

*4<sup>th</sup> IASPEI / IAEE International Symposium:*

## **Effects of Surface Geology on Seismic Motion**

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# Regional Correlations of $V_{S30}$ and Velocities Averaged Over Depths Less Than and Greater Than 30 m

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# Introduction

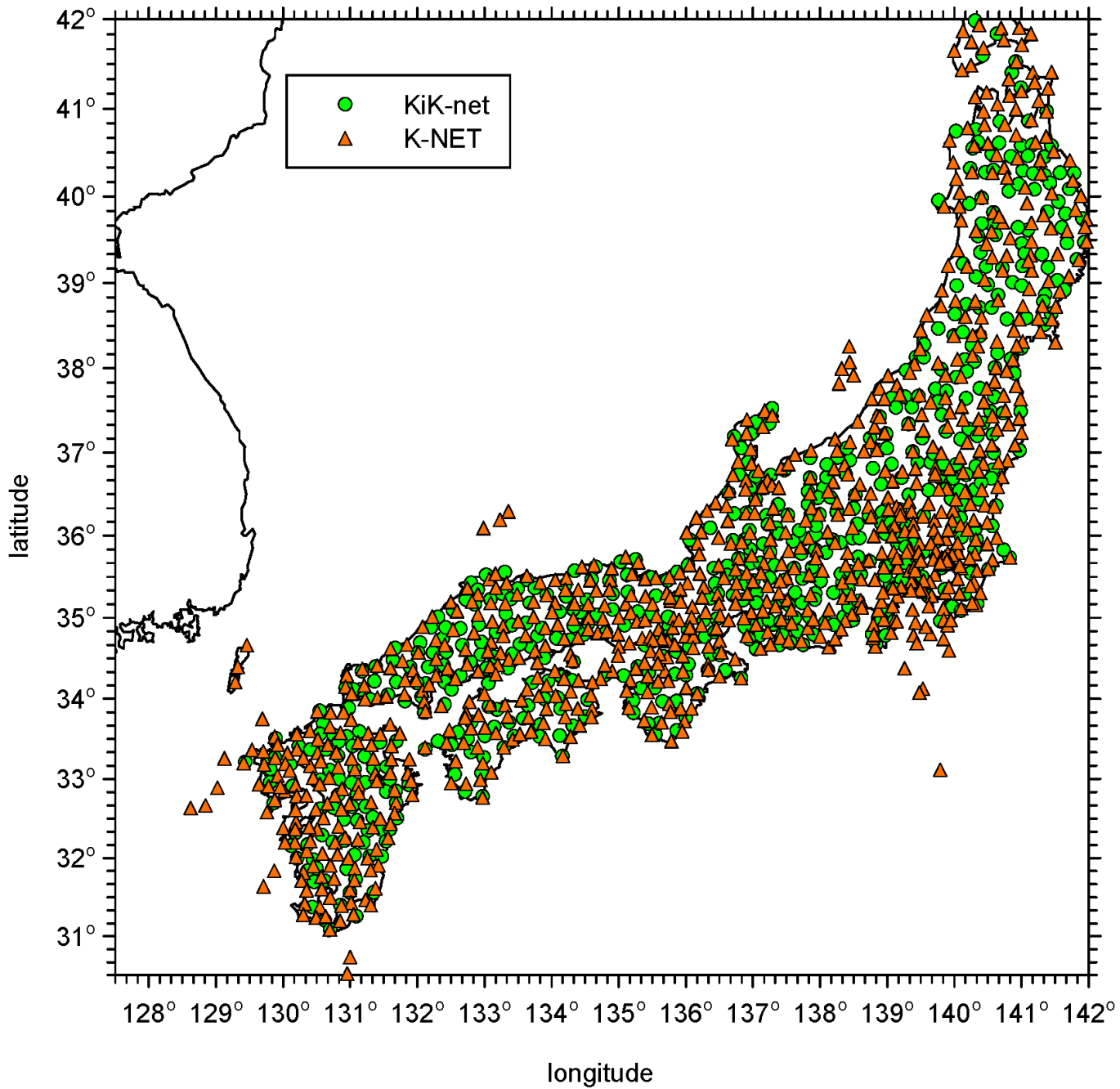
- Improvement strategies generally focus on additional parameters, e.g. thickness/depth
  - $Z_{1.0}$ ,  $Z_{2.5}$ ,  $f_0$ ,  $V_{SZ}$ , etc.
- $V_{S30}$  is a statistical parameter
- Regardless of physics, additional parameters are not useful unless they are statistically independent
- Additional parameters are also not useful if they cannot be accurately and efficiently measured

# Outline

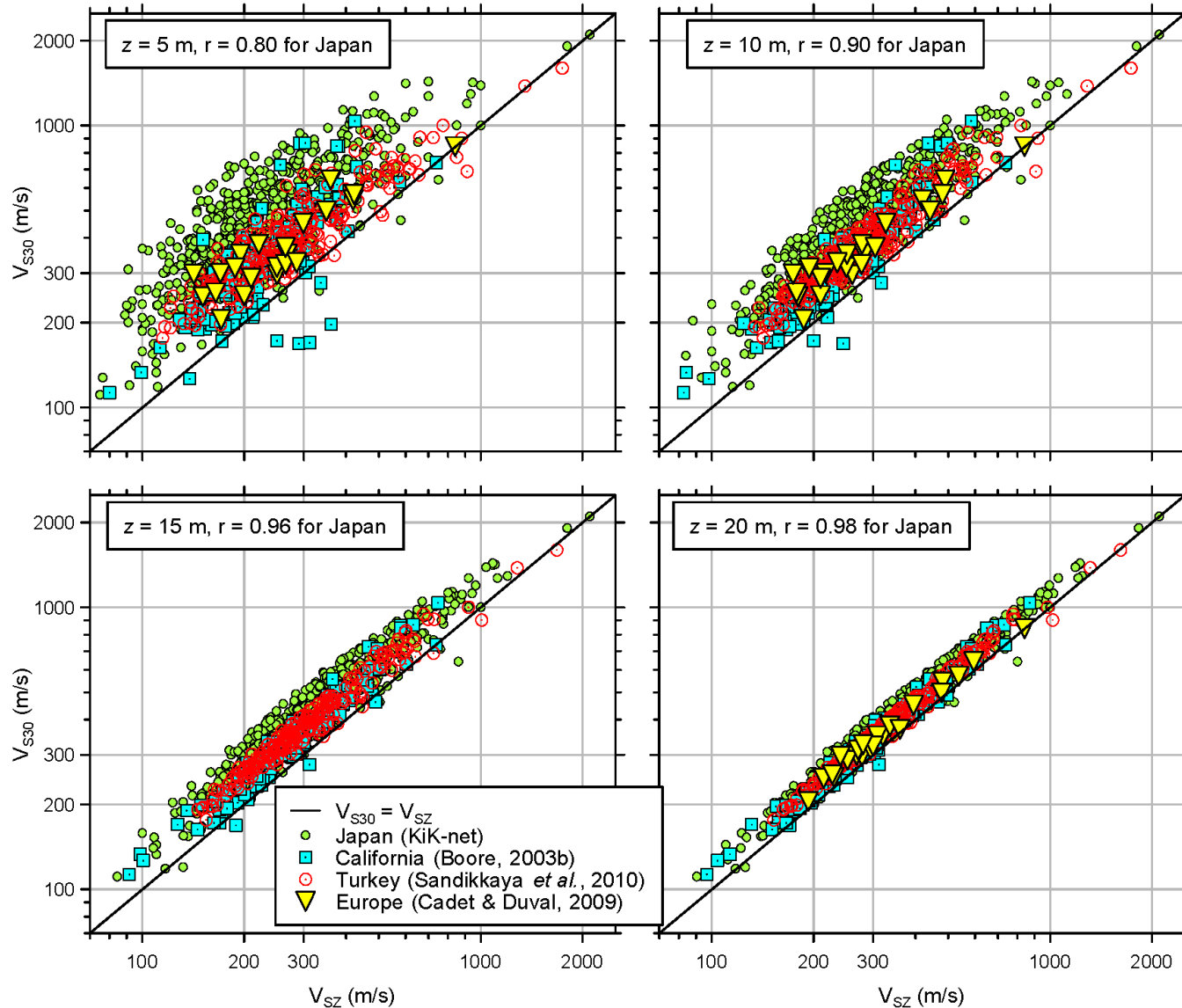
- 1. Regional Differences in Correlations of  $V_{S30}$  with  $V_{SZ}$  for  $z < 30$  m**
2. What averaging depths are important for site response?
  - Are those depths correlated with  $V_{S30}$ ?
3. How does  $V_{S30}$  uncertainty propagate into ground motion equations?

# Correlations of $V_{S30}$ with $V_{SZ}$ for $z < 30$ m

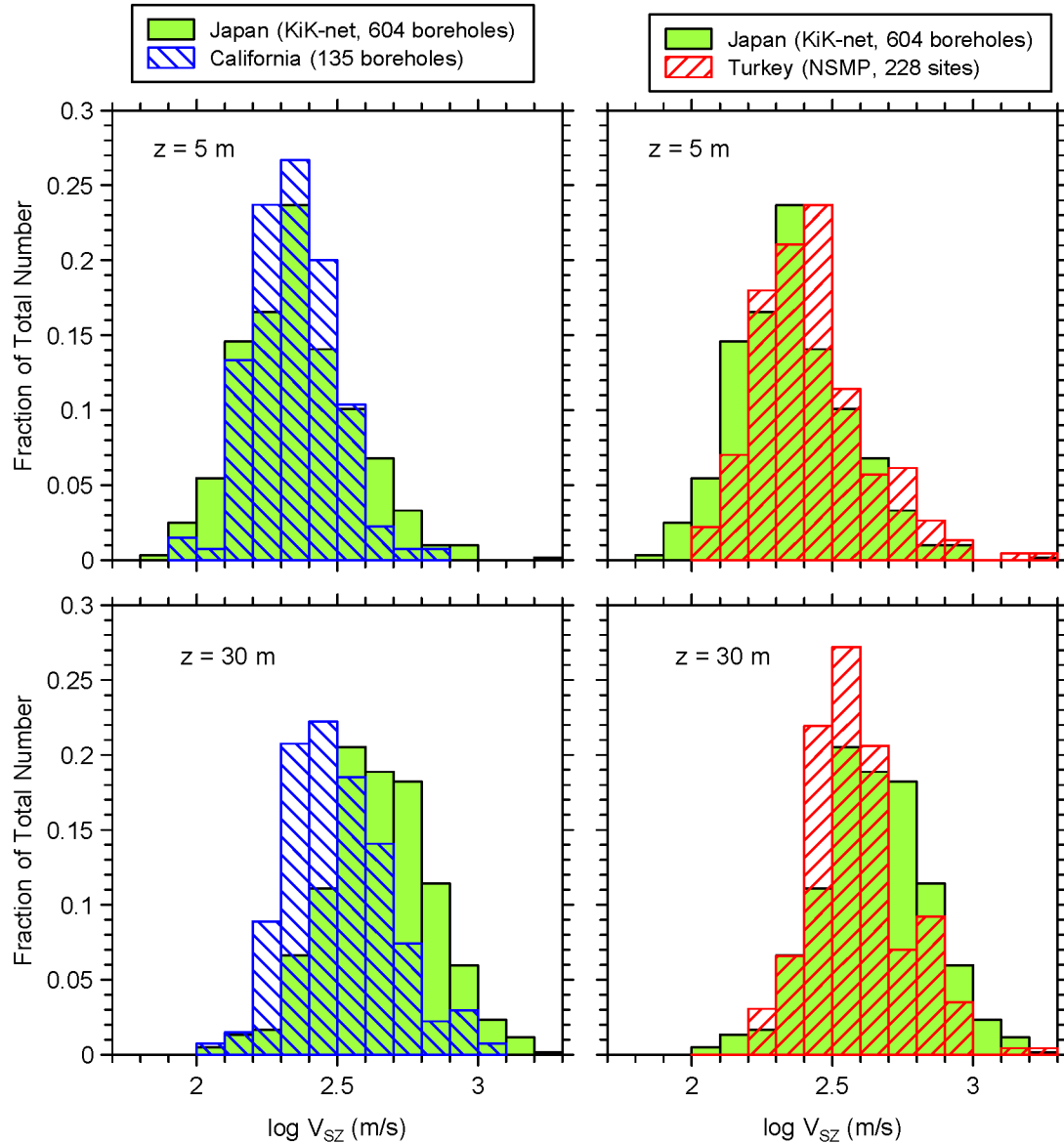
- Boore (2004) presented equations to compute  $V_{S30}$  from  $V_{SZ}$  based on California profiles
- Walt Silva found that these equations were inaccurate in China
- K-net profiles generally do not extend beyond 20 m
- Redo regression with KiK-net profiles



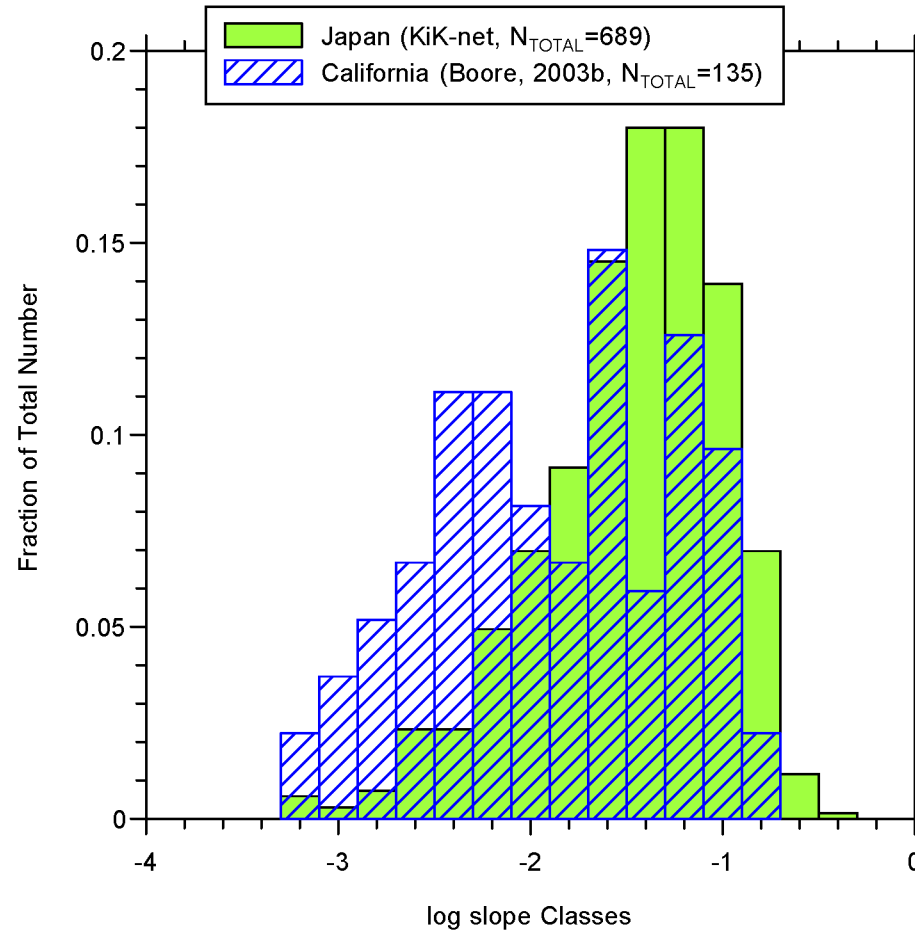
# Relationship Between $V_{S30}$ and $V_{SZ}$ by Region



# Regional Differences of $V_{SZ}$



# Why Are The $V_{SZ}$ Different?

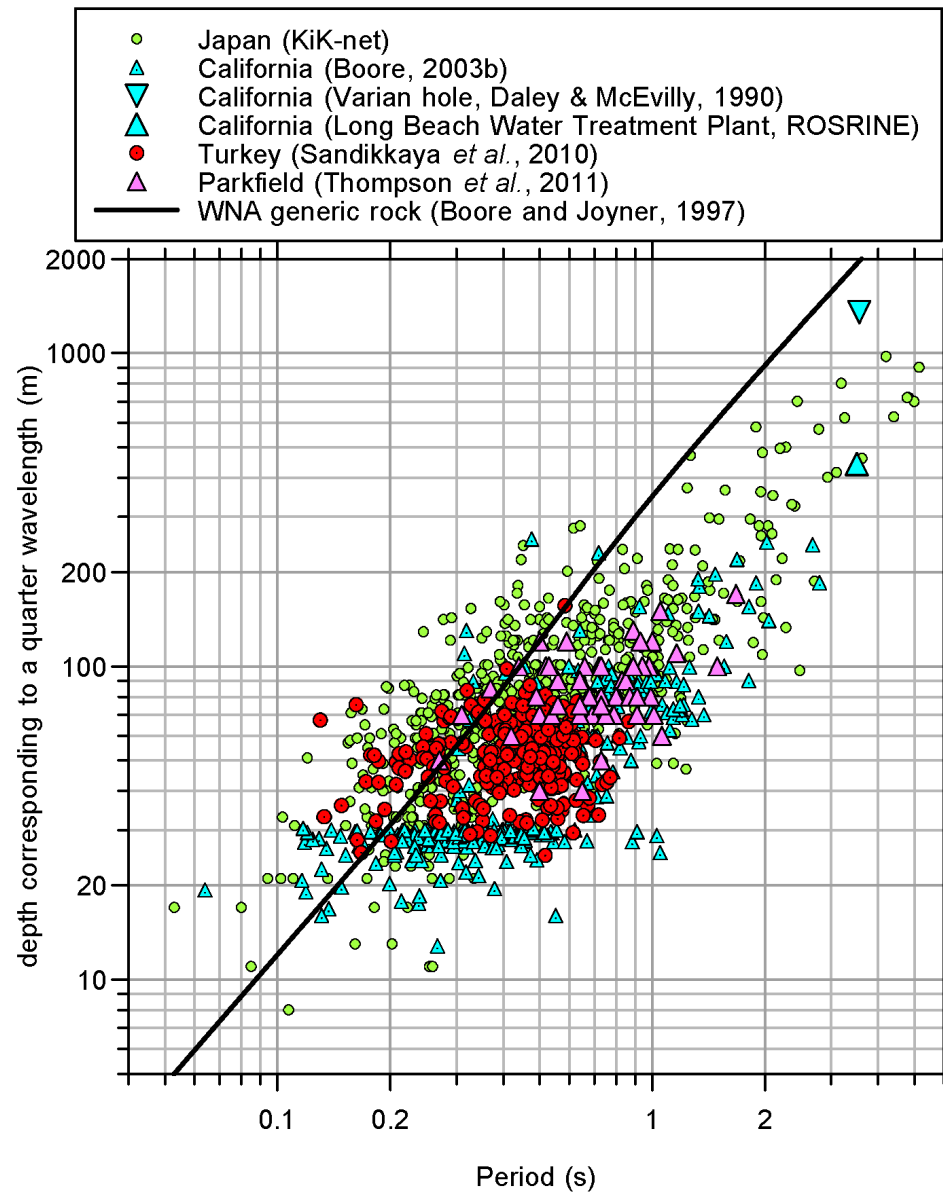




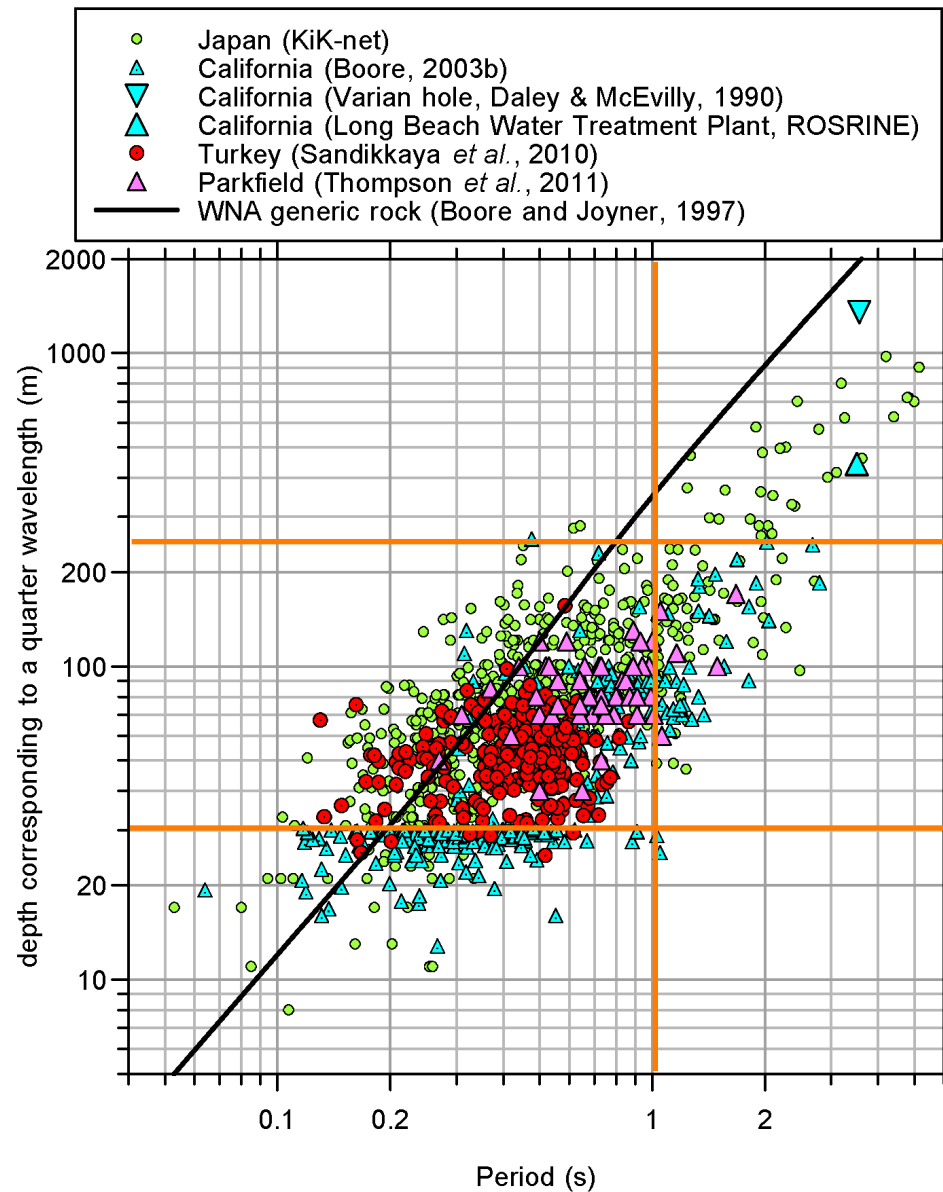
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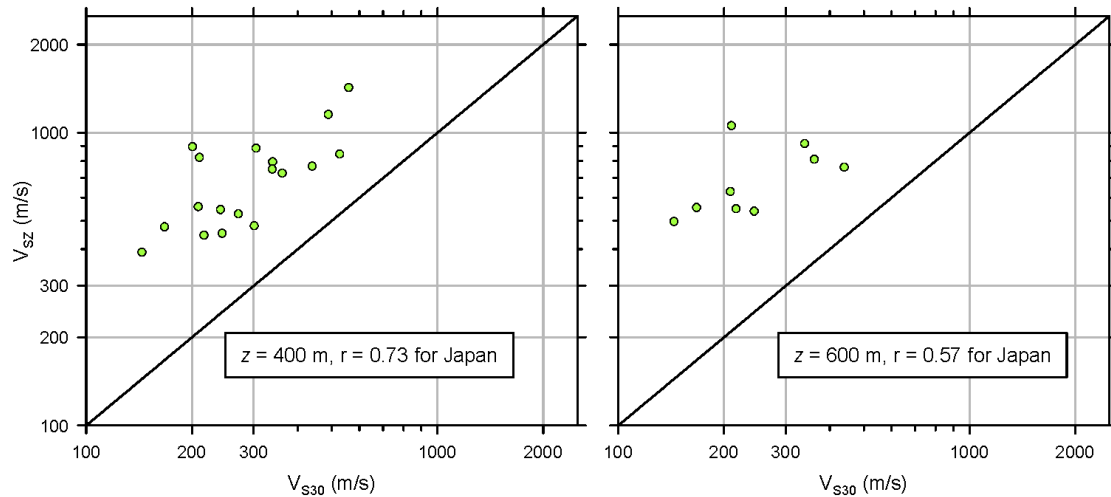
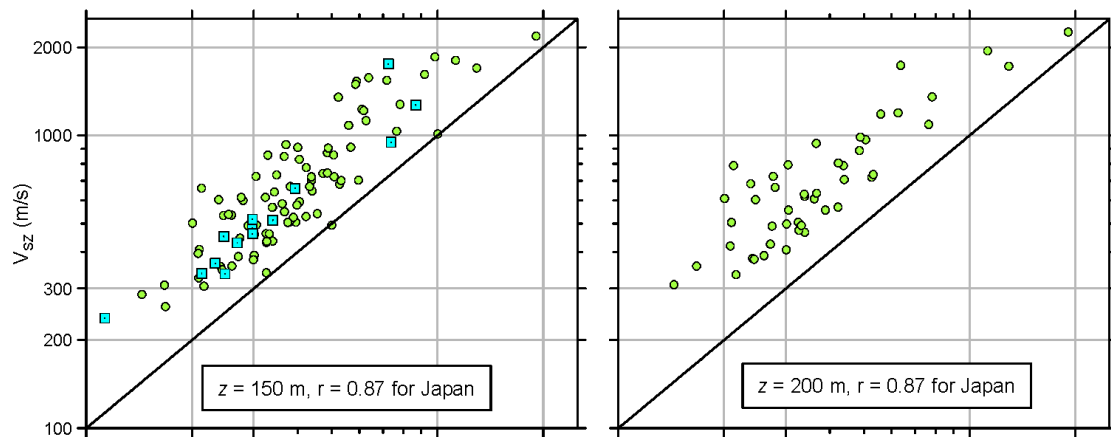
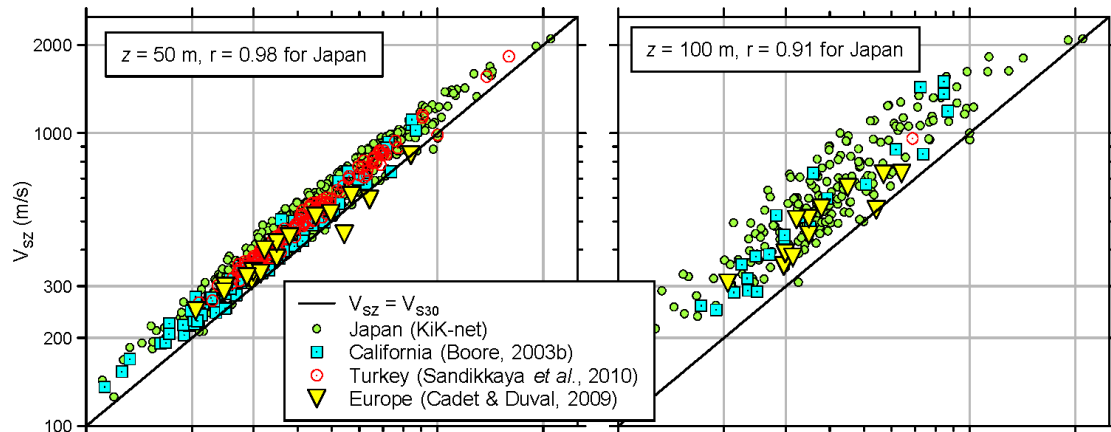
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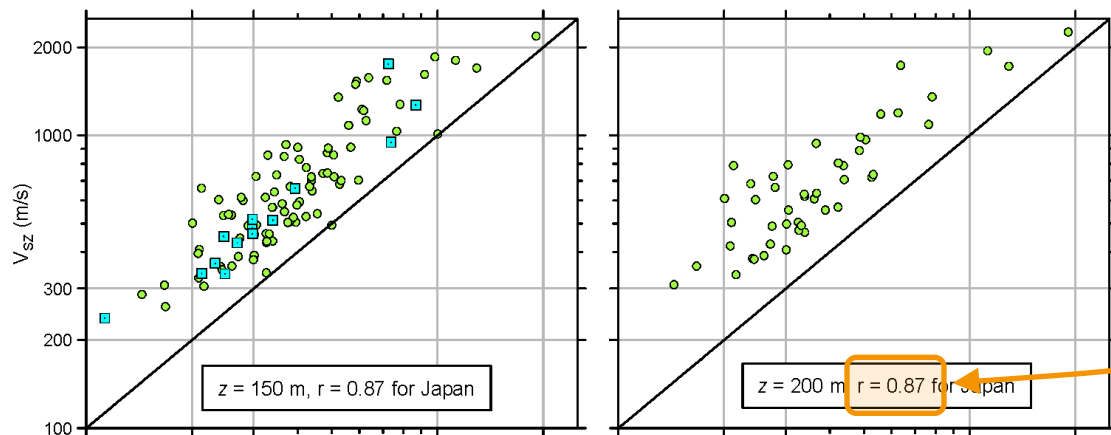
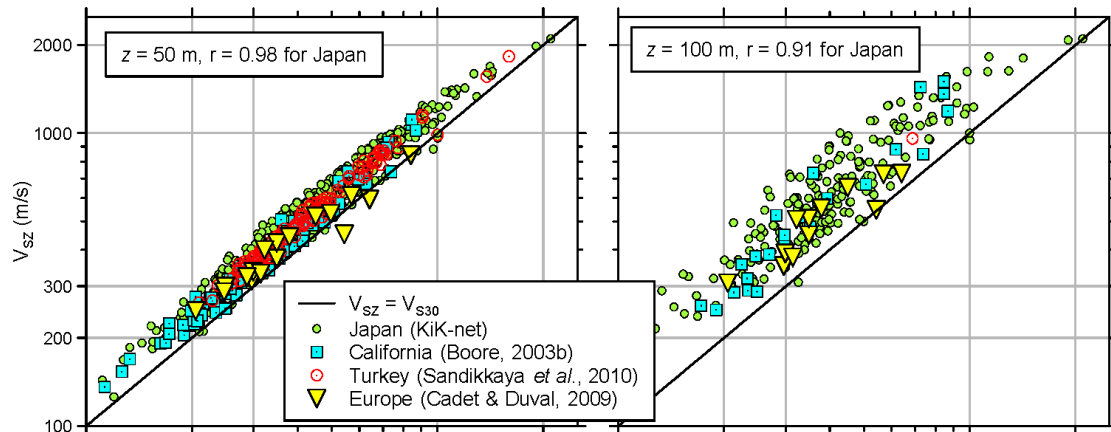
# What Depths Are Important?



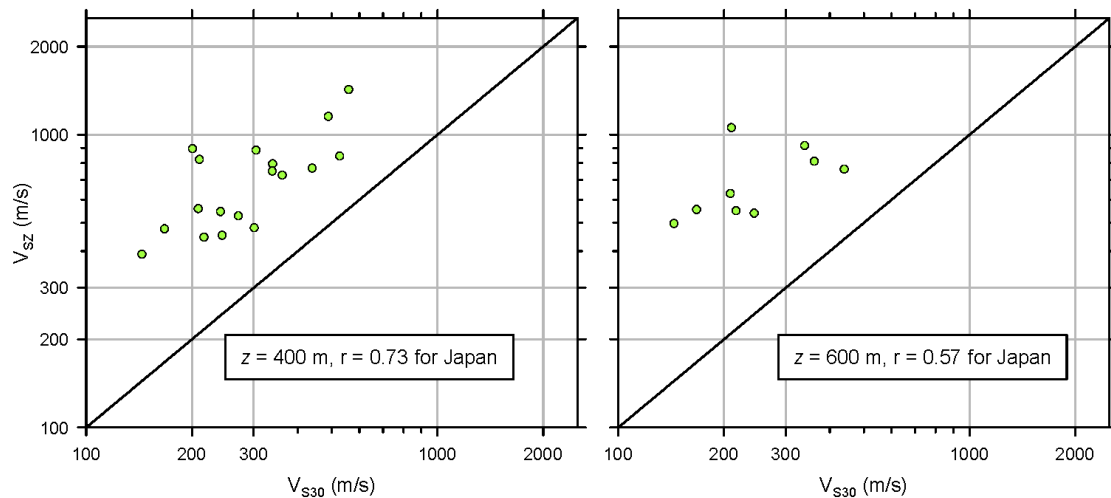
# What Depths Are Important?







Greater than  $r$   
 between  $V_{S30}$   
 and  $V_{S5}$

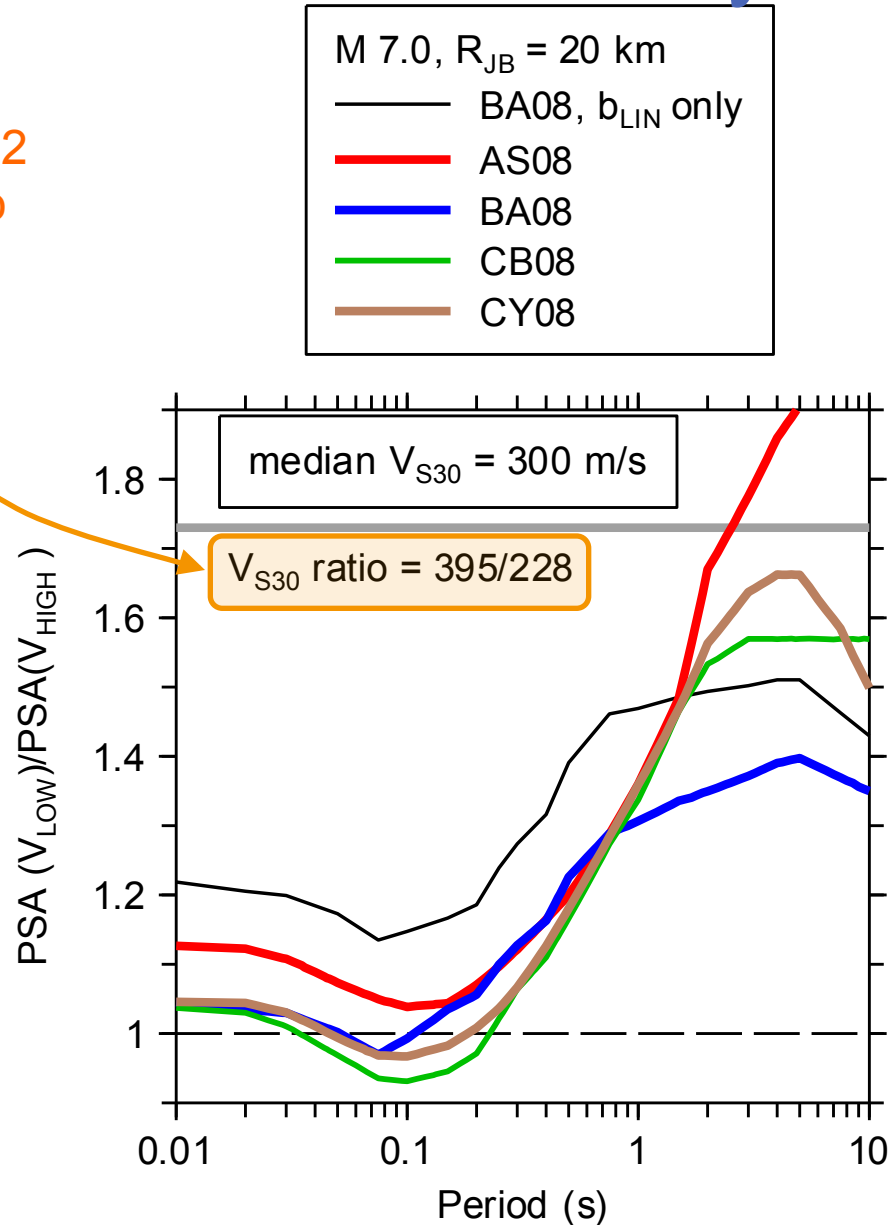


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1. Regional Differences in Correlations of  $V_{S30}$  with  $V_{SZ}$  for  $z < 30$  m
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3. **How does  $V_{S30}$  uncertainty propagate into ground motion equations?**

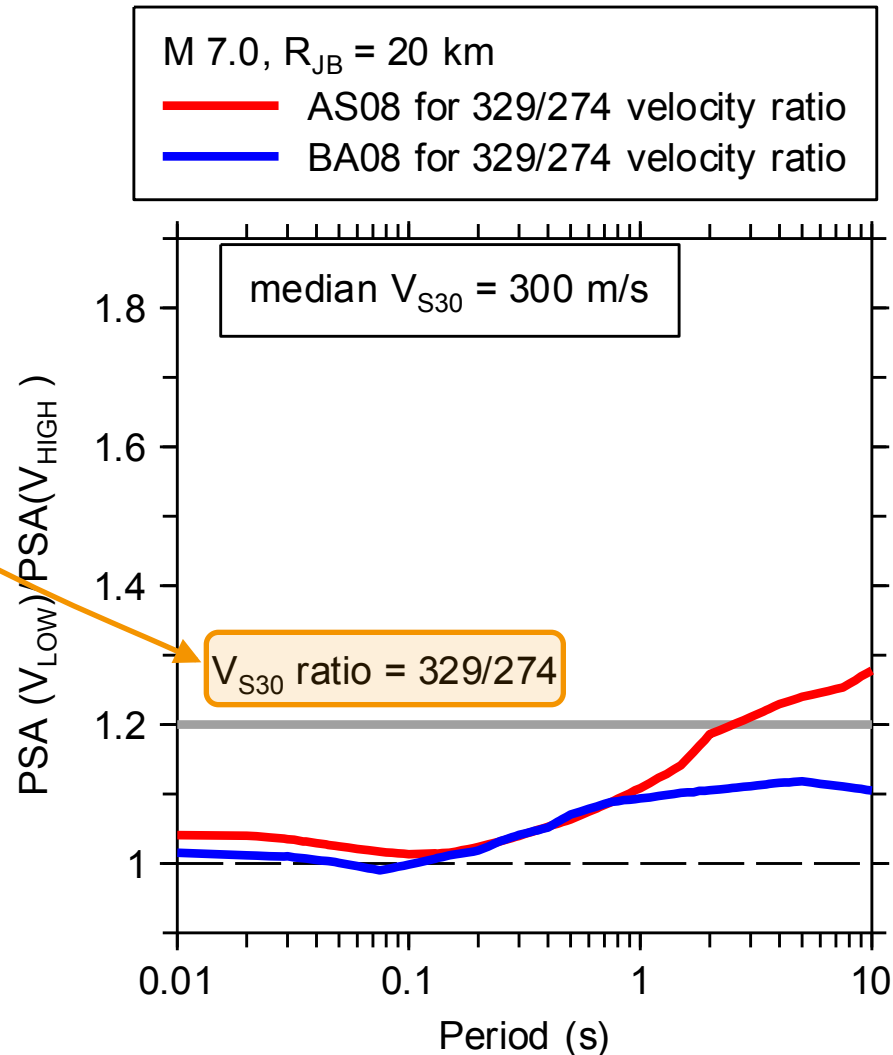
# Propagation of Uncertainty to GMPEs

For  $z = 5$  m,  $\sigma_{\log} \approx 0.12$   
- Same as  $V_{S30}$  ratio



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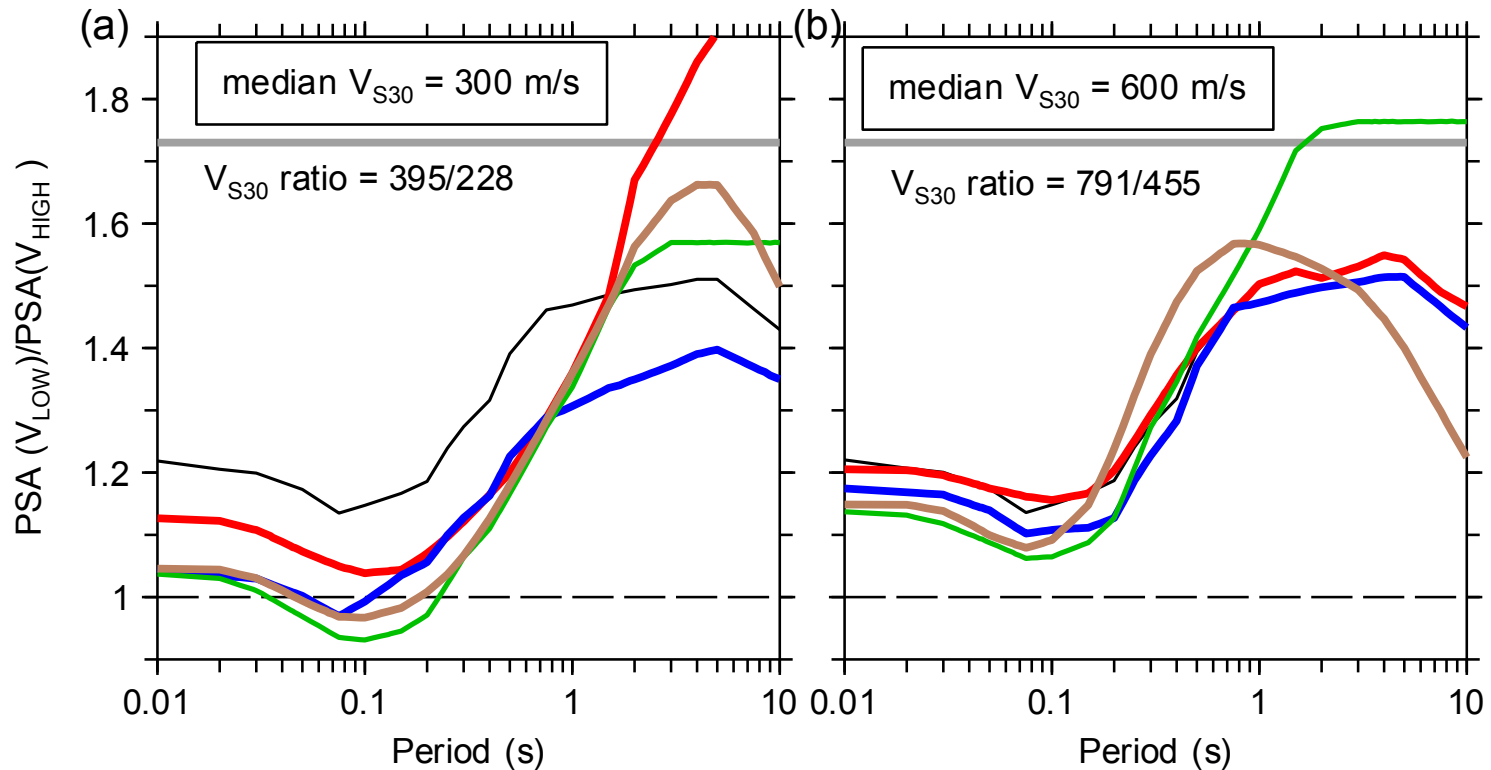
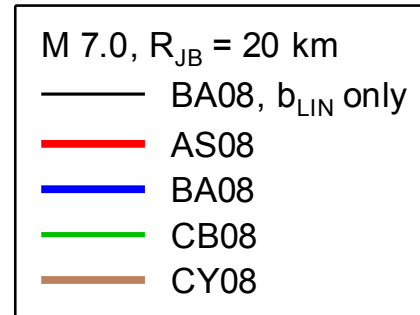
For  $z = 20$  m,  $\sigma_{\log} \approx 0.04$   
- Same as  $V_{S30}$  ratio





# Propagation of Uncertainty to GMPEs

For  $z = 5$  m,  $\sigma_{\log} \approx 0.12$   
- Same as  $V_{S30}$  ratio



# Concluding Remarks

- Uncertainty in ground motions from  $V_{S5}$  :
  - Less than 20% for short periods (<0.3 s)
- Still less than 20% for longer periods for  $V_{S20}$
- $V_{S30}$  tends to ‘work’ because it is correlated with both shallower and deeper averaging depths
- These correlations may vary by region