Major Changes to PSHA and SPRA Practice

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PSHA

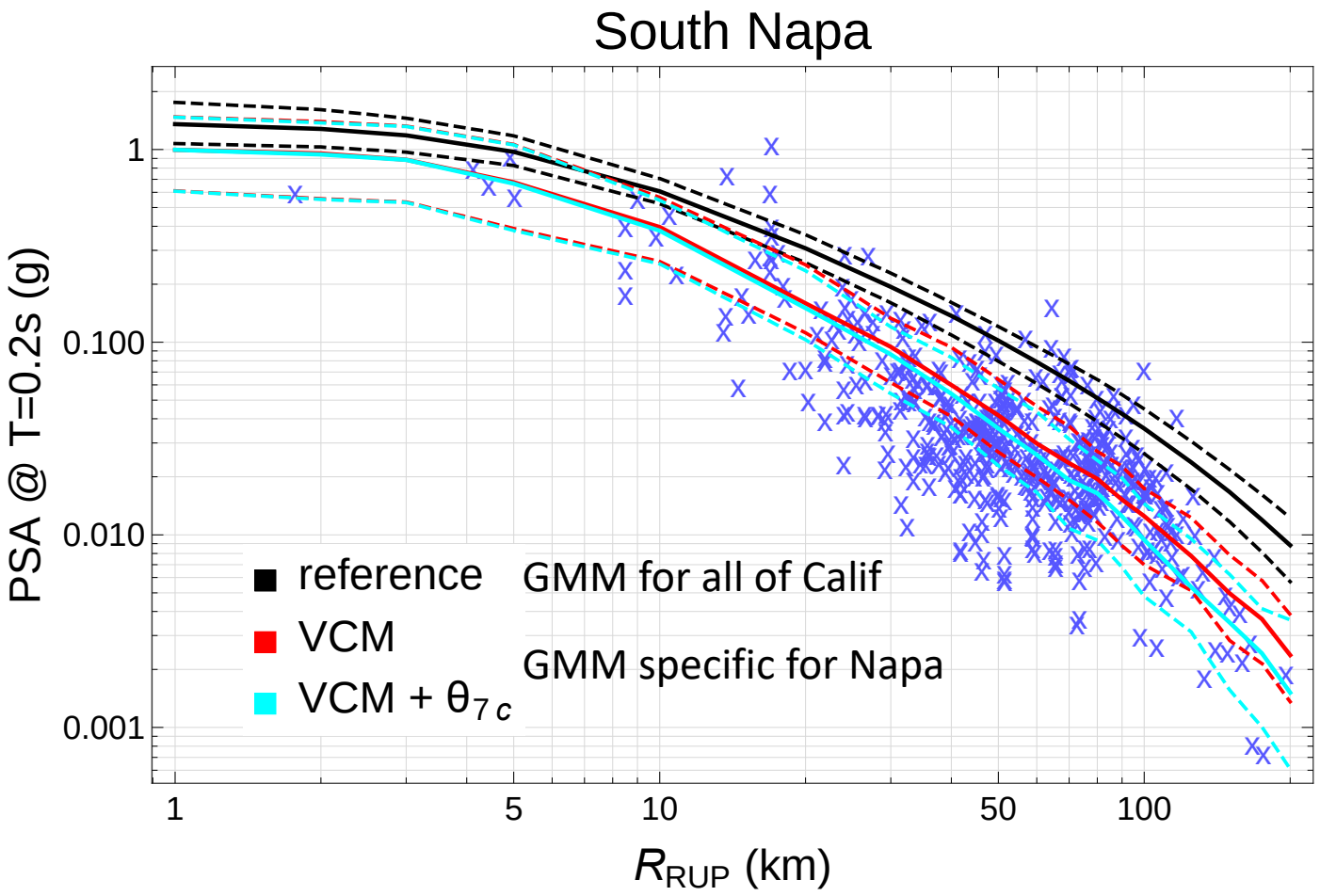
$$Rate\ (SA(T) > z) = \sum_{i=1}^{Nscenario} Rate(M_i, Loc_i, F_i)\ P(Sa(T) > z | M_i, Loc_i, F_i)$$

- In next 5 years, key improvements will come from the ground-motion model, not the source characterization model
- Move from average GMM for large regions to source/site-specific GMM

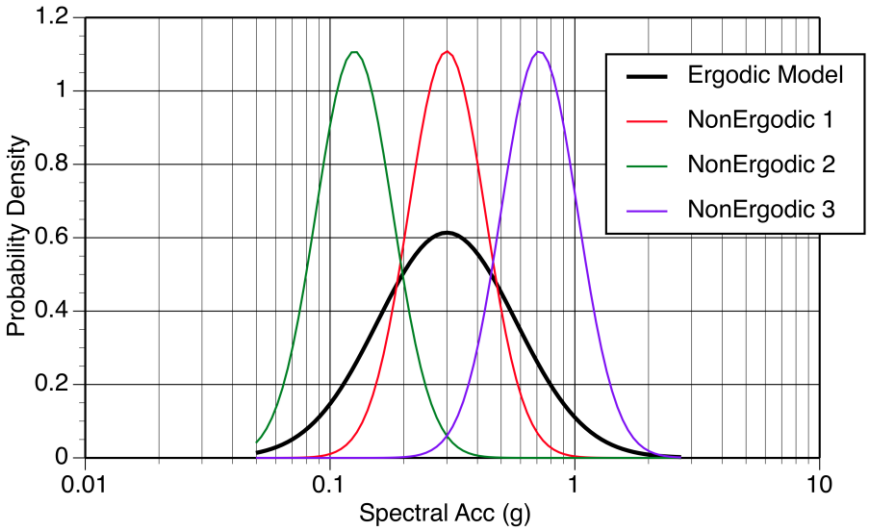
Aleatory Variability in Ground-Motion Models

- Most of the variability (standard deviation) in traditional GMM models is from systematic effects, not random variability
  - We now know how far off our egodic GM models are
- Can hazard a large effect on the hazard

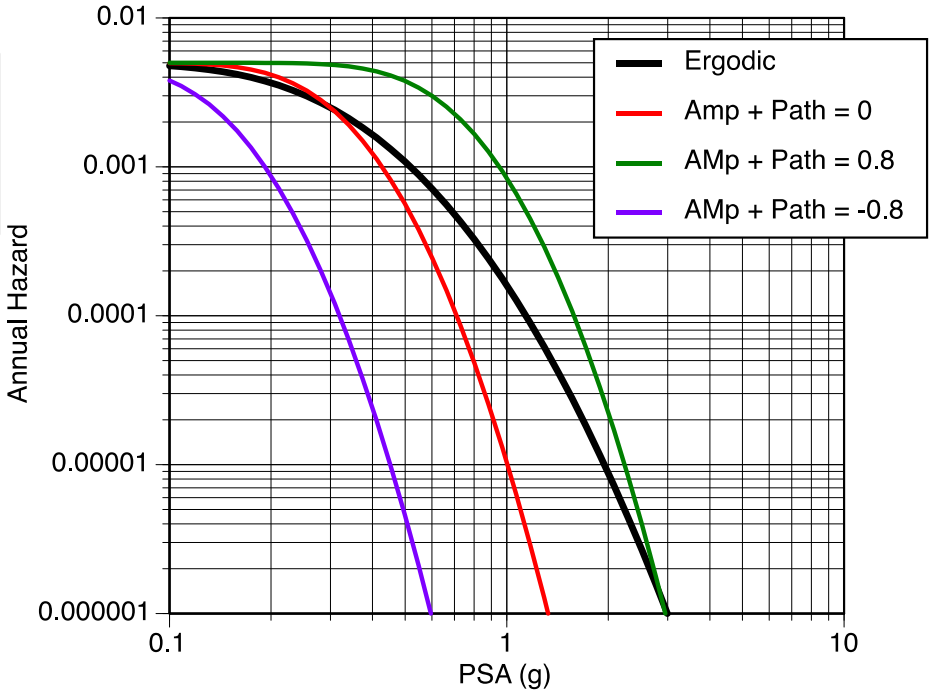
Example: 2014 Napa Earthquake



Epistemic Uncertainty for Nonergodic GM models (M7, R10)



Simple hazard application



SPRA

- Use 3-component time histories for initiating events in place of spectral acceleration

- Find a suite of 3-component time histories
  - Appropriate M, R from deaggregation
  - Appropriate inter-frequency correlations (widths of peaks and troughs of the response spectra)
  - Produce the hazard over a wide range of spectral periods and hazard levels relevant to risk

Traditional PSHA

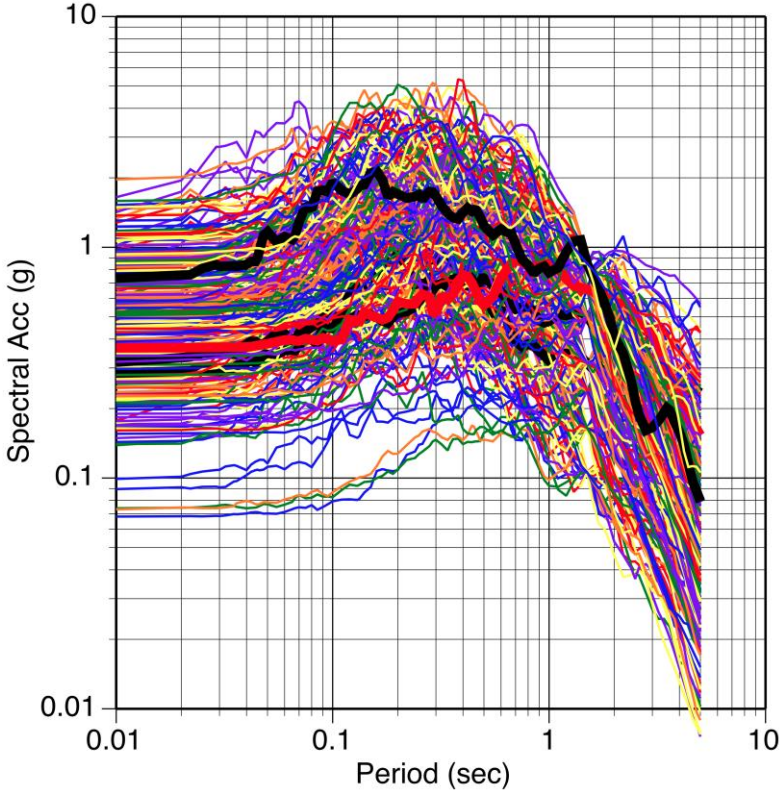
$$Rate\ (SA(T) > z) = \sum_{i=1}^{Nscenario} Rate(M_i, Loc_i, F_i)\ P(Sa(T) > z | M_i, Loc_i, F_i)$$

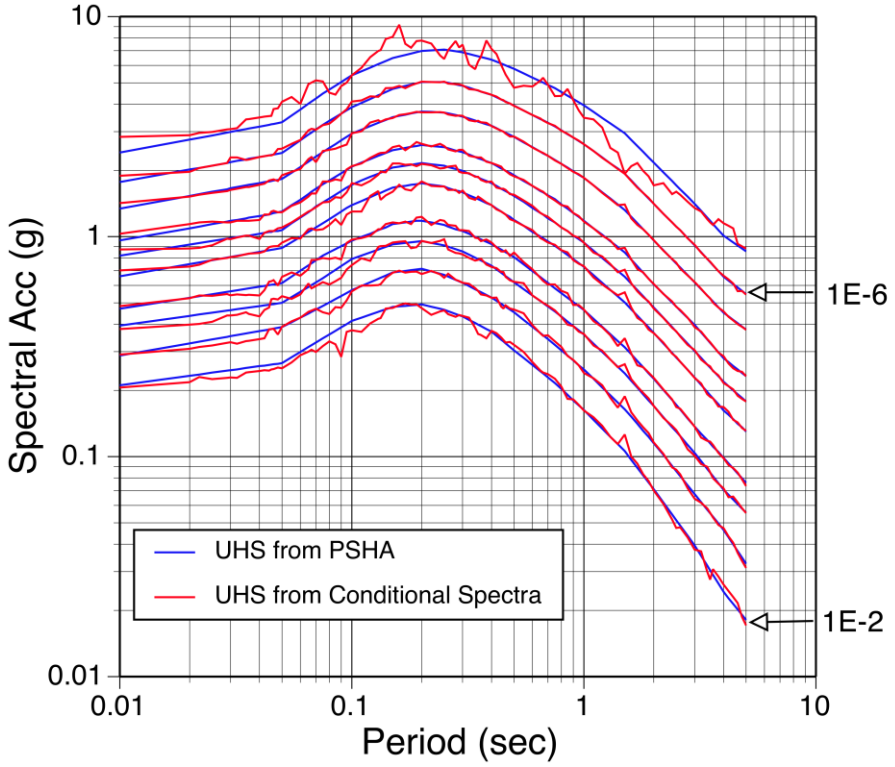
Time-History Based PSHA

$$Rate\ (SA(T) > z) = \sum_{i=1}^{N\_TH} Rate(TH_i)\ H(SA_i - z)$$

Example for Diablo Canyon

400 time histories needed to duplicate hazard





Use in SPRA

- Advantages
  - Complete description of the shaking hazard at the site
  - Fragility of each SSC can be evaluated using the relevant ground-motion parameter (or the full time history)
  - Easy to include other loading such as slope failure using the time histories
- Disadvantages:
  - Requires 100s of initiating events, not 10