

Calibration of Hybrid Simulation Procedure

Emel Seyhan and Jonathan P. Stewart
University of California, Los Angeles

Robert W. Graves
USGS, Pasadena, CA

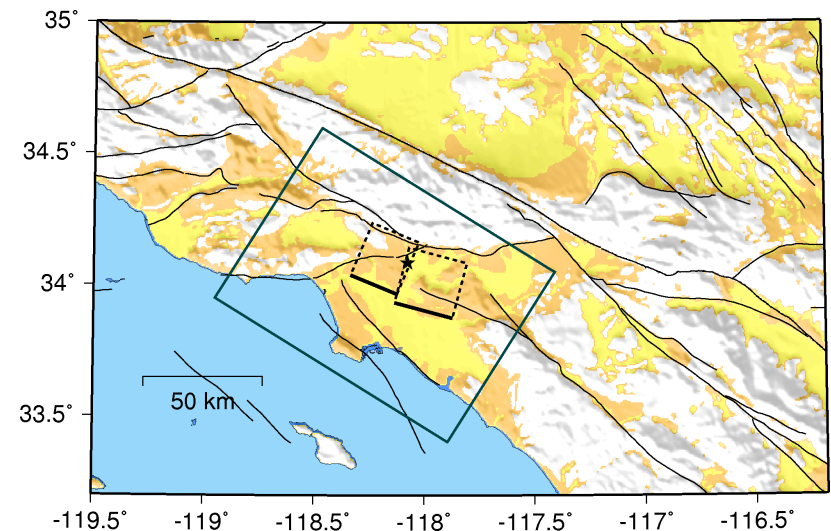
TSRP Coordination Meeting
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Davis Hall, Berkeley

Outline

- Hybrid simulation procedure
- Problems with existing procedure
 - Distance attenuation
 - Standard deviation
- Present study
 - Distance attenuation calibration
 - Intra-event scatter calibration

Motivation

- Broadband motions for response history analysis
- Some (M, R) ranges poorly sampled by recordings



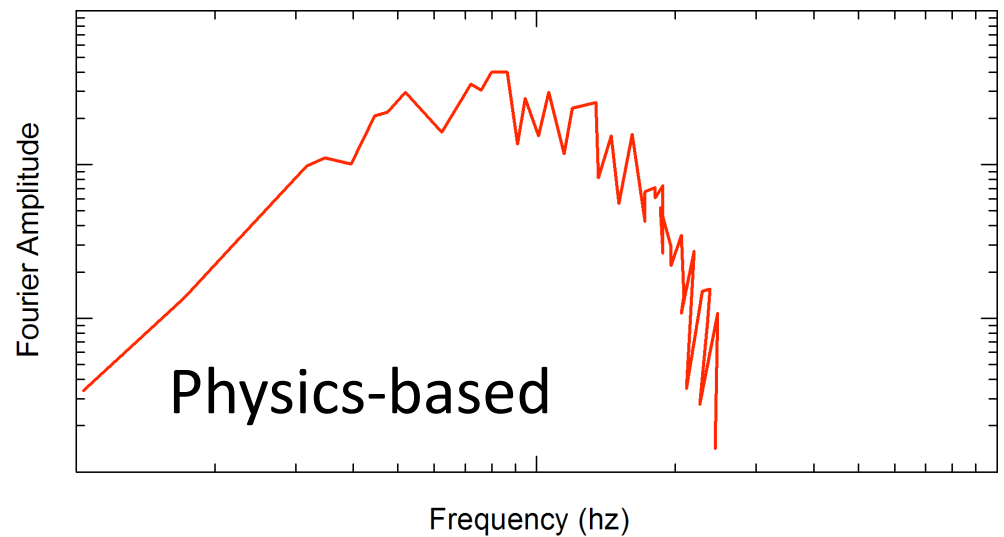
- Motions needed with

Simulations hold potential to provide useful ground motions for engineering application in these situations

- Near fault effects

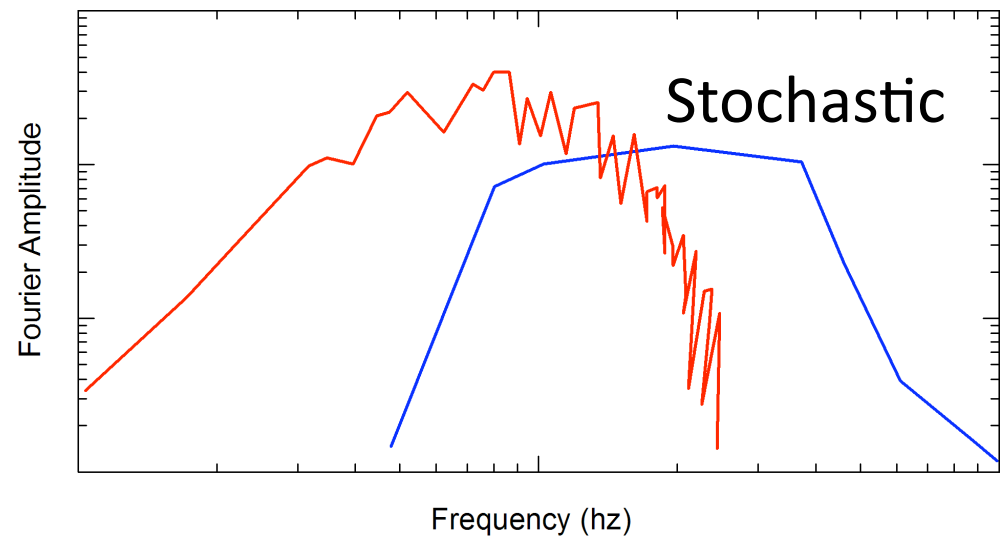
Simulation Procedure

- Hybrid procedure
 - $f < 1$ Hz: physics based



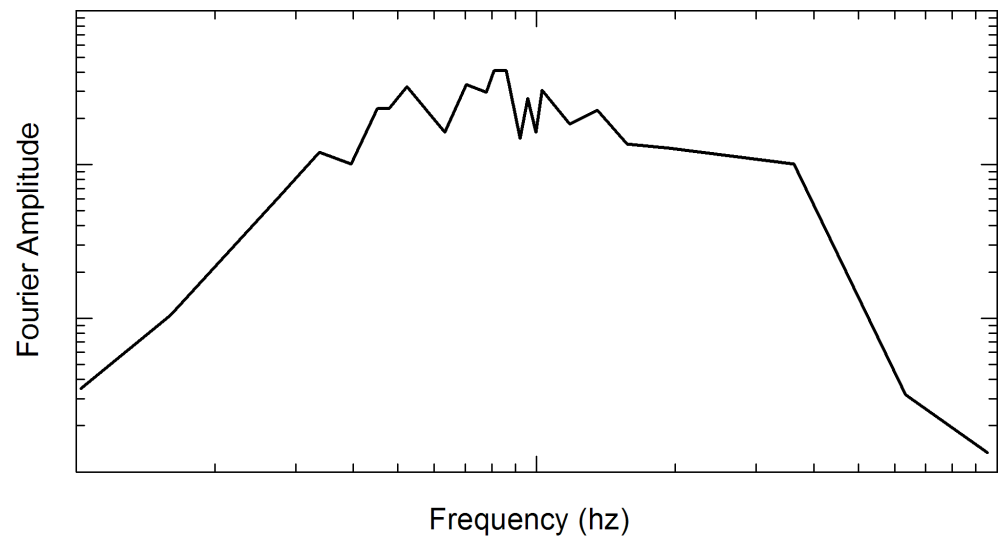
Simulation Procedure

- Hybrid procedure
 - $f < 1$ Hz: physics based
 - $f > 1$ Hz: stochastic



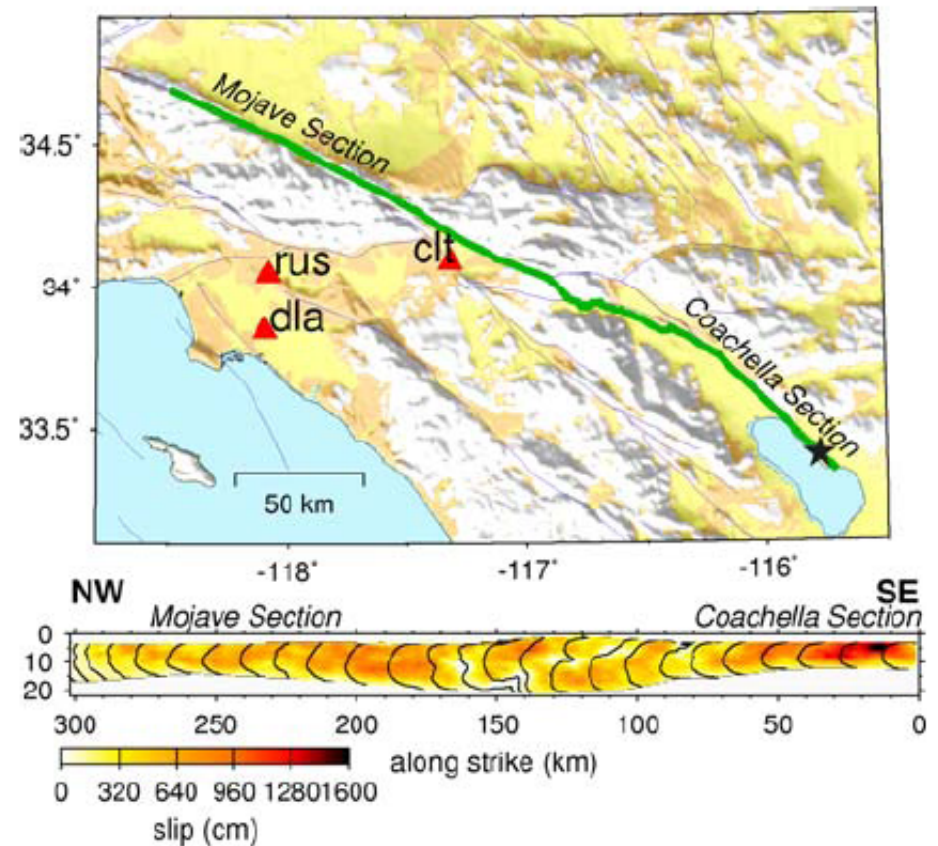
Simulation Procedure

- Hybrid procedure
 - $f < 1$ Hz: physics based
 - $f > 1$ Hz: stochastic



Simulation Procedure

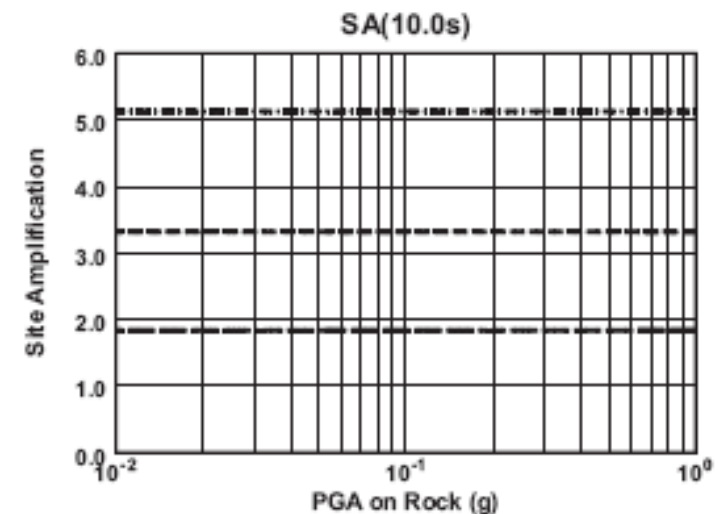
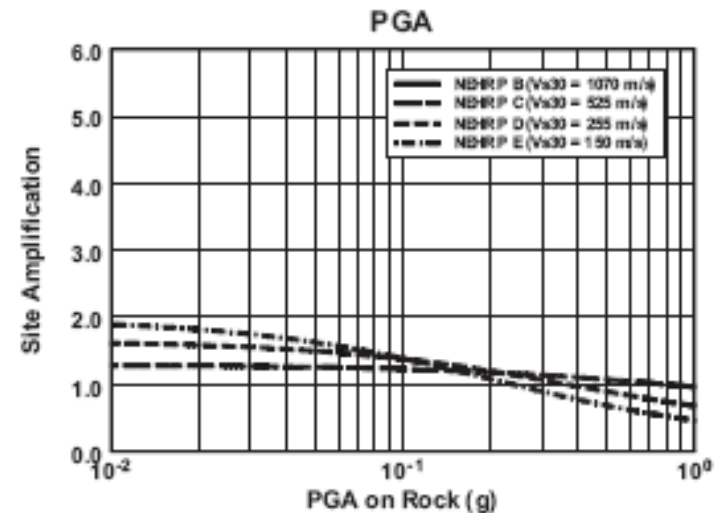
- Hybrid procedure
- Source function
 - Slip distribution
 - Rupture velocity



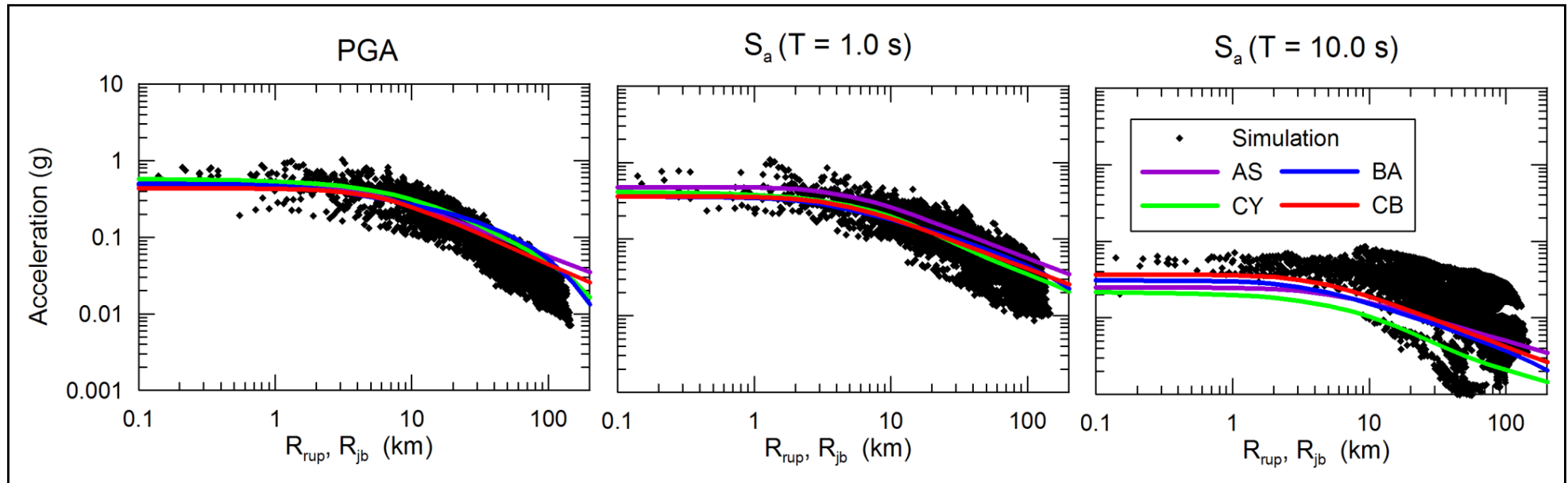
Shakeout, M_w 7.8

Simulation Procedure

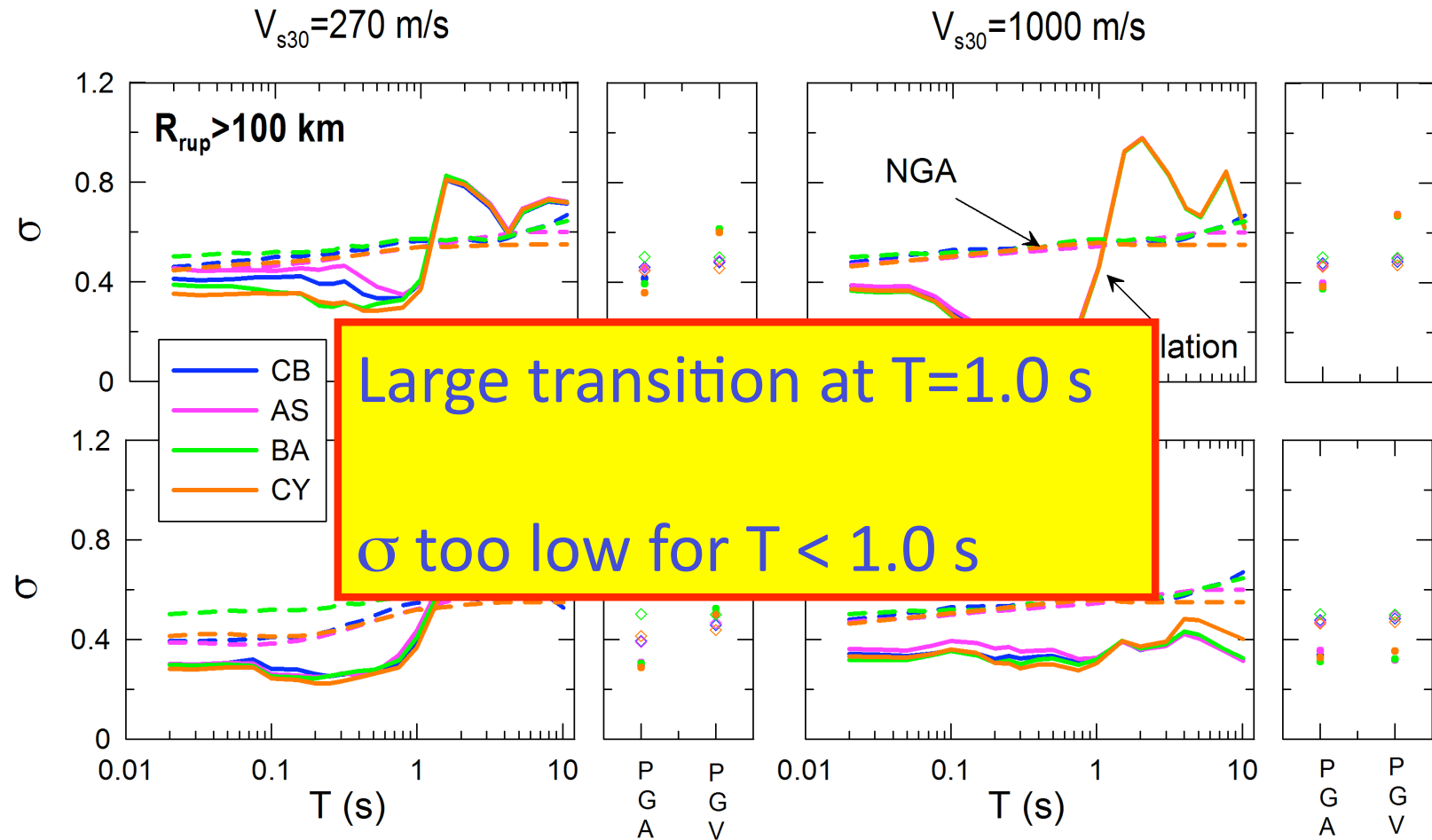
- Hybrid procedure
- Source function
- Semi-empirical site term (fn of V_{s30})



Distance Attenuation



Standard Deviation



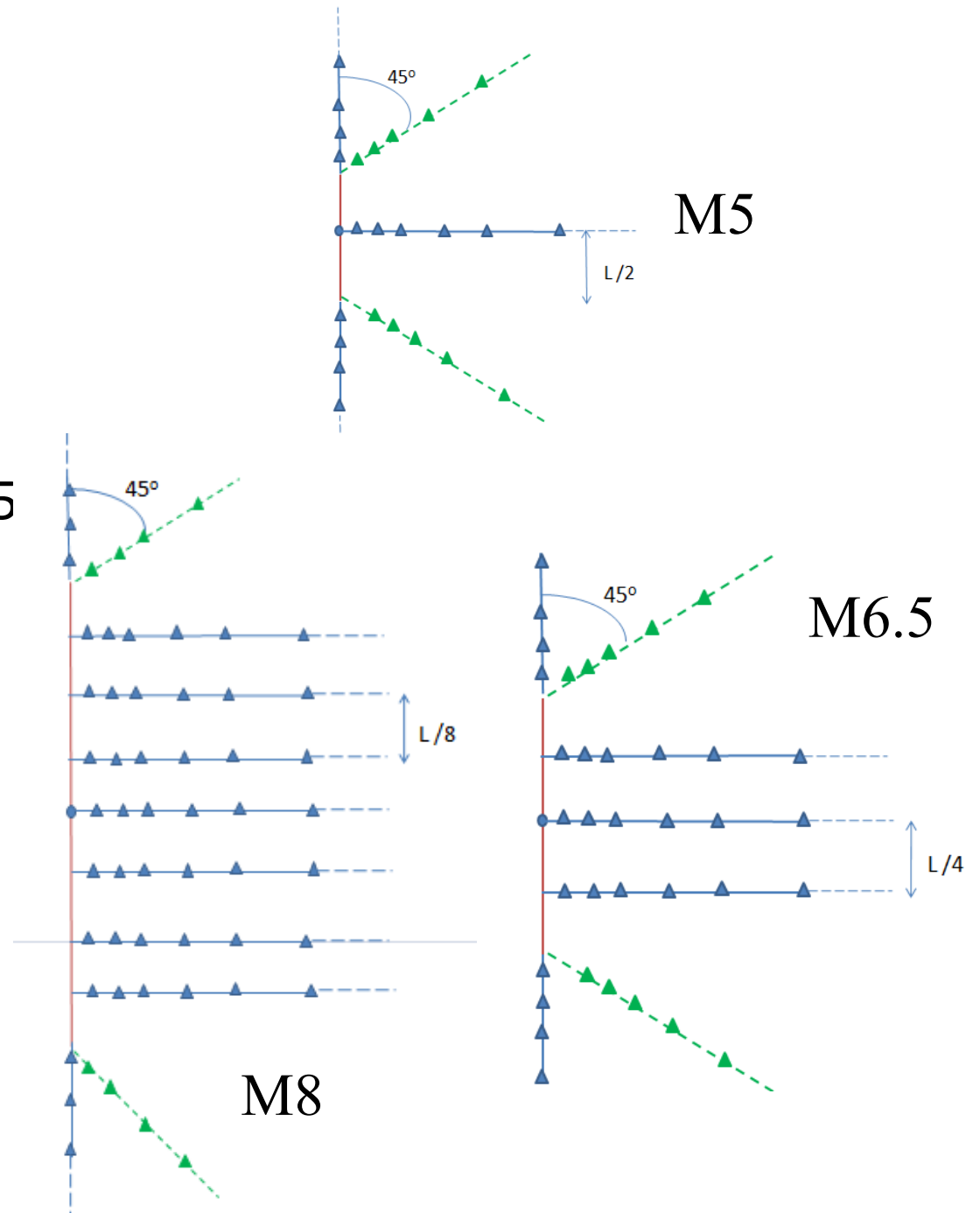
$$\sigma = \text{stdev}(\varepsilon)$$

Present Study

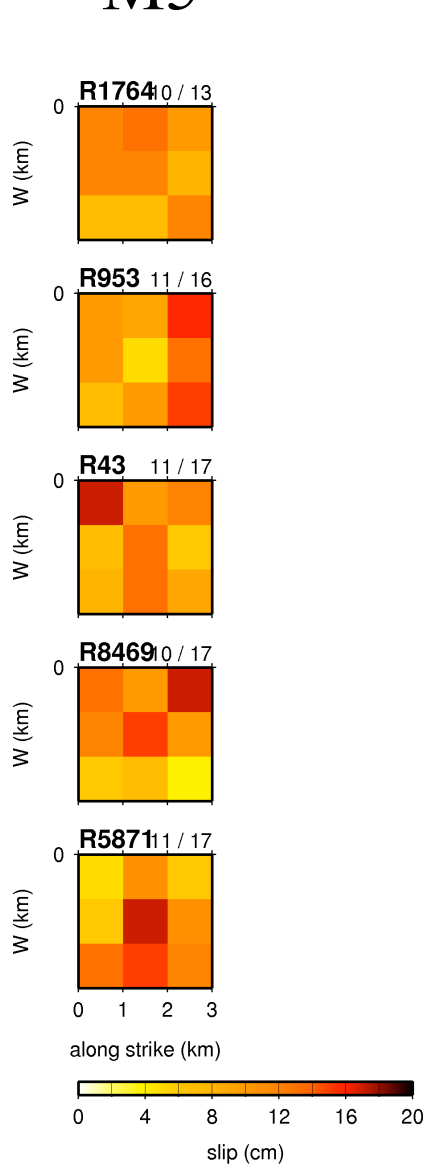
- Focus on high frequency stochastic model
- Parameters affecting stochastic model
 - Source parameters: Stress drop, slip function, rise time, rupture velocity
 - Path parameters: Distance, crustal damping (Q)
 - Site parameters: Crustal velocity, shallow site term
- We select Q as the parameter for modification for the distance attenuation
- We plan to randomize crustal velocity to increase the sigma

Scope

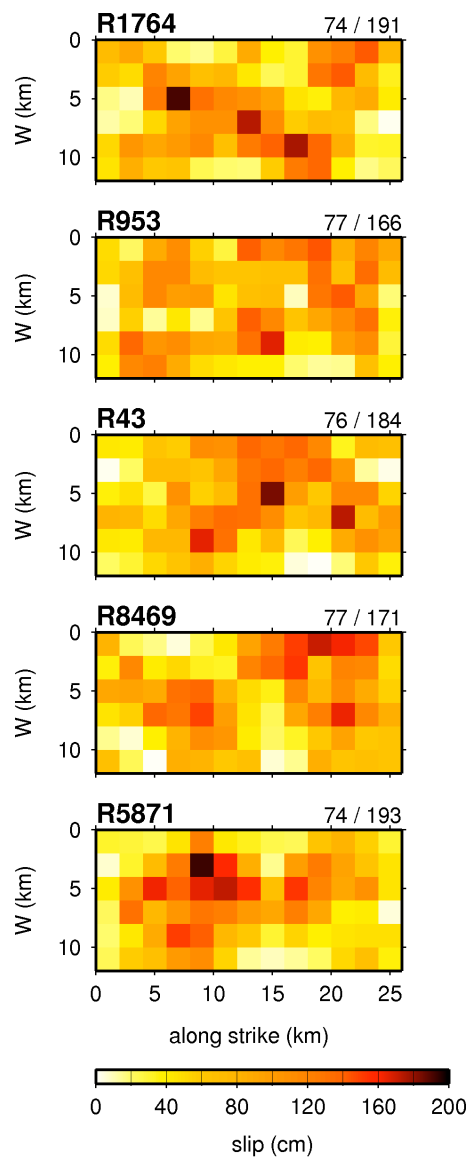
- Distance attenuation calibration
 - Strike slip fault M5, 6.5 and 8
 - Distributed arrays



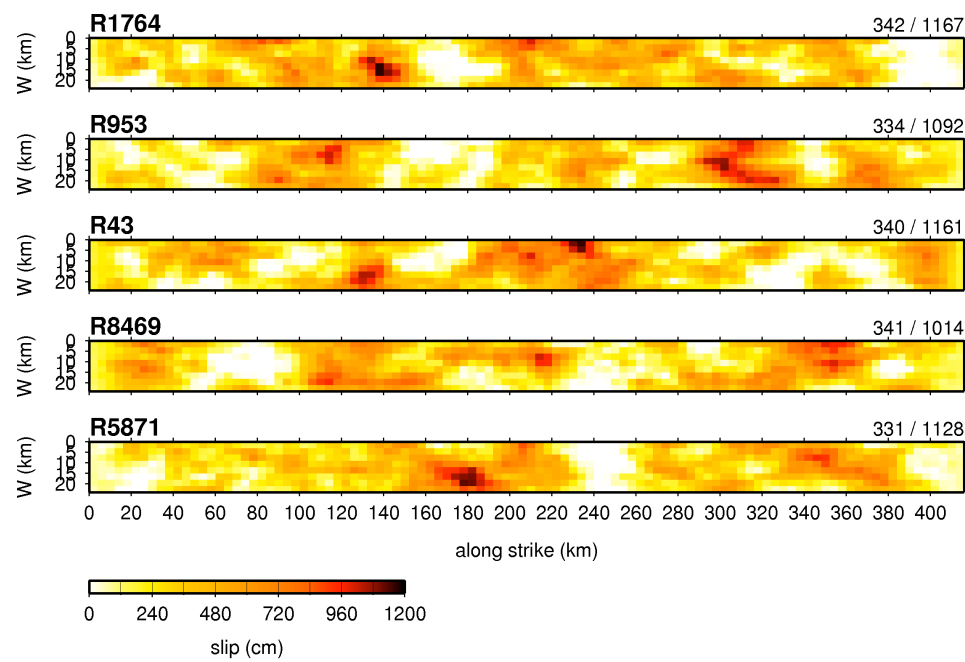
M5

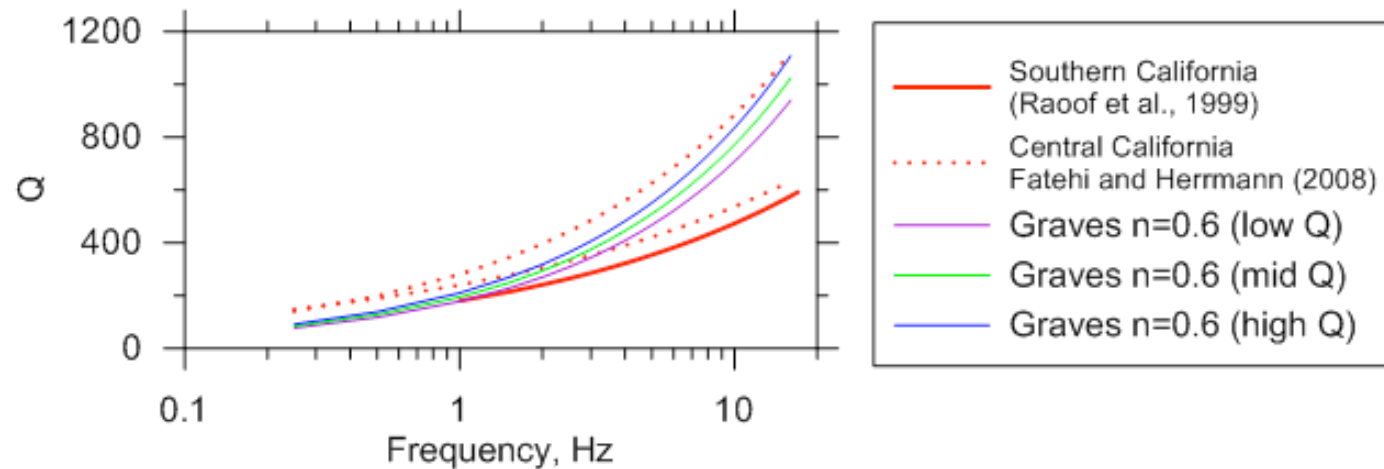


M6.5



M8

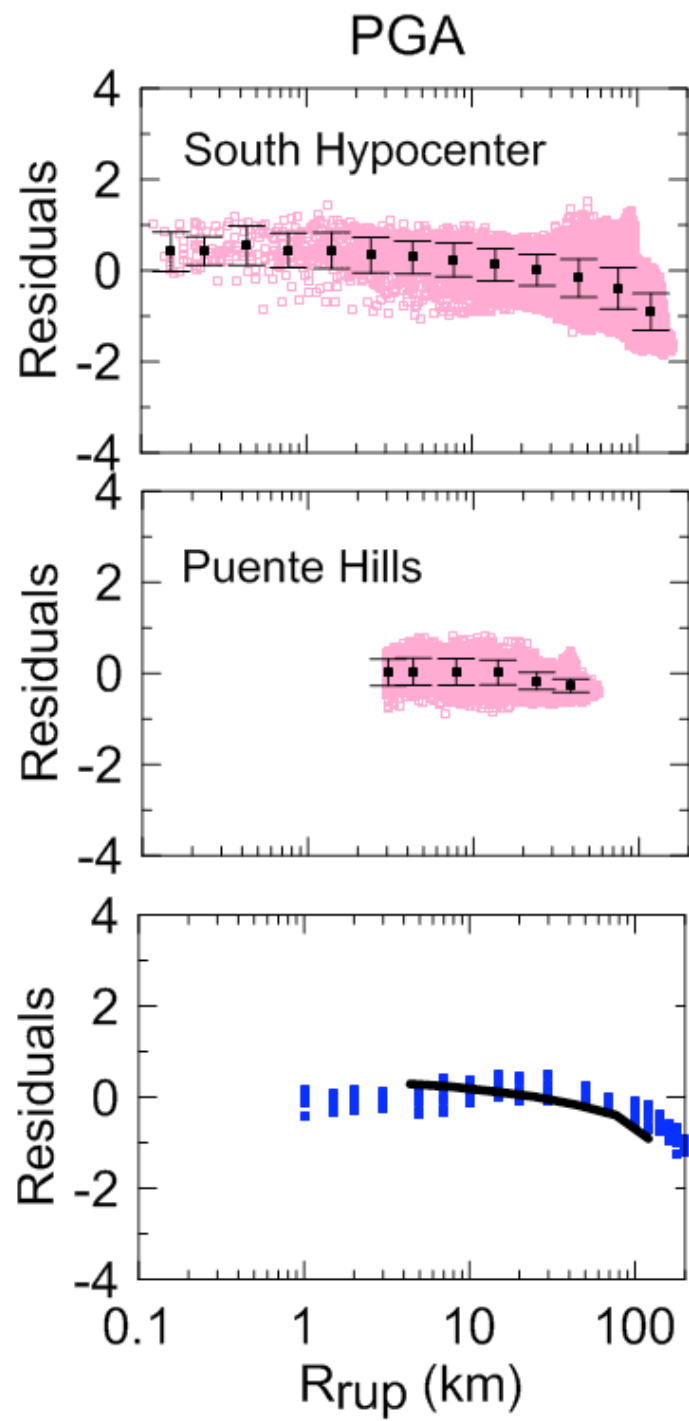


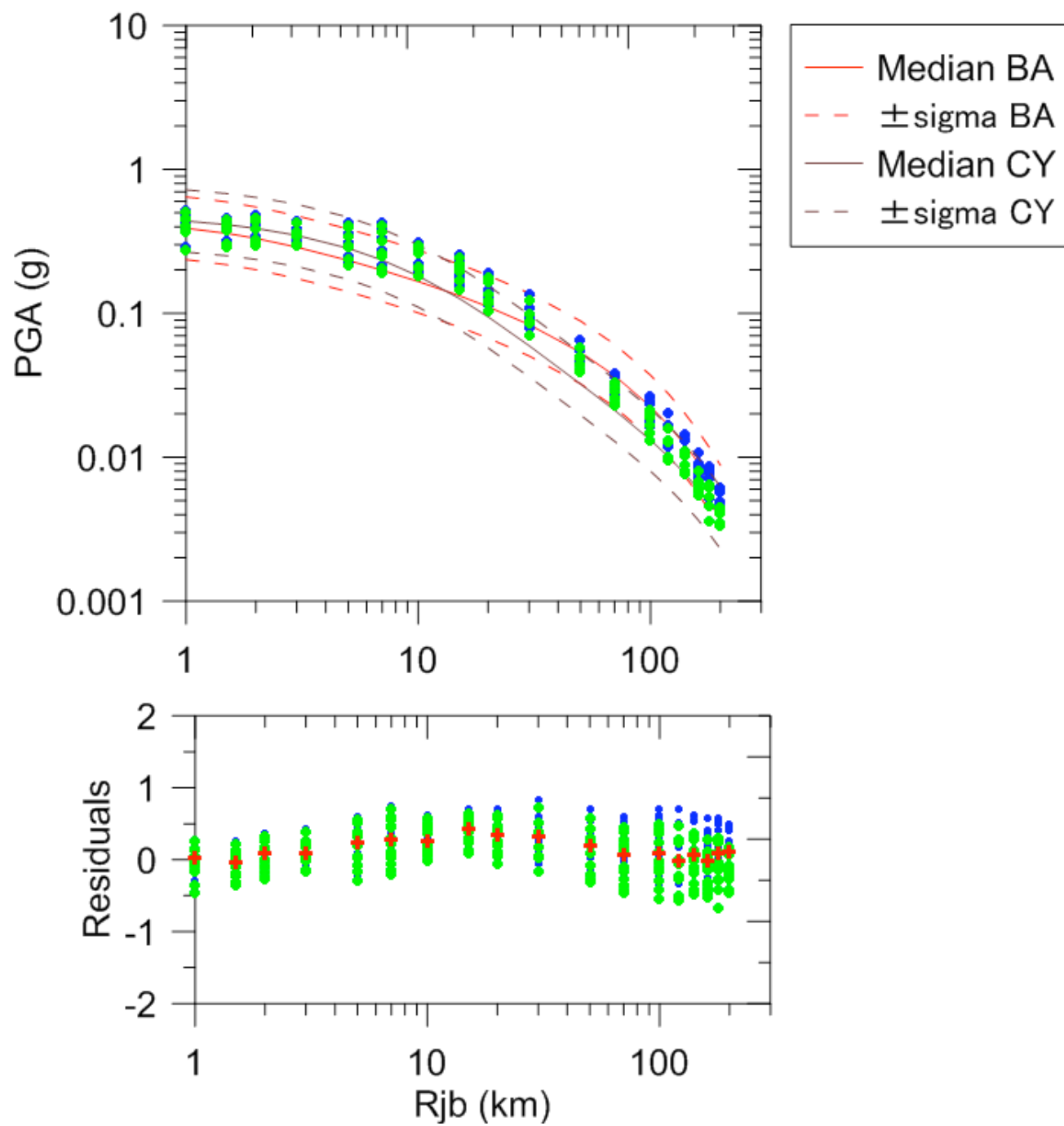


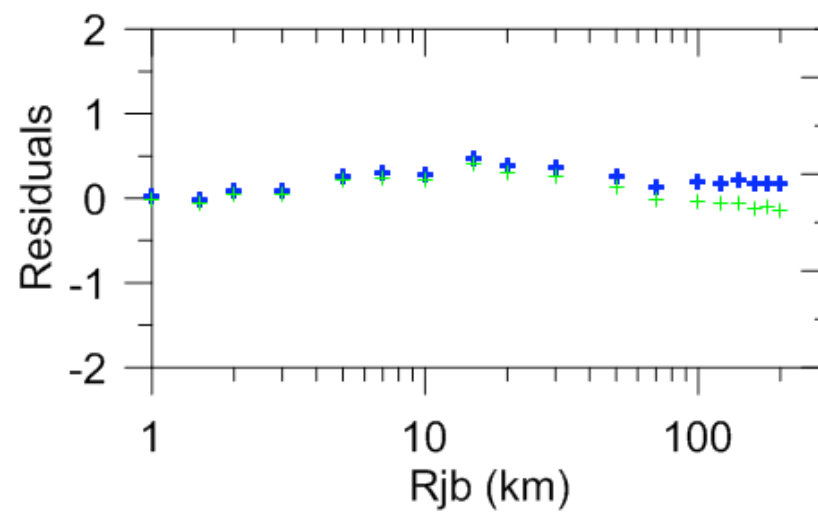
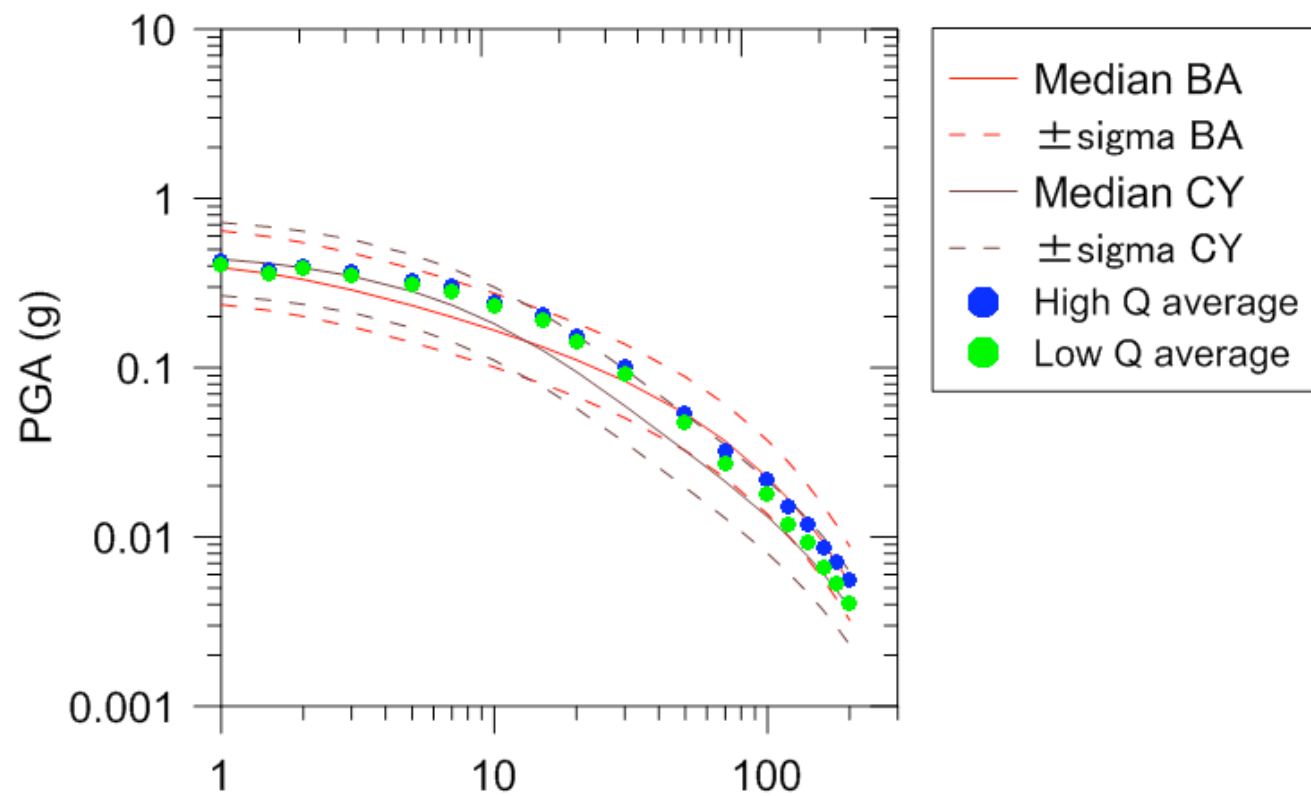
- Distance attenuation calibration
 - Strike slip fault, M 5, 6.5, 8
 - Distributed and dense arrays
 - Repeat Hybrid sim. for various levels of crustal damping, Q

$$Q(f) = Q_0 * f^n$$

$$Q_0 = a + bV_s$$

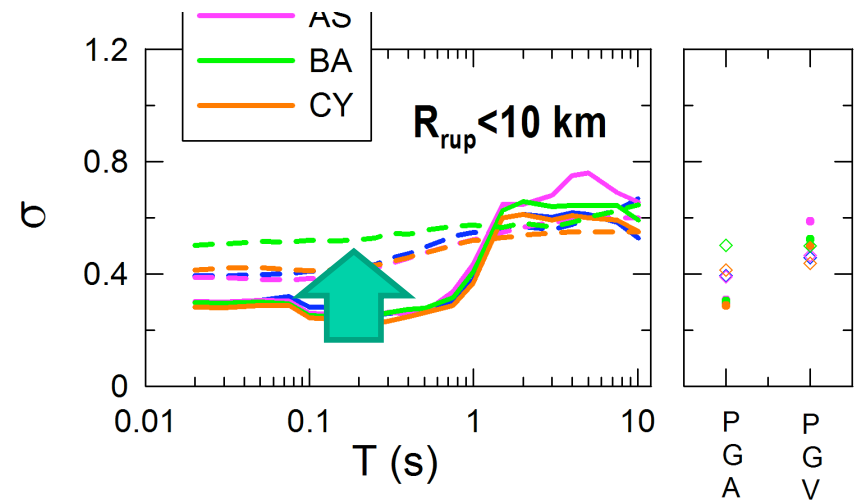






Scope

- Distance attenuation calibration
- Intra-event scatter calibration
 - Randomized velocity
 - Randomized Fourier Amplitude
 - Randomized Q



Summary of Work

Completed Work

- Distance attenuation calibration
 - Source model selected
 - Magnitude 6.5 simulations completed
 - The critical parameter for calibration identified (Q)

Remaining Work

- Distance attenuation calibration
 - Simulations for M5, M8
- Intra event scatter calibration

Thank you !