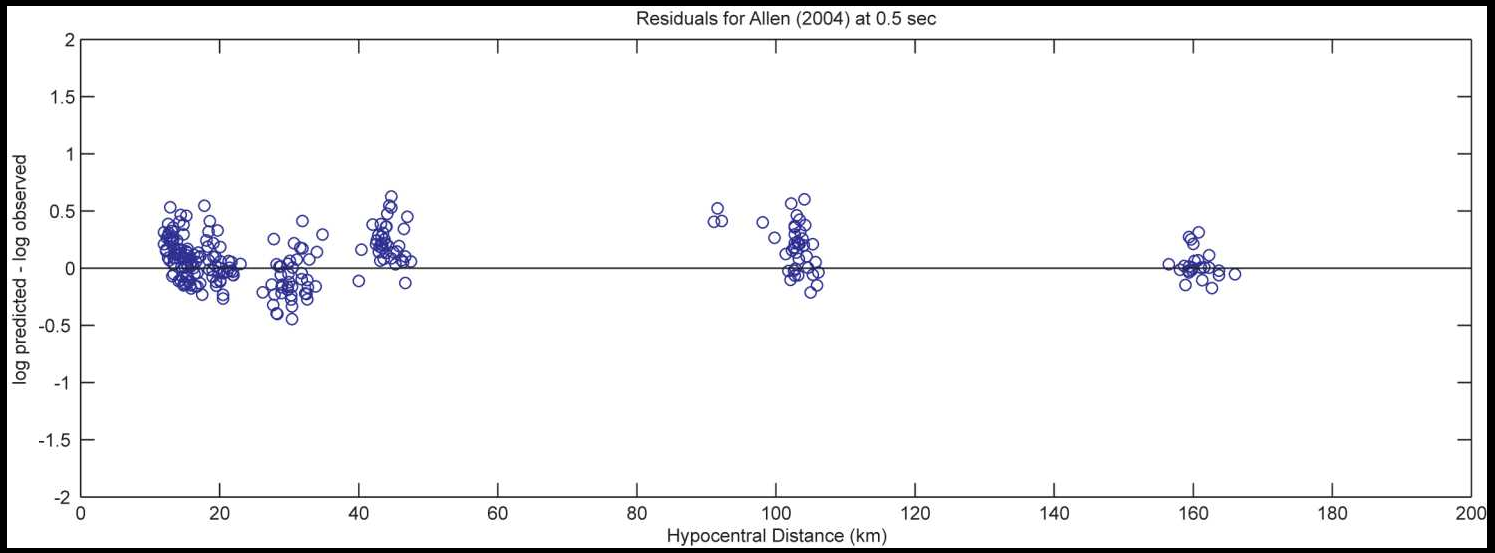
SEA



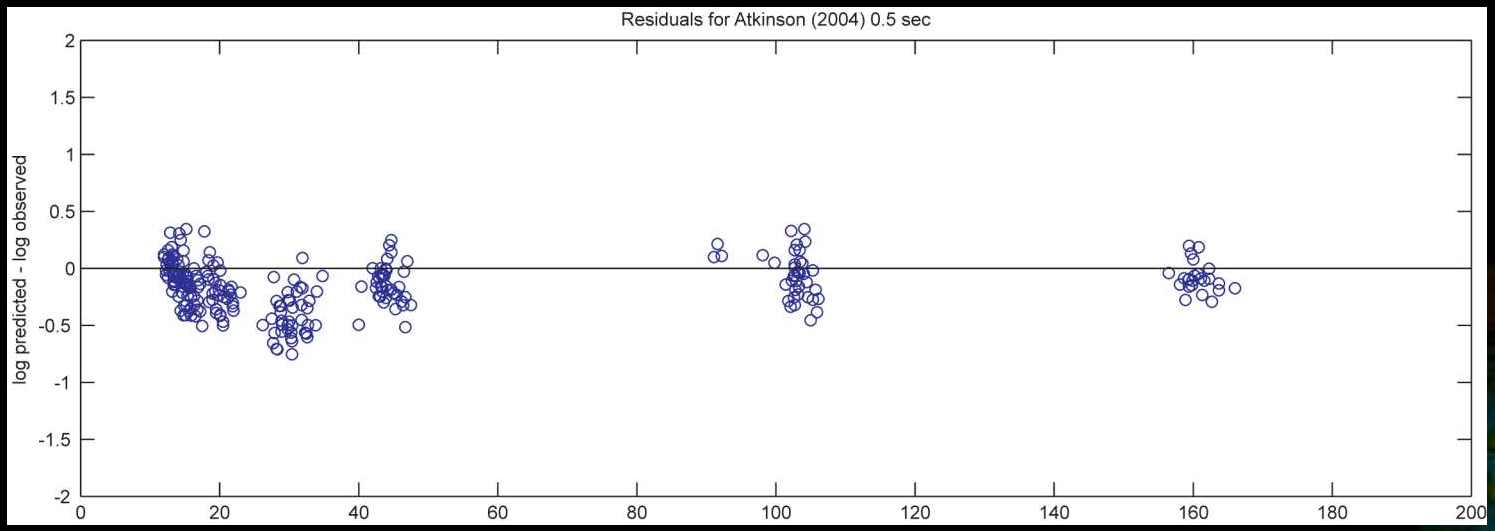
ENA



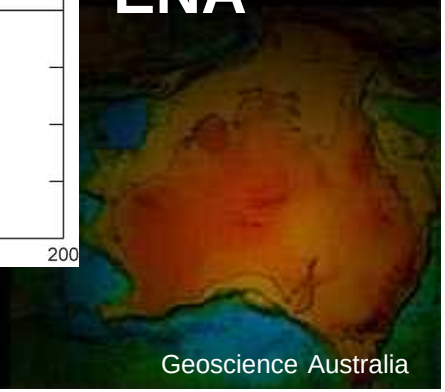
Modelling Ground-Motion (WA data)



WA



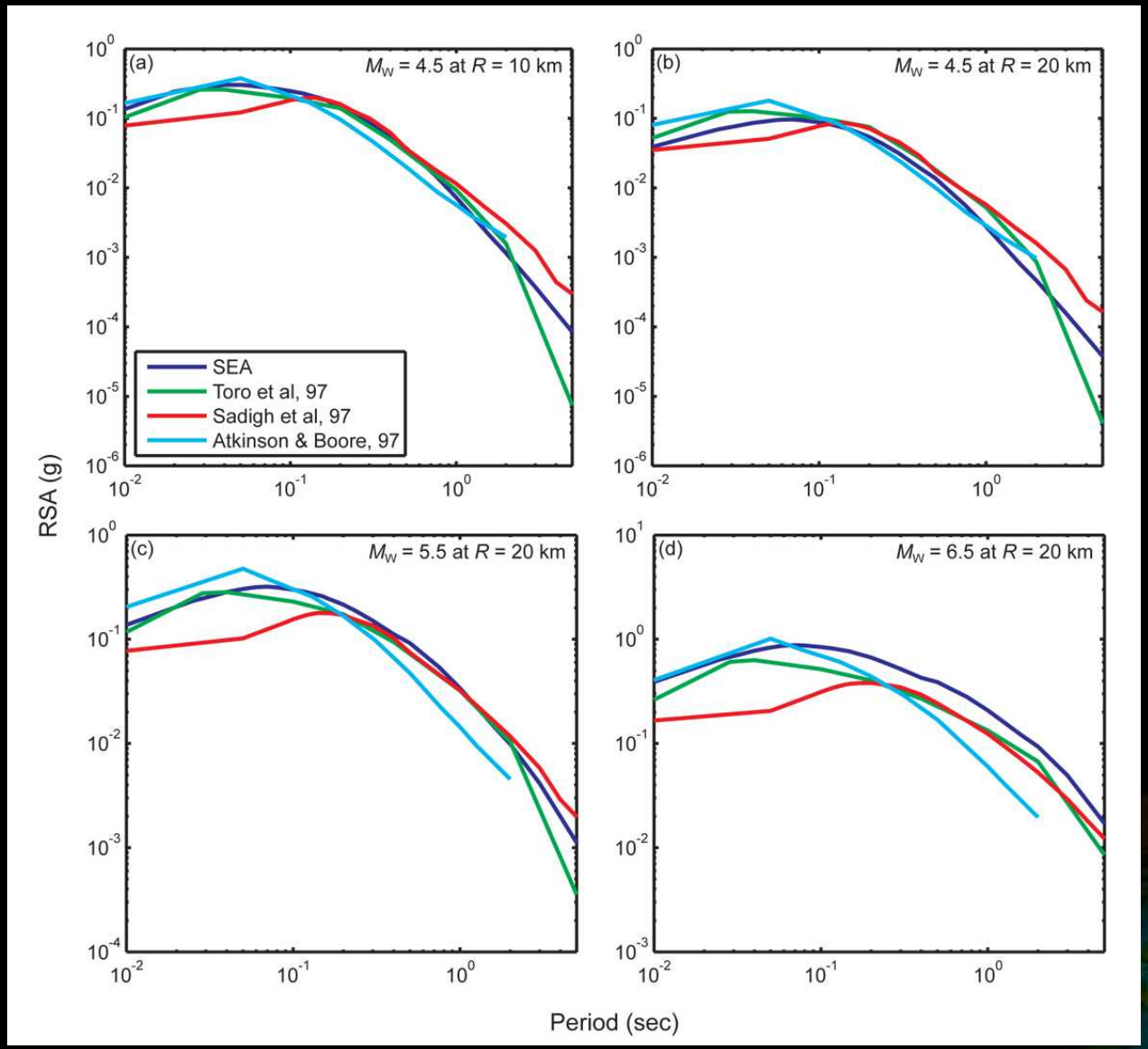
ENA



The Stochastic Method

- Only performed for SEA
- Based on data $R < 300$ km only
- Base input parameters for stochastic simulations
  - Quality factor, $Q_0 = 620$
  - $\eta = 0.26$
  - Stress drop $\Delta\sigma = 160$ bar
  - Kappa, $\kappa = 0.01$ sec
  - Geometrical attenuation assumed to be magnitude dependent (Pers. comm. Silva, 2005)

The Stochastic Method



Conclusions

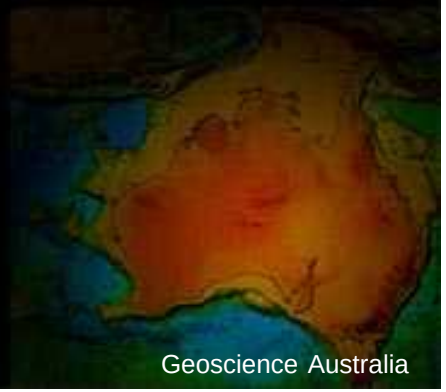
- Ground-motions appear to attenuate less in WA than in SEA (particularly at low frequencies $f < 2$ Hz)

- Empirical SEA & ENA ground-motions are very similar at shorter hypocentral distances (i.e. $R <= 70$ km

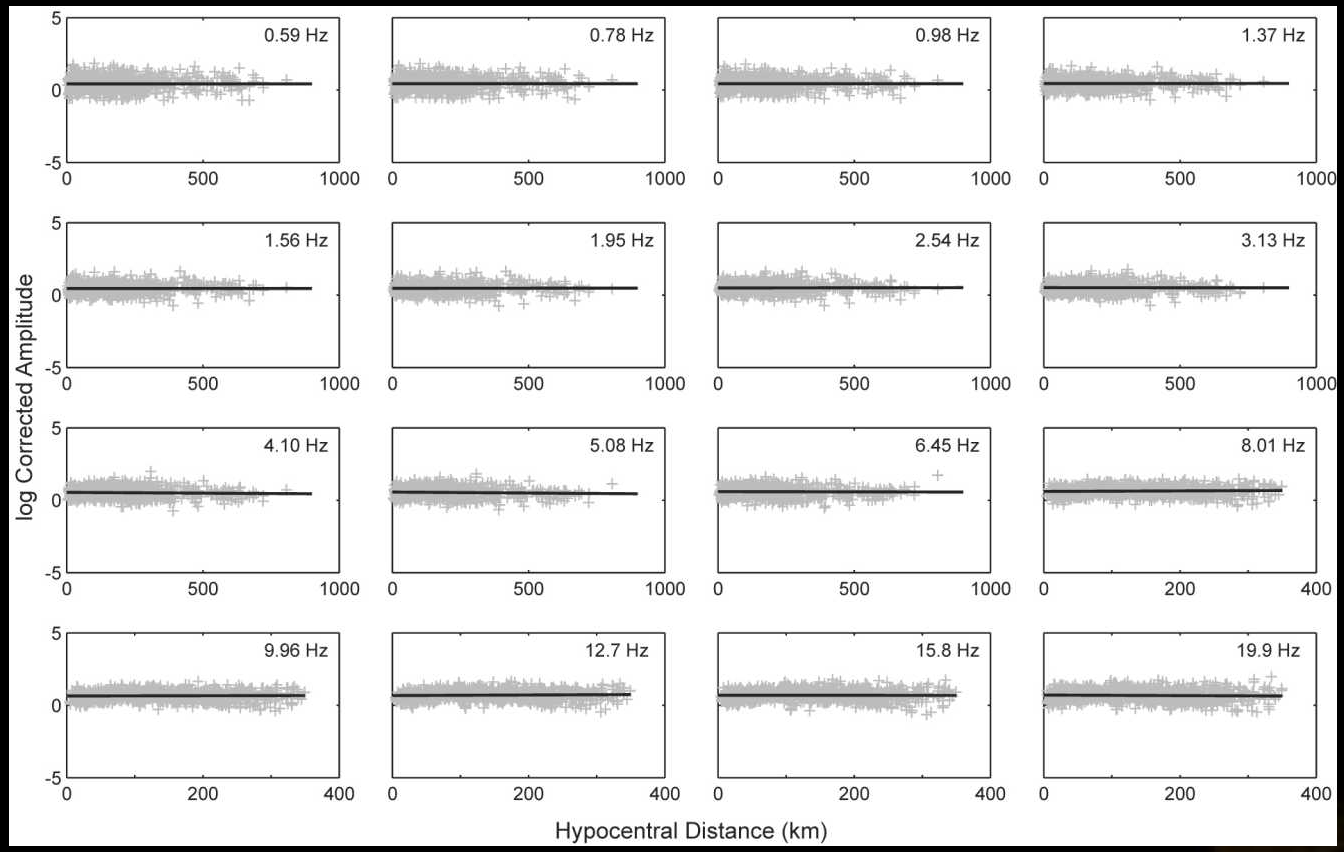
  – i.e. ENA ground motion models could serve as sufficient proxies, particularly at shorter return periods

Recommendations & Future Work

- Requires more work to refine current stochastic & empirical models
- Use data from Flinders Ranges deployment
- Actively monitor ground-motion in and near urban centres



Modelling Ground-Motion



Normalised, source spectra (i.e. *R* = 1 km, corrected for *G*(*R*) & *Q*(*f*))