UCSB Simulations

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Method for UCSB Simulations

Finite fault

Kinematic modeling

Correlated kinematic parameters

Random slip on the fault determined by a power spectrum in wavenumber, amplitudes from a heavy-tailed function (Cauchy, generally).

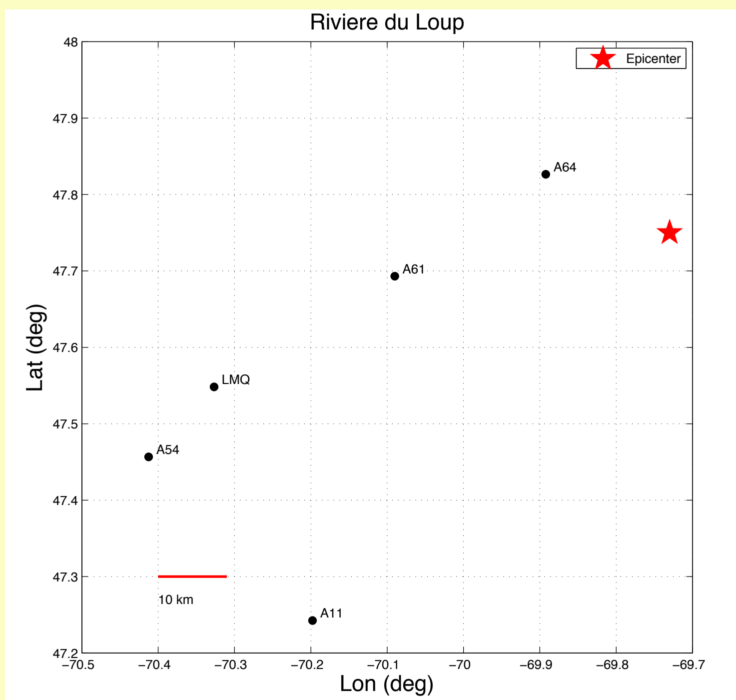
- A slip rate function that fits the dynamically computed slip rate.
- Rupture velocity correlates well with peak slip rate.
- Total slip correlates well with rise time.
- Rise time and peak rise time correlate, i.e., ruptures with a shorter rise time are more impulsive.
- No significant correlation between total slip and rupture velocity.

UCSB Simulations: Parameters

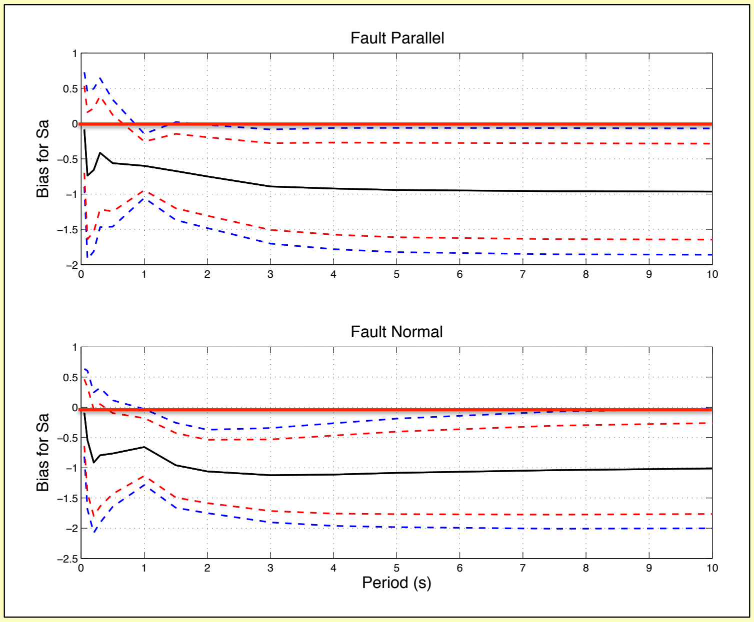
Given Parameters	Fixed Faulting Parameters	Variable Faulting Parameters
Seismic Moment, equivalently Mw	Relationship between slip spatial spectrum and spatial decay of rise time, rupture time, peak time	Brune corner frequency--total rupture moment rate function
Fault Geometry: Length, Width, Dip, Strike, Top of Fault	Distributions for rupture time, peak time, rise time	Wavenumber exponent for power-law of slip
Crustal Structure Vp, Vs, Qs, Qp, Kappa	Correlation matrix peak time, rise time, rupture time,	Amplitude distribution for slip (we use Cauchy primarily; it must be heavy-tailed)
	Hypocenter	Cross-over frequency for radiation pattern
		Range of angles for rake, dip and azimuth--high frequency

Rivière-du-Loup (Mw 4.6)

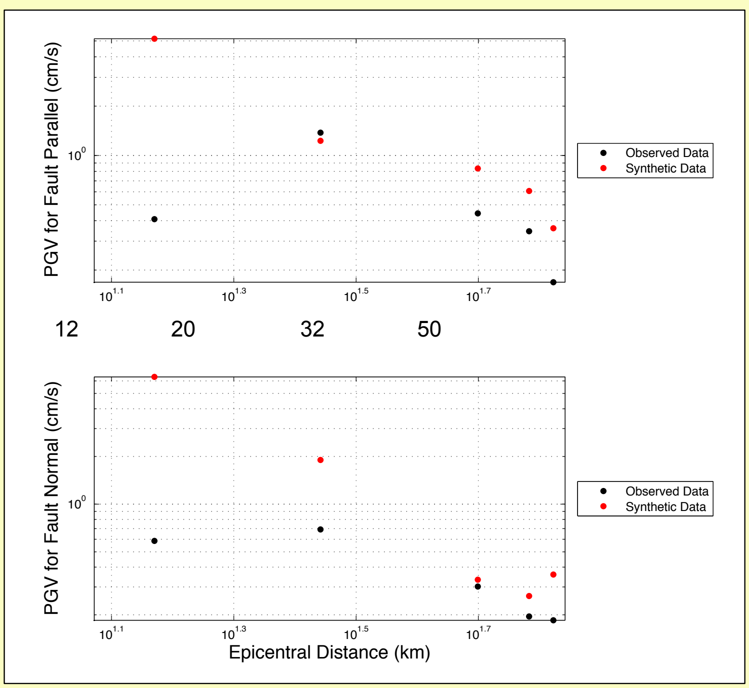
Stn	Epi Dist (km)
A64	14.80
A61	27.66
LMQ	50.01
A54	60.68
A11	66.48



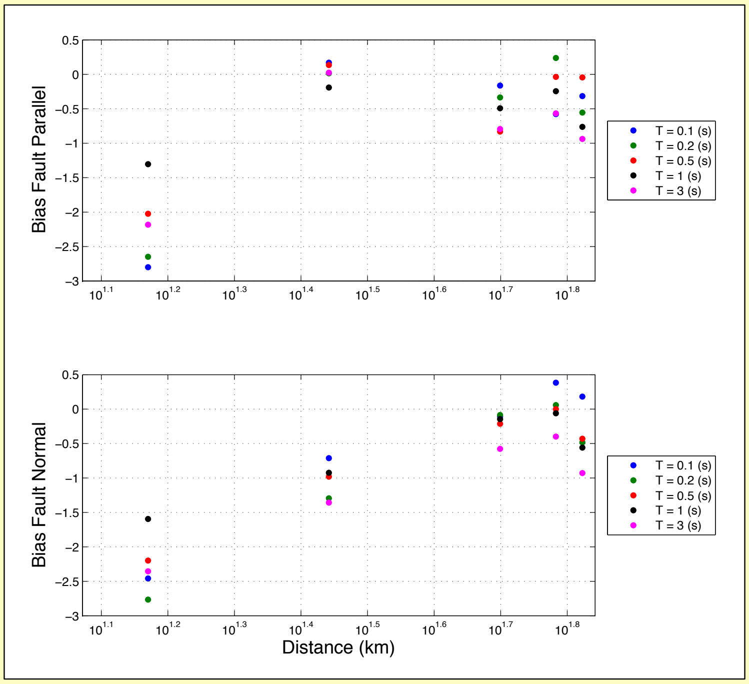
Rivière-du-Loup: Response Spectrum Bias



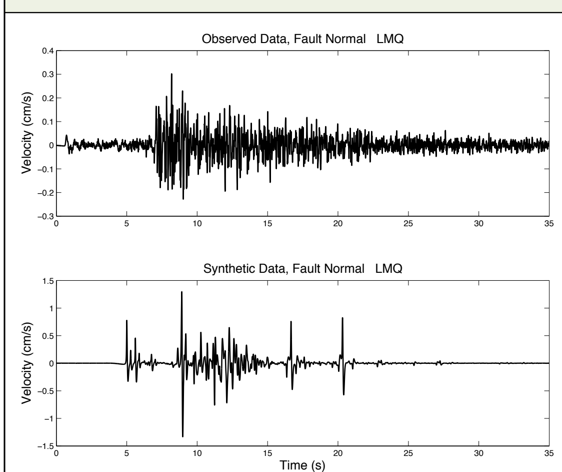
Rivière-du-Loup: PGV vs Distance

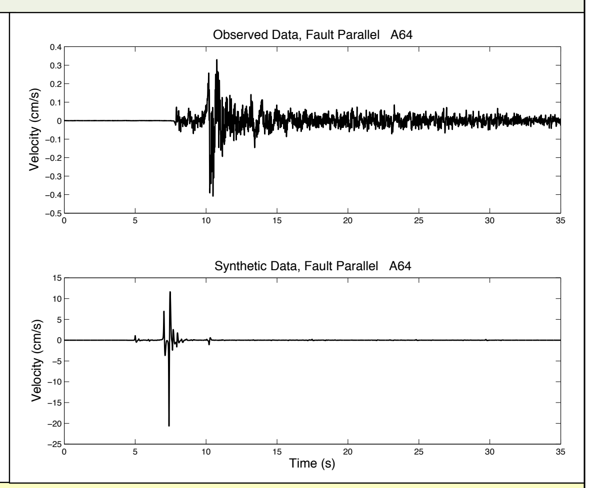


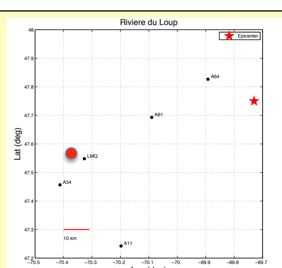
Rivière-du-Loup: Bias(T) vs Distance

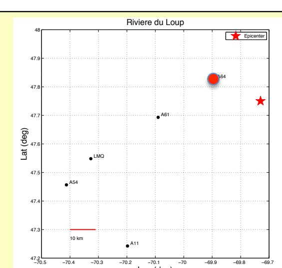


Rivière-du-Loup: Data and Synthetics









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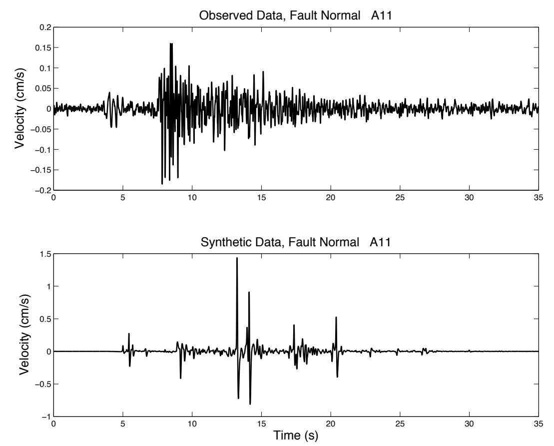
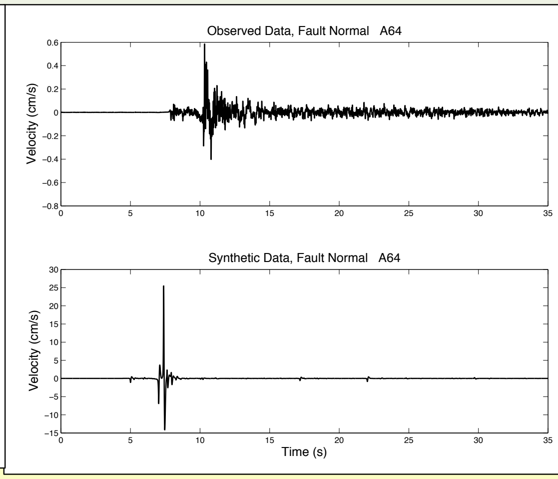
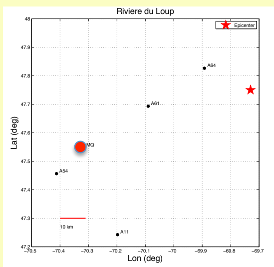
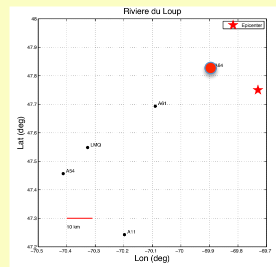
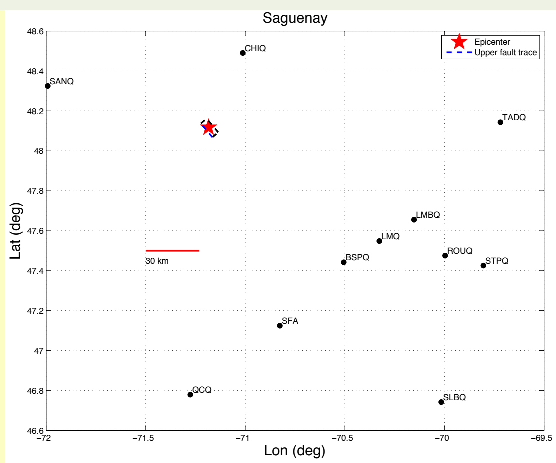






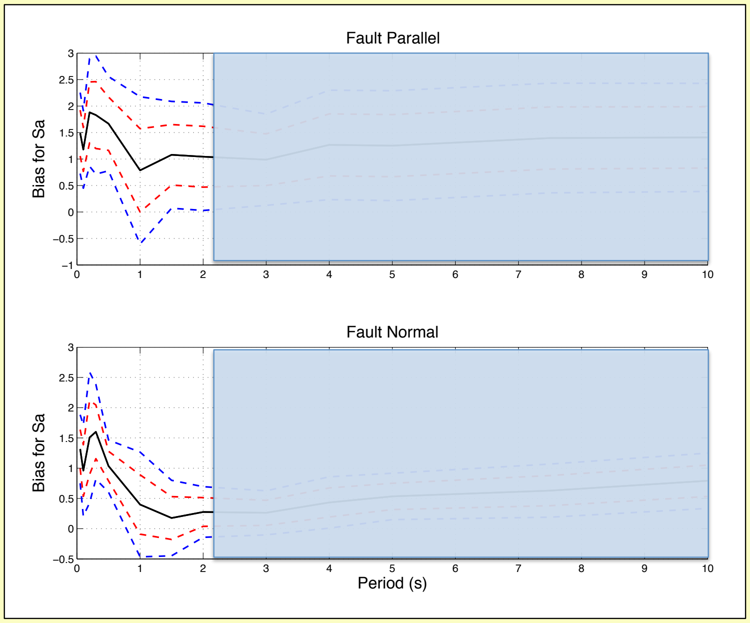


Saguenay

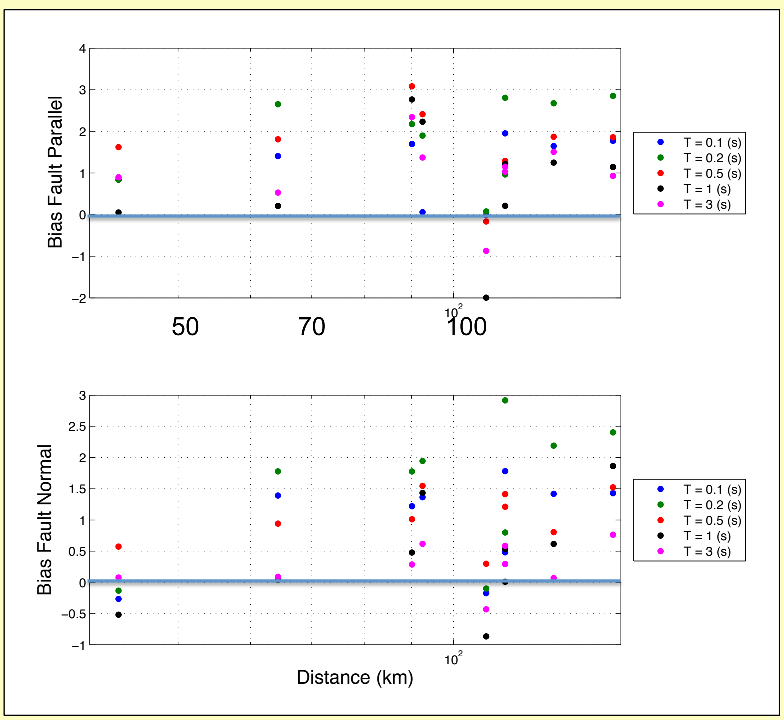


Thickness [km]	Vp [km/s]	Vs [km/s]	d[kg/dm^3]	Qp	Qs
1.44	4.5	2.6	2.3	500	250
6	5.5	3.4	2.5	1000	500
12	6.1	3.5	2.67	4000	2000
14	6.6	3.7	2.85	4000	2000
10	7	4	3.02	4000	2000
0	8.2	4.7	3.335	4000	2000

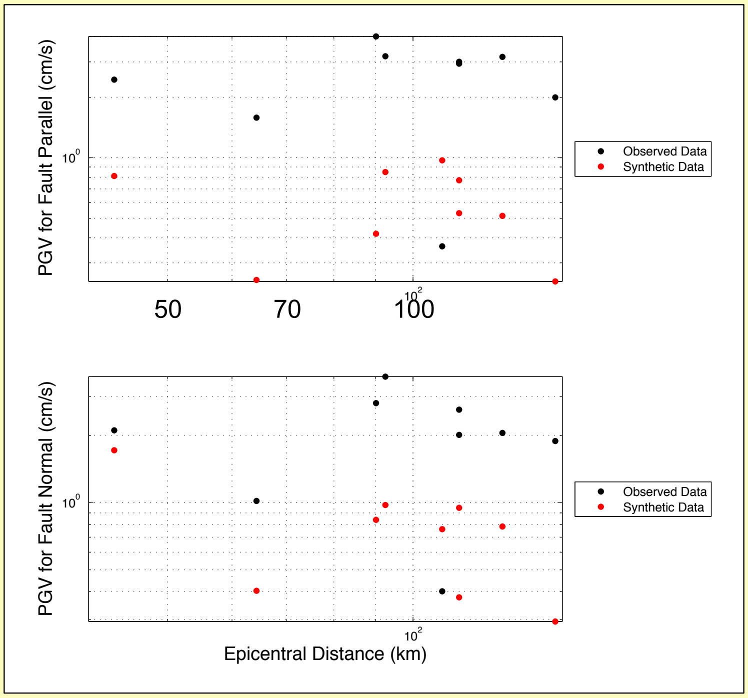
Saguenay: Response Spectrum Bias



Saguenay: Bias (T) vs Distance (km)

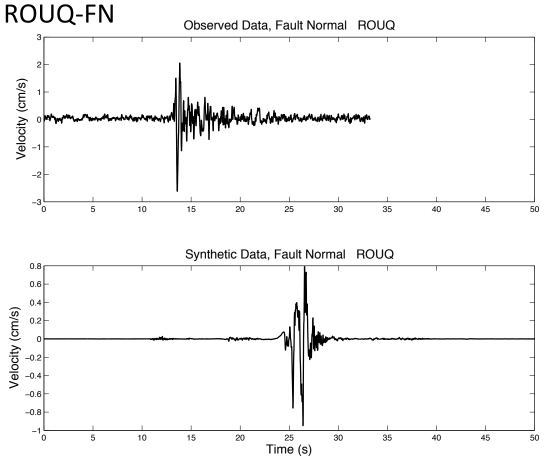


Saguenay: PGV vs Distance

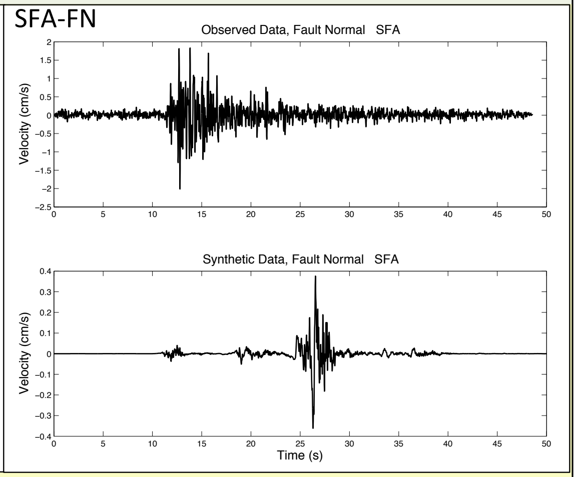


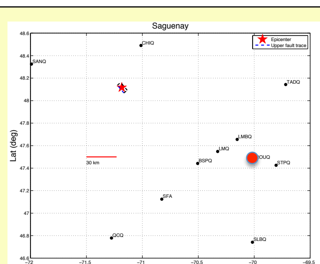
Saguenay: Data and Synthetics

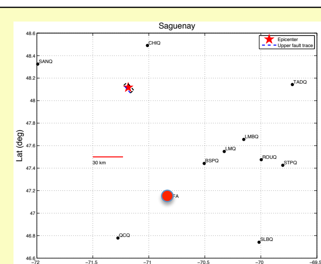
ROUQ-FN



SFA-FN







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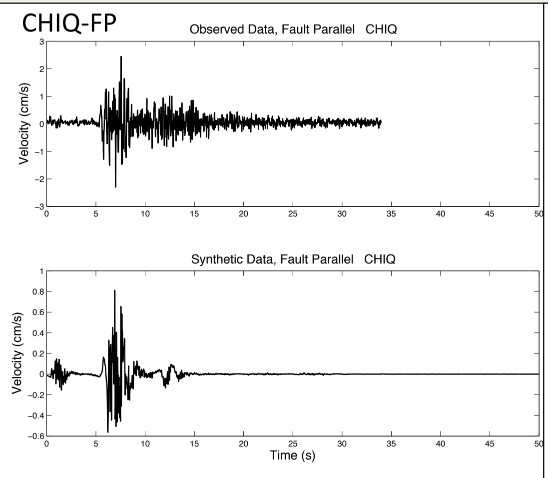
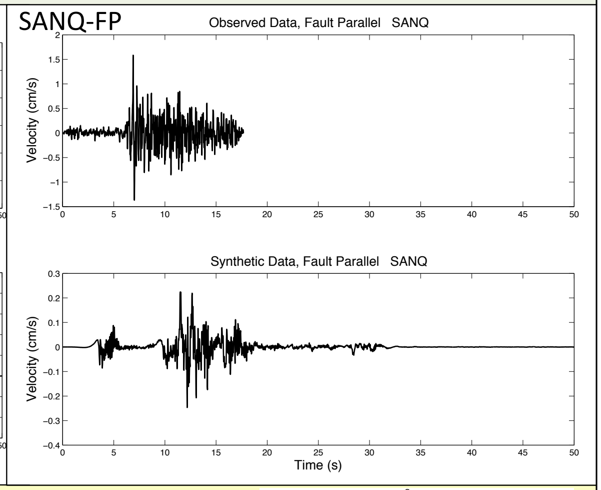
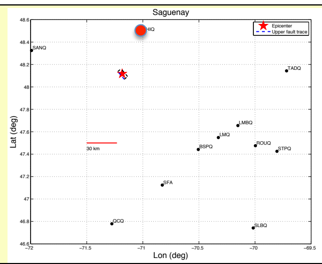
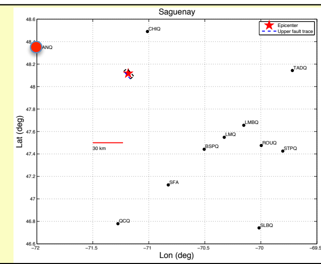
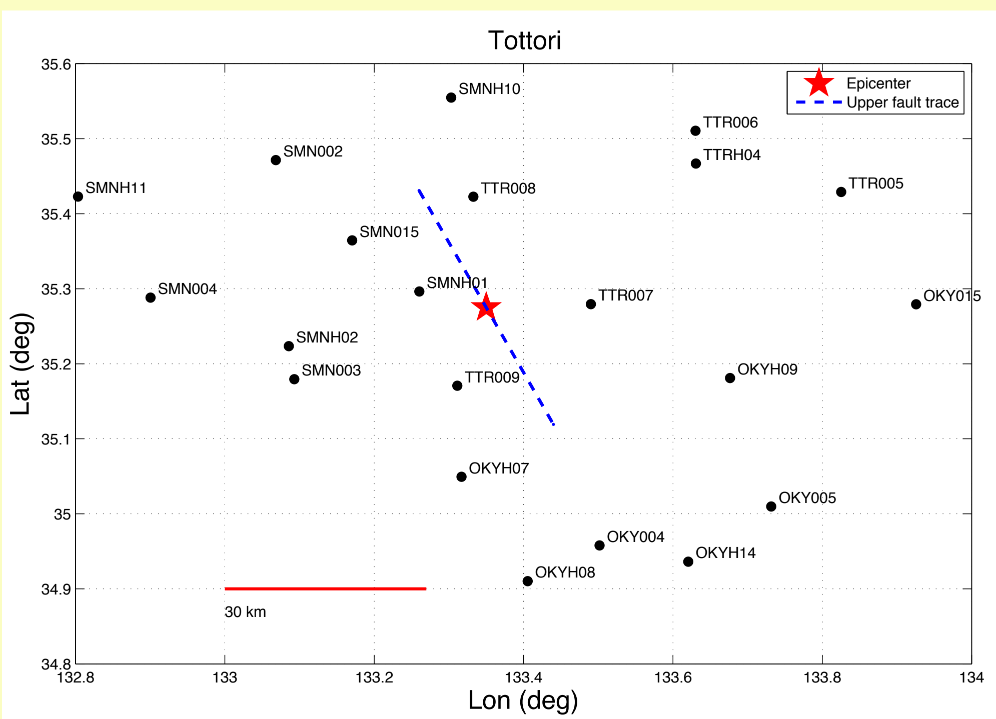




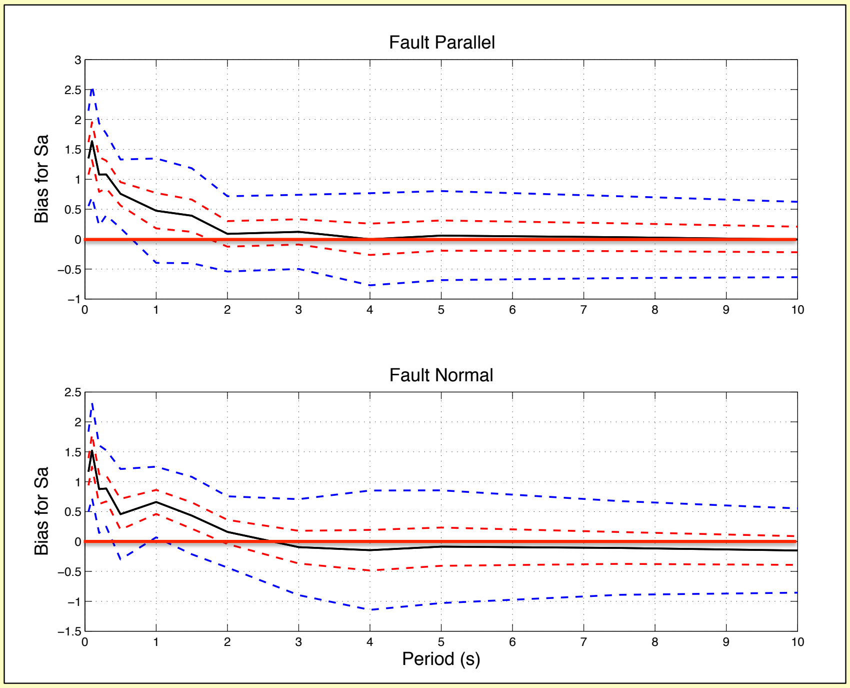




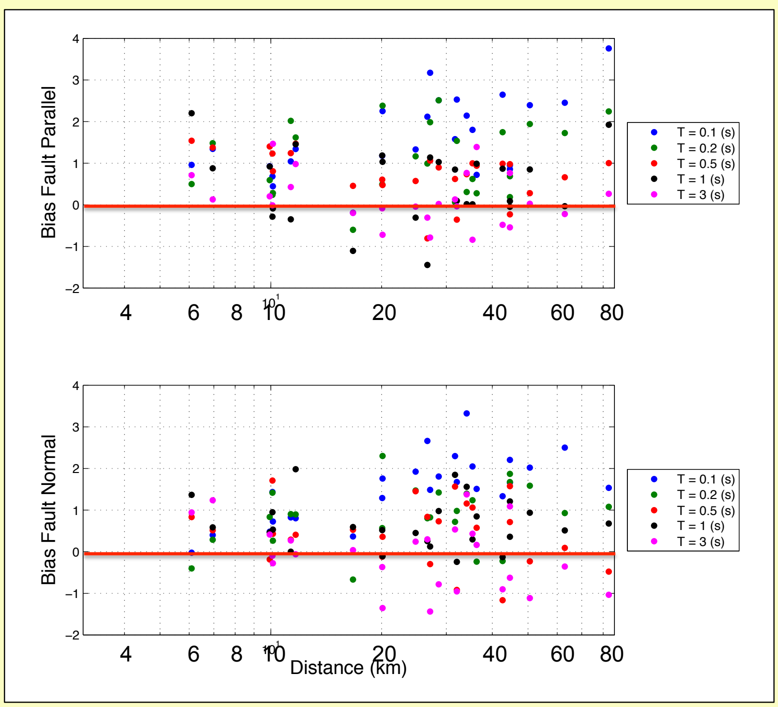
Tottori



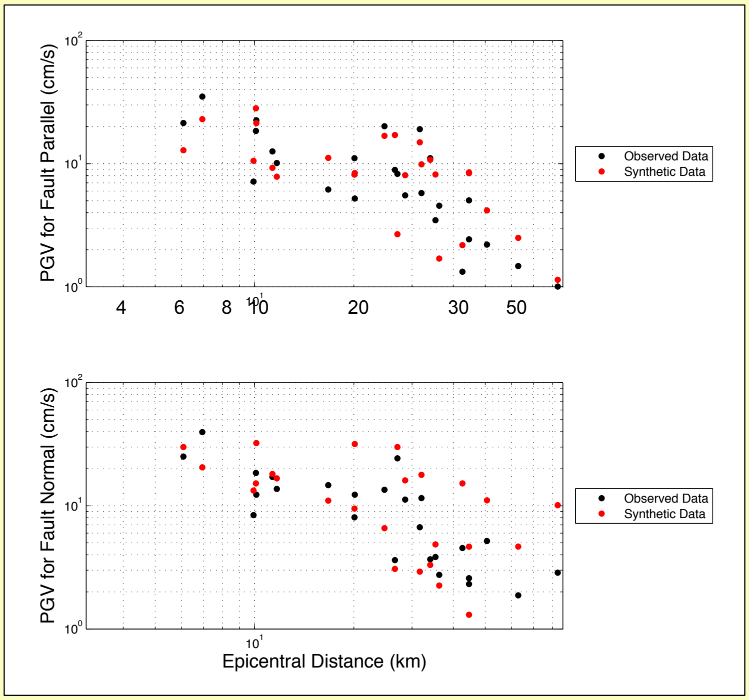
Tottori: Response Spectrum Bias



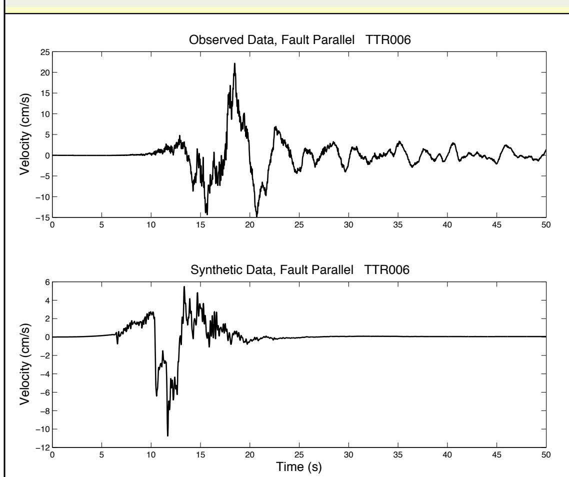
Tottori: Bias (T) vs Distance

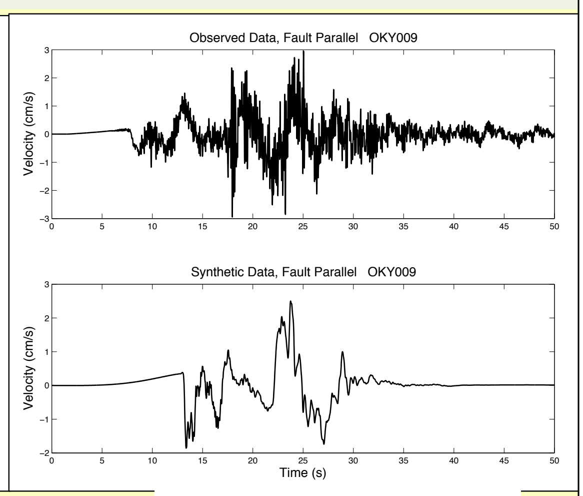


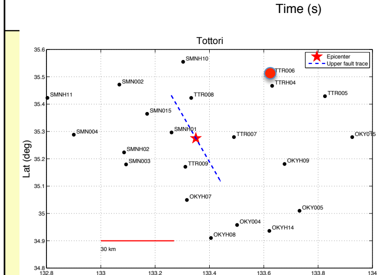
Tottori: PGV vs Distance

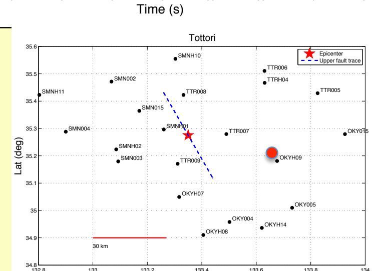


Tottori: Data and Synthetics









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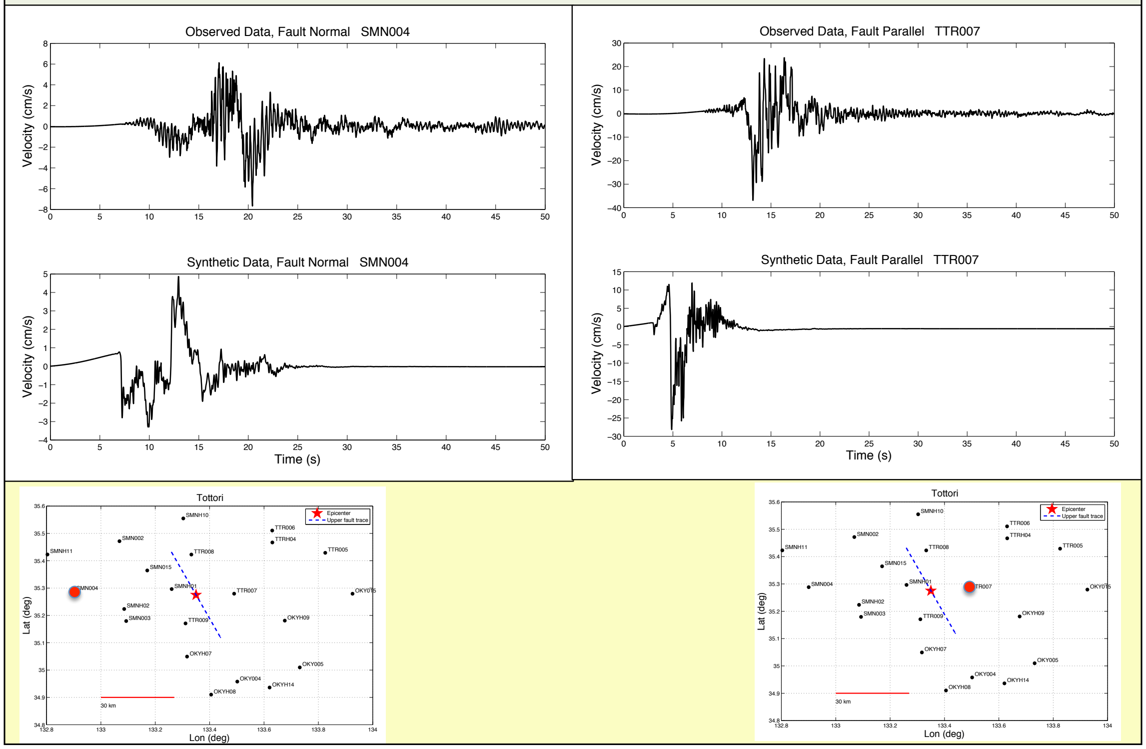

Summary

- The UCSB method was designed to compute ground motions with a minimum of assumptions about how the earthquake rupture will take place.
- The UCSB method does not depend on an a priori slip distribution. The slip description is stochastic with the spatial variation determined by spatial correlation determined by the decay of a power law and the amplitude determined by a heavy tailed probability distribution (Cauchy).
- The parameters that determine the shape of the slip rate function and the rupture time are derived by correlated distributions.
- Wave propagation is either in a 1D or 3D medium. If 1D, the entire calculation is done without stitching the high frequencies to the low frequencies. If 3D, the stitching of the high- and low-frequency spectrum is done using wavelets.
- The results for Riviere du Loup, Saguenay and Tottori produce realistic seismograms in both amplitude, duration and phase. The bias for Saguenay and Tottori can be improved by including kappa or other means of taking into account the low velocity surface layer.