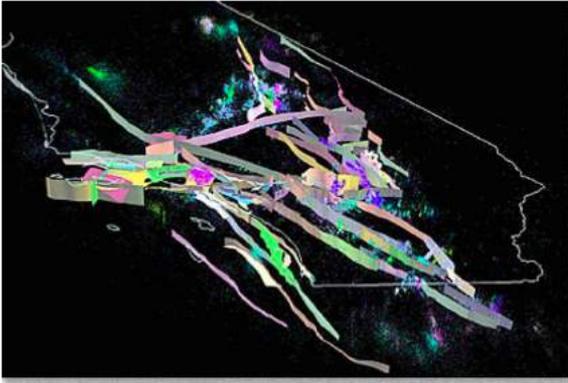


Selection of CyberShake ground motions for engineering practice

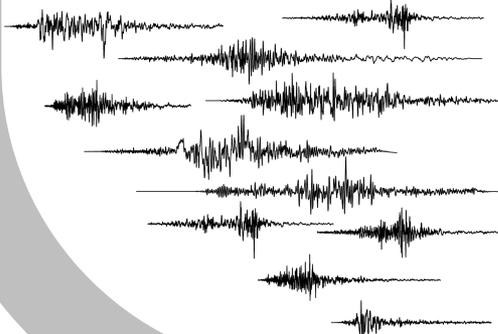
Jack W. Baker and Ganyu Teng

Uses of ground motions in earthquake engineering practice

Seismic sources



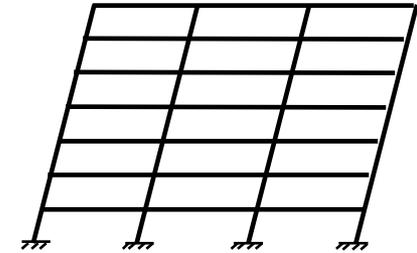
Ground motions



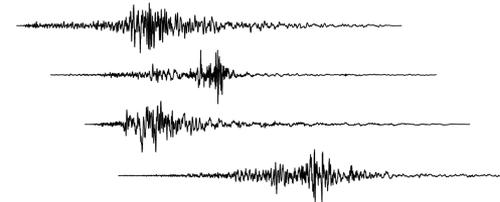
Ground motion
hazard analysis

- Study this portion
- Using recordings or simulations
- Satisfy ASCE 7-16 requirements for new building design

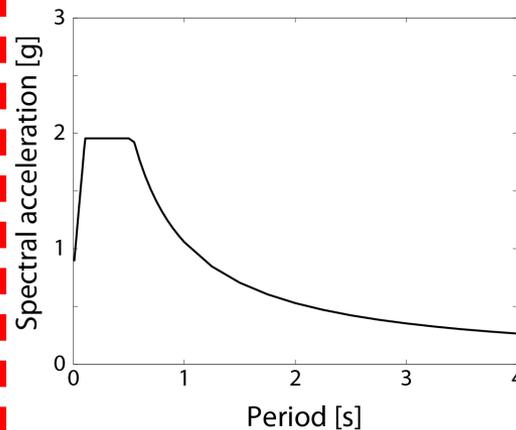
Structural performance



Ground motions



Target response spectrum



Response history analysis

Goals

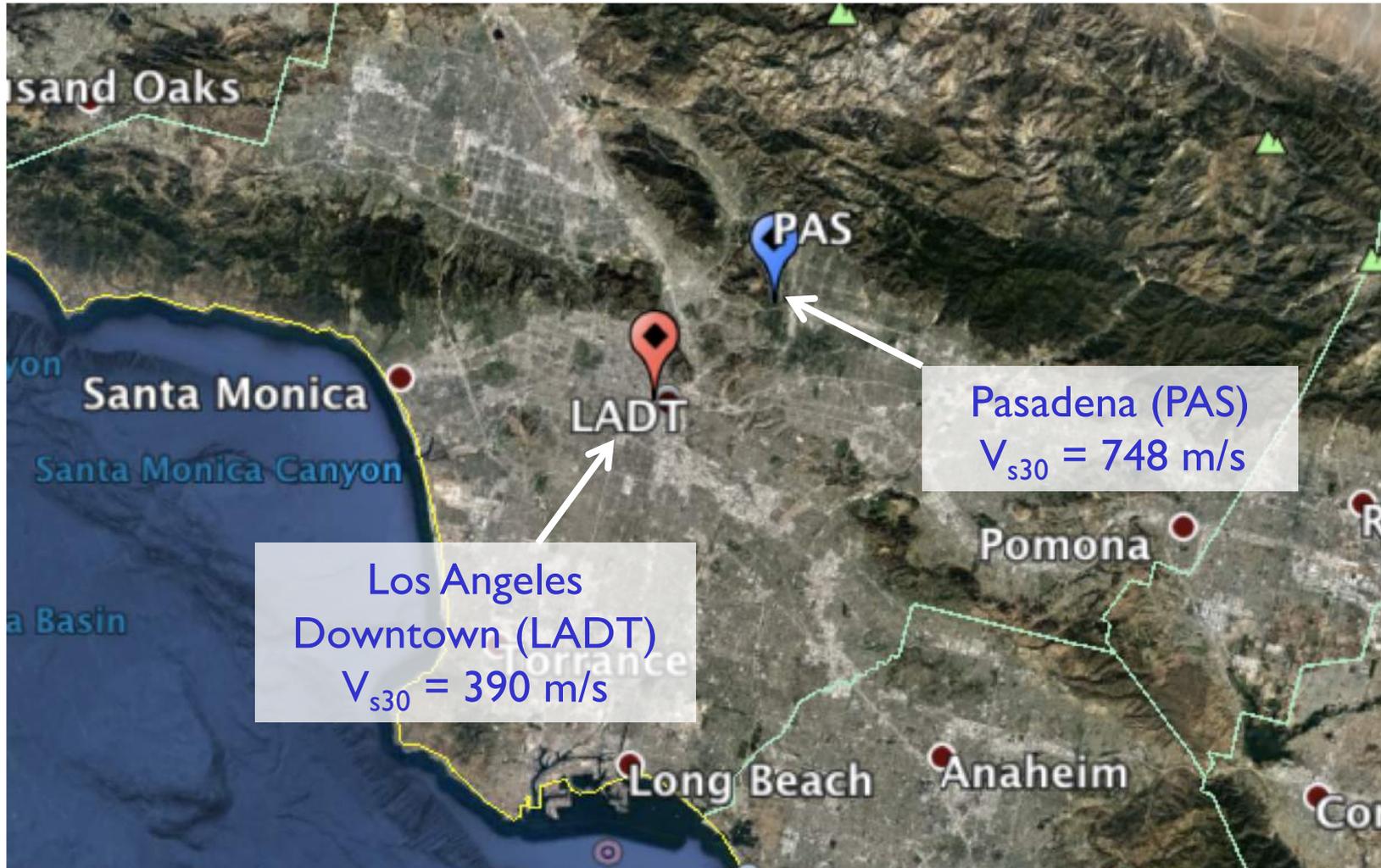
Select time series from the CyberShake database that would satisfy ASCE 7-16 criteria, and evaluate their suitability for this purpose

Select comparable recorded ground motions, for comparative evaluations

Tall buildings are an the envisioned application

- Response history analysis is often used
- Simulations provide greatest insights at long periods

Two considered locations



Record selection

11 two-component ground motions were selected

ASCE 7-16 site-specific MCE_R spectrum from USGS.

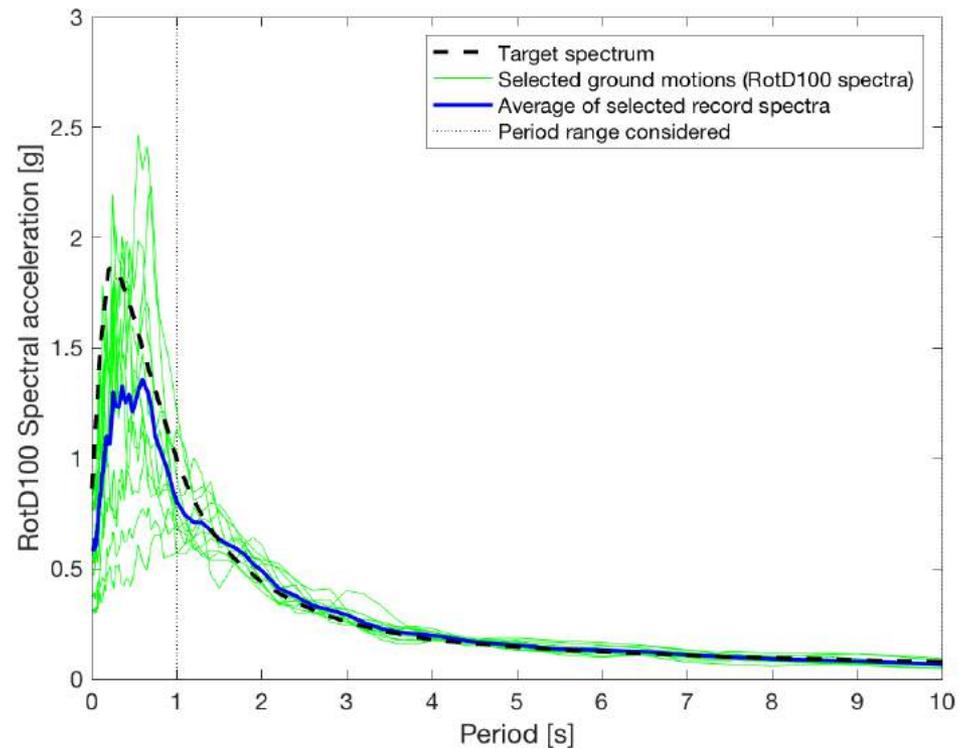
A period range of 1 to 10s was matched.

Magnitude/distance somewhat constrained to match deaggregation

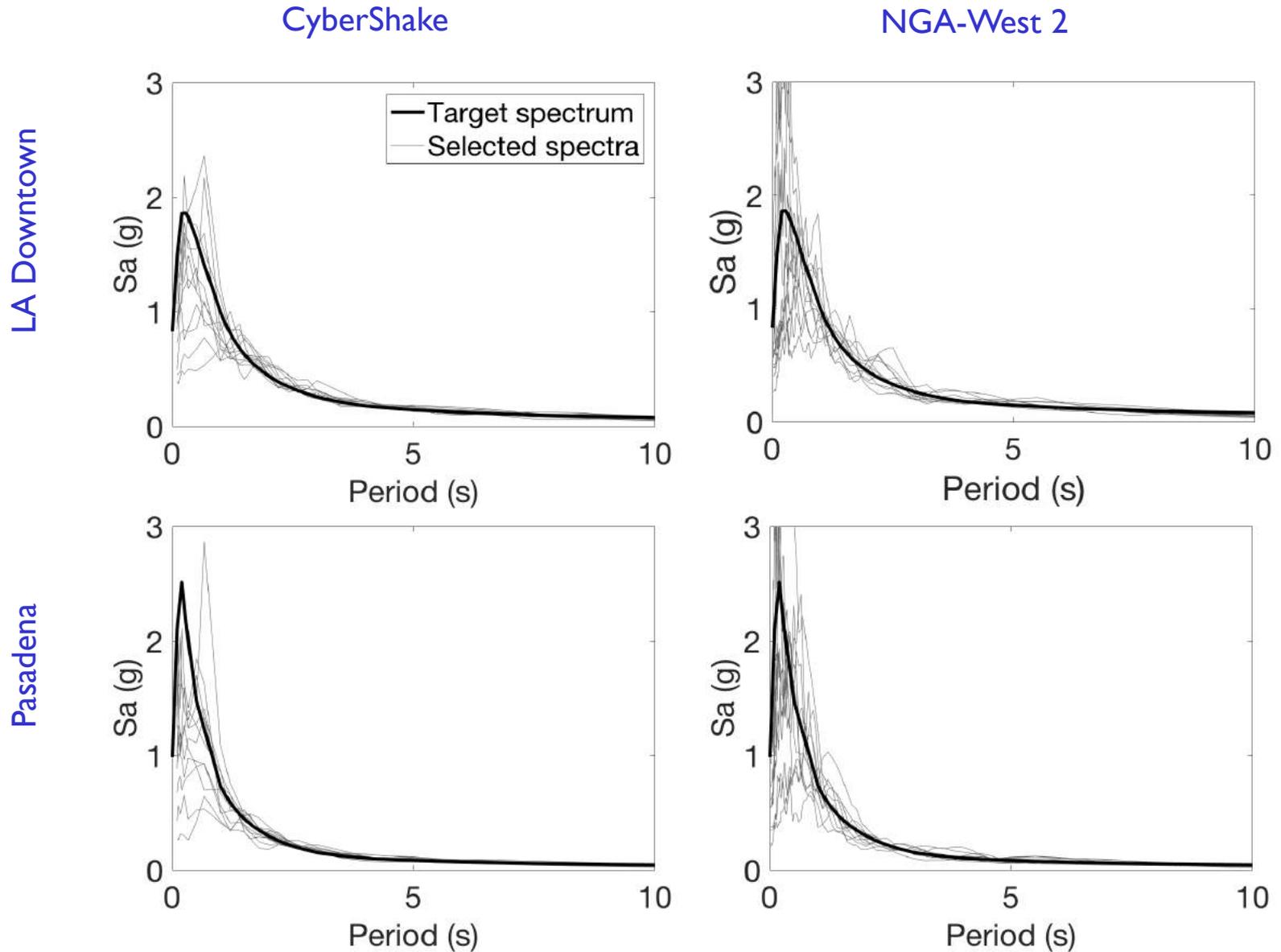
CyberShake ground motions were taken from the reference site's simulations

NGA-West2 ground motions were scaled by up to 4x

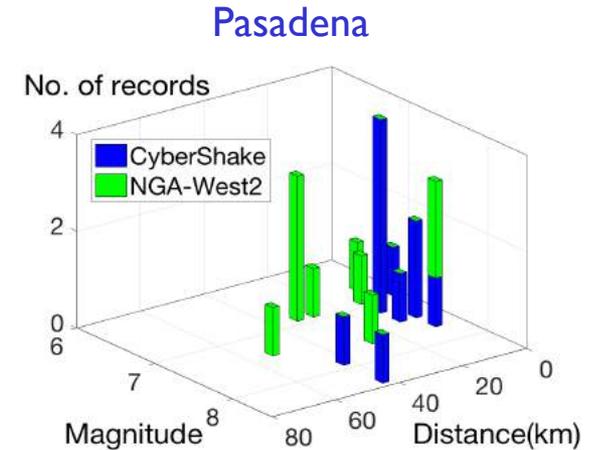
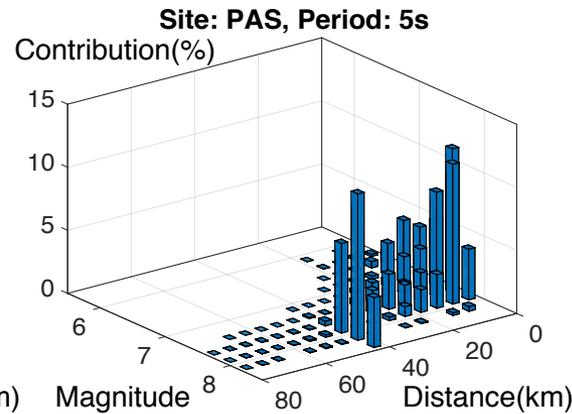
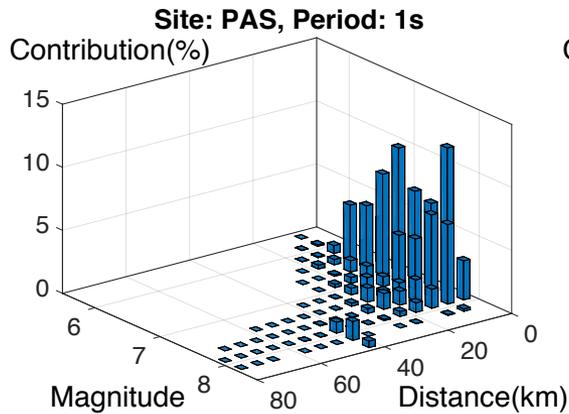
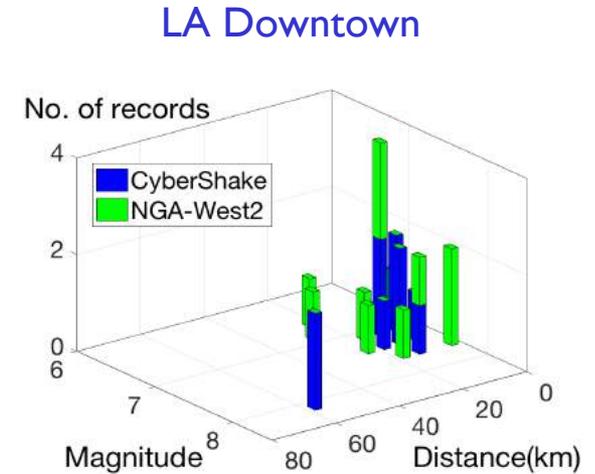
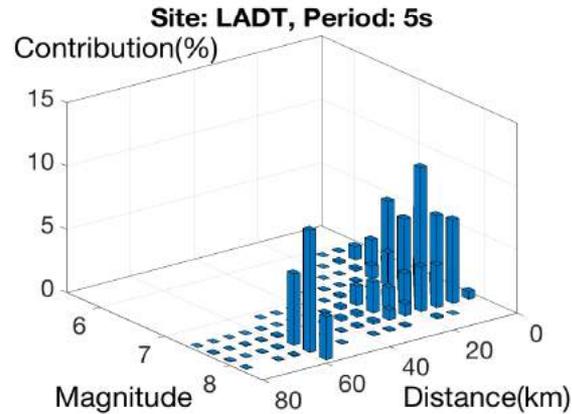
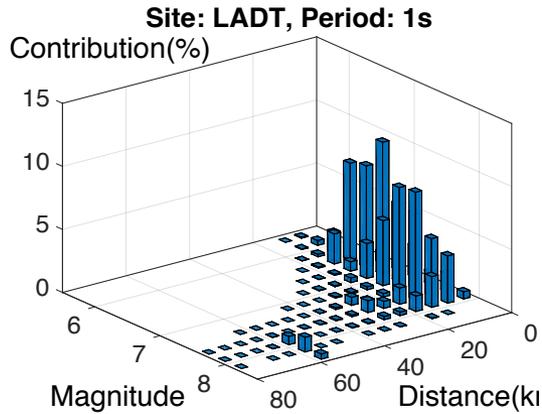
LA Downtown MCE_R and CyberShake motions



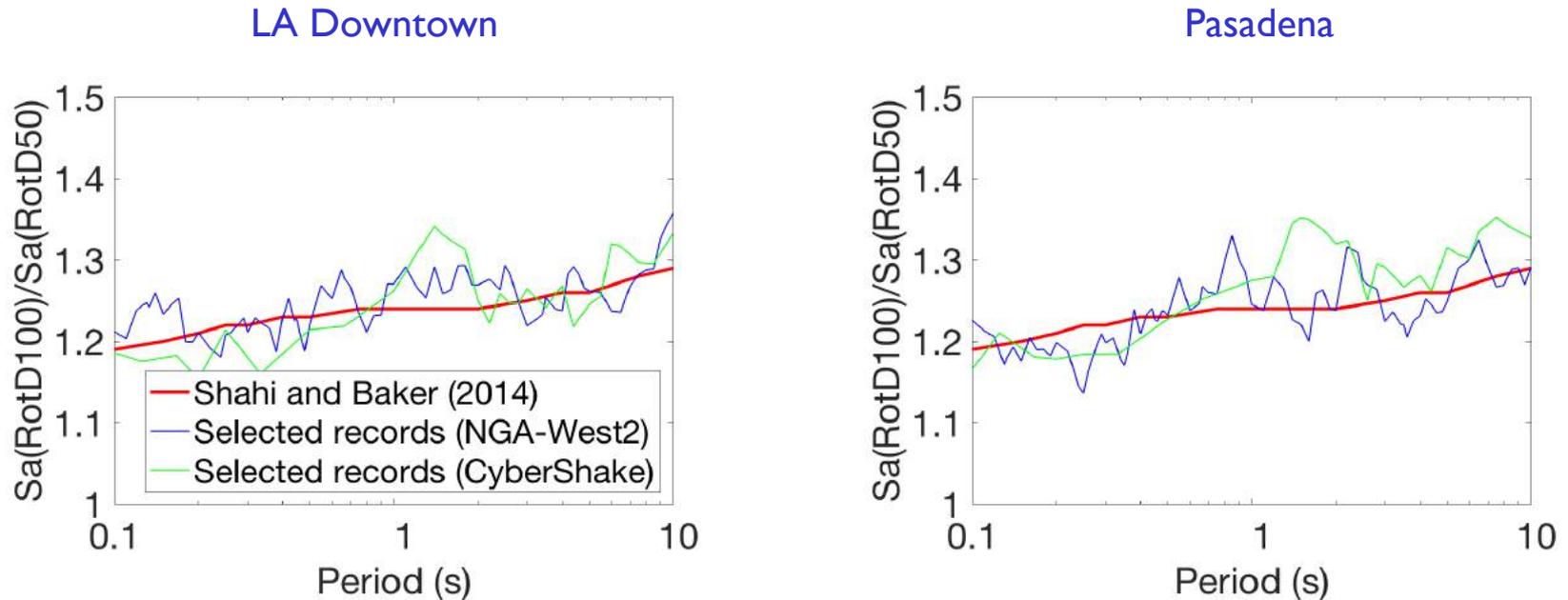
Response spectra of all selected ground motions



Deaggregation versus selected records

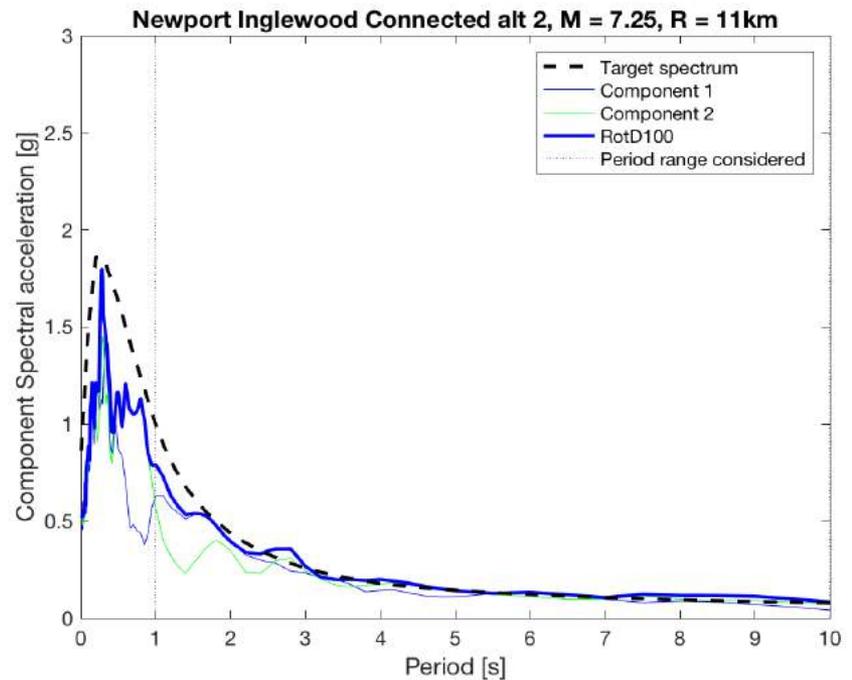
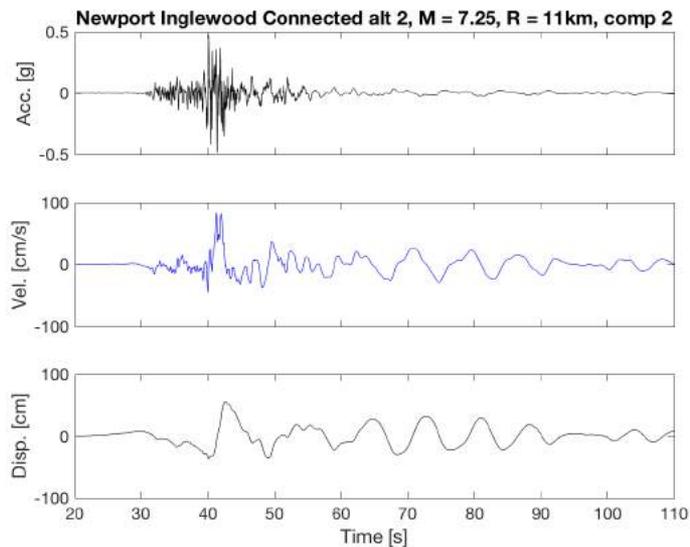
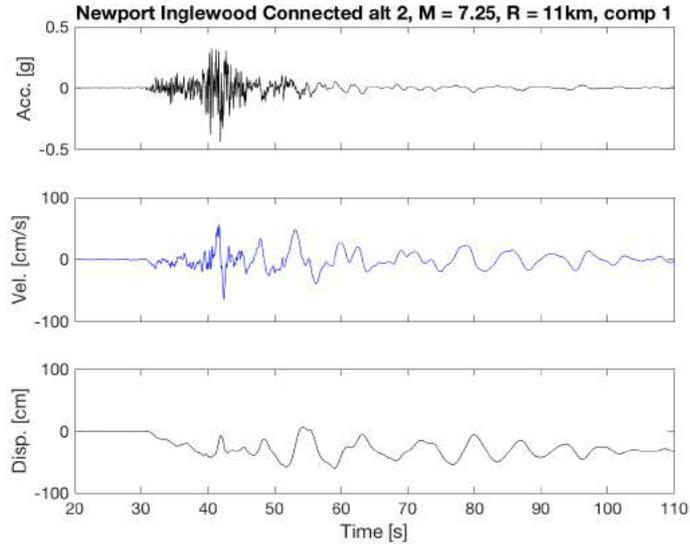


Response spectra directional polarization

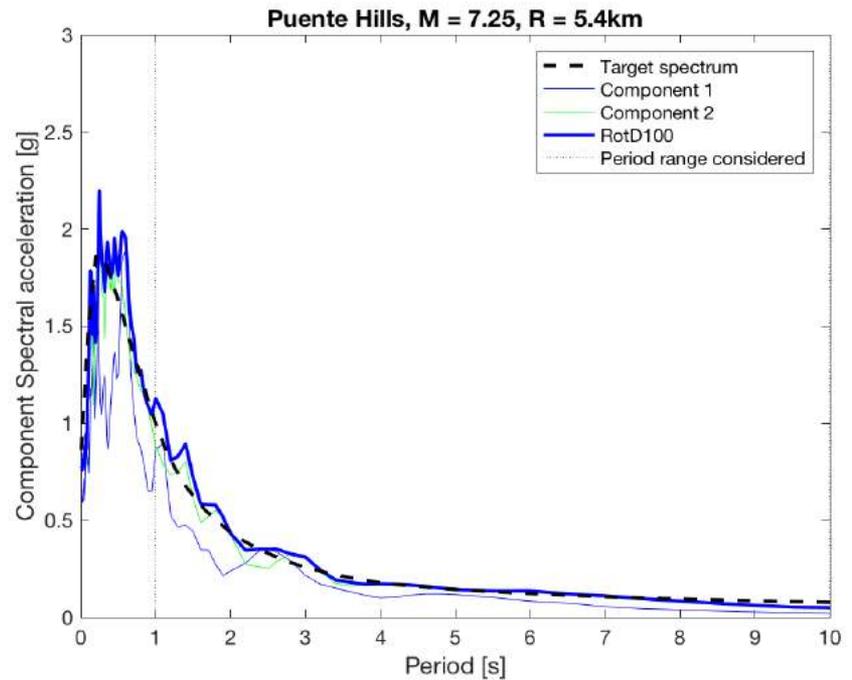
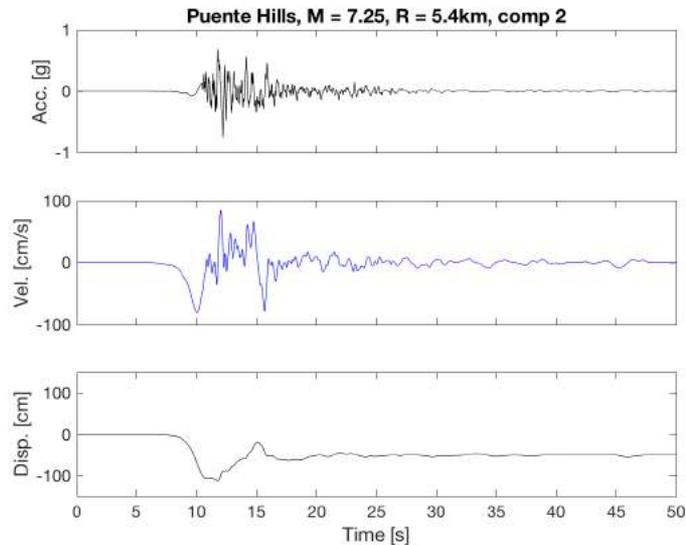
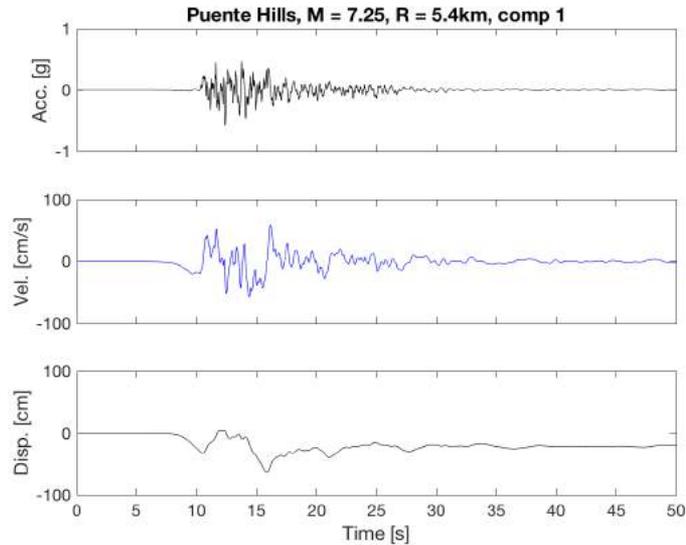


Some particular CyberShake ruptures produce excessively polarized ground motions. But for the record selection exercise these can be easily avoided.

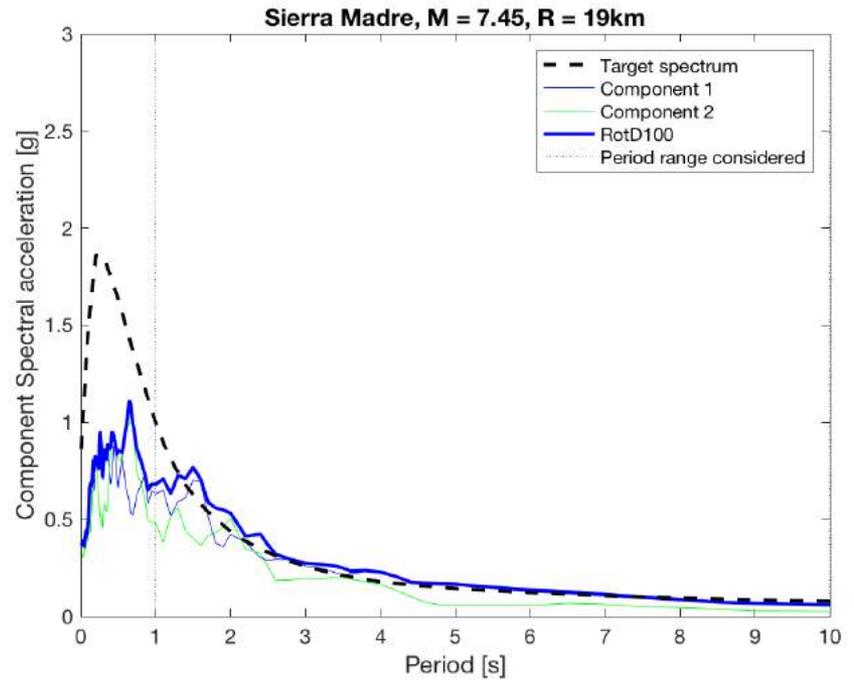
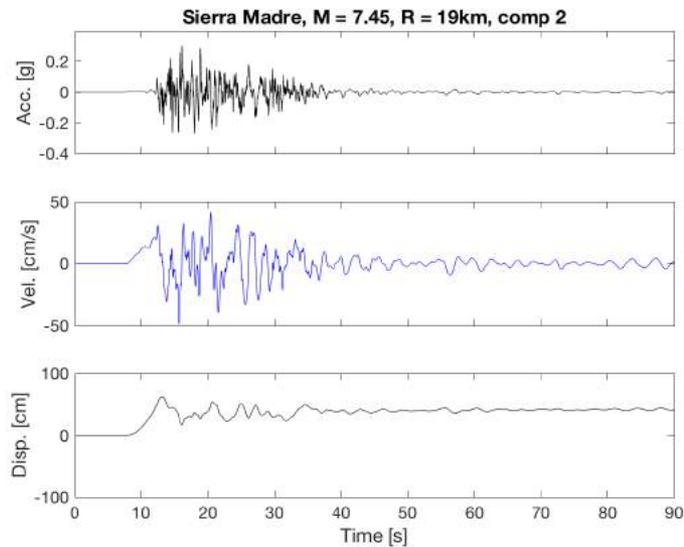
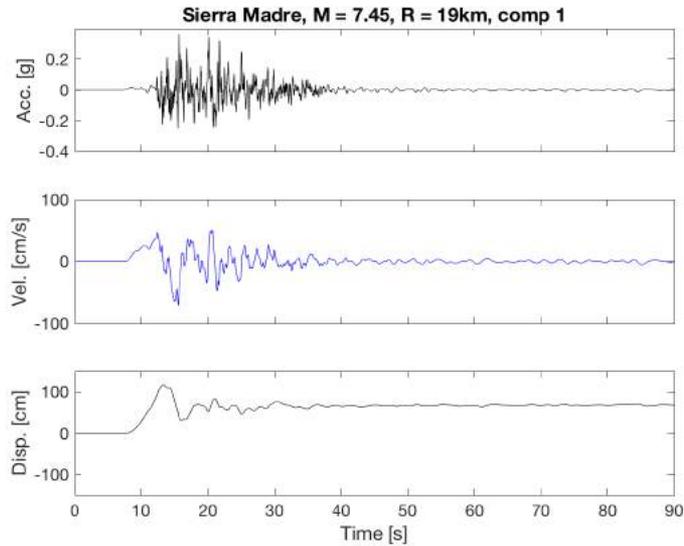
Example CyberShake record #1 (Newport Inglewood)



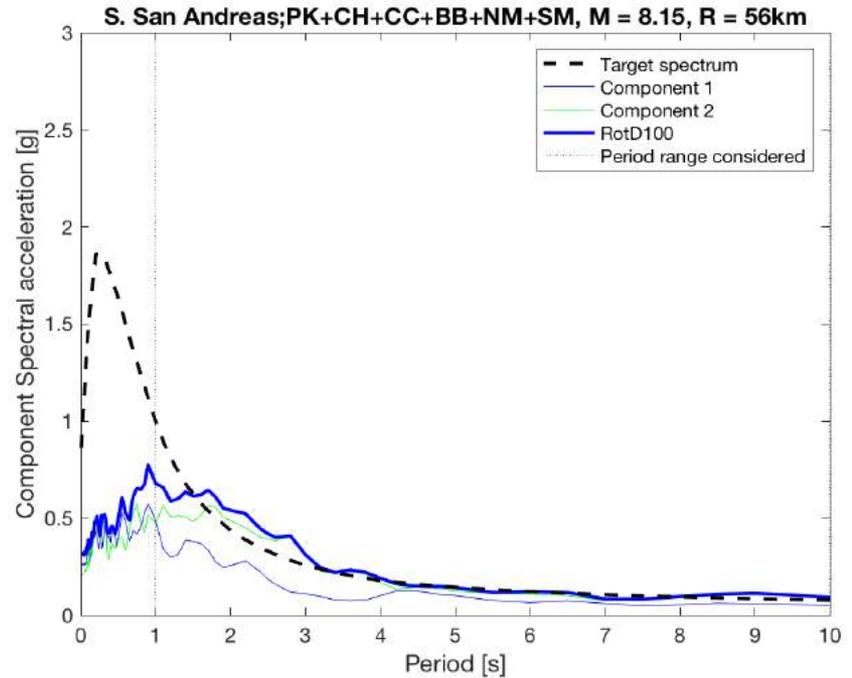
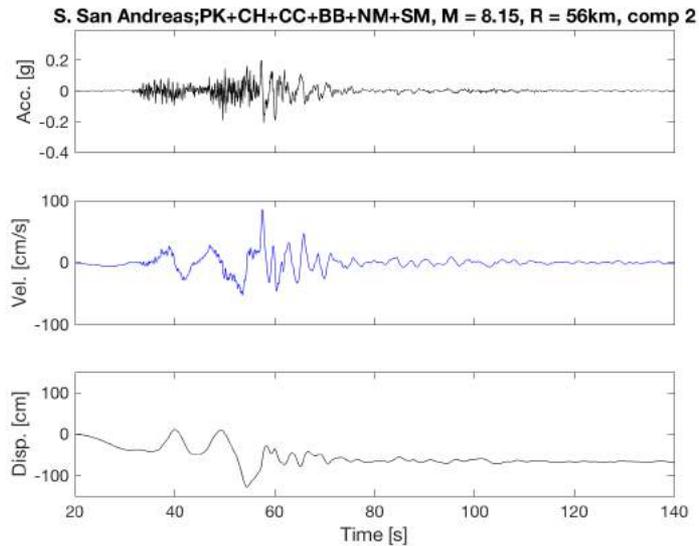
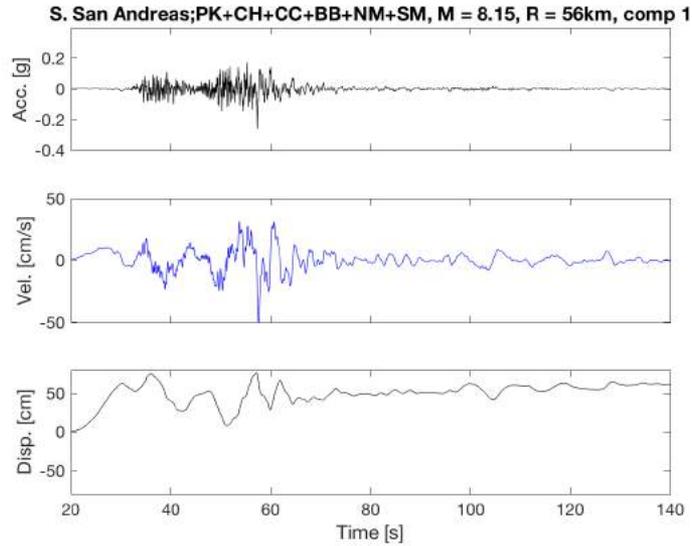
Example CyberShake record #2 (Puente Hills)



Example CyberShake record #5 (Sierra Madre)



Example CyberShake record #10 (San Andreas)



Additional documentation

- We have a ground motion selection report with figures for every selected time series and response spectrum, plus tabulated data
- We would love to hear feedback from interested users

Fault	Station Name	Magnitude	Distance (km)	Vs30 (m/s)	Scaling Factor	5-75% significant duration (s)
Newport Inglewood Connected alt 2	LADT	7.25	11.1	390	1	7.2
Puente Hills	LADT	7.25	5.4	390	1	4.6
Puente Hills	LADT	7.35	5.4	390	1	8.2
Newport Inglewood Connected alt 2	LADT	7.45	11.1	390	1	7.7
Sierra Madre	LADT	7.45	19.1	390	1	10.6
Newport Inglewood Connected alt 1	LADT	7.25	13.3	390	1	5.3
Newport-Inglewood, alt 2	LADT	7.45	11.1	390	1	10.0
Newport Inglewood Connected alt 2	LADT	7.65	11.1	390	1	6.7
Puente Hills	LADT	7.15	5.4	390	1	3.6
S. San Andreas;PK+CH+CC+BB+NM+SM	LADT	8.15	55.7	390	1	22.4
S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB	LADT	8.15	55.7	390	1	18.5

Conclusions

- We have selected ground motions from the CyberShake database for sites in Los Angeles Downtown and Pasadena
 - Targeted for tall buildings analysis
 - Compliant with ASCE 7-16 Response History Analysis requirements
- Reference ground motions from NGA-W2 were also selected
- The CyberShake motions appear suitable for engineering use (other than excessive polarization in a few cases) and offer a much richer set of motions for large-magnitude and basin conditions
- Moving forward, we hope to solicit feedback from practicing engineers, and build users' confidence in the simulations

Thoughts on selecting time series for the UGMS tool

- Site-specific motions or a general suite that can be further searched?
 - **Site-specific**—easier to provide a small suite, but for users with a different site or target spectrum, it may be challenging to use these
 - **General suite**—easier to provide the “large magnitude small distance” motions that are most useful, but may require further searching within the set by a user
- A question to you—how would you envision using CyberShake time series for your projects?