Source Inversion Validation (SIV): Quantifying Uncertainties in Earthquake Source Inversion

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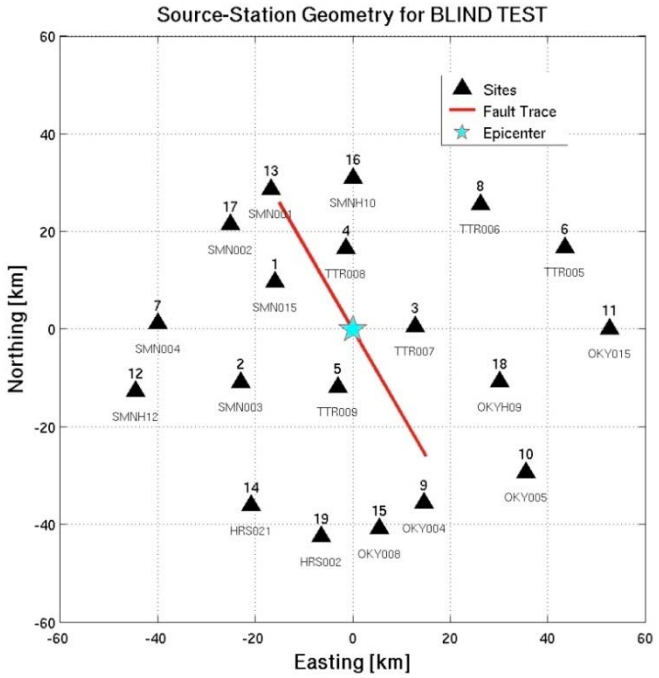
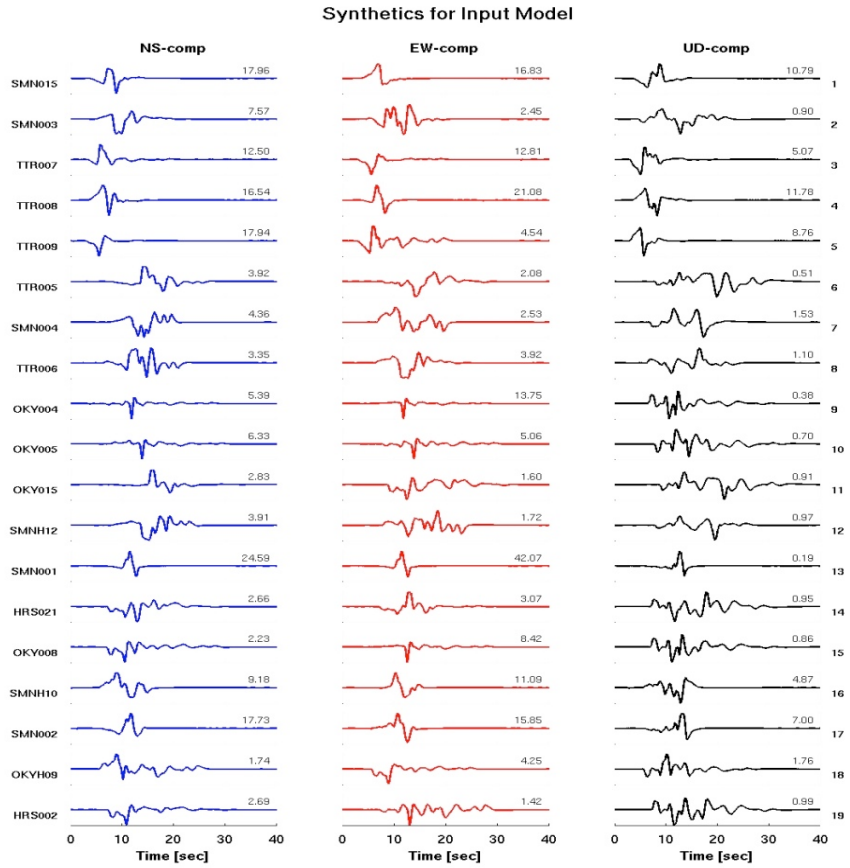
SPICE: Blind Test on Source Inversion

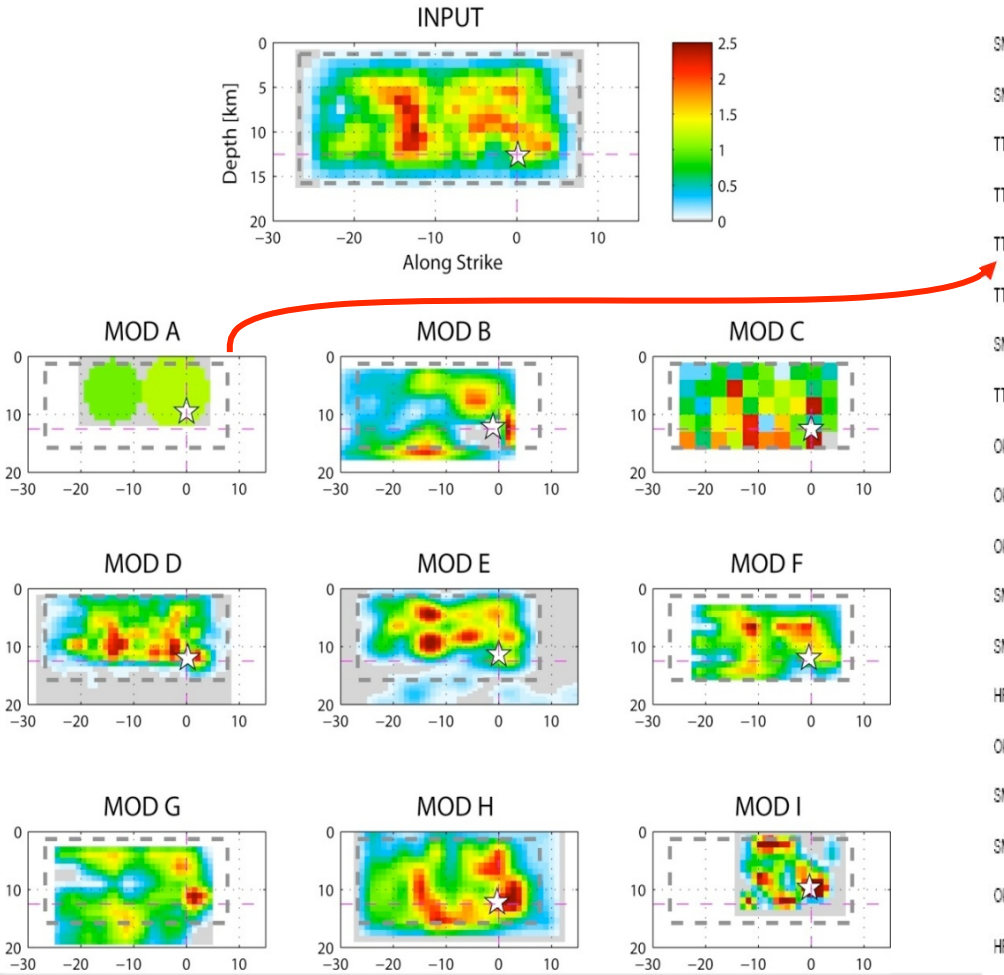
- Source geometry and station distribution similar to the 2000 Tottori earthquake
- Synthetic seismograms for 19 (33) near-fault sites (COMPSYN, f_{max} ~ 3 Hz)
- Known: seismic moment: 1.43 x 10^{19} Nm, geometry (strike, dip, rake: 150°, 90°, 180°), hypocentral location and depth (Z= 12.5 km), velocity-density structure
- Unknown: slip on fault plane, rupture velocity & rise time (both constant)

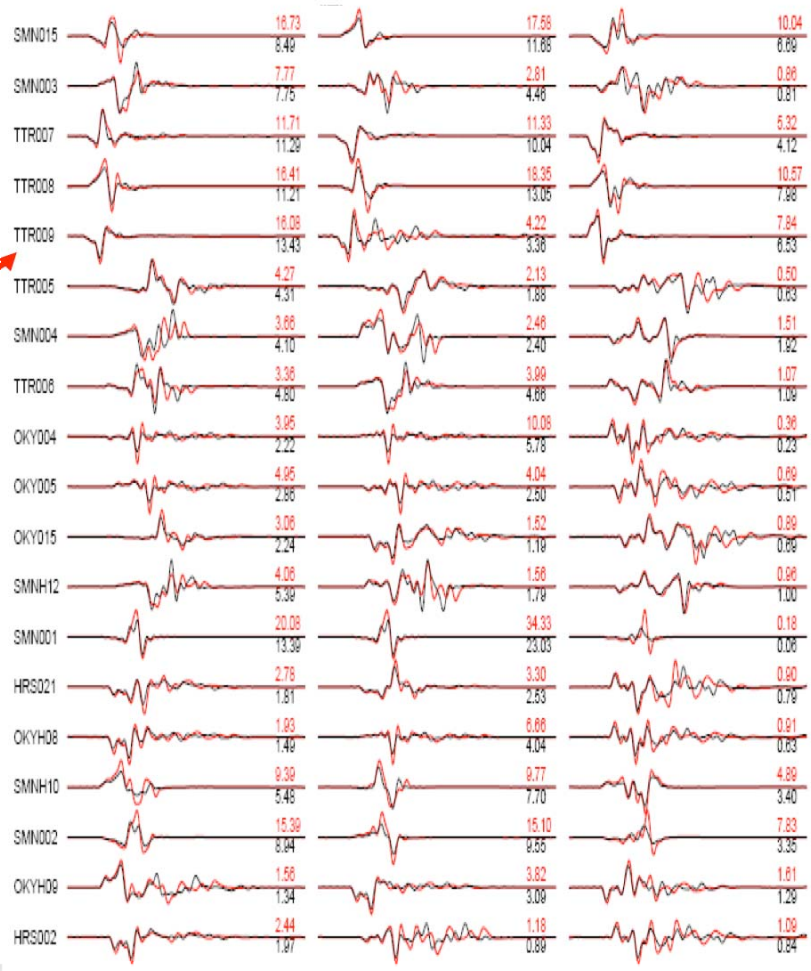




SPICE: Blind Test on Source Inversion

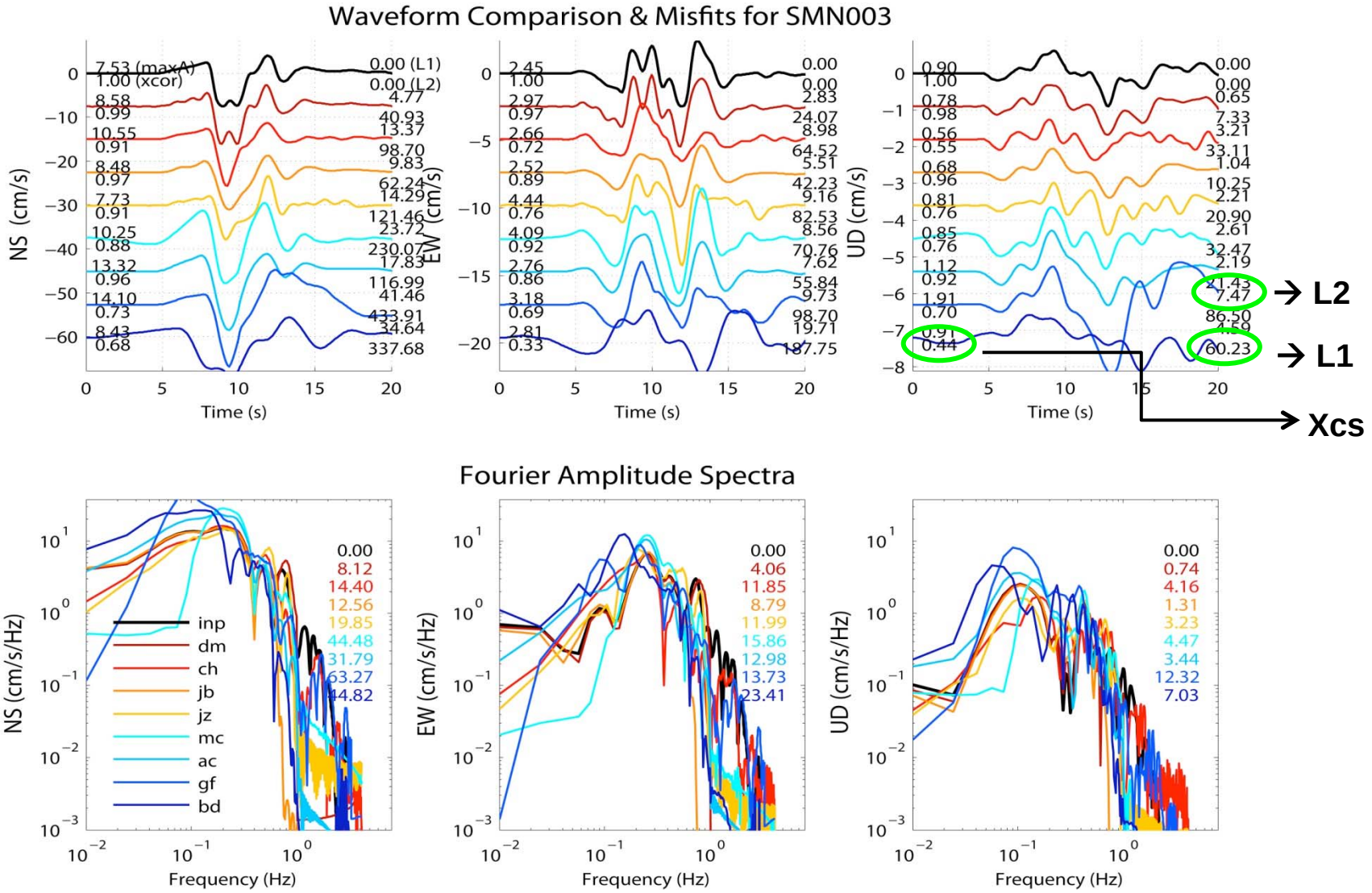
- 9 groups; the slip models from 5 groups are “visually” similar to the input model
- variability in inferred rise time and rupture velocity (both constant) up to 20%
- waveform fits in all cases implied visually a “very good fit” ….





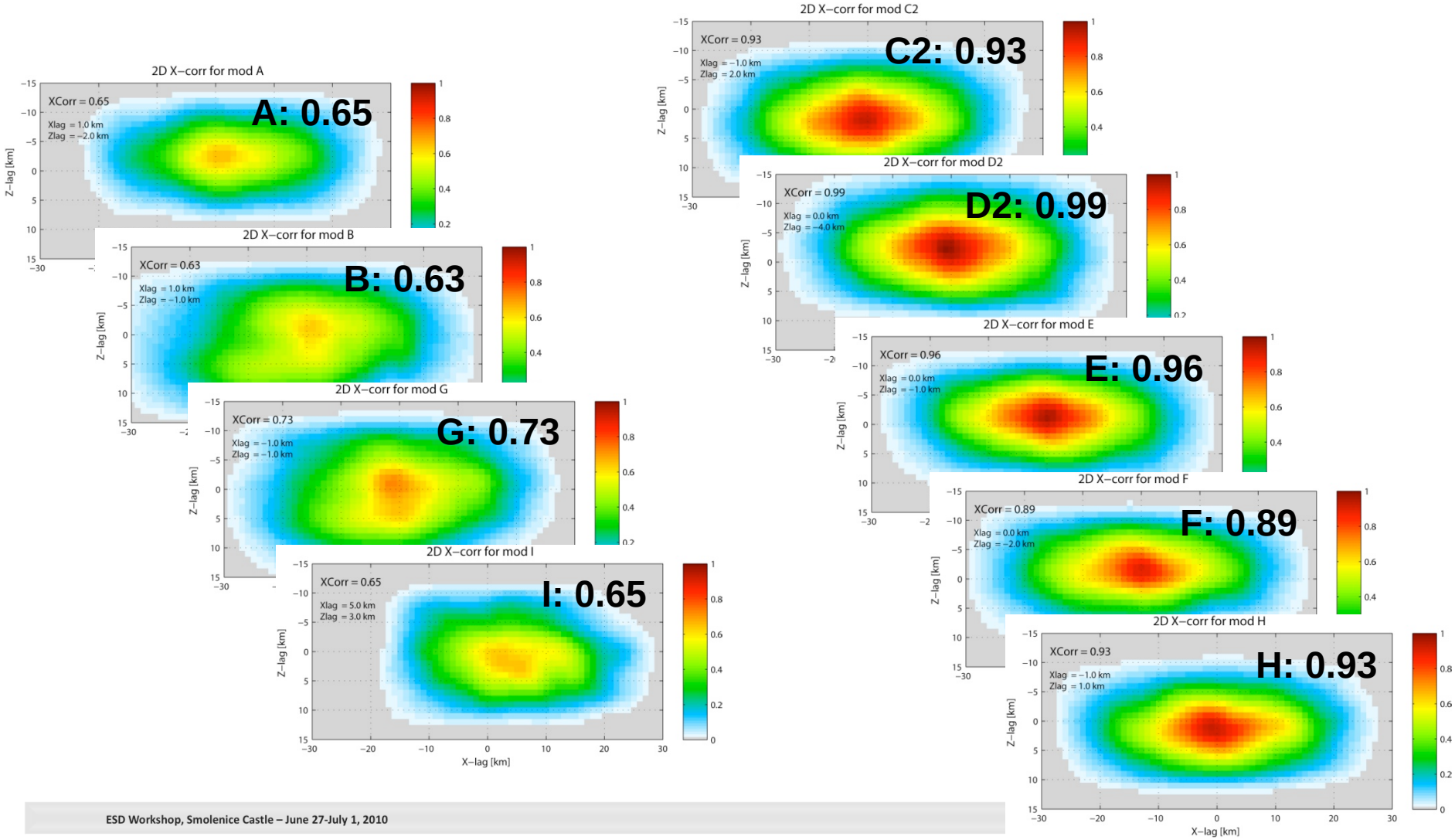
Waveform fits at a representative station

- **Investigating the waveform fits at a representative station:**



Quantitative comparison: 2D cross-correlation input vs. solution

- 4 out of 9 inversion results show a CC-coef like a random, but correlated model!
- 5 out of 9 cases we obtain a correlation coefficient of ~0.9, while the lag is small (~2 km)



Outcome of the blind test was unexpected

- Despite the "simplicity" of the input model, inversions could not resolve slip very well; uncertainties in rupture velocity and rise time up to 20%
- Despite differences among all inversion solutions, predicted waveforms are remarkably similar (f < 1 Hz), resulting in low misfit values (generally L_2-norm)
- 4 out of 9 inversion results are, statistically speaking, NOT better than a random model with somehow correlated slip!

- Issues in the inversion method?
- Issues in the parameterization?
- Issues in the provided synthetics ("correct" solution)
- Issues in the "basics": Green's function computation