Realistic and Computationally Efficient Source Characterization

Realistic variability in source characterization:

. - How can we make progress with parameter uncertainty distributions for rupture generators
- What sampling criteria should be followed
- *What is the probability that a supershear rupture occurs ?*
- *What is the probability that the fault breaks the ground surface and up to which spatial extent with respect to the total fault length?*

Number of rupture realizations:

- What is the minimum number of rupture scenarios that can capture source related ground motion variability

Multi-segment faults:

- How to tackle multi-segment ruptures in kinematic rupture generators with appropriate dynamic constraints?
- Kinematic (pseudo-dynamic) rupture generators for multi-segment ruptures, including rupture jumps

Rupture nucleation:

- Where does rupture start? Can we develop physical constraints useful for kinematic rupture generators?

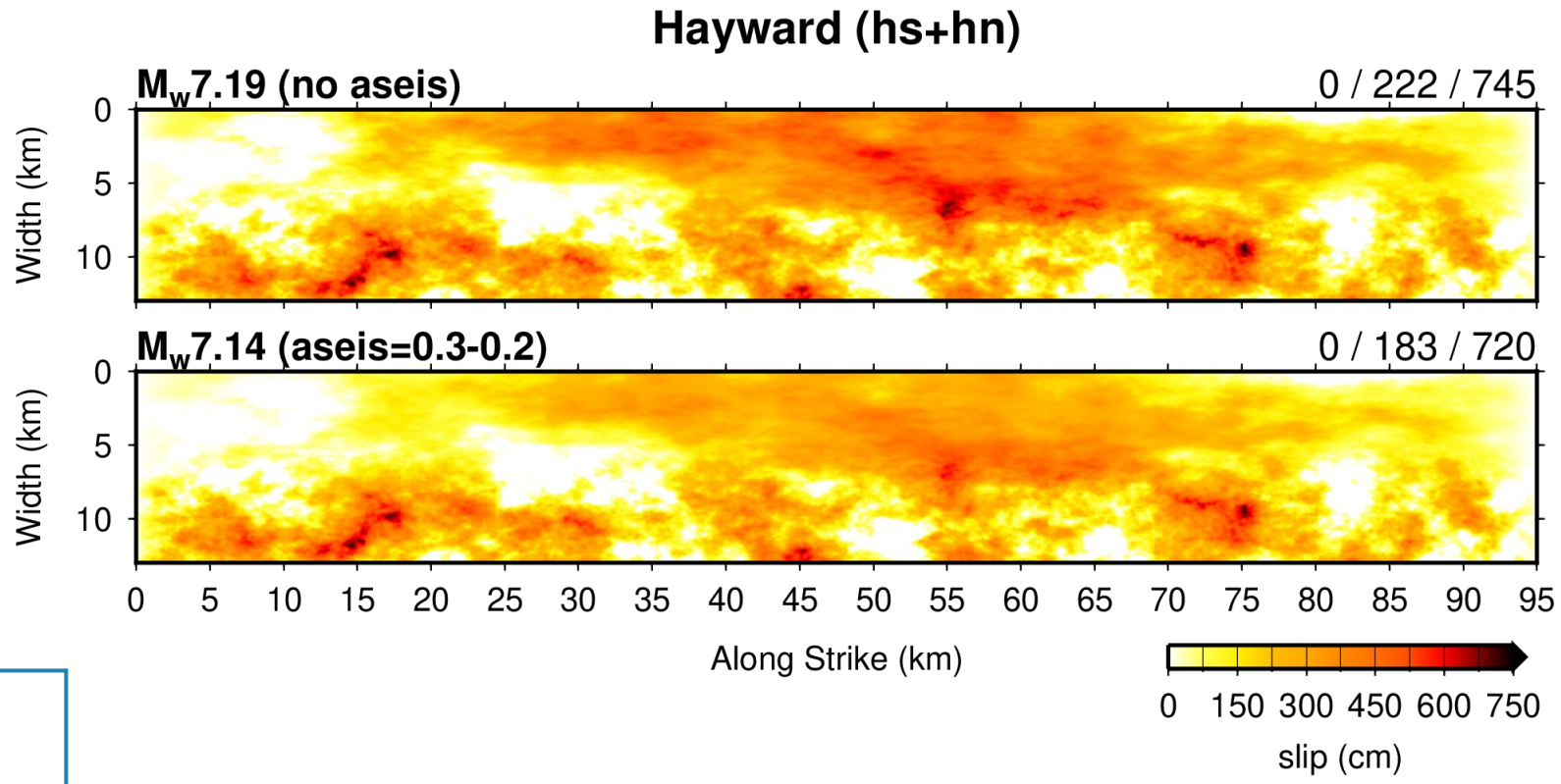
Panelists:

Martin Mai, Rob Graves, Ricardo Taborda, Roberto Paolucci, Chiara Smerzini, Brendon Bradley

Rob Graves

Sampling Kinematic Rupture Parameters

- Rupture speed
- Slip distribution
- Fault rupture area
- Hypocenter
- *Creeping zones* →



Sampling criteria can be problem dependent

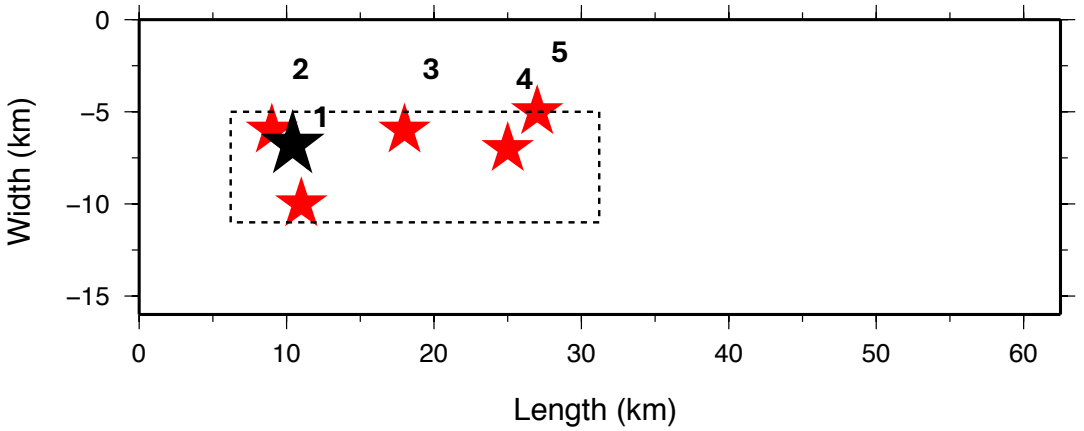
How many rupture scenarios are needed to capture ground motion variability due to source parameterization ?

Arben Pitarka

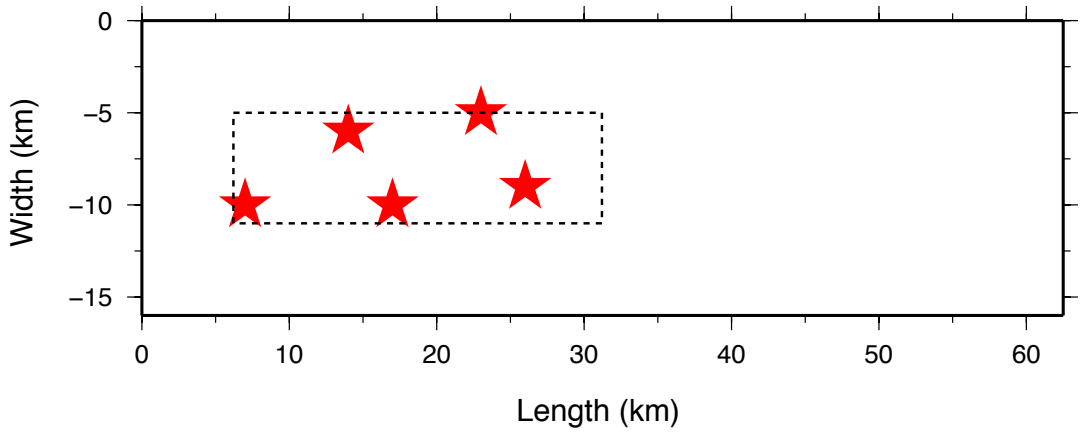
Simulations using 25 rupture scenarios

Rupt init. location along strike direction : (10% - 50%Length) **6 - 31 km**
Rupt. init. location along dip direction : **5 - 11 km**

Group 1



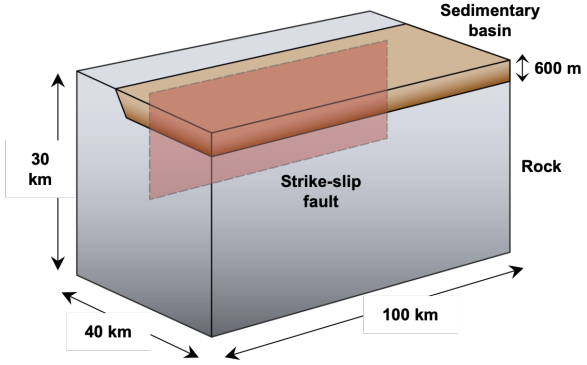
Group 2

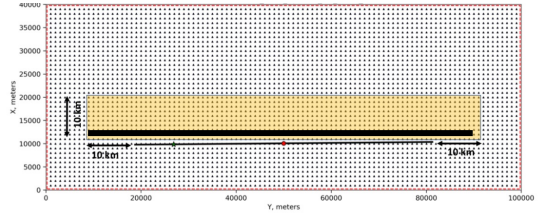


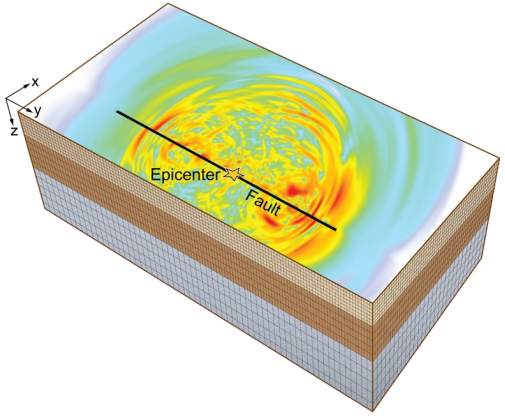
Hypo1	Hypo2	Hypo3	Hypo4	Hypo5
S1, S2, S3, S4, S5	S6, S7, S8, S9, S10	S11, S22, S13, S14, S15	S16, S17, S18, S19, S20	S21, S22, S23, S24, S25

M7 5 Hz simulations using a canonical shallow basin

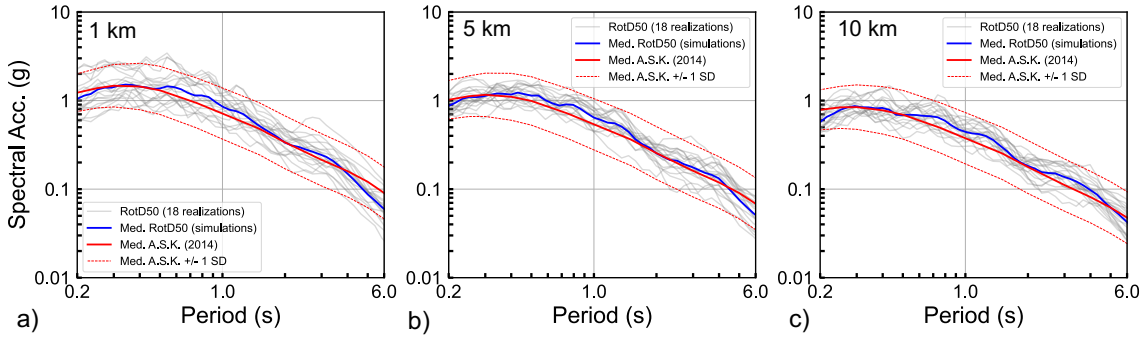
3D Canonical Basin Model



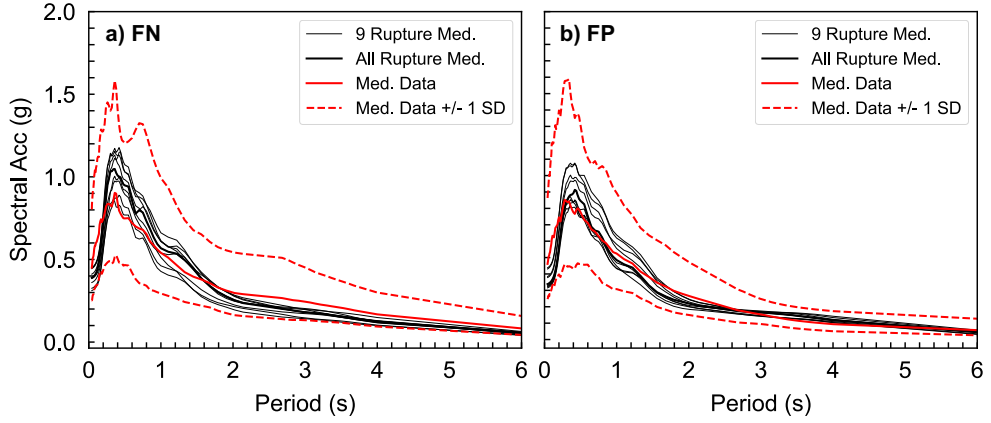




Comparison of synthetic and NGA-West GMMs RotD50 SA



Comparison of synthetic and recorded NGA-West Spectral Responses

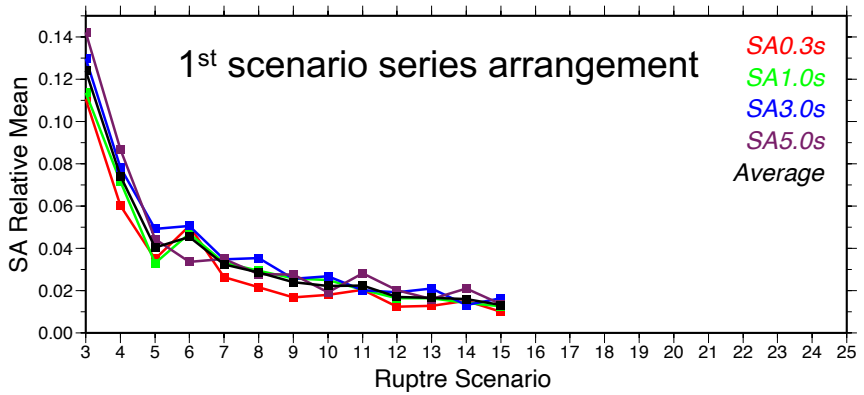


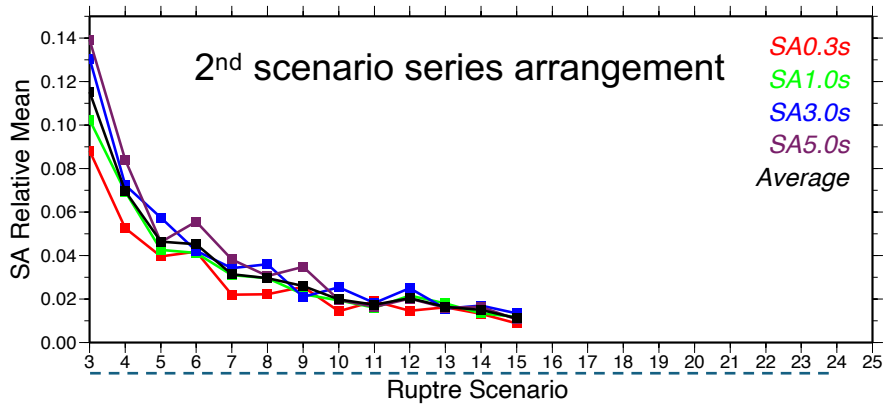
How many rupture scenarios are needed to capture ground motion variability due to source parameterization ?

R (n) = mean SA(current scenario) /mean SA(for n-1 scenarios)

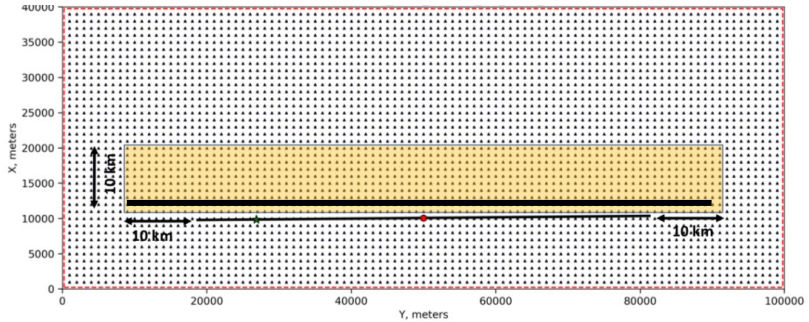
The mean is computed over all stations located at 2 km from the fault

Between Event SA variability at 2km distance





Stations Layout



Conclusion:
Not more than 12 rupture realizations are needed to capture the between events ground motion variability

Earthquake magnitude and source model complexity…

- Given the variability they can introduce, how much do they matter in consideration of the intended use of synthetics?

The velocity models behind forward and inverse simulations…

- How do we escape the circular problem about source inversions, validation of synthetics, and the underlying velocity models they both depend on.

Energy losses…

- Considering the influence of anelasticity and nonlinearity at the source, in the propagating media, and at the site (in the near-surface, low-velocity deposits), where should we devote our efforts? Should or can we choose at all?

In the verge of the current AI explosion…

- How much physics should we put into our models?