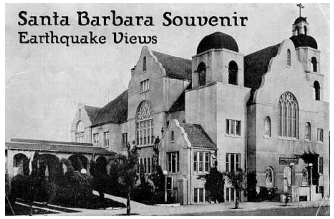


4th IASPEI / IAEE International Symposium:

Effects of Surface Geology on Seismic Motion

August 23–26, 2011 · University of California Santa Barbara

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

D. M. Boore
U.S. Geological Survey
Menlo Park USA

E. M. Thompson
Tufts University
Medford USA

H. Cadet
ISTerre, CNRS,
University of Grenoble
Grenoble FRANCE

26 August, 2011

Introduction

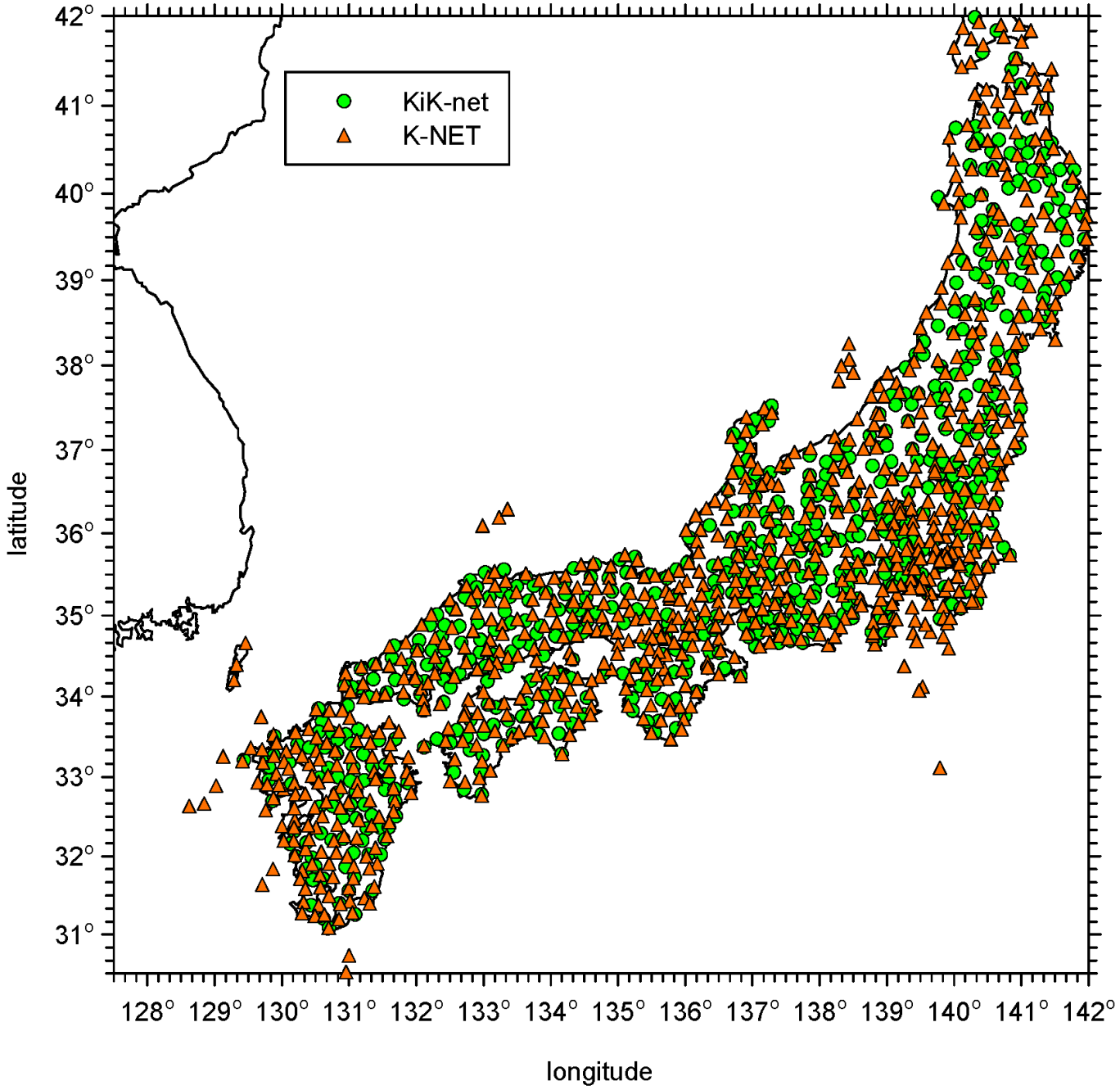
- Improvement strategies generally focus on additional parameters, e.g. thickness/depth
  - $Z_{1.0}$, $Z_{2.5}$, f_0, V_{SZ}, etc.
- V_{S30} is a statistical parameter
- Regardless of physics, additional parameters are not useful unless they are statistically independent
- Additional parameters are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

Outline

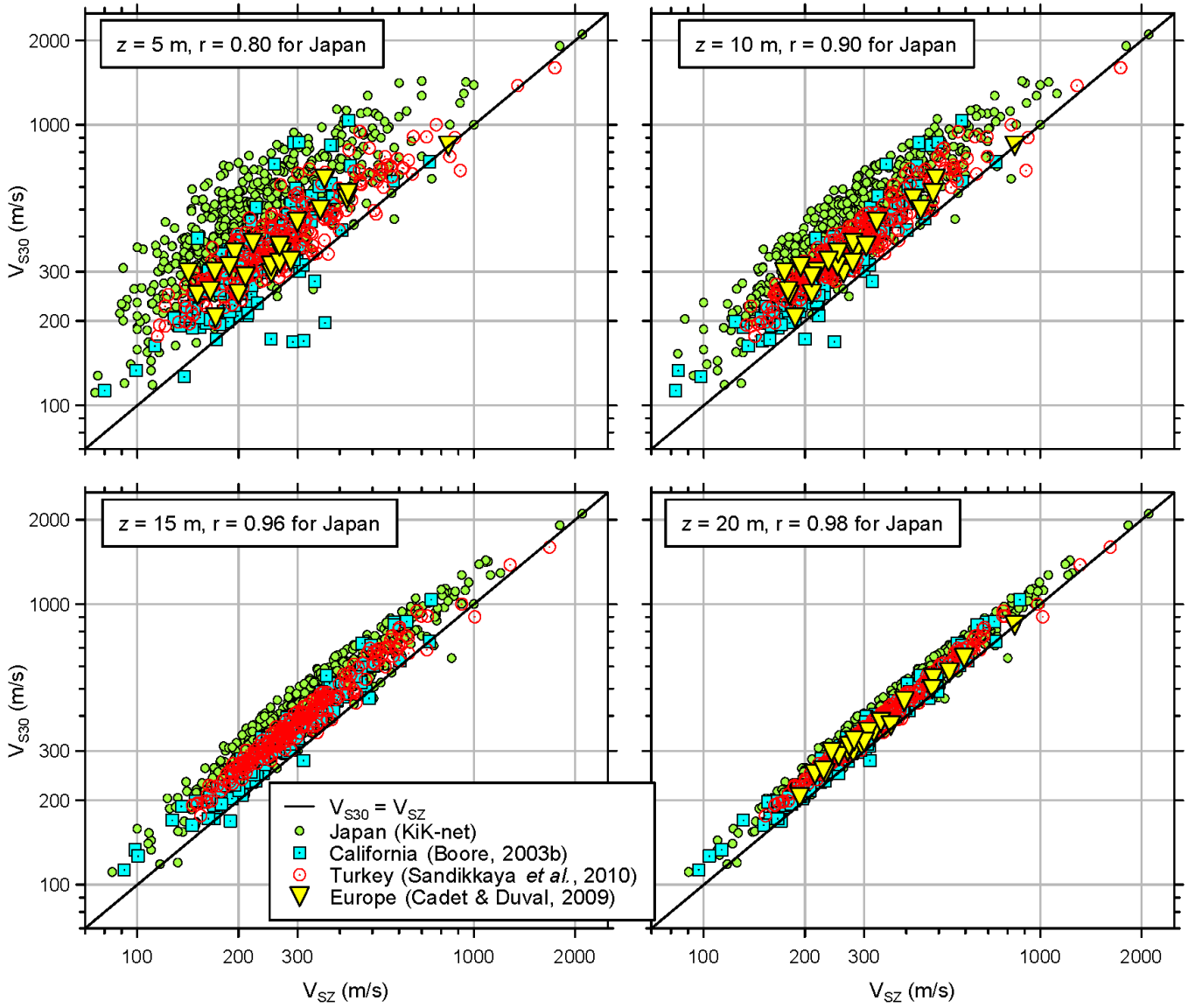
1. **Regional Differences in Correlations of V_{S30} with V_{SZ} for z < 30 m**
2. What averaging depths are important for site response?
   - Are those depths correlated with V_{S30}?
3. How does V_{S30} uncertainty propagate into ground motion equations?

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

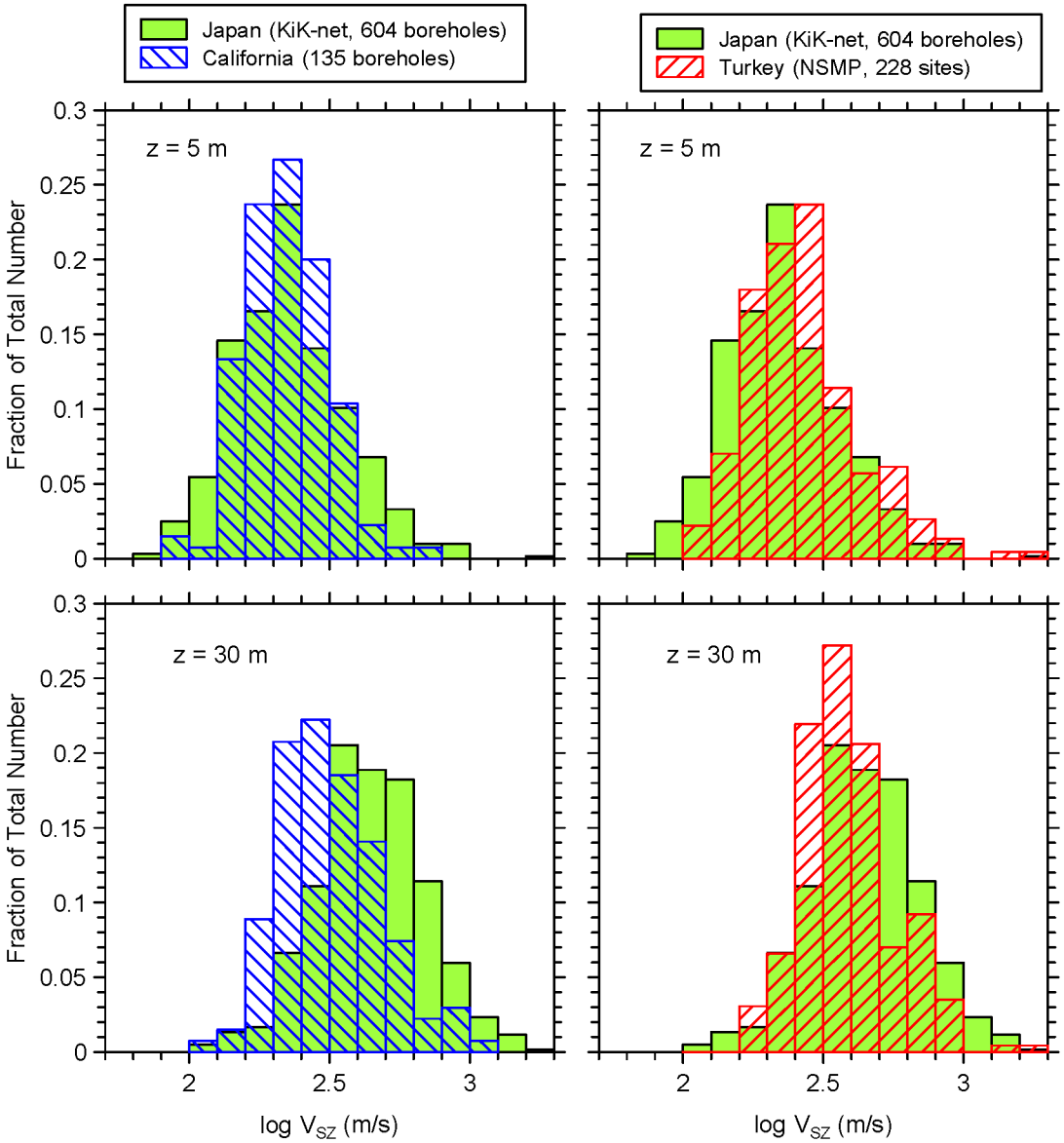
- Boore (2004) presented equations to compute V_{S30} from V_{SZ} based on California profiles
- Walt Silva found that these equations were inaccurate in China
- K-net profiles generally do not extend beyond 20 m
- Redo regression with KiK-net profiles


KiK-net
K-NET
42°
41°
40°
39°
38°
37°
36°
35°
34°
33°
32°
31°
latitude
128°
129°
130°
131°
132°
133°
134°
135°
136°
137°
138°
139°
140°
141°
142°
longitude

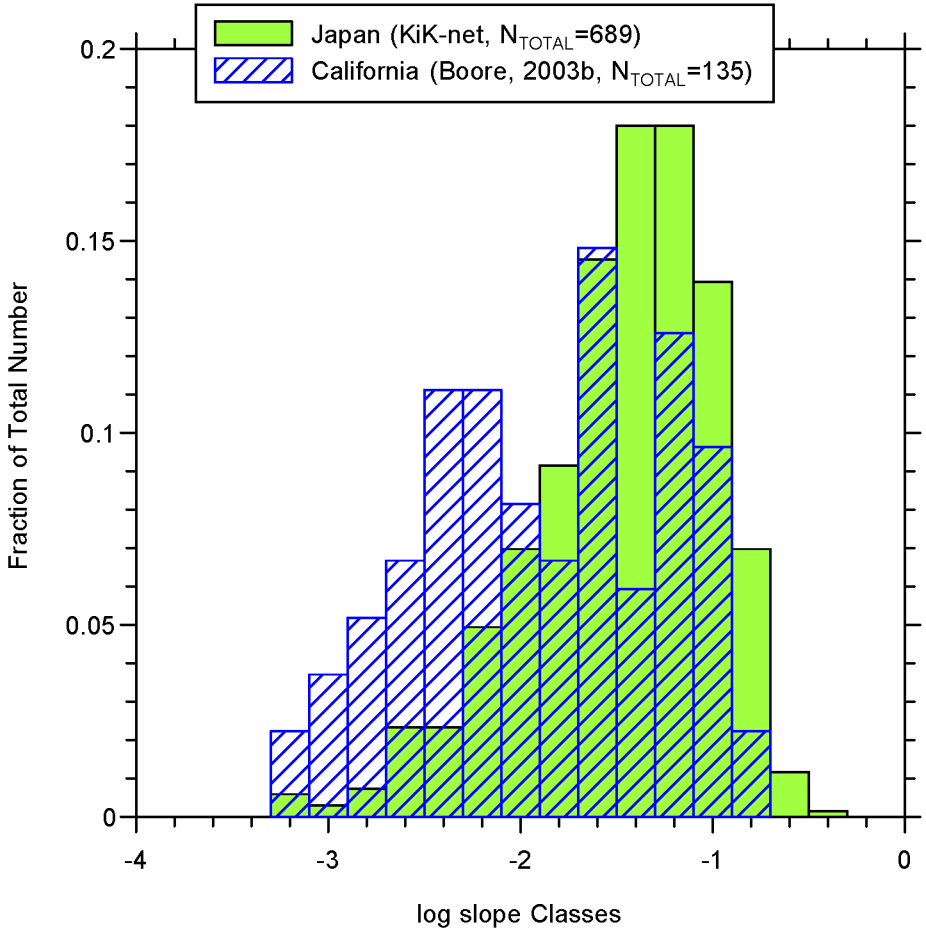
Relationship Between V_{S30} and V_{SZ} by Region



Regional Differences of V_{SZ}



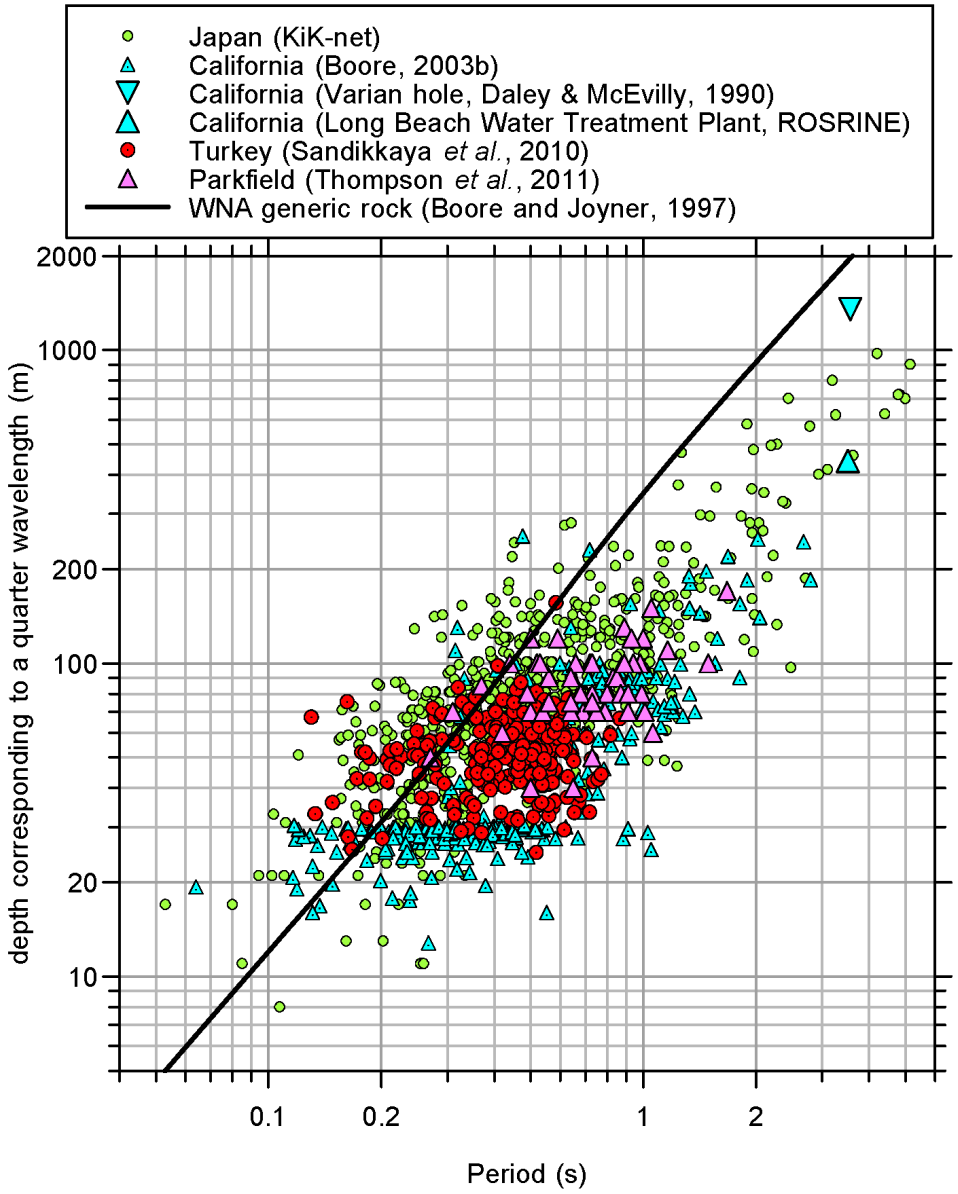
Why Are The V_{SZ} Different?



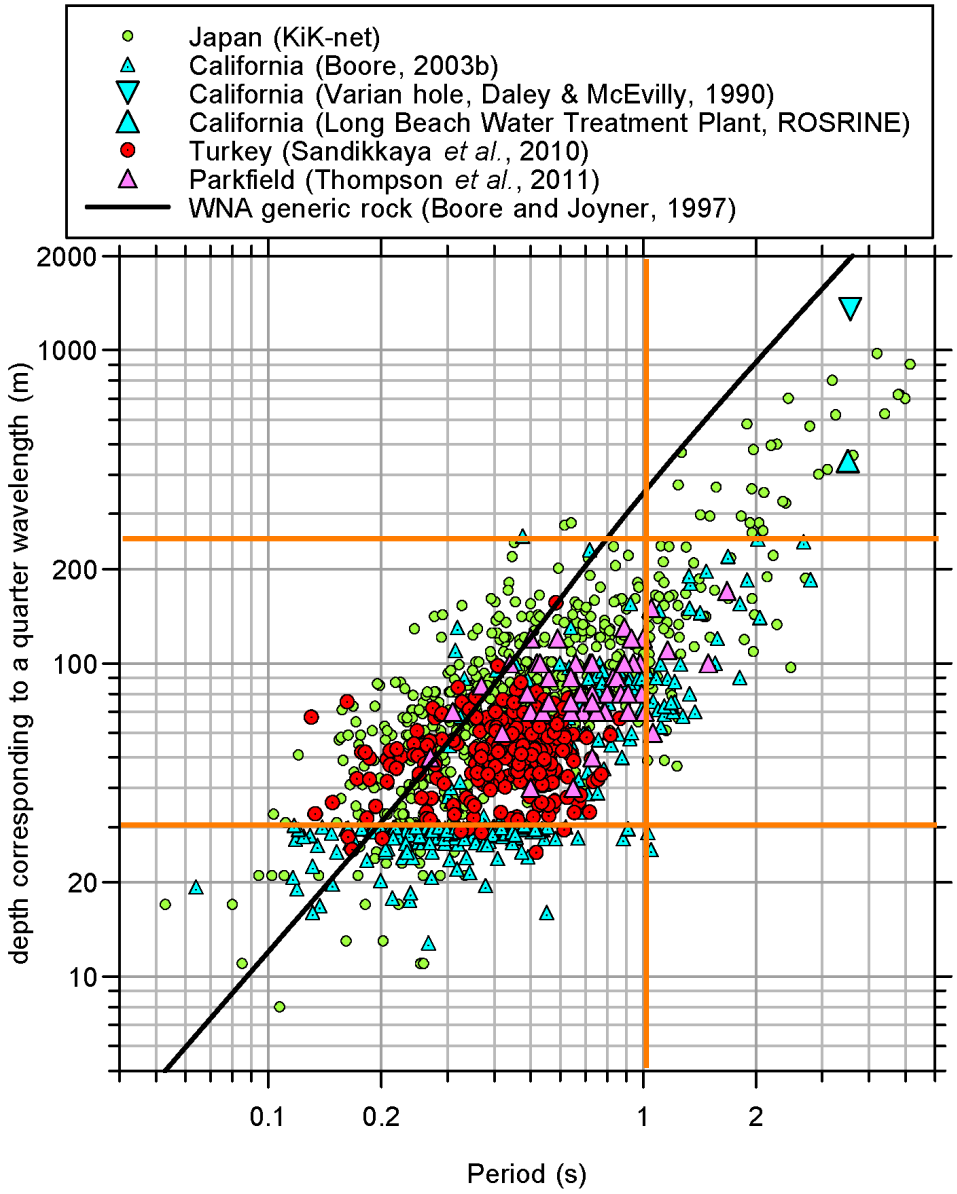
Outline

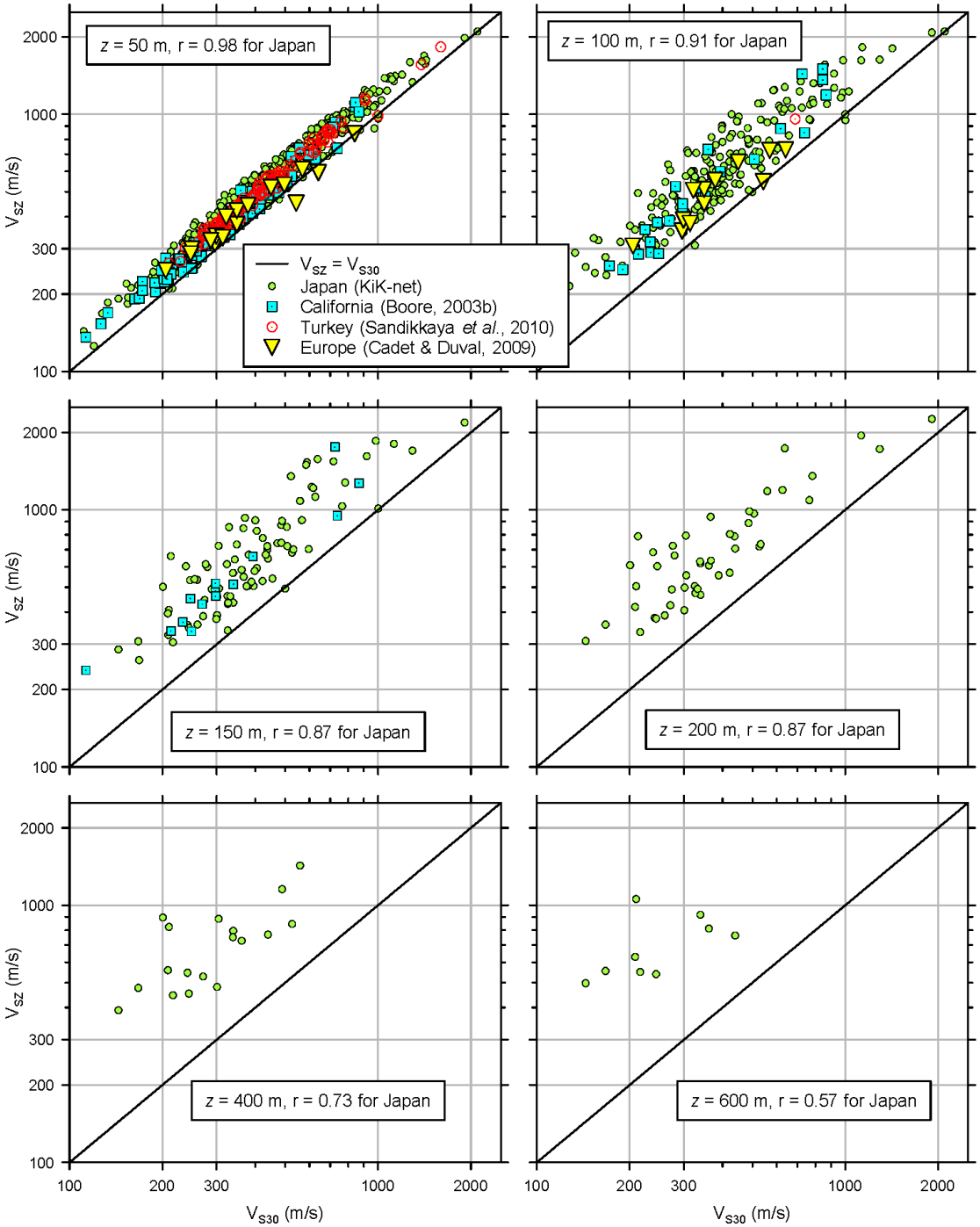
1. Regional Differences in Correlations of V_{S30} with V_{SZ} for z < 30 m
2. **What averaging depths are important for site response?**
   - Are those depths correlated with V_{S30}?
3. How does V_{S30} uncertainty propagate into ground motion equations?

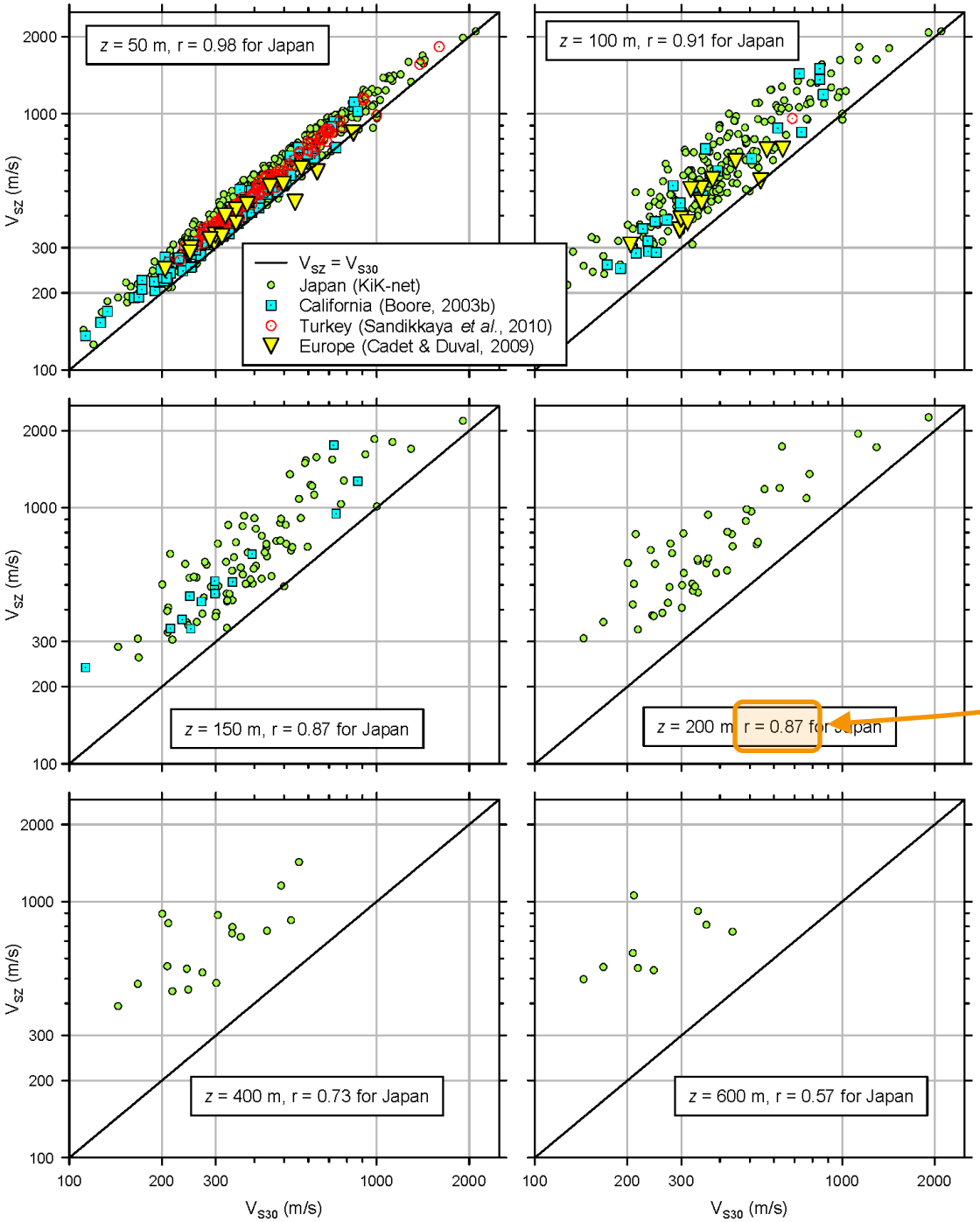
What Depths Are Important?



What Depths Are Important?




z = 50 m, r = 0.98 for Japan
z = 100 m, r = 0.91 for Japan
z = 150 m, r = 0.87 for Japan
z = 200 m, r = 0.87 for Japan
z = 400 m, r = 0.73 for Japan
z = 600 m, r = 0.57 for Japan
Vsz = Vs30
Japan (KiK-net)
California (Boore, 2003b)
Turkey (Sandikkaya et al., 2010)
Europe (Cadet & Duval, 2009)
Vsz (m/s)
Vs30 (m/s)
100
200
300
1000
2000



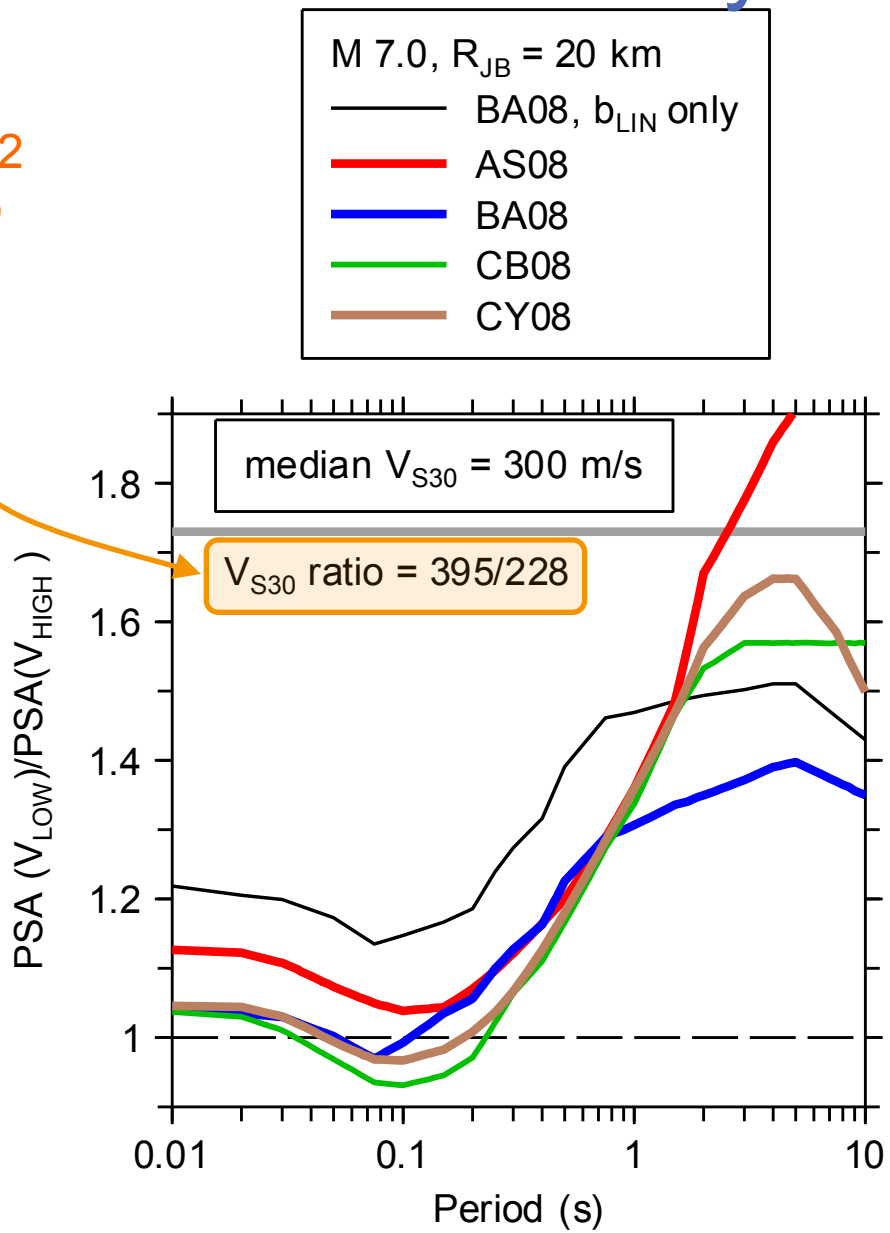
Greater than *r* between V_{S30} and V_{S5}

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?**

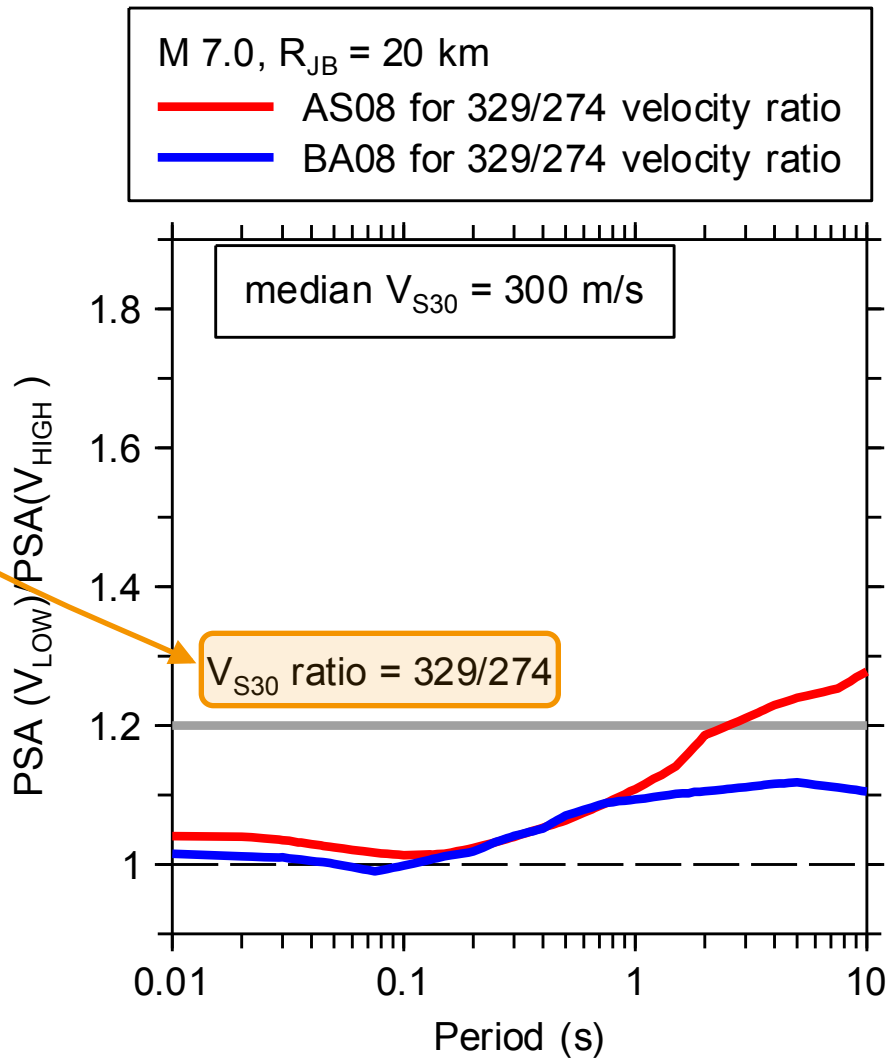
Propagation of Uncertainty to GMPEs

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



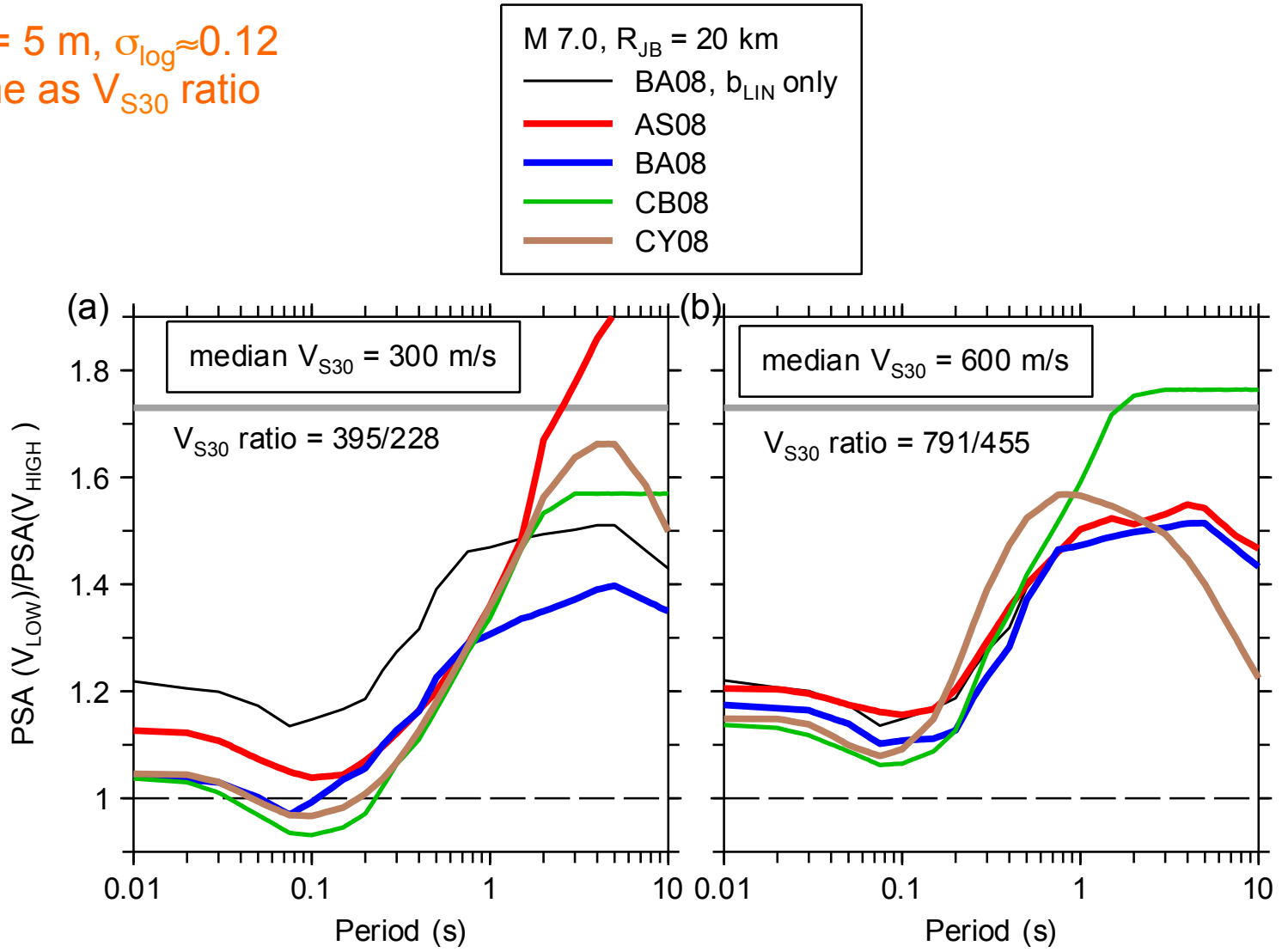
Propagation of Uncertainty to GMPEs

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