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Title: SPE-5 Ground-Motion Prediction at Far-Field Geophone and Accelerometer Array Sites and SPE-5 Moment and Corner-Frequency Prediction

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SPE-5 Ground-Motion Prediction at Far-Field Geophone and Accelerometer Array Sites and SPE-5 Moment and Corner-Frequency Prediction

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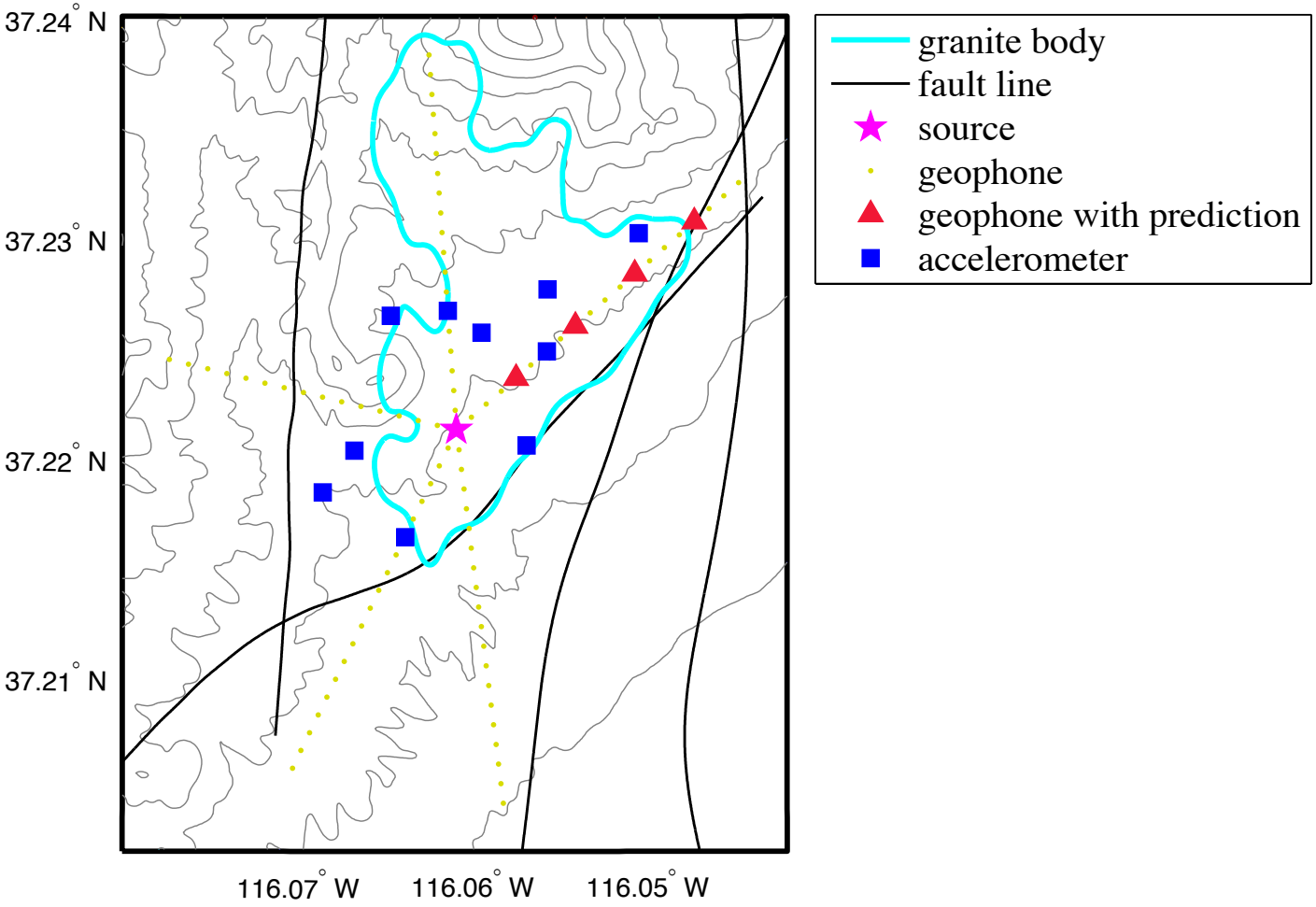
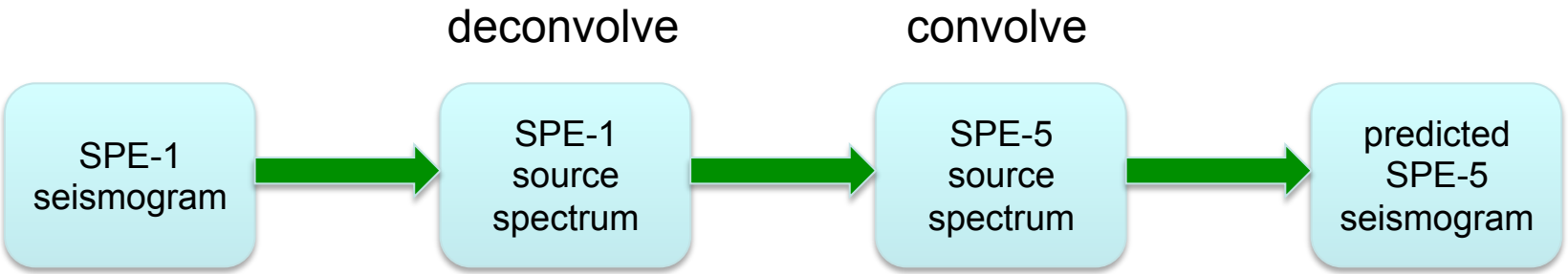

37.24° N
37.23° N
37.22° N
37.21° N
116.07° W
116.06° W
116.05° W
granite body
fault line
source
geophone
geophone with prediction
accelerometer

What We Predict …

- Waveform and spectral amplitude at certain geophone sites using Denny&Johnson source model and a source model derived from SPE data
- Waveform, peak velocity and peak acceleration at accelerometer sites using the SPE source model and the finite-difference simulation with LLNL 3D velocity model
- SPE-5 Moment and corner frequency

I. Waveform and spectral amplitude prediction at geophone sites



$$M(\omega) = \frac{\pi\rho\alpha^2 P_0 R^3 \omega_e^2}{\mu(2i\eta\omega_e + \omega_e^2 - \omega^2)}$$

Denny & Johnson

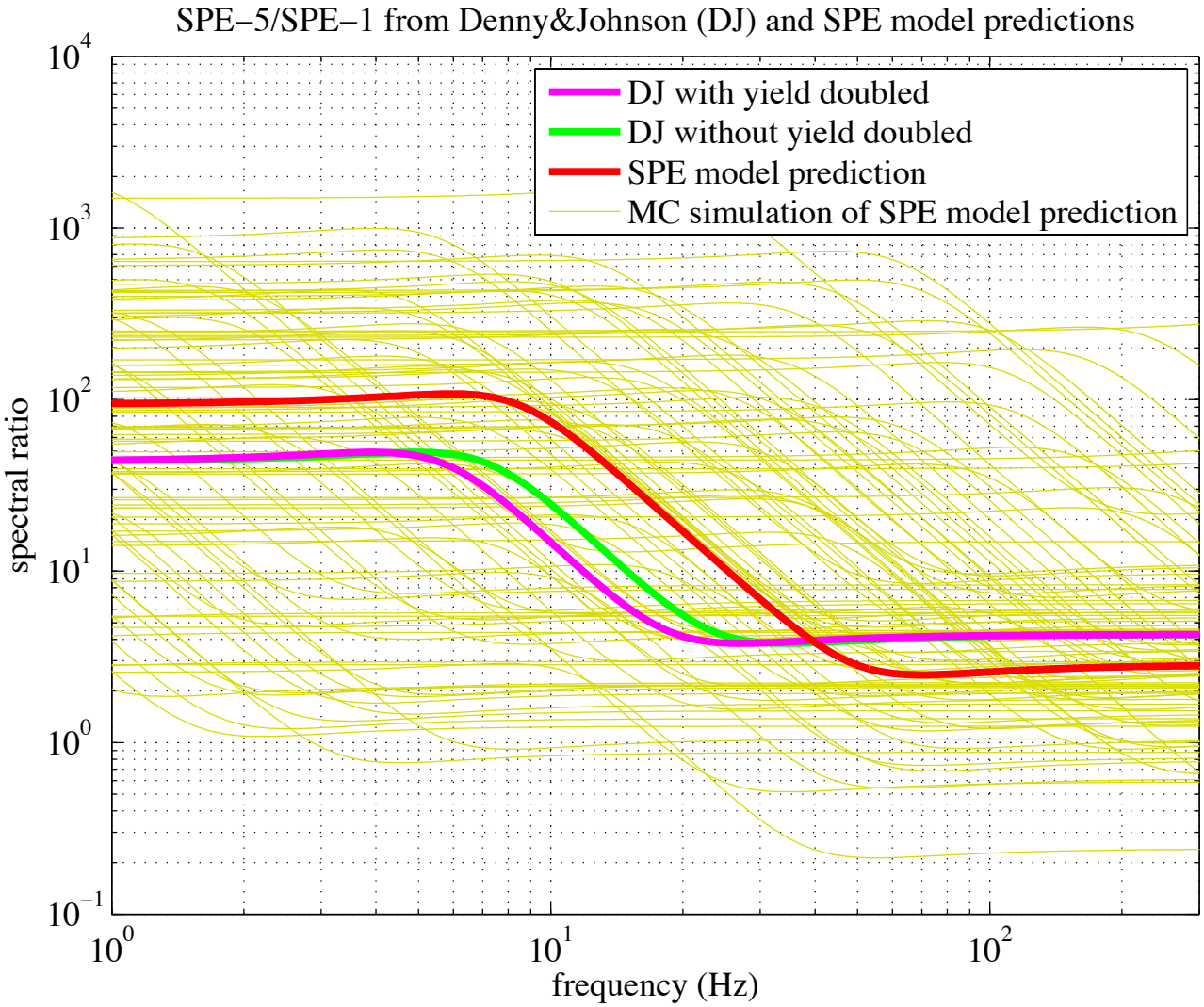
$$P_0 = A(\alpha, \beta, \rho, GP)h^{1.2181}$$

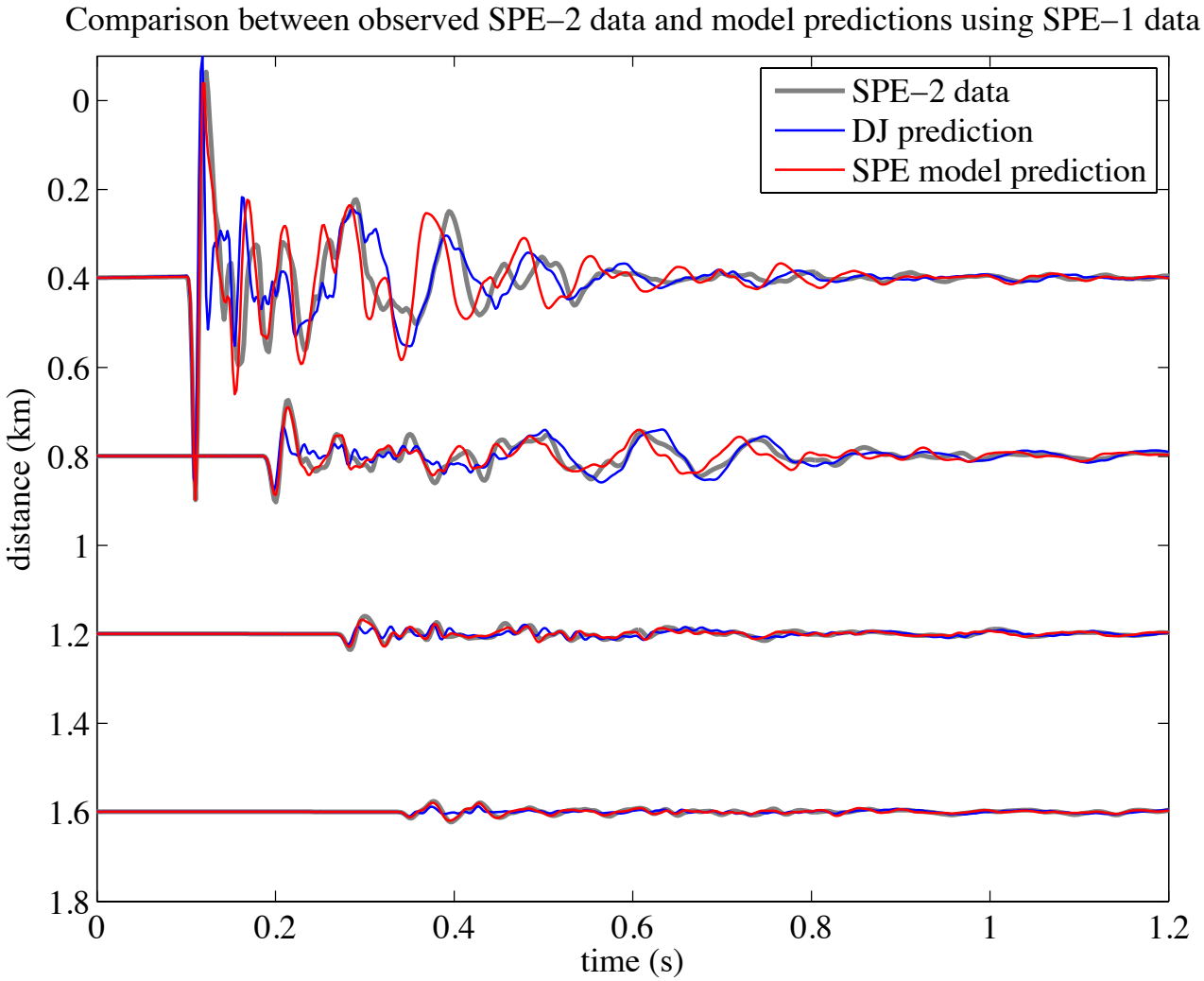
$$R = B(\alpha, \beta, \rho, GP)W^{0.3333}h^{-0.5522}$$

Model based on SPE data

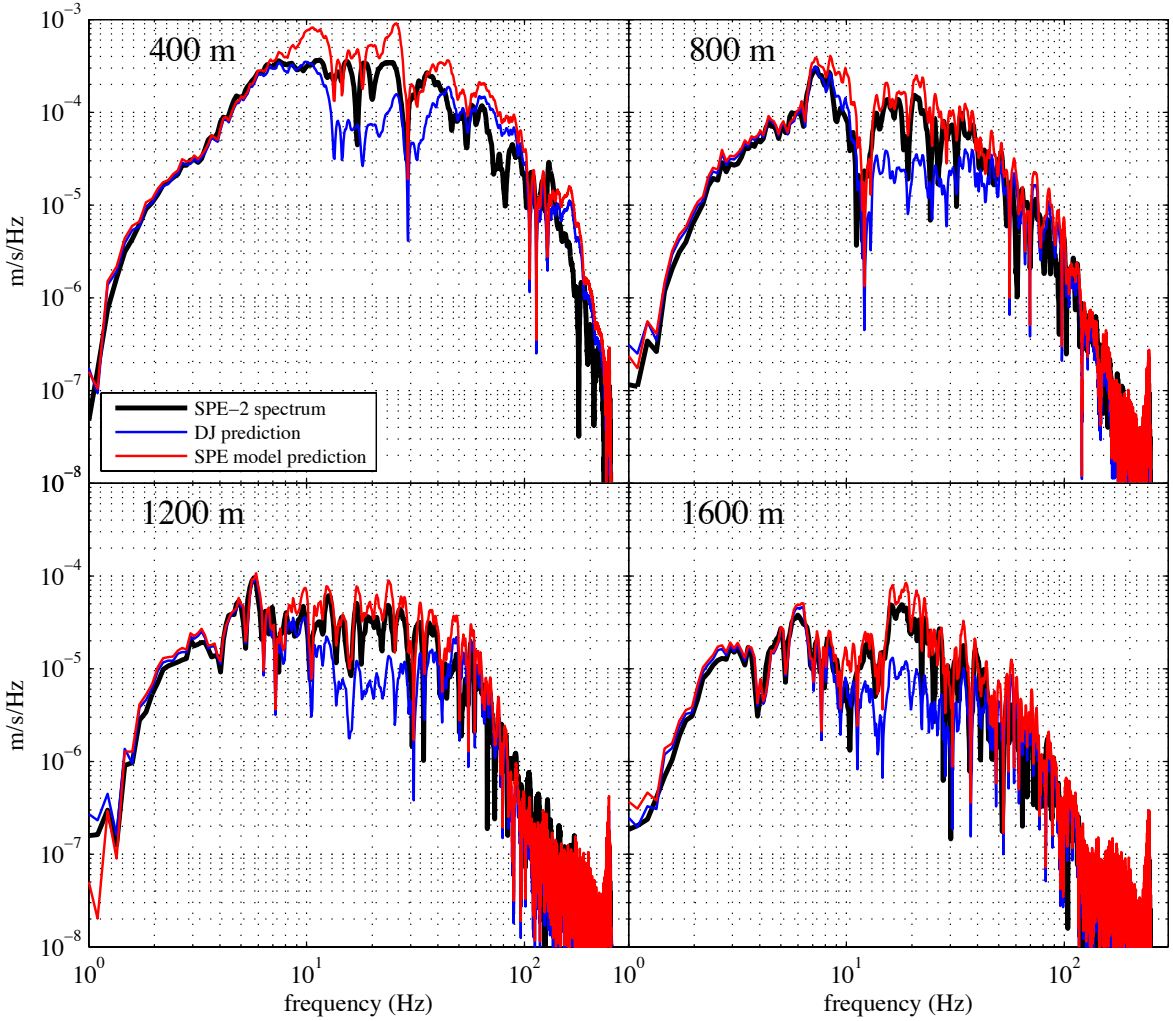
$$P_0 = CW^{-0.0067}h^{-2.0413}$$

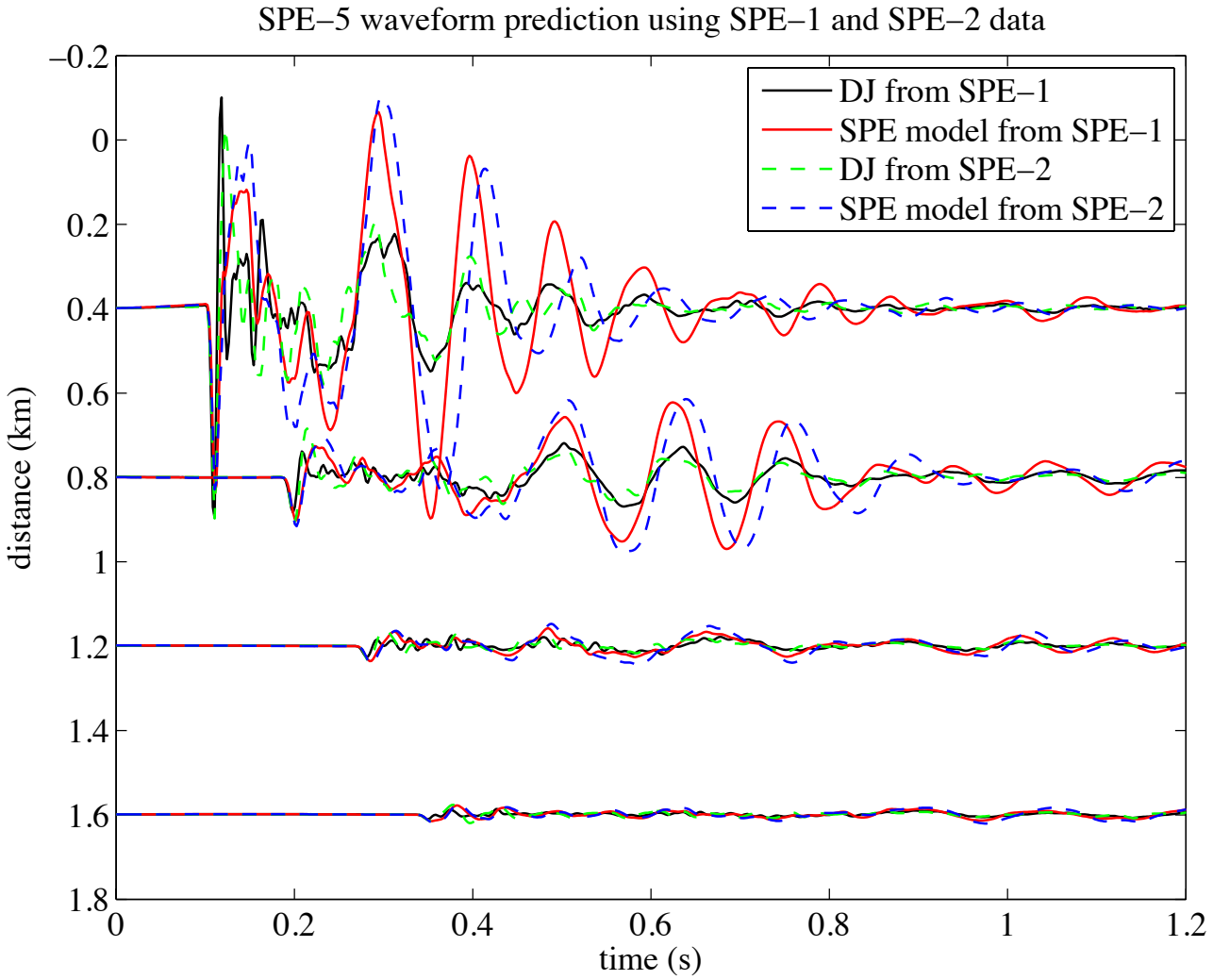
$$R = DW^{0.3751}h^{0.7068}$$


SPE–5/SPE–1 from Denny&Johnson (DJ) and SPE model predictions
DJ with yield doubled
DJ without yield doubled
SPE model prediction
MC simulation of SPE model prediction
spectral ratio
frequency (Hz)
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{0}
10^{1}
10^{2}

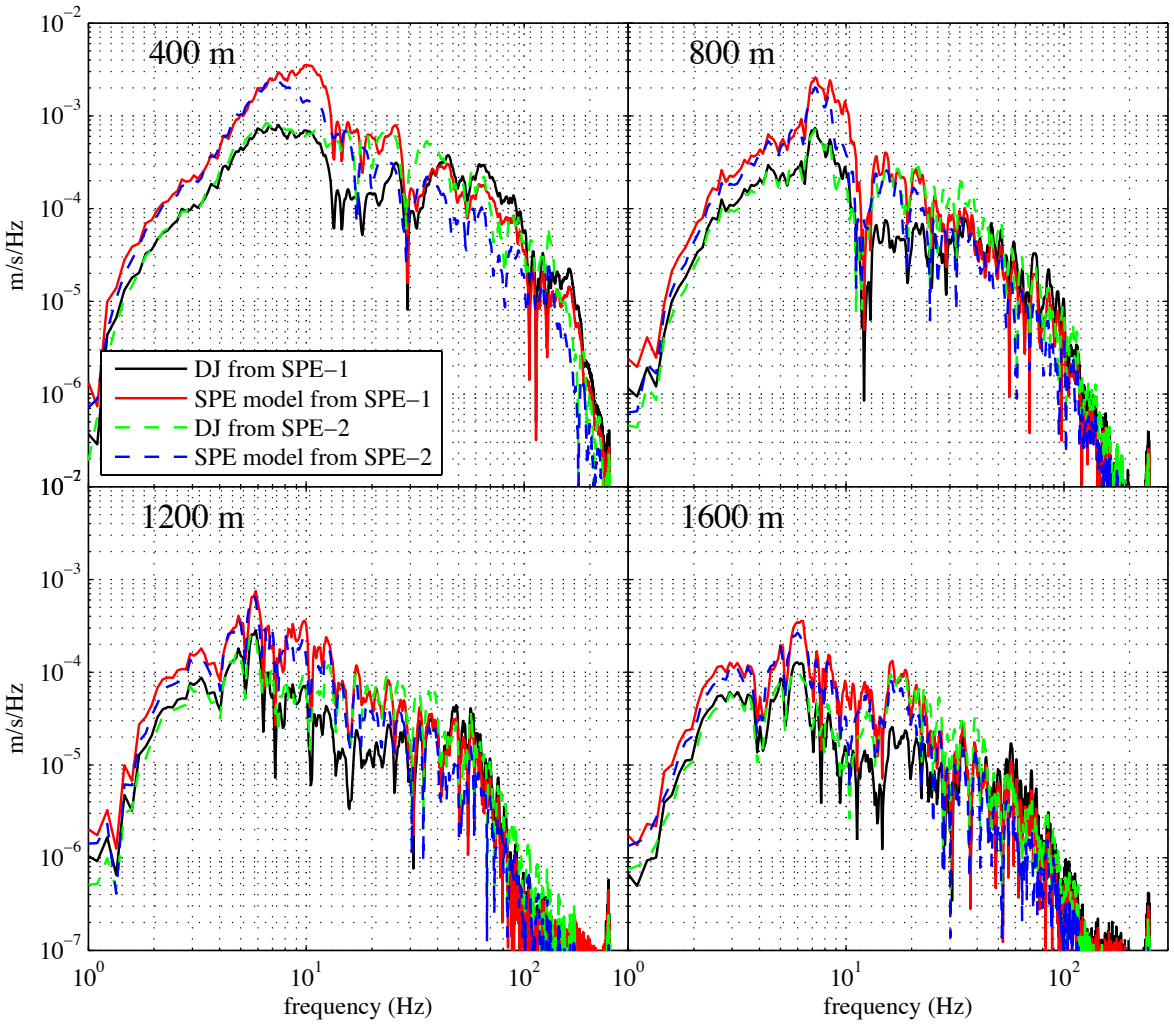

Comparison between observed SPE–2 data and model predictions using SPE–1 data
SPE–2 data
DJ prediction
SPE model prediction
distance (km)
time (s)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8

Comparison between observed SPE-2 spectra and model predictions using SPE-1 data




SPE–5 waveform prediction using SPE–1 and SPE–2 data
DJ from SPE–1
SPE model from SPE–1
DJ from SPE–2
SPE model from SPE–2
distance (km)
time (s)
–0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
0.2
0.4
0.6
0.8
1
1.2

SPE-5 spectra prediction using SPE-1 and SPE-2 data



II. Waveform and peak amplitude modeling at accelerometer sites

Green's functions from finite-difference simulation with LLNL Earth model

↓

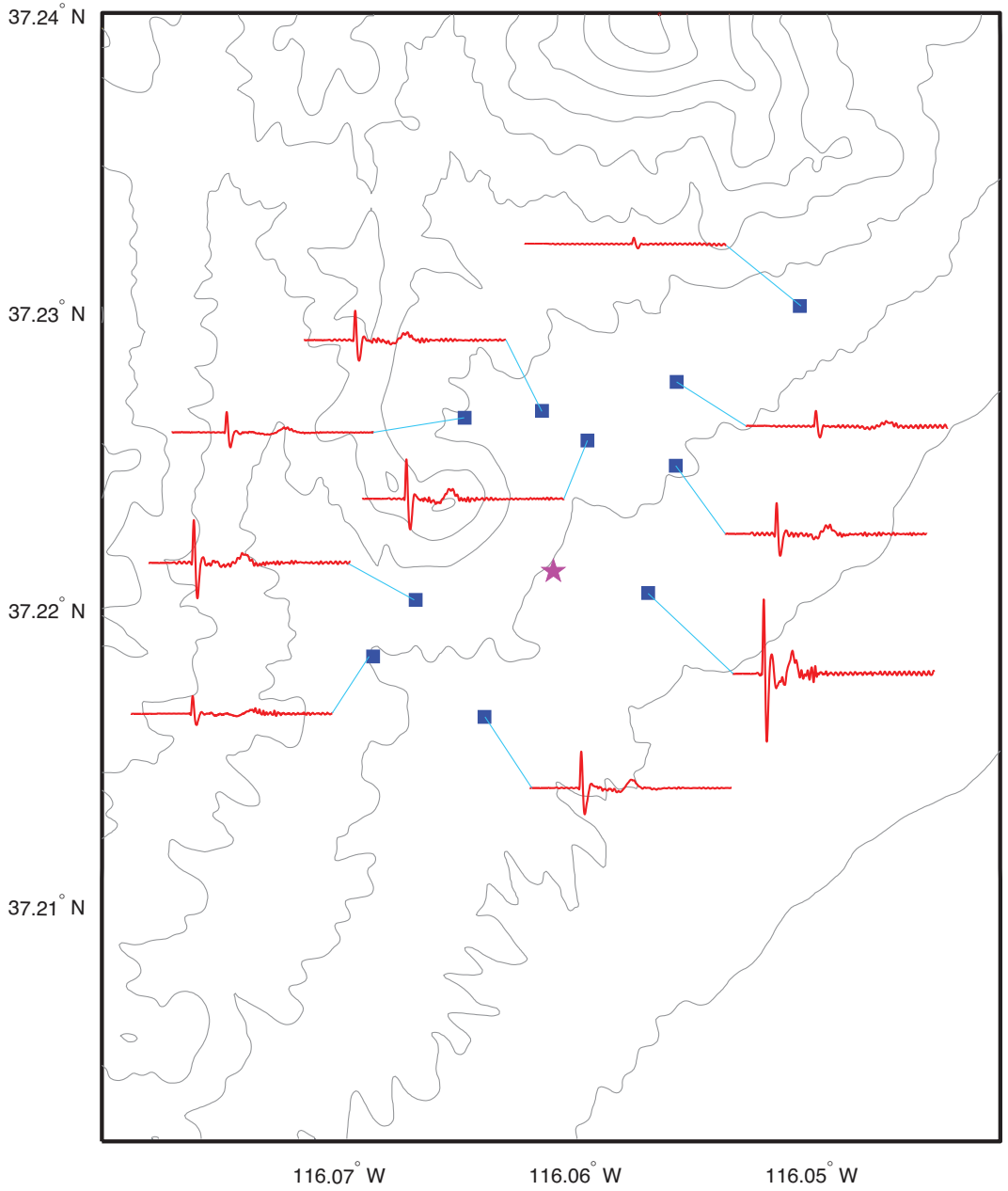
Convolution of Green's function and SPE-1 source time function

↓

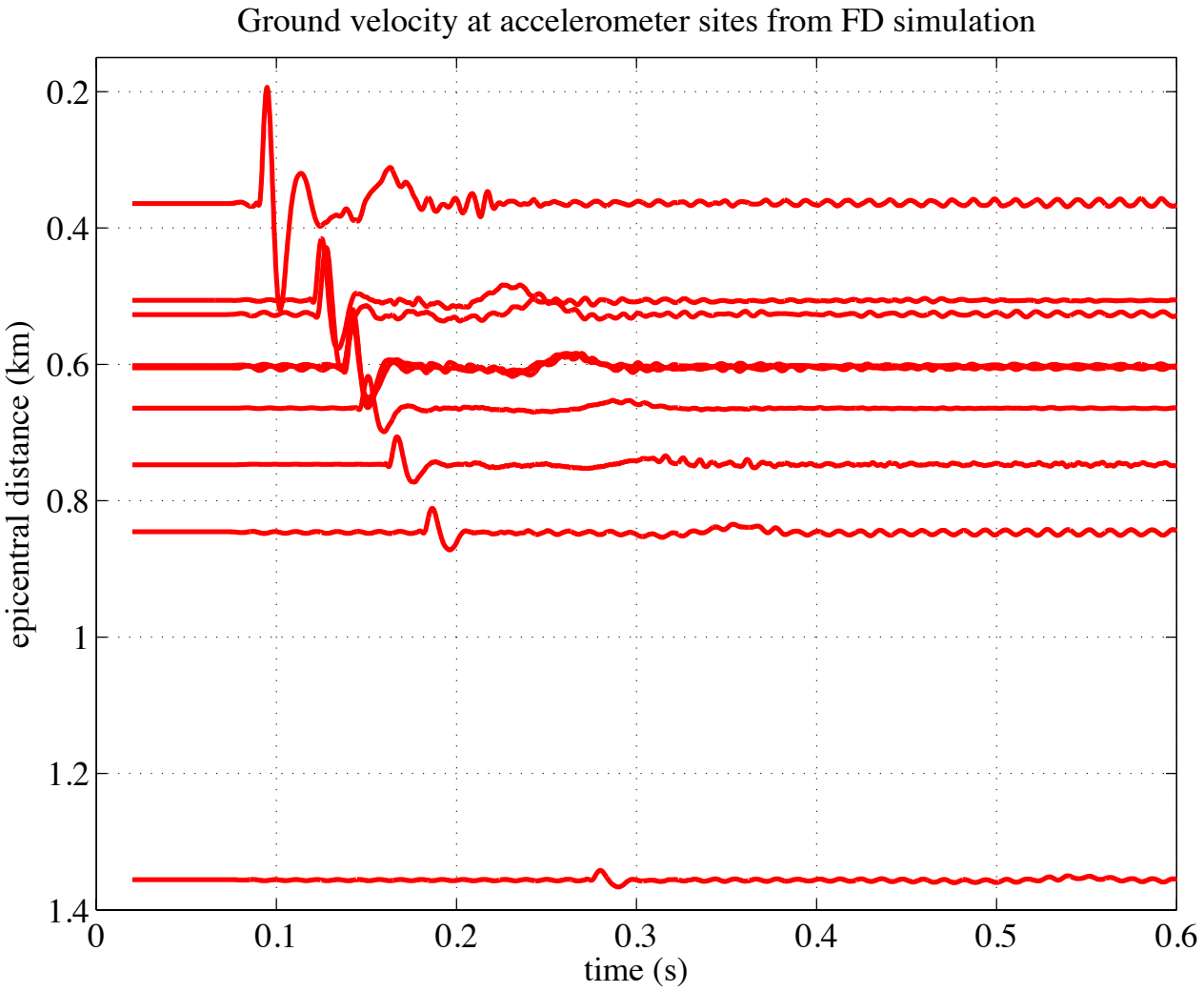
Scaling of amplitudes using observed geophone data at a collocated site

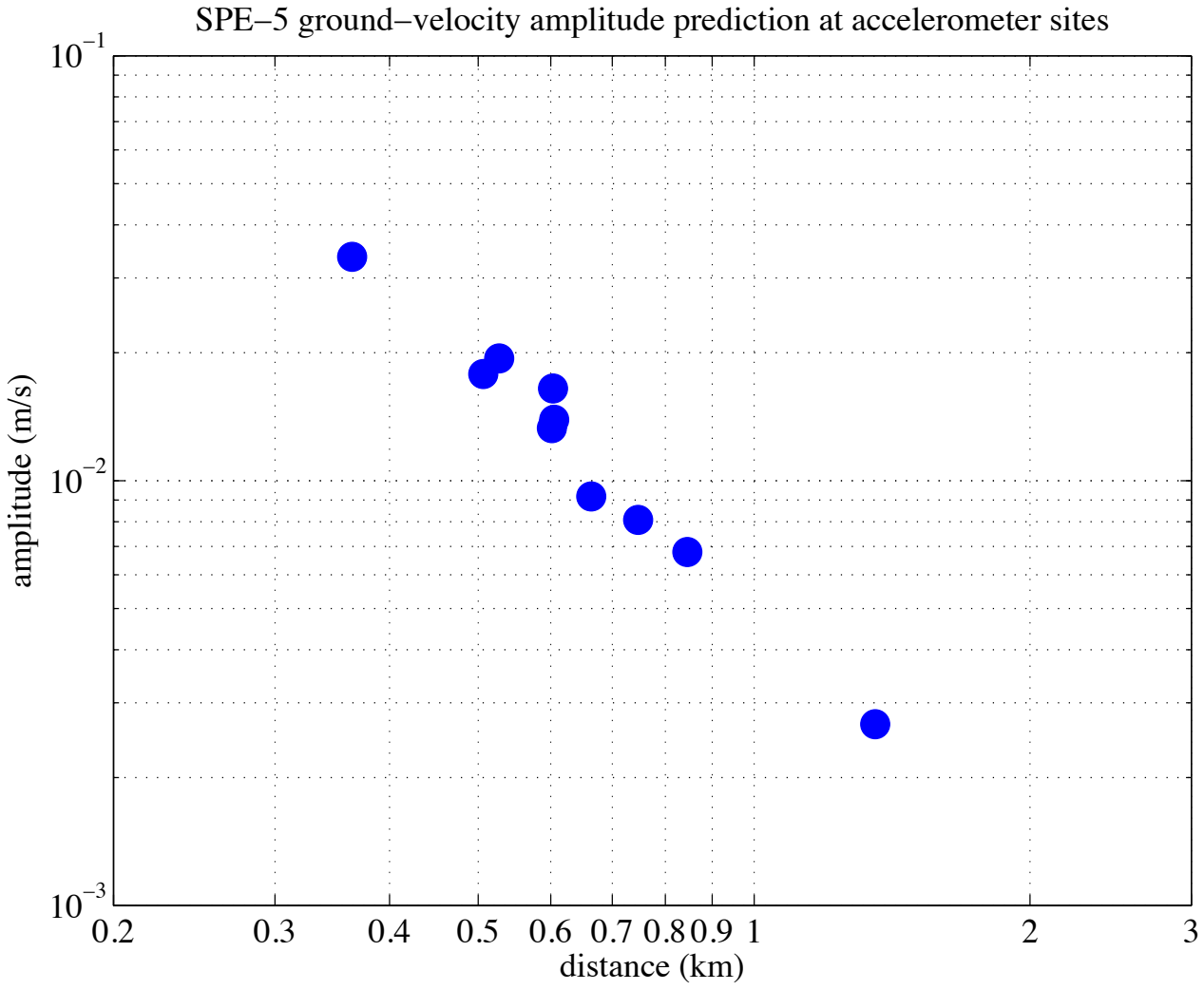
↓

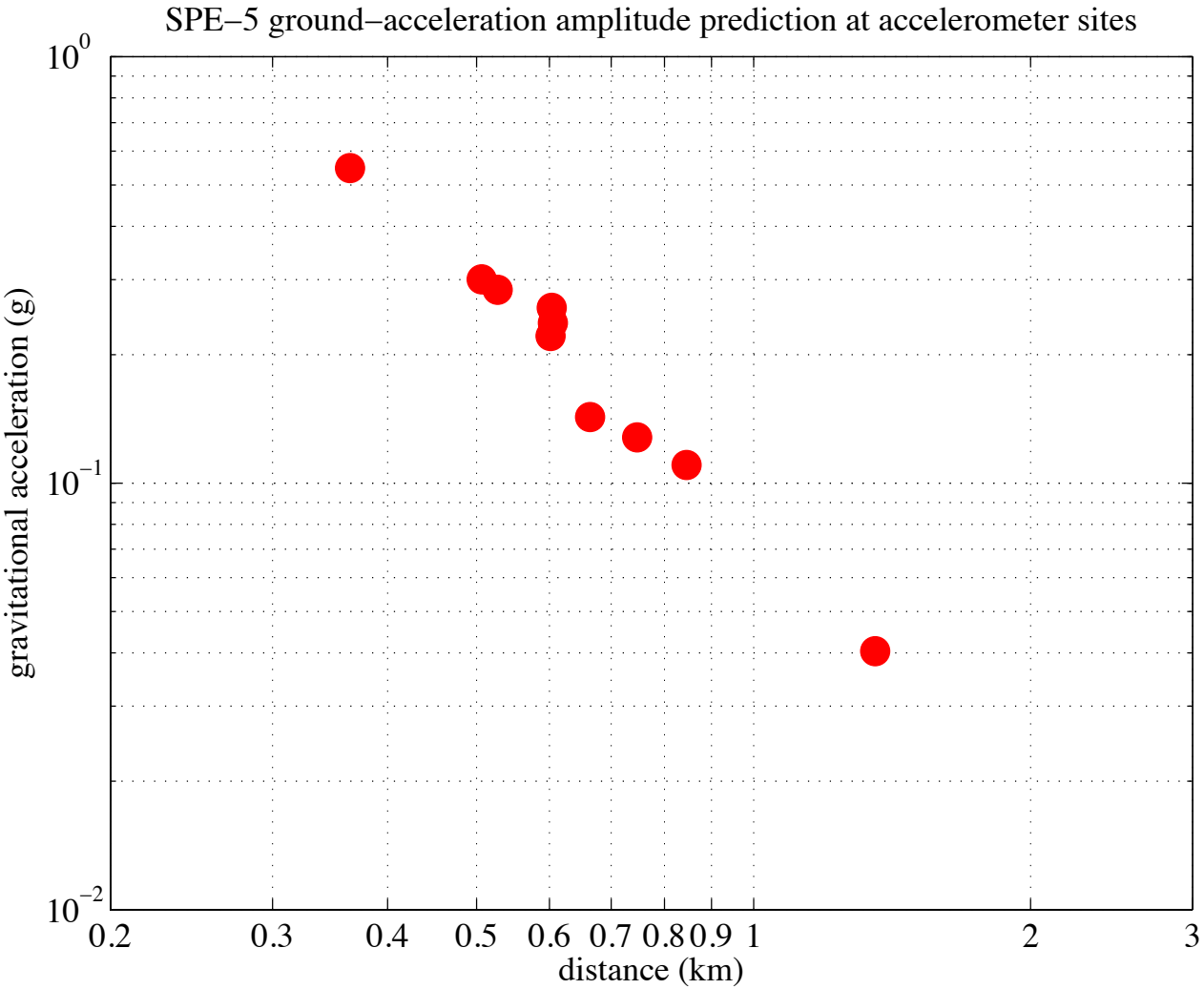
Deconvolution of SPE-1 source and convolution of SPE-5 source



Ground velocity from FD simulation


Ground velocity at accelerometer sites from FD simulation
epicentral distance (km)
0.2
0.4
0.6
0.8
1
1.2
1.4
0
0.1
0.2
0.3
0.4
0.5
0.6
time (s)

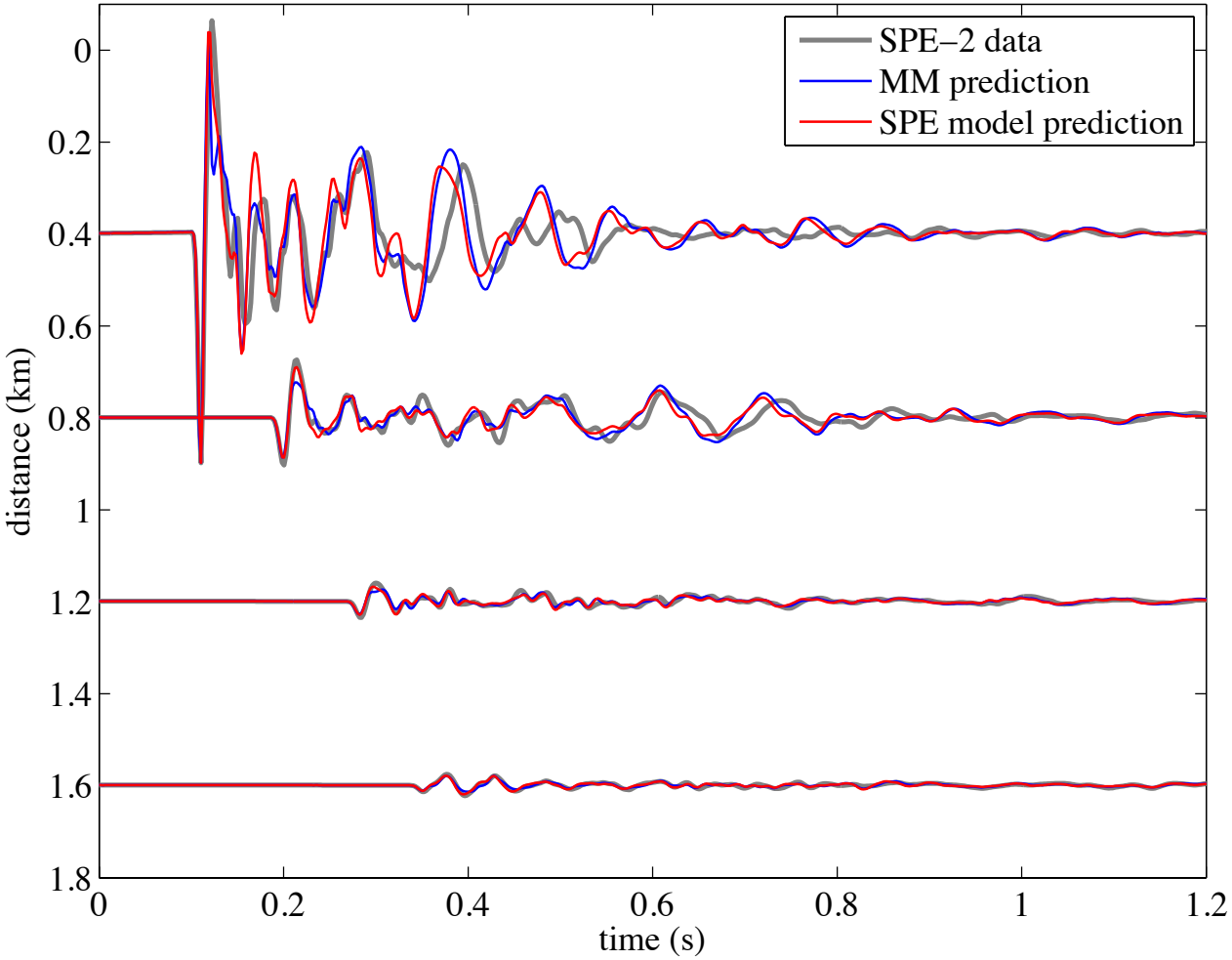

SPE–5 ground–velocity amplitude prediction at accelerometer sites
amplitude (m/s)
10^{-1}
10^{-2}
10^{-3}
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2
3
distance (km)

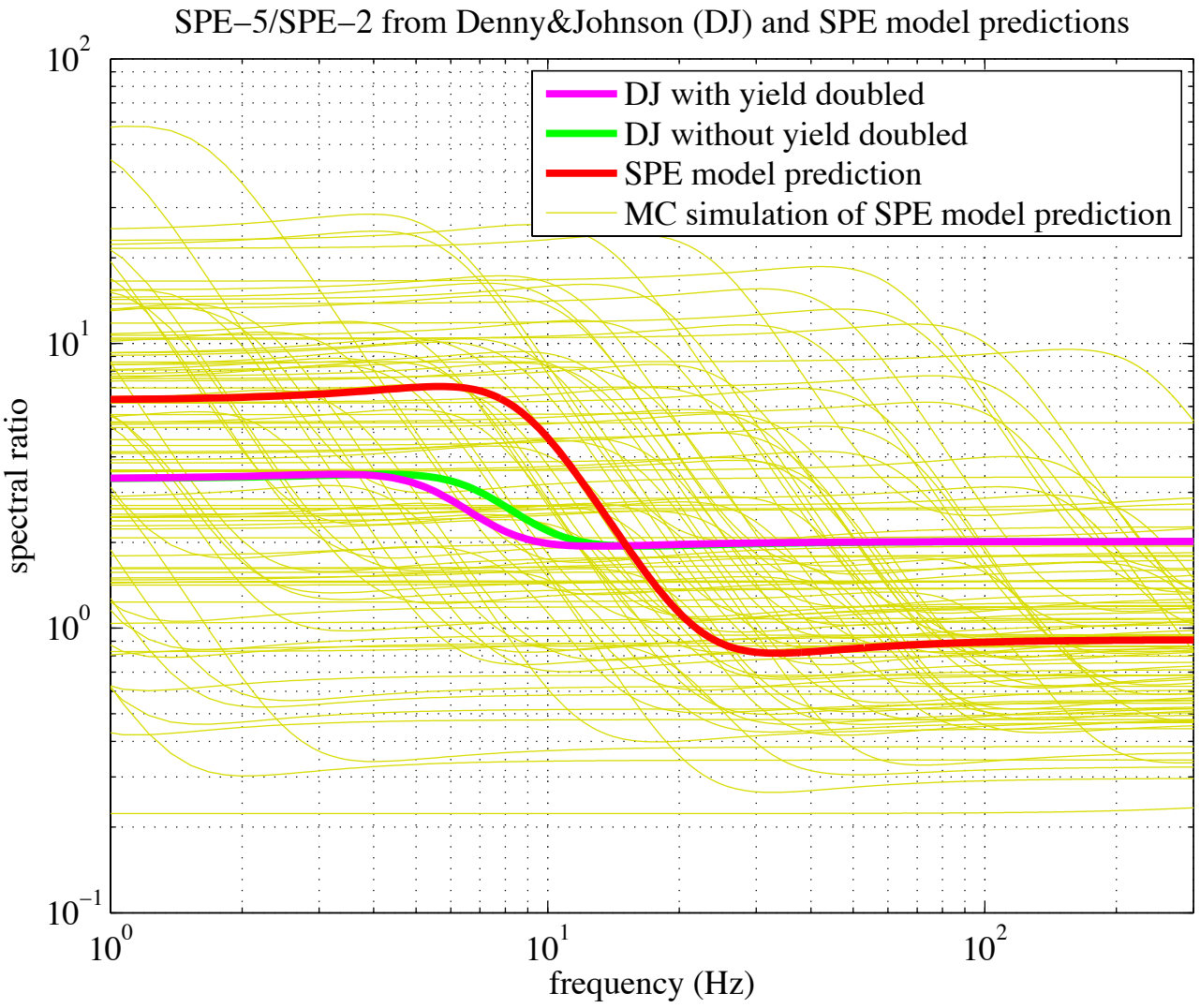

SPE–5 ground–acceleration amplitude prediction at accelerometer sites
gravitational acceleration (g)
10^{0}
10^{-1}
10^{-2}
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2
3
distance (km)

III. SPE-5 Moment and Corner Frequency

	M_0 (Nm)	F_c (Hz)
MM Model	7.87E12	13
DJ Model	5.41E12	7
SPE Model	13.72E12	8

Comparison between observed SPE–2 data and model predictions using SPE–1 data

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10^{0}
10^{-1}
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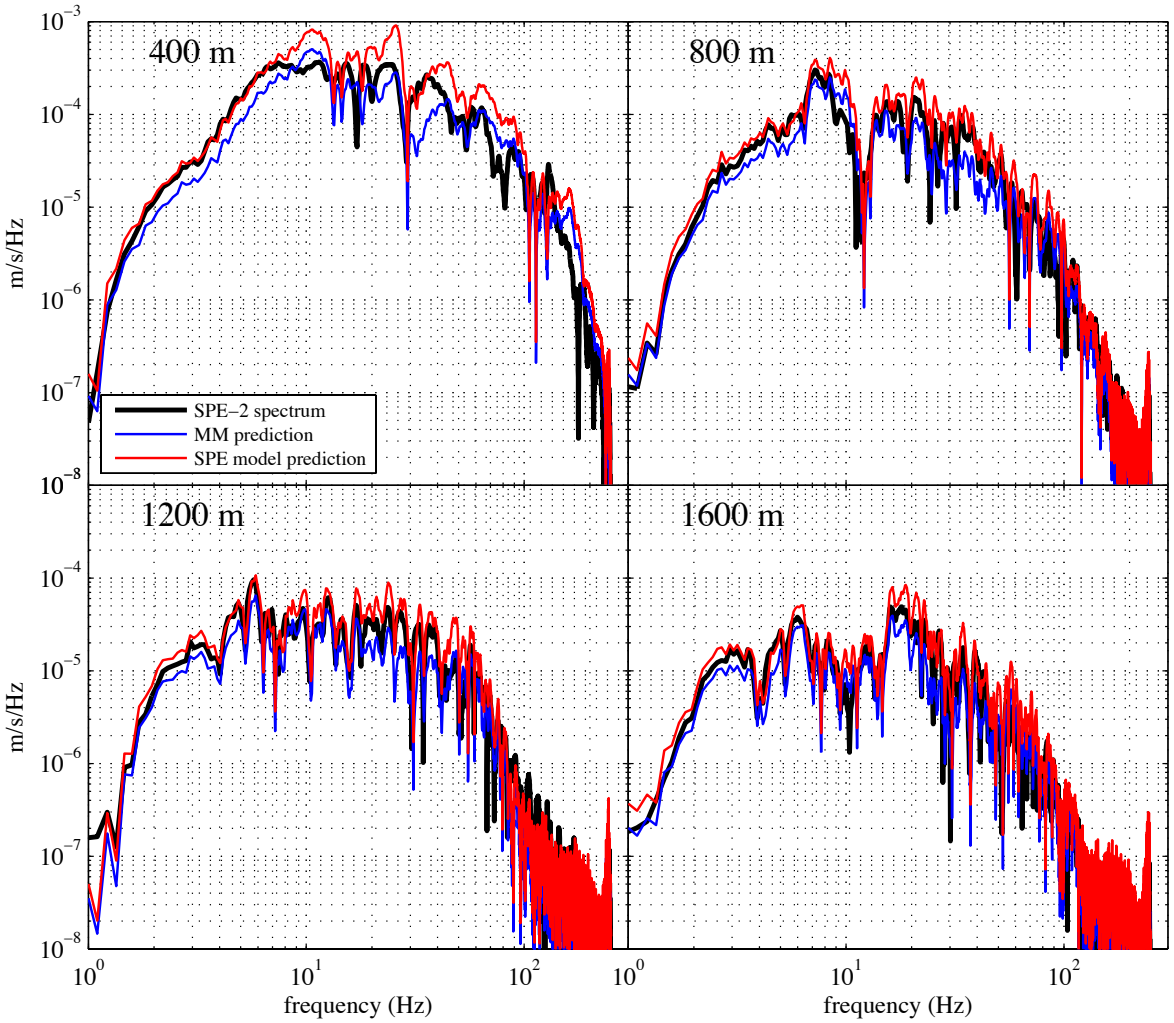
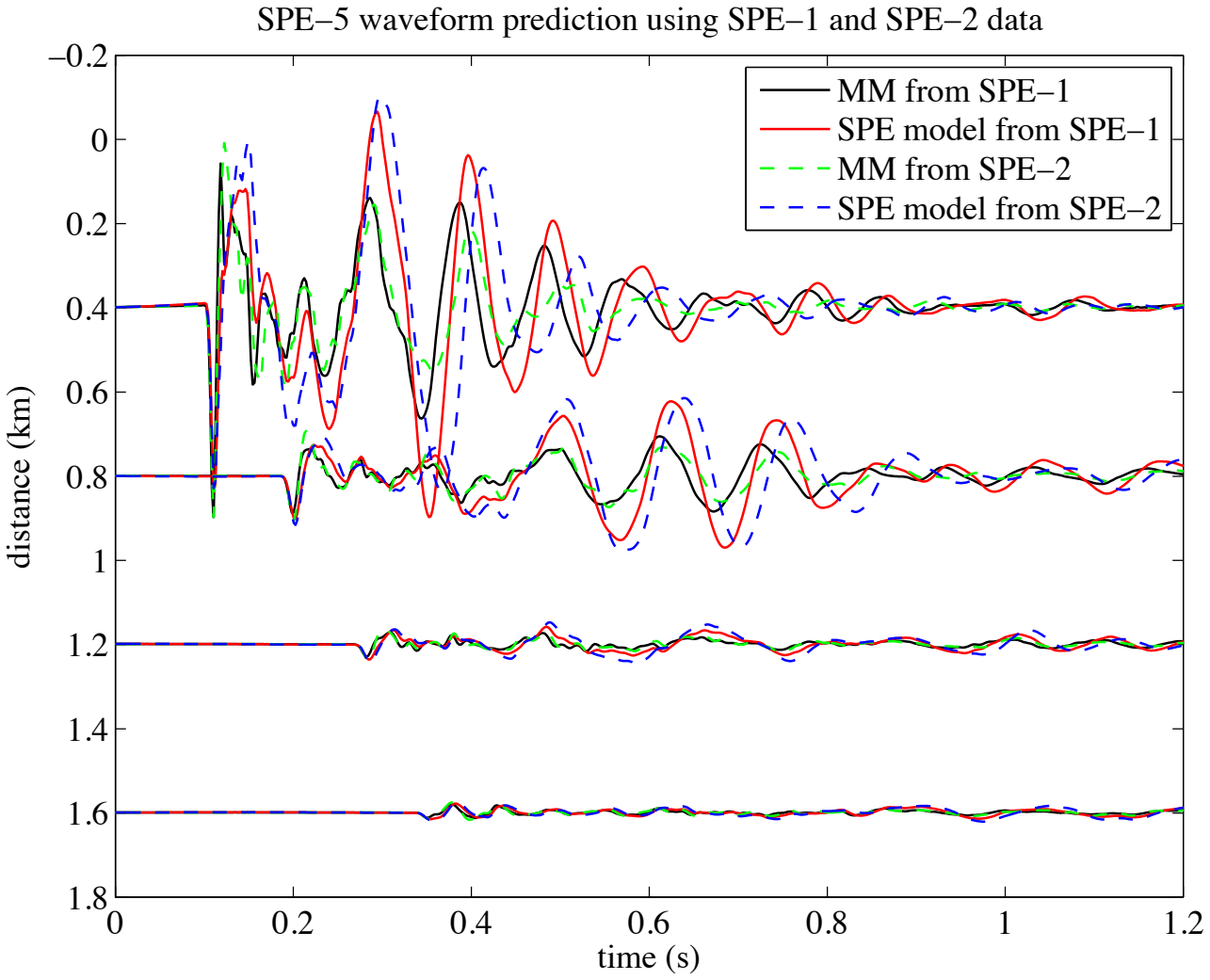
10^{1}
10^{2}

Comparison between observed SPE-2 spectra and model predictions using SPE-1 data




SPE–5 waveform prediction using SPE–1 and SPE–2 data
MM from SPE–1
SPE model from SPE–1
MM from SPE–2
SPE model from SPE–2
distance (km)
time (s)
–0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
0.2
0.4
0.6
0.8
1
1.2

SPE-5 spectra prediction using SPE-1 and SPE-2 data