NGA-East SSHAC Workshop 2

κ estimation and related issues

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QUESTIONS

1. Definition of kappa
2. Alternative methods for estimation
3. Need for consistent treatment of site amplification for different methods
4. Difficulties in getting kappa from the TA data due to band limitation
5. The AZ experience using the TA data (consistent results with 2 methods)
Definition & estimation

Corner frequency?

include

$K_{0\_BB}$
Fit the entire spectrum to the PSSM

Get a set of parameters: \( \Delta \sigma, \kappa, Q(f) = Q_0 f^\beta \)

and amplification!
Anderson & Hough (1984)

Biasi & Smith (2001)
\[
\kappa_r = \kappa_0 + \kappa(R)
\]

'Site' / 'régional'

1. Objective criteria to select frequency band
Hold noise $S$

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>FAS</th>
<th>Usable frequency range (gain, filters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$LUF$</td>
<td></td>
<td></td>
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<tr>
<td>$HUF$</td>
<td></td>
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</tbody>
</table>
Usable frequency range (gain, filters)
Signal-to-noise

Source corner frequency
Procedure

1. Objective criteria to select frequency band
2. Compute individual values
Which horizontal components?

Orientation may matter!!

Use SRSS (vector sum) i.e. orientation-independent
Procedure

1. Objective criteria to select frequency band

2. Compute individual values

component

moving windows
Sensitivity to window width:

- $Df > x$
- $Dfi = y$
- overlap = $z$

*J. Anderson, pers. comm.*
Procedure

1. Objective criteria to select frequency band
2. Compute individual values
   - component
   - moving windows
   - amplification
Is it significant within the frequency band we use?
Amplification

Is it significant within the frequency band we use?

Is it near-horizontal?

How is it computed?
- W. Silva (RASCAL) => consistent for both approaches

What detail do we consider?
- only crustal (see GWG)

Randomise profile (PEA approach)

CORRECT FAS FOR IT
(DECONVOLVE)
Procedure

1. Objective criteria to select frequency band
2. Compute individual values
   component
   moving windows
   amplification
3. Interpret individual values to get $\kappa_0$ (and Q)

Interpretation

• separate regions
• group similar sites
• weigh data points with quality
• get $\kappa_0$ & Q (regress with distance)
Difficulties with the TA – the Arizona experience

- low seismicity
- # of records
- nearby events
- magnitude coverage
- sampling rate and instrument response
- SNR
- $\Delta \sigma/fc$ uncertainty
- distance coverage
Usable frequency range

(sampling rate, instrument gain, filters)

Nyquist = 20 Hz
HUF = 16 Hz
Corner frequency & stress drop uncertainty

Corner frequency (Hz)

$K_{r\_AS}$

16 Hz

$\varepsilon$

$fc$

$1.5*fc$

Corner frequency (Hz)
Comparable results from BB and AS/DS (after CONSISTENT crustal amplification correction)

For NGA-East

Δσ scenarios:
assuming a mean of 160 bar, range of 50 - 500 bar

Maximise data for each method and create overlap to check epistemic uncertainty
Many thanks for discussions with

Norm Abrahamson
John Anderson
Glenn Biasi
Jim Brune
NGA E&W people
Where do we want $\kappa_0$?

Surface $\kappa_0$
- Includes soil damping
- Includes scattering
- Does not include amplification

Bedrock $\kappa_0$
- @ 3000 m/s
- No soil damping
- No scattering