CENA Empirical Linear Site Amp Updates

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Outline

- Gulf Coast GMM adjustment factors
- Updated V_{S30}
- Updated Results, with influence of:
  - Gulf Coast
  - PIE
- Glaciated vs. Non-glaciated Profiles

NGA-East GC Adjustment

- Gulf Coast adjustments
  - For when source, path and site are all in GC
  - Still excluding recordings where path crosses into/ out of GC
- Two Models
  - PEER Empirical
  - DASG Simulation Based

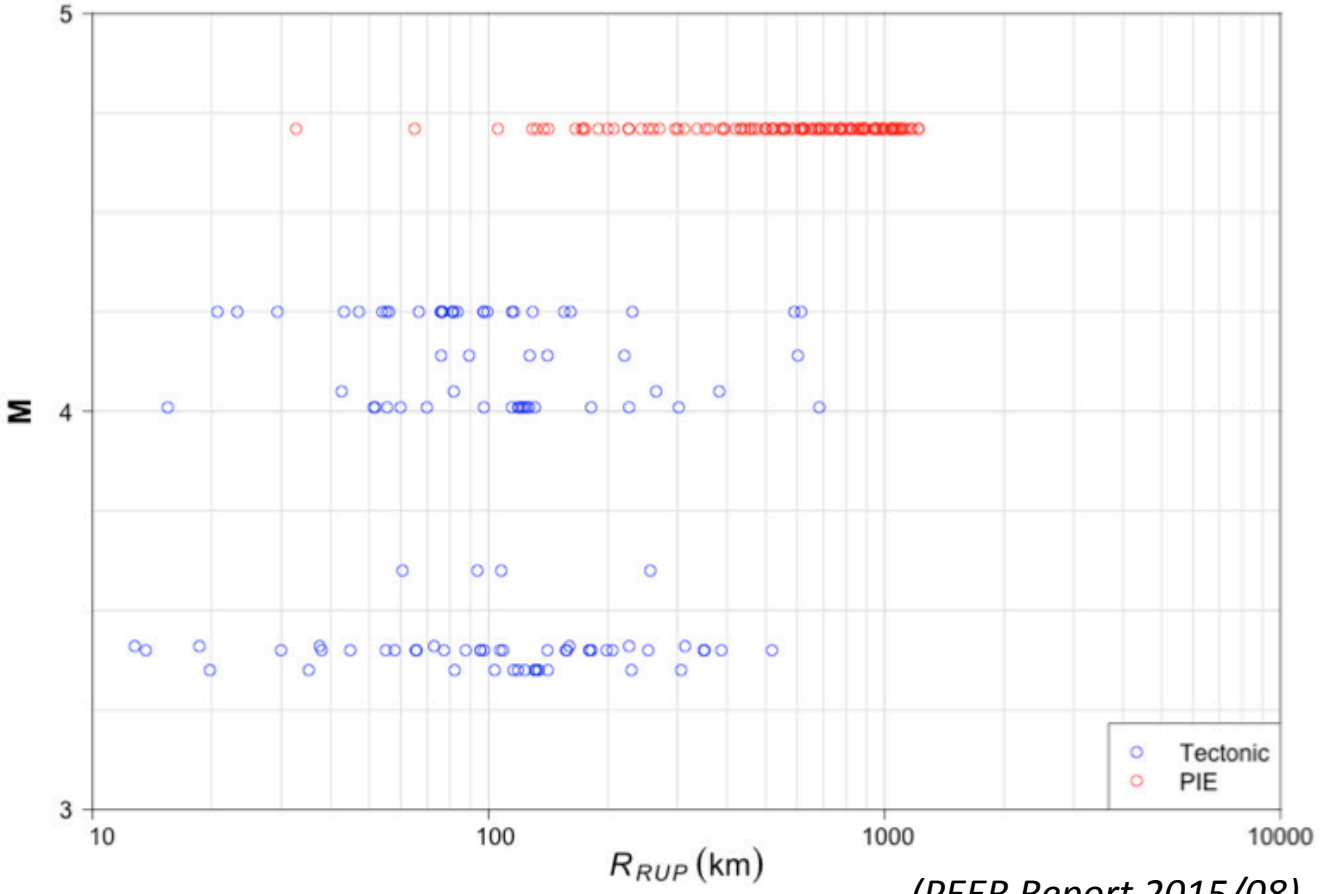
PEER Empirical

- Based on residuals between NGA-East GMMs and Gulf Coast data

EQ Name	EQ I.D.	M	Z_{HYP} (km)	PIE	R_{RUP} (km)	V_{S30} (m/sec)
Blytheville 2003-04-30	22	3.6	23	No	60.62 - 255.93	235.2 - 1288
Bardwell 2003-06-06	23	4.05	1.25	No	42.58 - 382.1	235.2 - 1288
MilliganRdg 2005-02-10	31	4.14	15	No	75.91 - 603.34	235.2 - 1288
ShadyGrove 2005-05-01	33*	4.25	8	No	20.68 - 614.84	185 - 1288
Miston 2005-06-02	34*	4.01	15	No	15.49 - 683.17	185 - 1288
Ridgely 2006-09-07	38*	3.35	7	No	19.8 306.21	185 - 1288
Marston 2006-10-18	41*	3.41	8.2	No	12.79 - 313.1	210 - 1288
Whiting 2010-03-02	58*	3.4	5	No	13.64 - 518.85	160 - 1288
Comal 2011-10-20	92*	4.71	4	Yes	32.68 - 1216.91	217.6 - 1288

(PEER Report 2015/08)

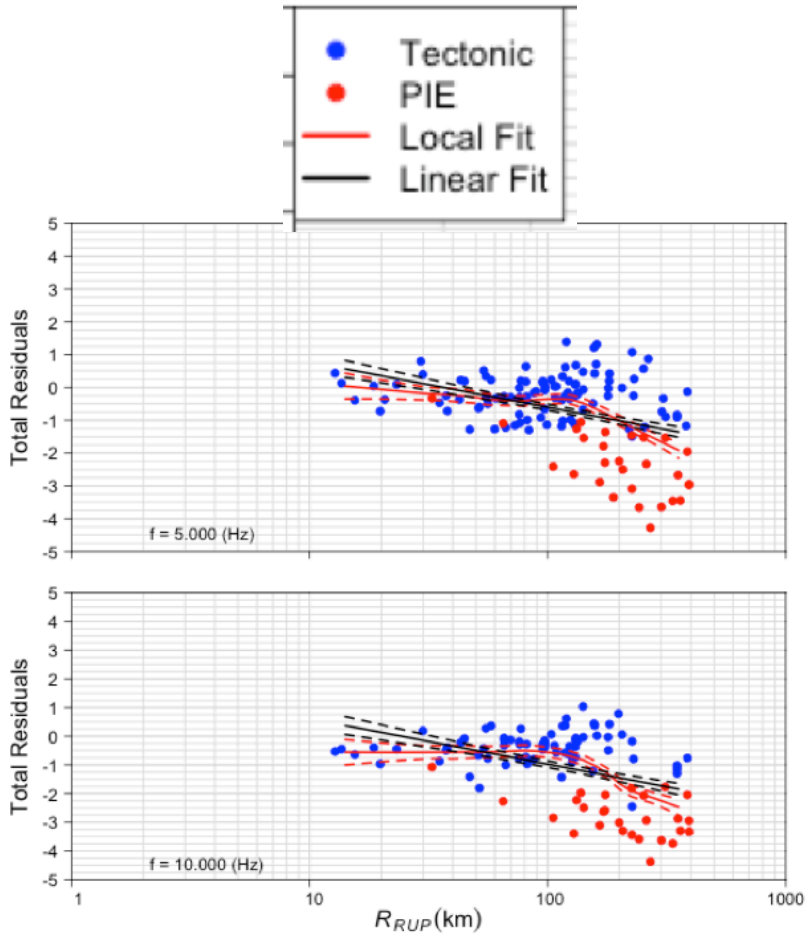
Gulf Coast Data



(PEER Report 2015/08)

Trends in Total Residual

1. Slope ~ 0 for $R_{RUP} \leq$ 100 km.
2. Beyond 100 km, slope is linear and negative

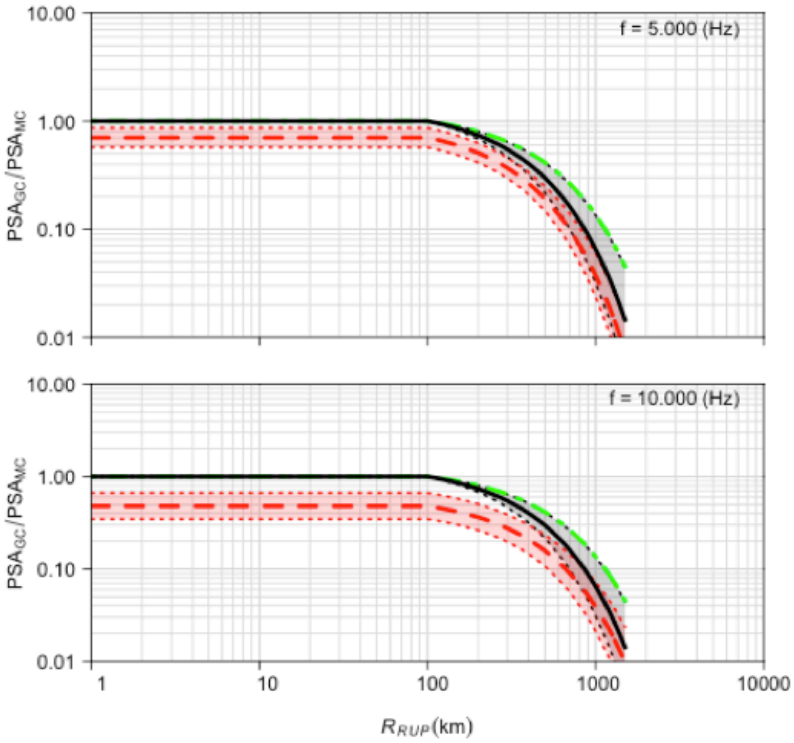


(PEER Report 2015/08)

PEER Model

$$\frac{PSA_{GC}}{PSA_{MC}}(f) = \begin{cases} c_0 & R_{RUP} < 100km \\ c_0 + c'_7 \left(R_{RUP} - 100\right) & R_{RUP} \geq 100km \end{cases}$$

Coefficients set by mixed-effects regression

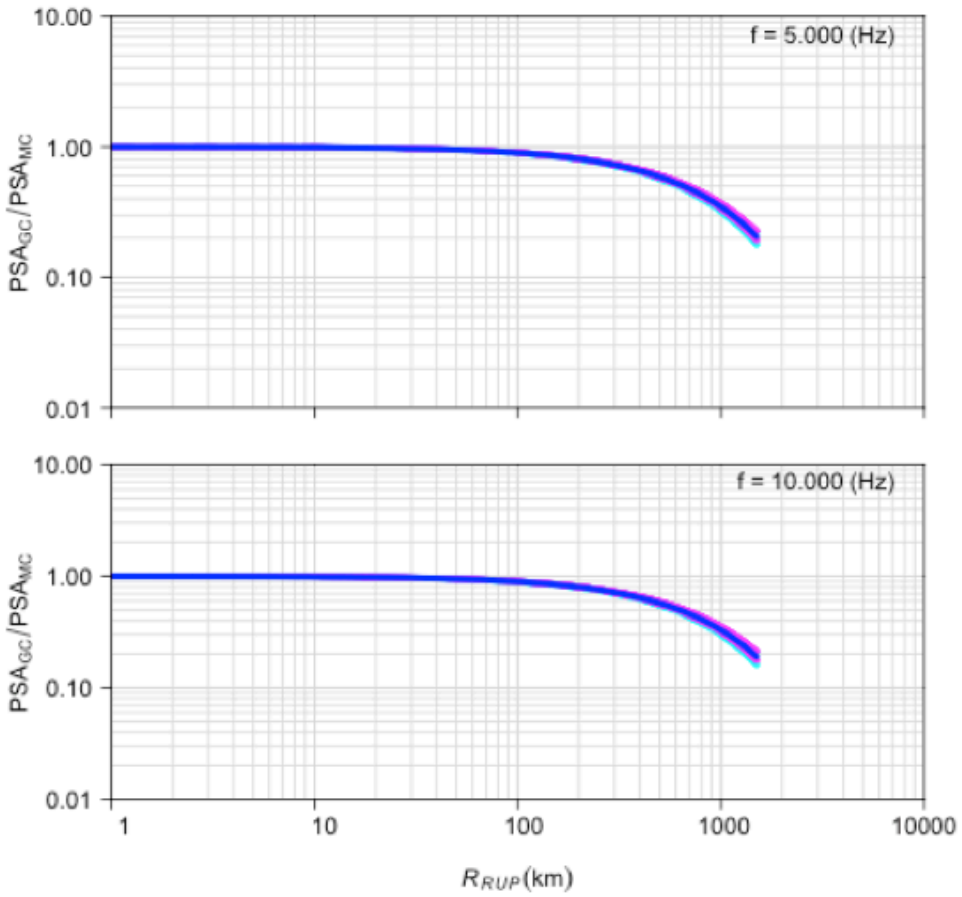


(PEER Report 2015/08)

DASG15 Model

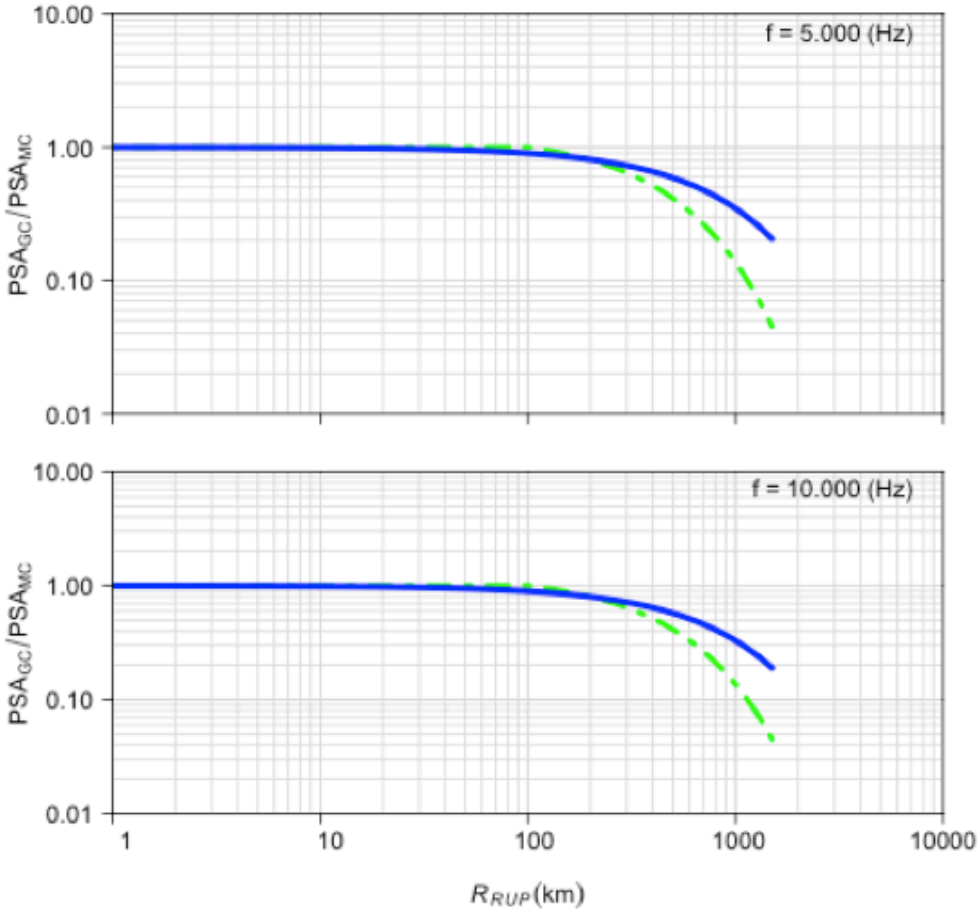
- PS simulation with simulation inputs (κ, $Q_{0,}$ stress drop) inverted for using GC region data
- Simulations used to update DASG NGA-East GMM
- Ratio of predicted GMIMs fromthe two GMMs is the adjustment factor
- Given as a table

PSA Ratio Model



(PEER Report 2015/08)

Comparisons of PEER and DASG Adjustments

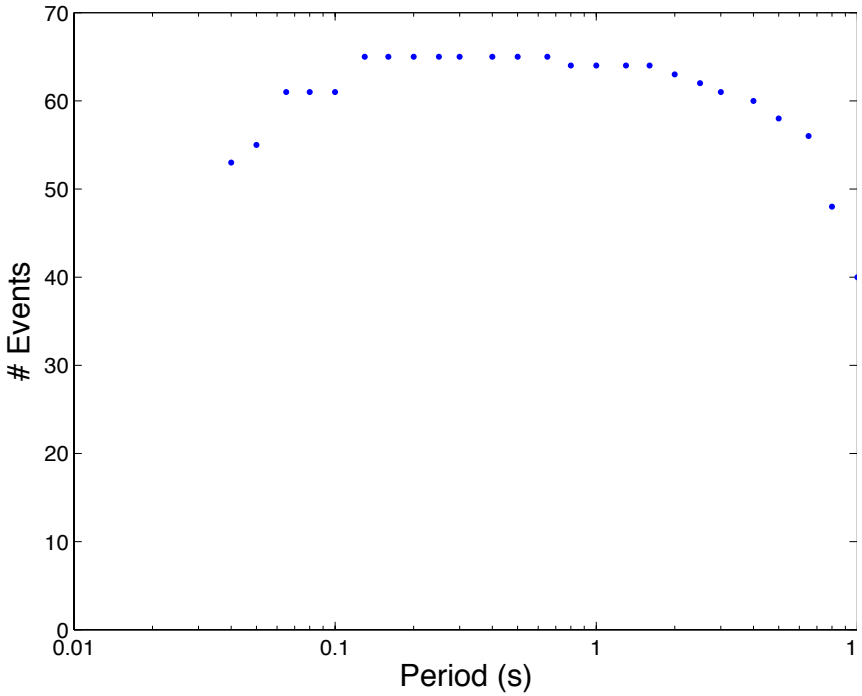


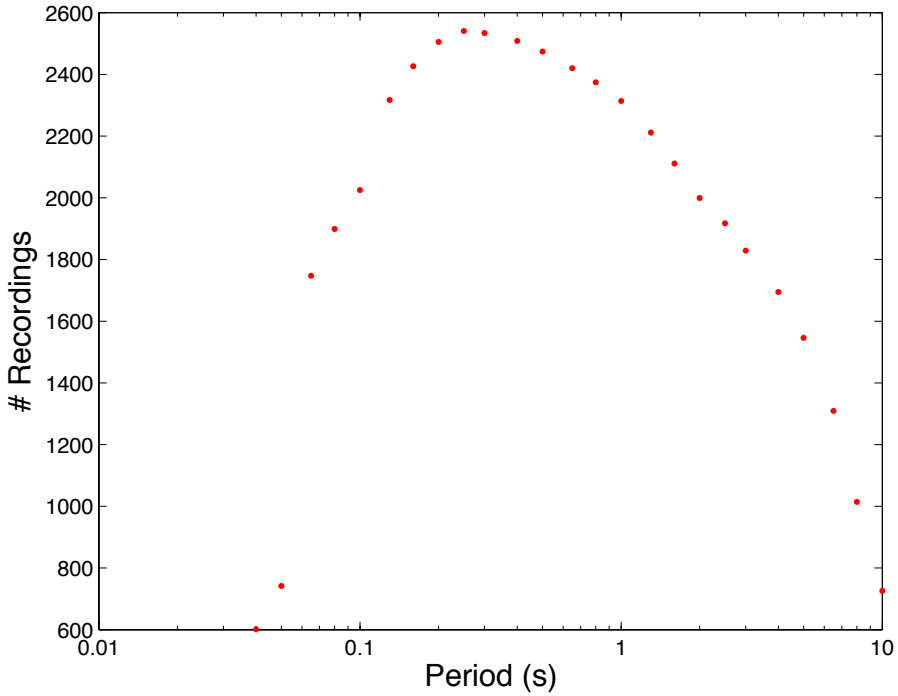
(PEER Report 2015/08)

Update to Site Amp Model Data

- Average of PEER and DASG adjustments taken
- Applied to records with source and site in GC
- Records with either source only or site only in GC excluded

Events and Records

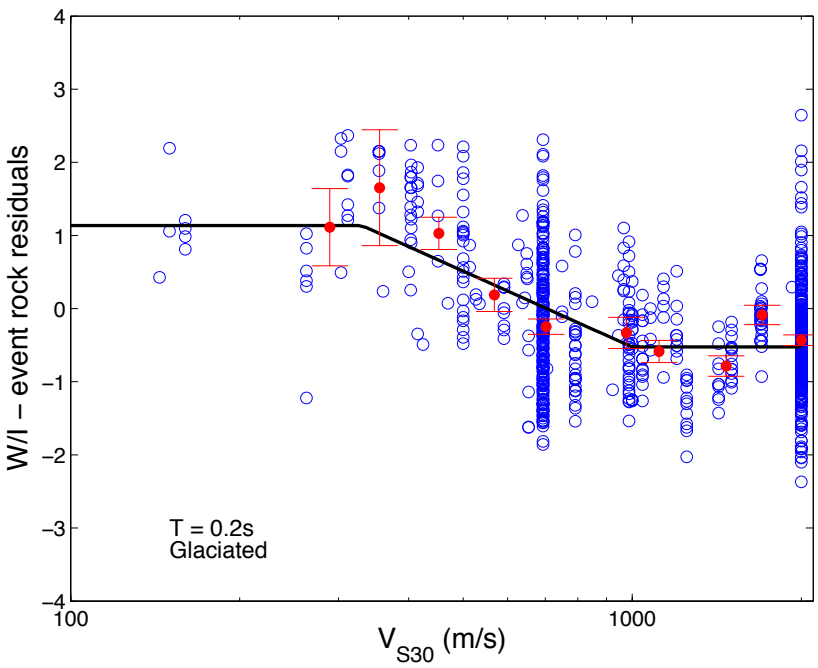


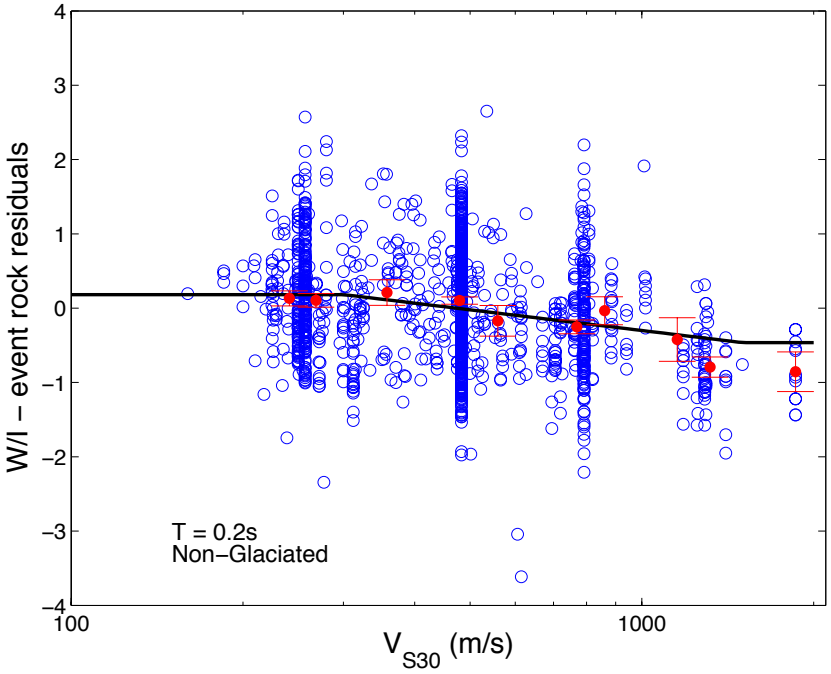


Updated V_{S30}

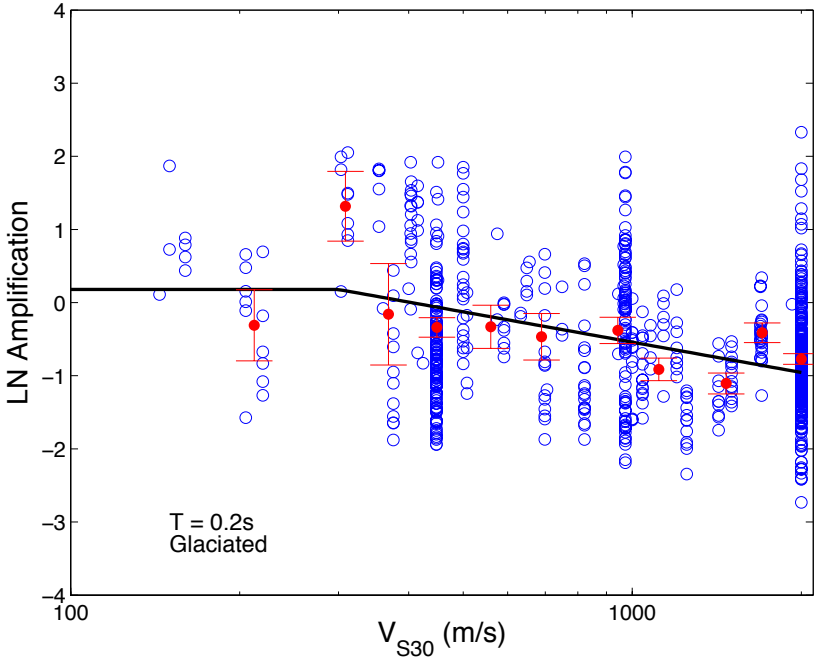
- Previously 445 flagged stations had been updated
- Thanks to Caio Vilar now all code 3, 4, and 5 stations have updated V_{S30} values

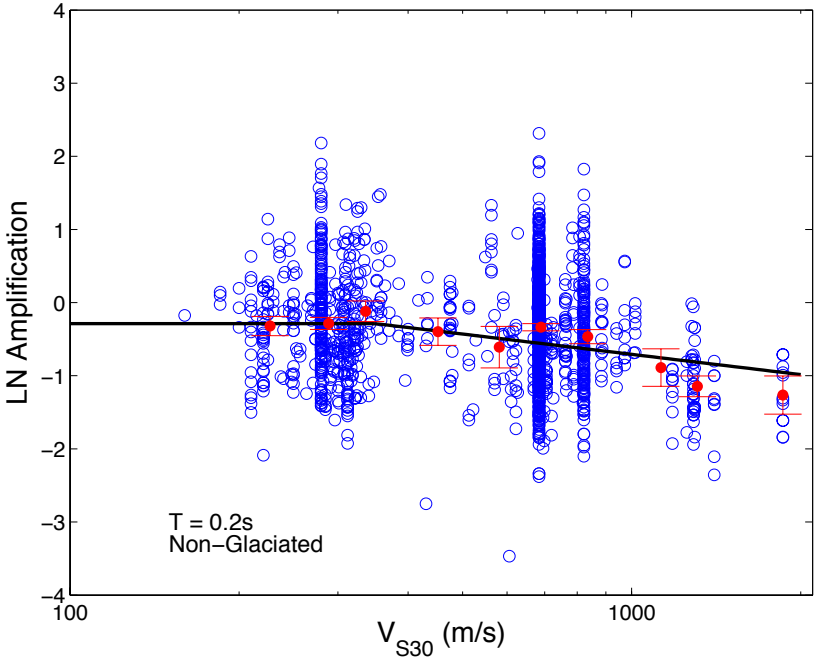
Model Before Updates



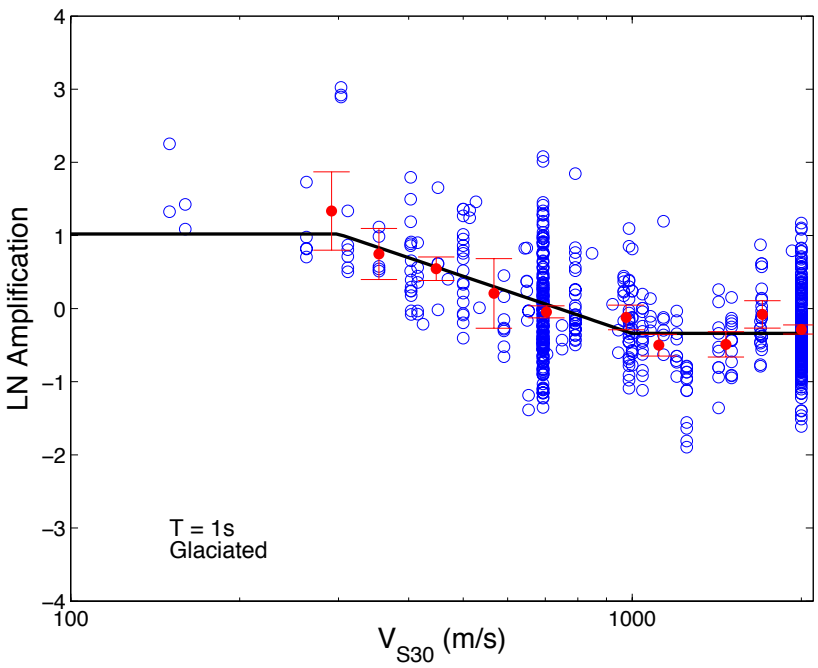


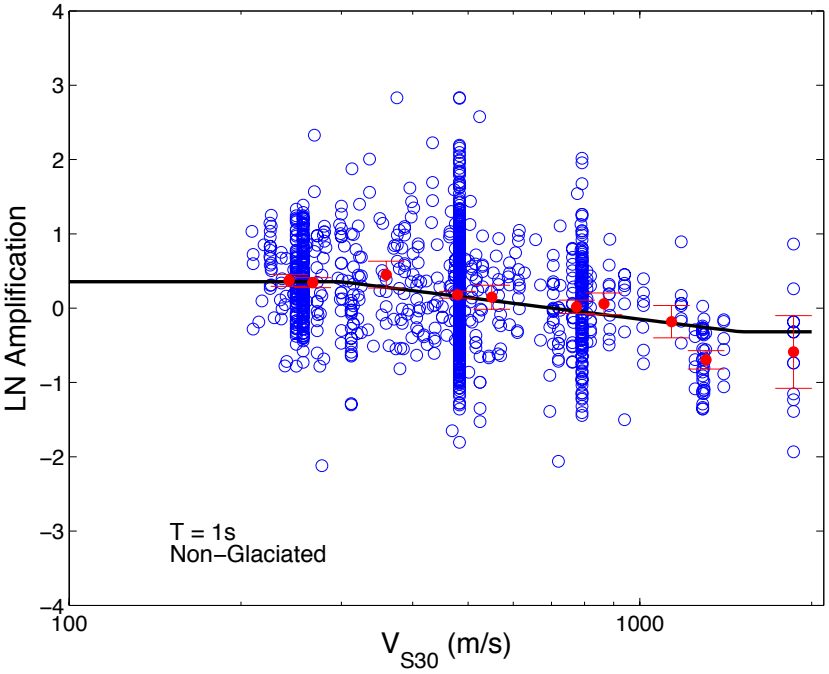
Updated Results



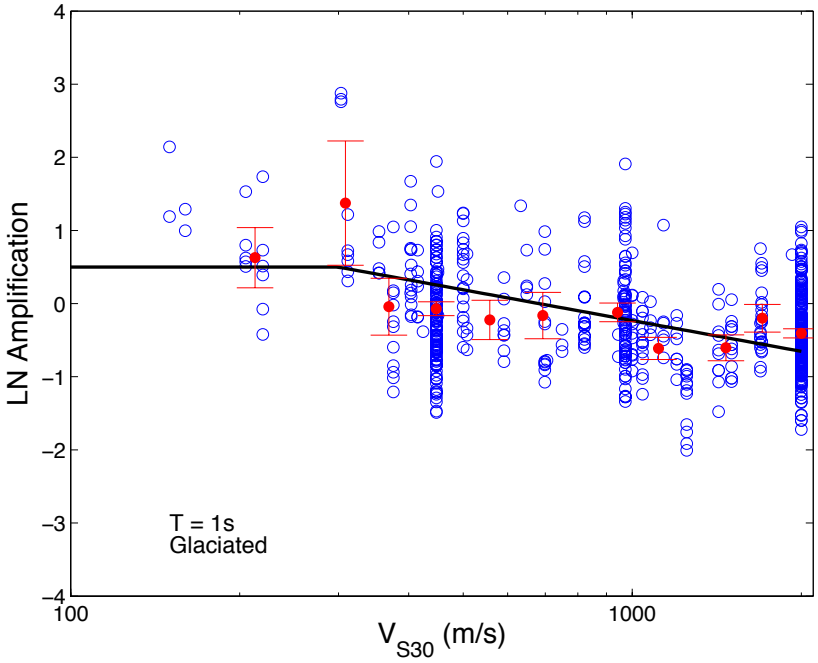


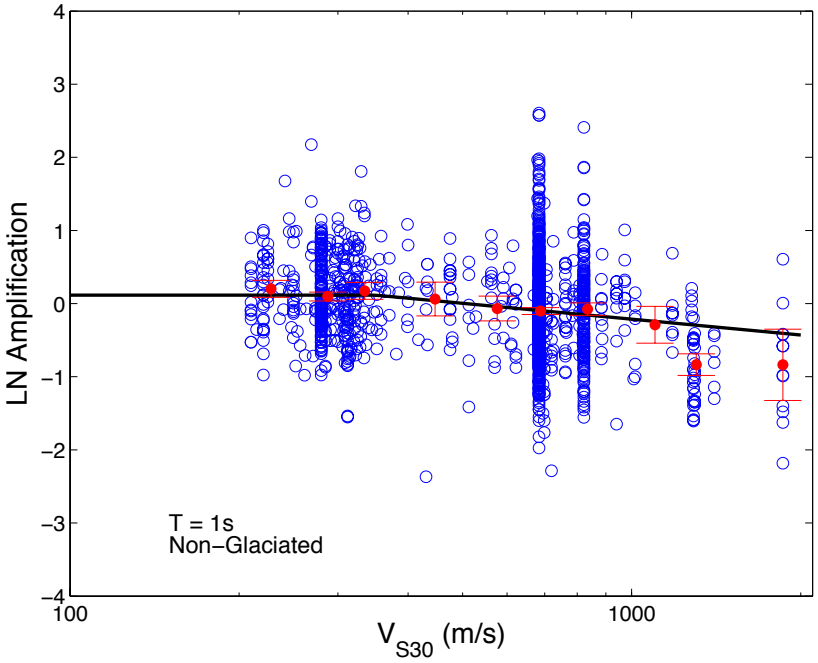
Model Before Updates



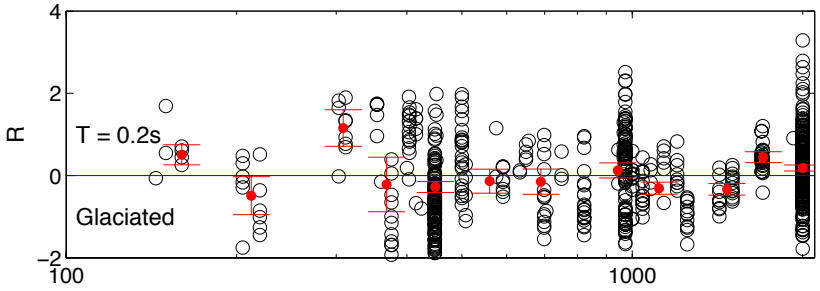


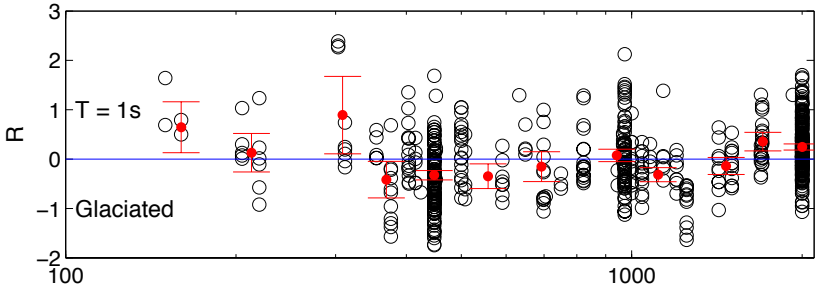
Updated Results

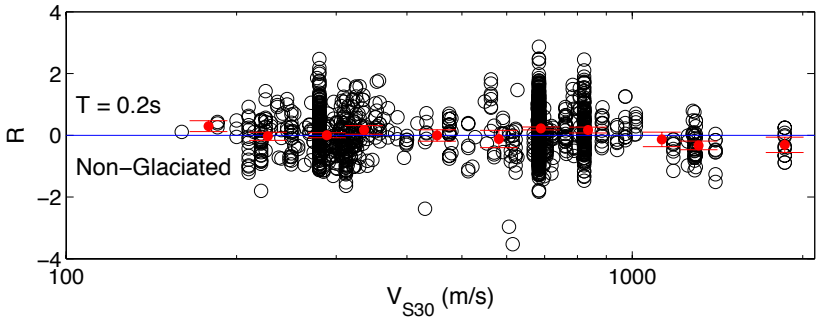


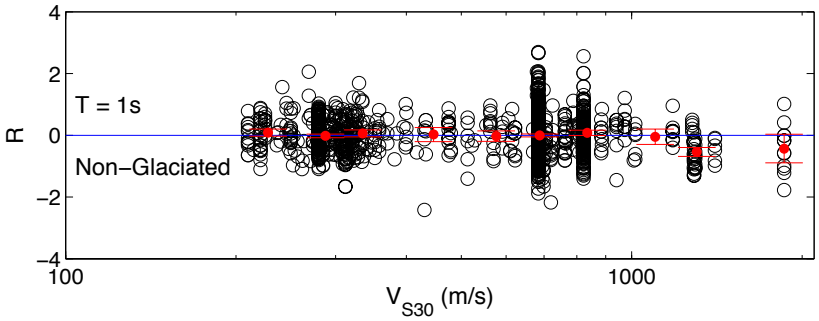


Updated Residuals

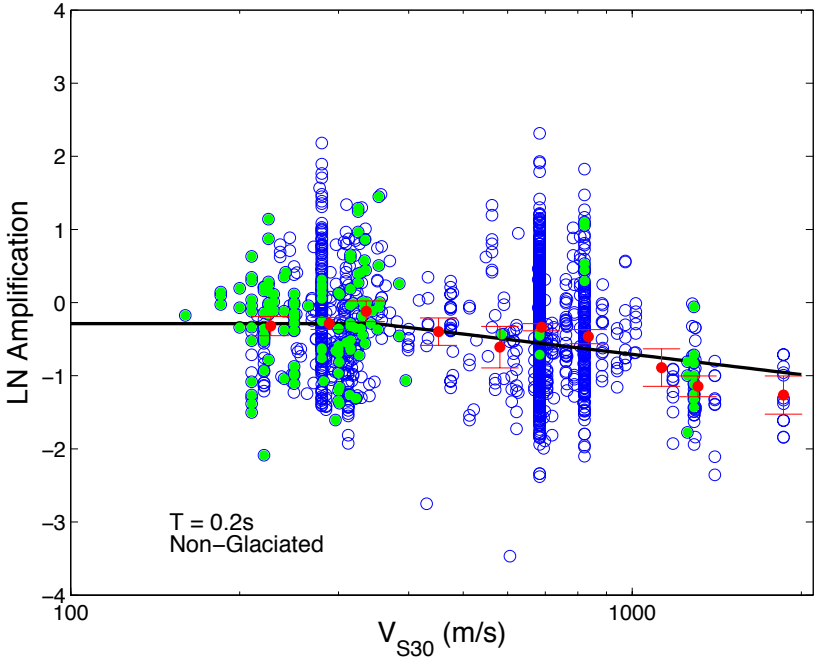


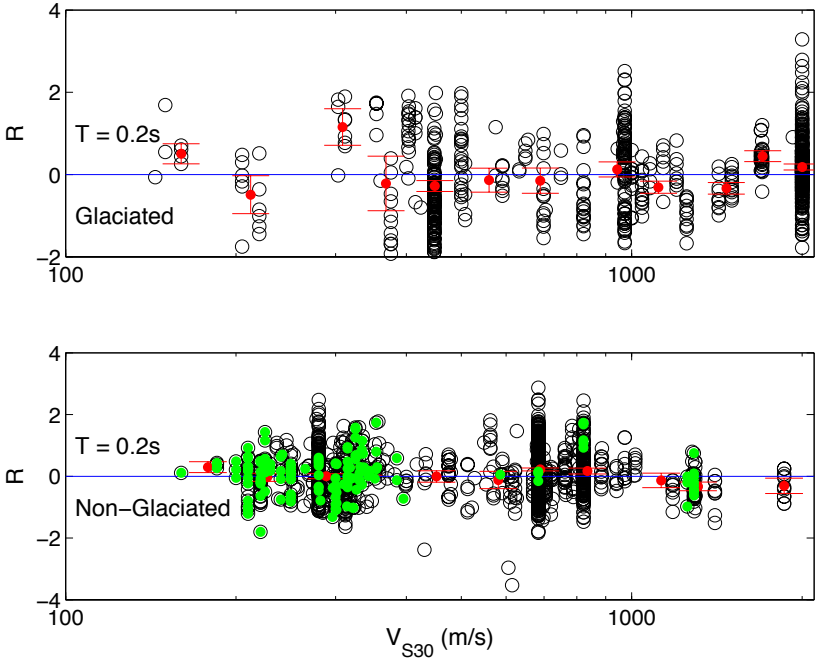




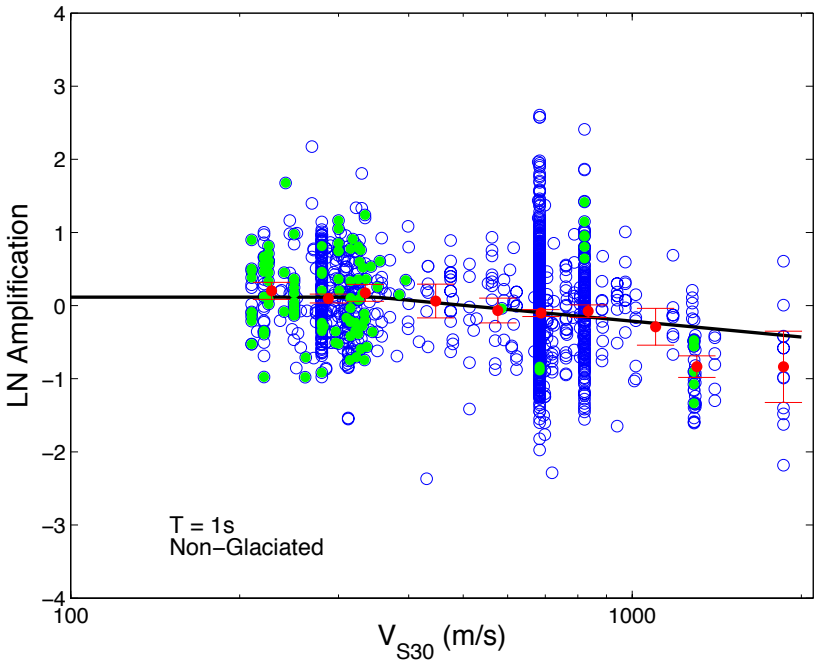


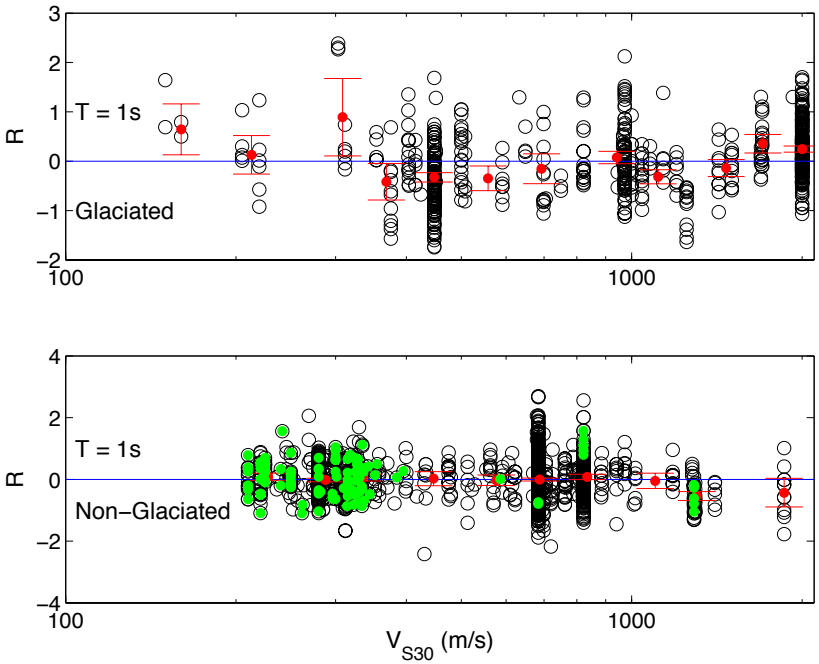
Results – Gulf Coast



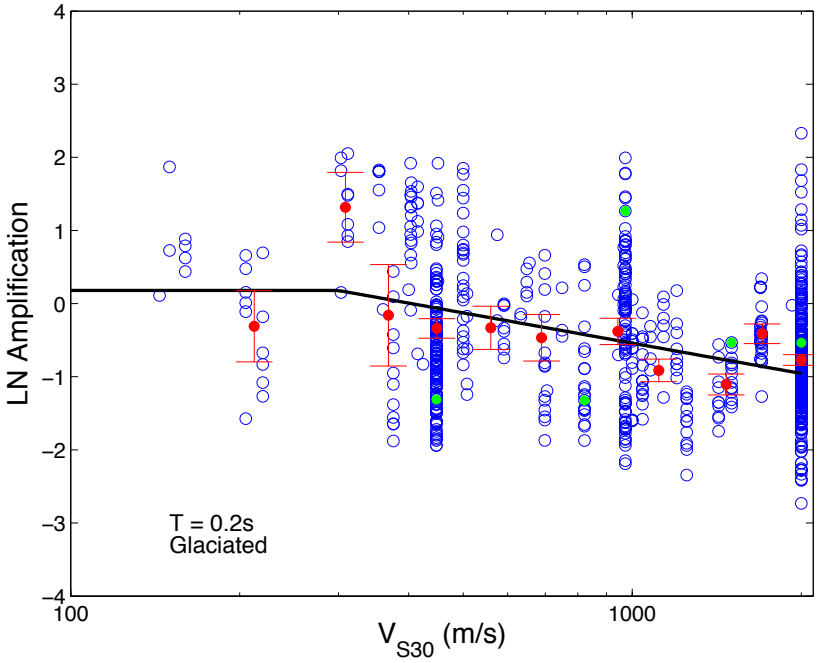


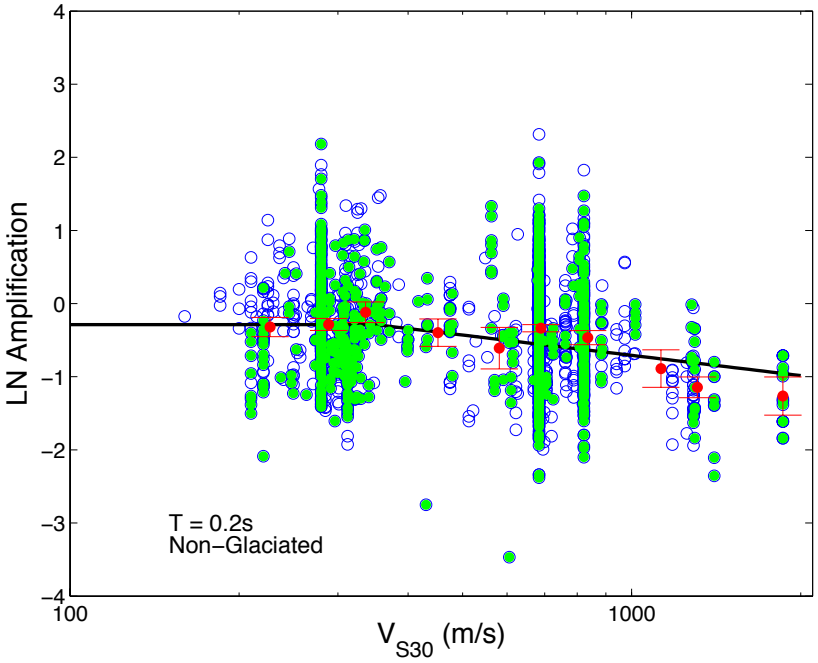
Results – Gulf Coast



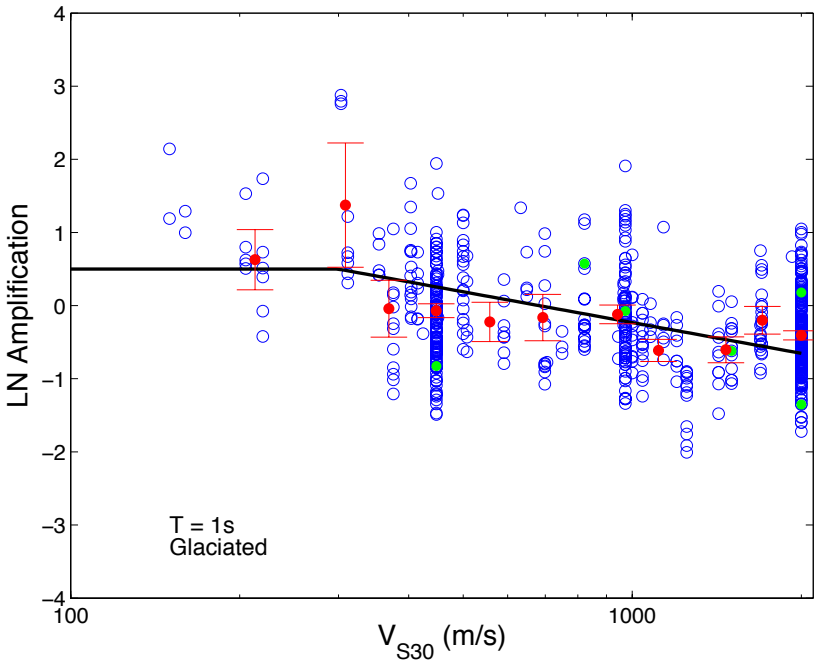


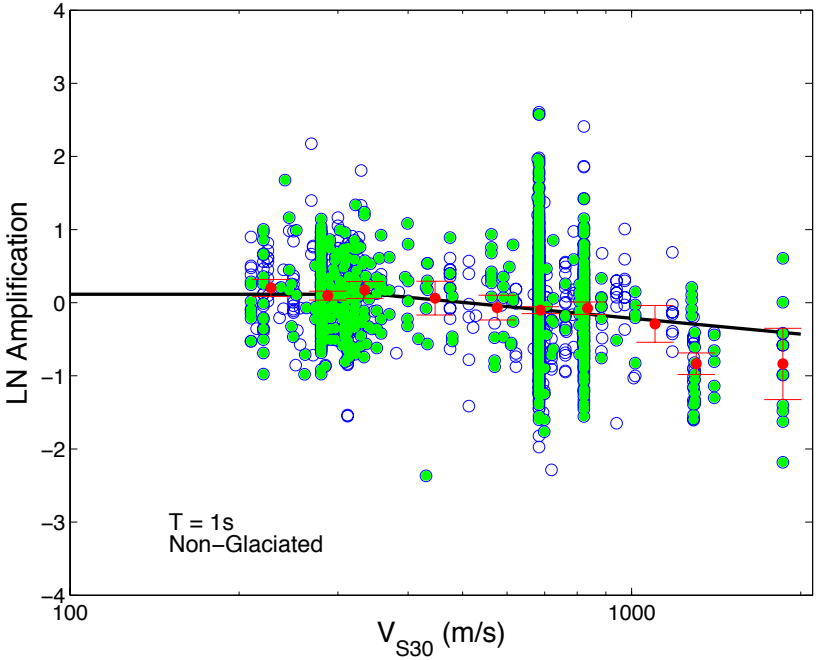
Results- PIE


LN Amplification
T = 0.2s
Glaciated
100
1000
V_{S30} (m/s)

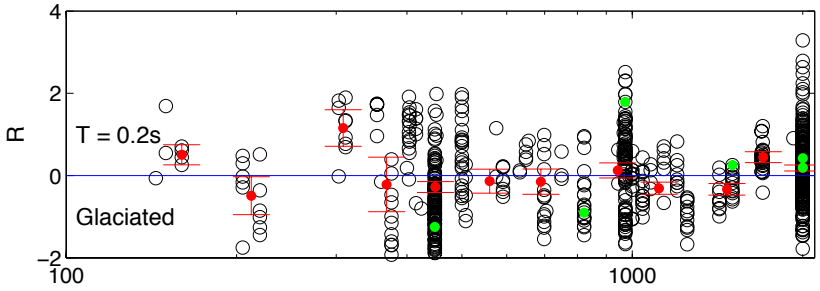

LN Amplification
T = 0.2s
Non–Glaciated
100
1000
V_{S30} (m/s)

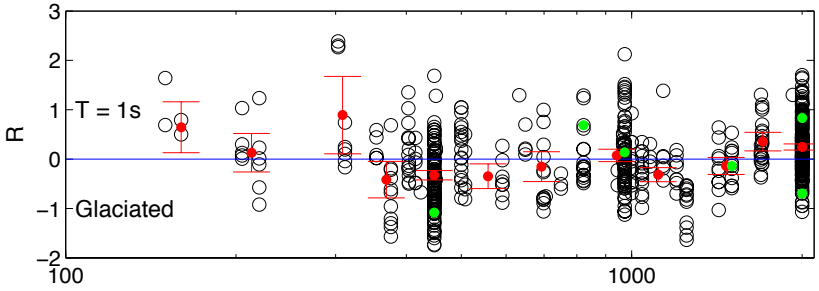
Results- PIE

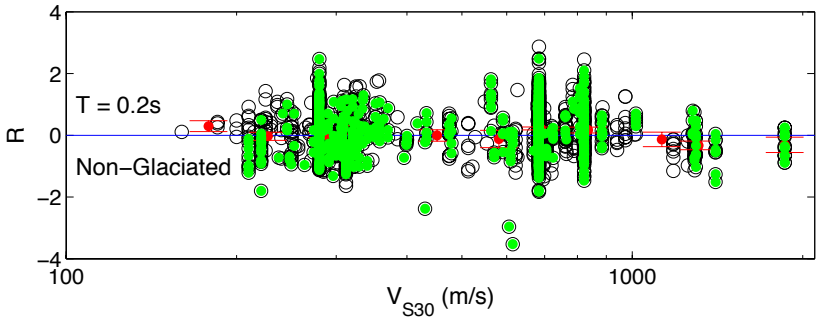

LN Amplification
T = 1s
Glaciated
100
1000
V_{S30} (m/s)

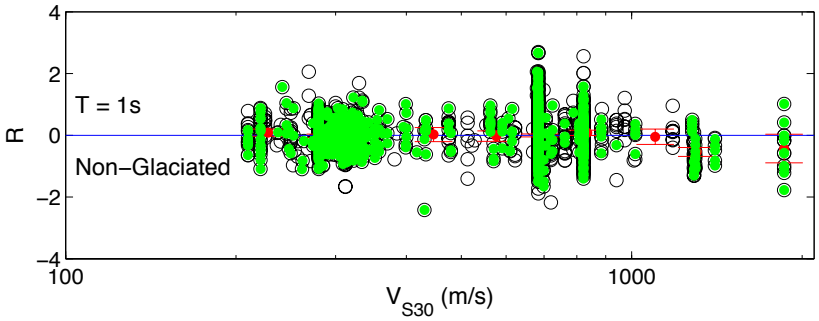

LN Amplification
T = 1s
Non−Glaciated
100
1000
V_{S30} (m/s)

Results- PIE


T = 0.2s
Glaciated
R
4
2
0
−2
100
1000


T = 1s
Glaciated
R
3
2
1
0
−1
−2
100
1000

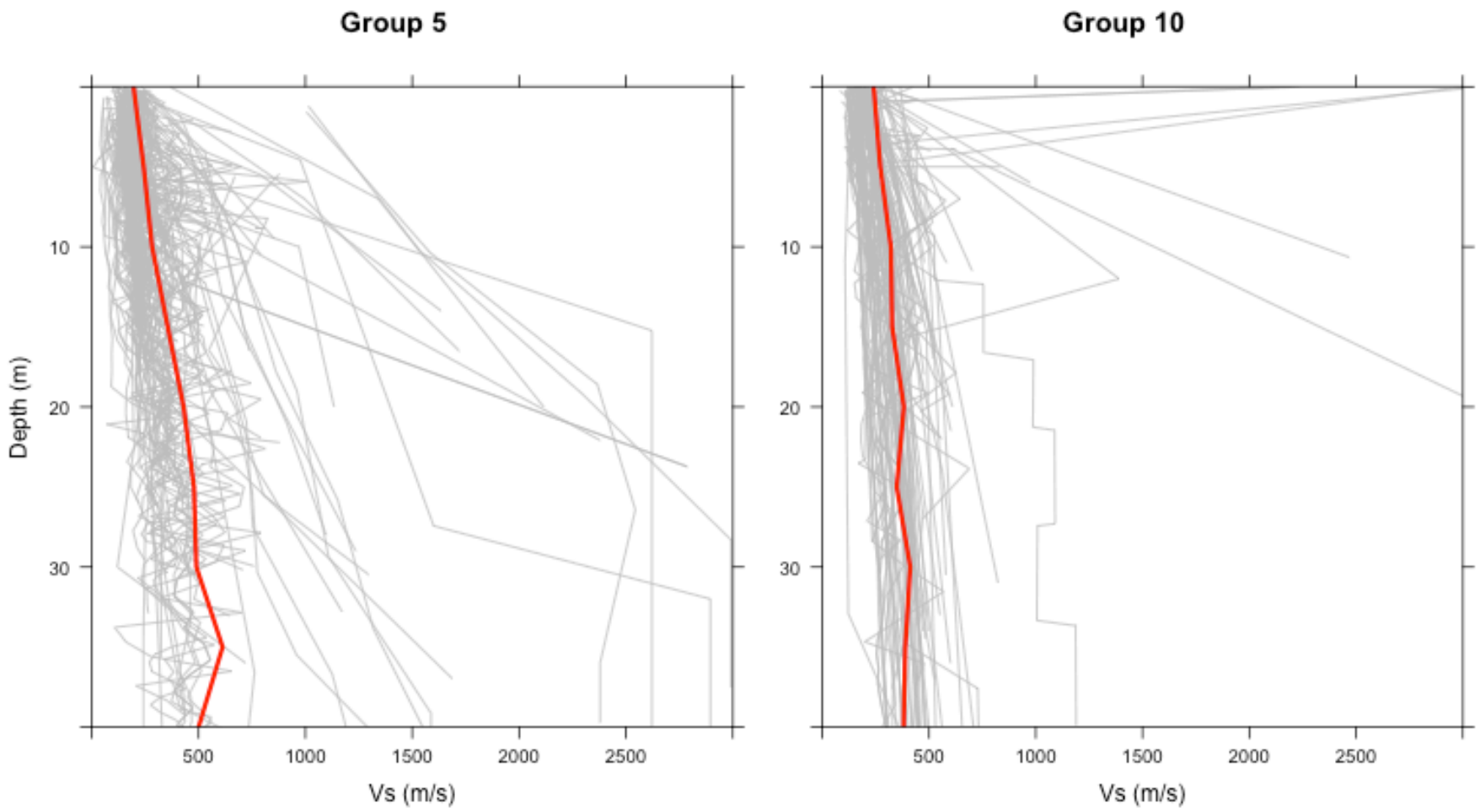

T = 0.2s
Non−Glaciated
R
4
2
0
−2
−4
100
1000
V S30 (m/s)


T = 1s
Non−Glaciated
R
4
2
0
−2
−4
100
1000
V S30 (m/s)

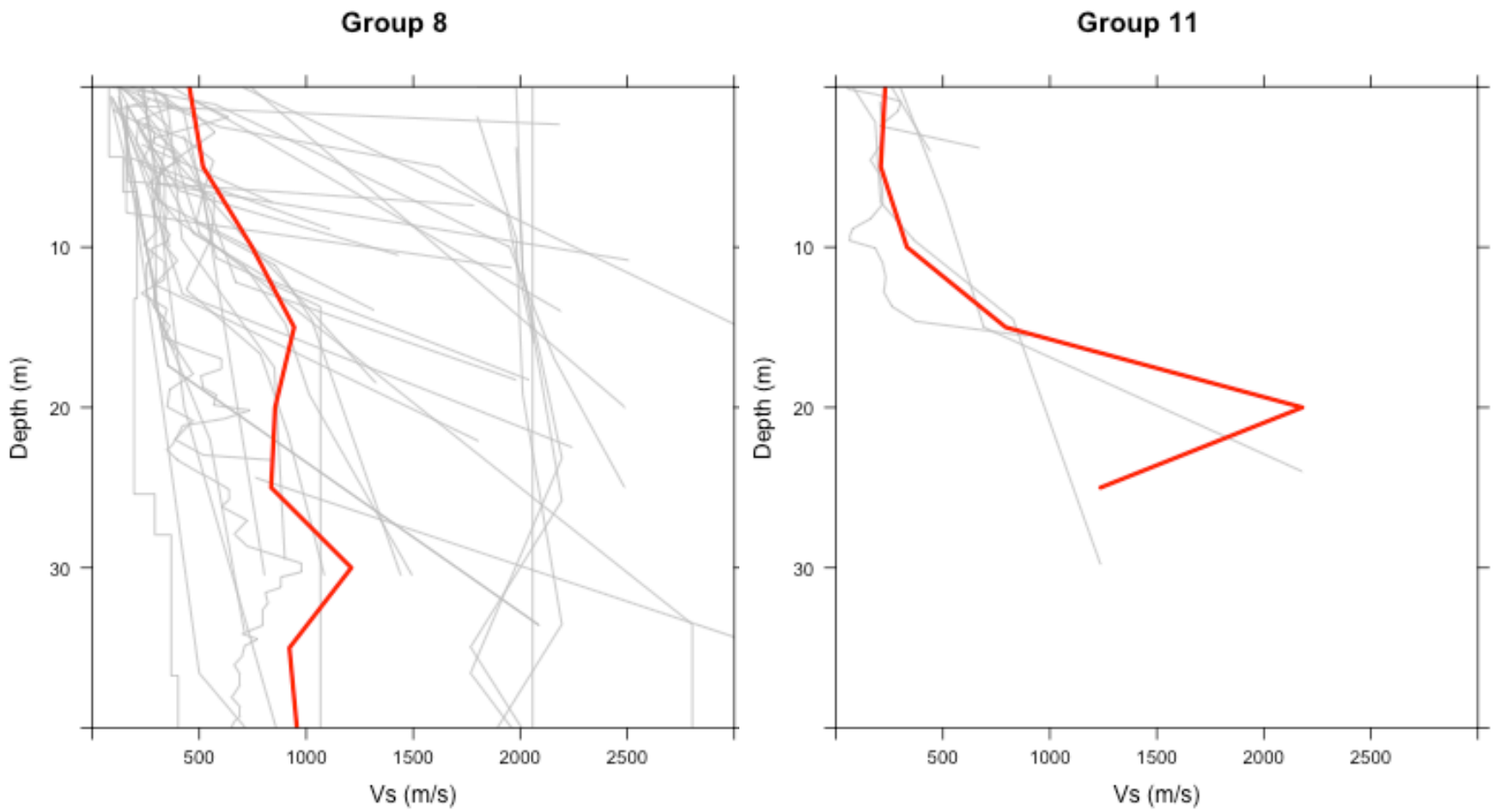
Glaciated Vs. Non-Glaciated Profiles

- Grouped profiles according to glaciation and surface geology (using proxy groups)

Non-Glaciated



Glaciated


Group 8
Depth (m)
10
20
30
500
1000
1500
2000
2500
Vs (m/s)
Group 11
Depth (m)
10
20
30
500
1000
1500
2000
2500
Vs (m/s)

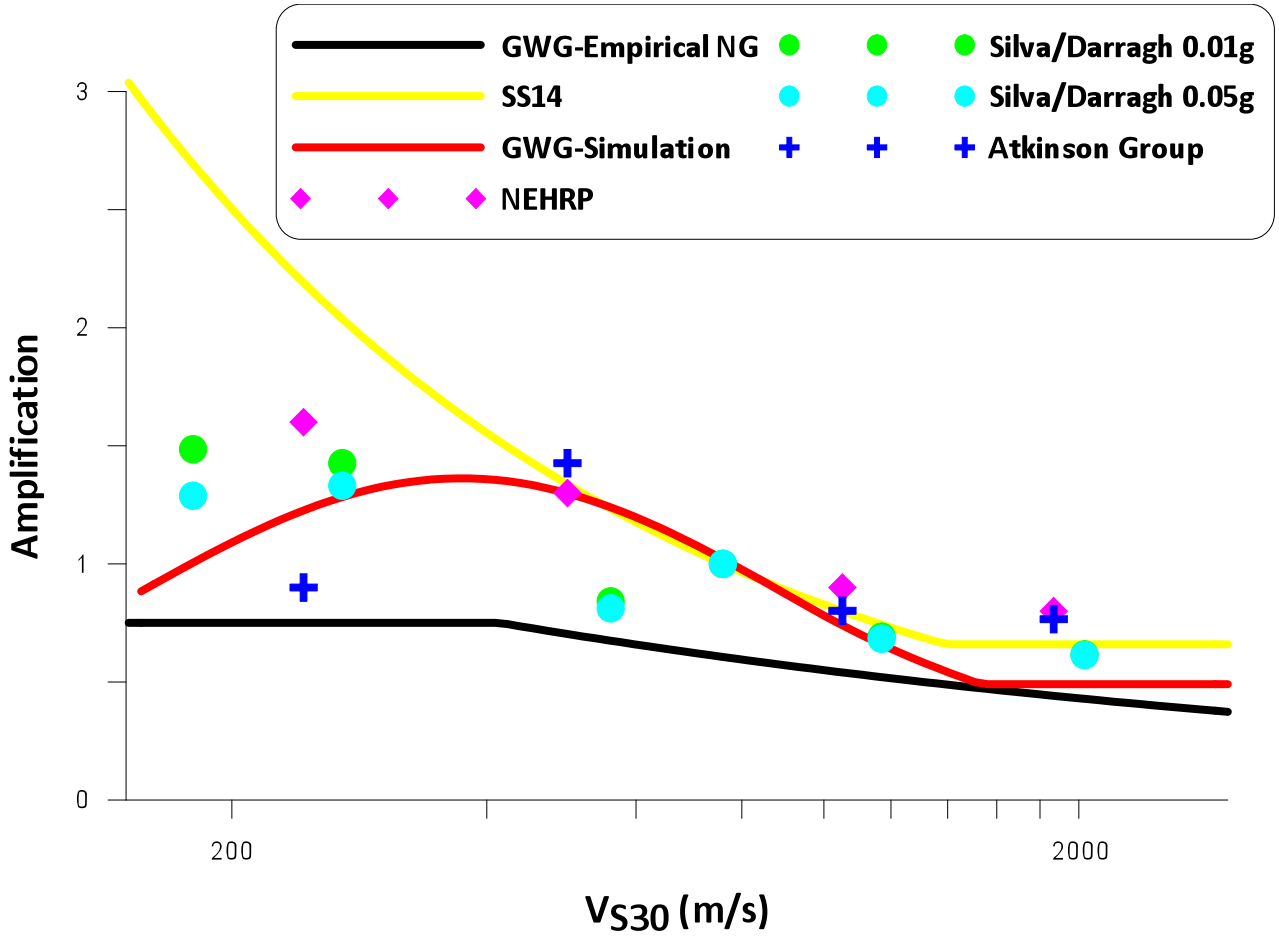
Future Work

- Finalize glaciated model for comparison
- Look at influence of F_{peak}

References

- Harmon, J.A., Y.M.A. Hashash, J.P. Stewart, E.M. Rathje, K.W. Campbell, W. Silva, G.A. Parker, and B. Xu (2016). A Site Amplification Model for Central and Eastern North America from Linear Elastic and Nonlinear Site-Response Simulations [abstract]. In: Proceedings of the Seismological Society of America Annual Meeting; 2016 Apr 20-22; Reno NV. California (CA): SSA; Abstract 16-537
- Hassani, B., and Atkinson, G. M. (2015). Referenced empirical ground-motion model for eastern North America. *Seismological Research Letters*, ***86***(2A), 477-491.
- Reed, J.C., and C.A. Bush (2005). Generalized geologic map of the United States, Puerto Rico, and the U.S. Virgin Islands. *USGS National Atlas Small-Scale Collection*. Available online at: http://pubs.usgs.gov/atlas/geologic/.
- PEER (2015).NGA-East: Adjustments to Median Ground-Motion Models for Central and Eastern North America. PEER report 2015/08.
- Seyhan, E., and Stewart, J. P. (2014). Semi-empirical nonlinear site amplification from NGA-West2 data and simulations. *Earthquake Spectra*, ***30***(3), 1241-1256.
- Yenier, E, and G.M. Atkinson (2015). Regionally adjustable generic ground-motion prediction equation based on equivalent point-source simulations: Application to central and eastern North America. *Bulletin of the Seismological Society of America*, ***105***(4), 1989-2009.

Amplification Model Comparisons
T = 0.2s



Amplification Model Comparisons
T = 0.2s