PBEE Needs
Seismic Hazard Perspective

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PBEE Needs

- Parameterization of the severity of ground motion
- Uncertainty in the estimated hazard

PEER Framing Equation

$$v(DV) = \int_{DM} \int_{IM} G_{DV}(DM)\, dG_{DM}(IM) \frac{d\lambda(IM)}{dIM}\, dDM\, dIM$$

Probabilistic Hazard Analysis

Compute ground motions for all earthquake scenarios (all faults, magnitudes, locations, rupture directions, std dev of ground motion)

Ranking of earthquake scenarios in the order of the severity of the ground motion

$\lambda(IM)$

Hazard Analysis for a Single Parameter

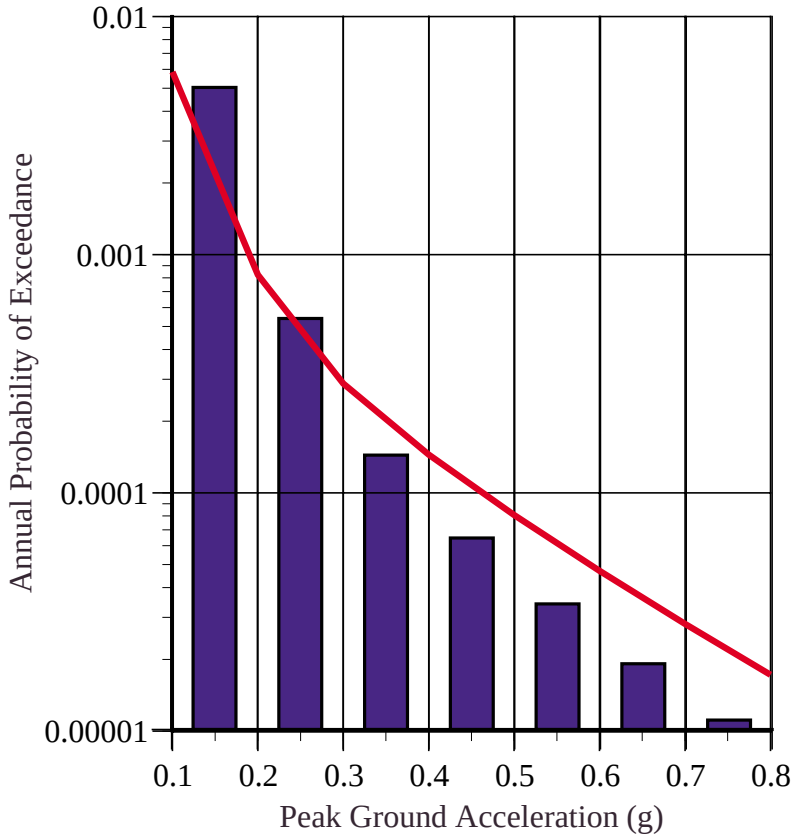

Figure 6. Example of a ground motion histogram computed from the hazard curve.

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Severity of Ground Motion

- Currently use single parameters to define severity of the ground motion
  - e.g. Sa(T), PGA, PGV, PGD
- For a particular structure or class of structures, severity of the ground motion may depend on more than one parameter

Damaging Features of Ground Motion

- What are the damaging features of ground motions?
  - Single scalar parameter
  - Combination of existing scalar parameters
  - Wave form characteristics
    - e.g. Velocity pulse width and amplitude?
- Need “attenuation” models for the identified damaging features

Time Domain Characterizations

- Wavelet decompositions
  - Need a small generalized basis space for the wavelets. For example:
    - One-sided velocity pulse
    - Two-sided velocity pulse
    - Multiple velocity pulses
  - Selection of a basis space needs input from geotechnical and structural analyses

New Hazard Analysis

- Replace hazard curve with rates of ground motion scenarios; e.g PGV and pulse period

	0-20 cm/s	20-80 cm/s	80-150 cm/s
0.5 - 1 s	0.01	0.005	0.0001
1 - 2 s	0.02	0.005	0.001
2 - 3 s	0.01	0.001	0.002

Uncertainty in Hazard

- Consider credible alternative models
  - Source characterization
  - Ground motion attenuation
  - Site response
- Which components leads to the largest uncertainty in the performance of a structure?

Uncertainty in Hazard

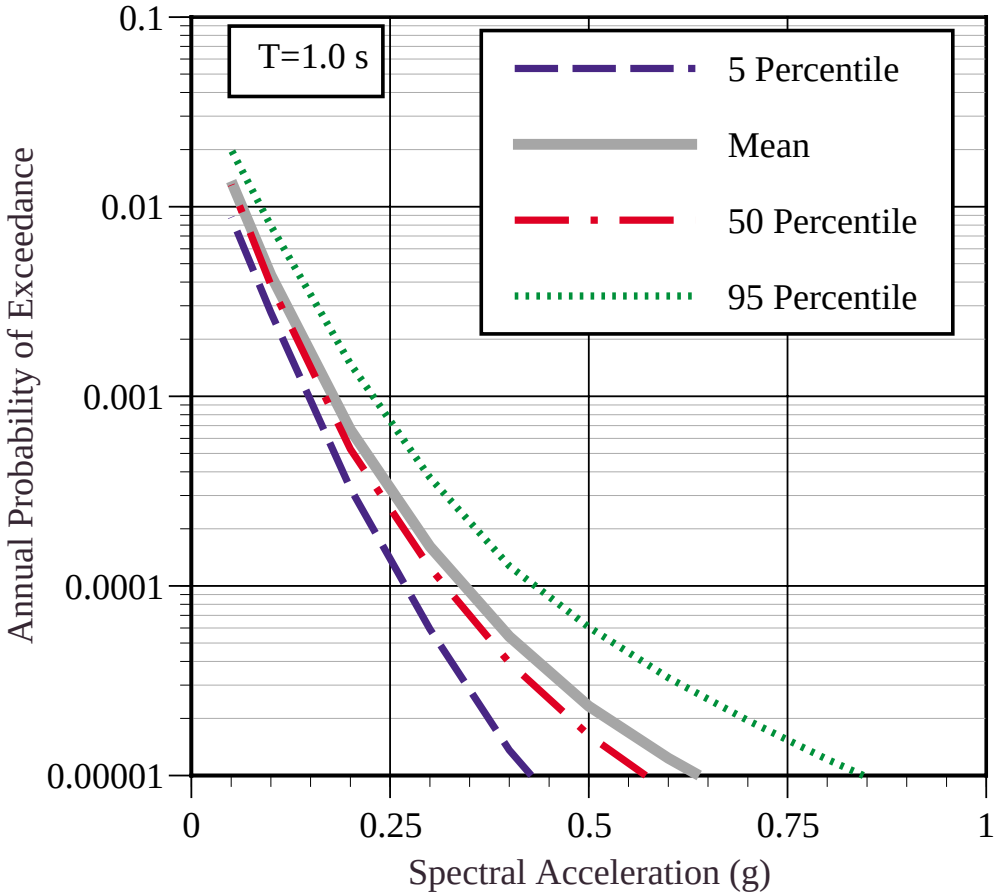

Figure 21. Example of the scientific (epistemci) uncertainty in the hazard as computed from the logic trees.

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PBEE Needs Summary

(1) Severity of Ground Motion
   (1) Need to identify the damaging features of ground motions
   (2) Need "attenuation" models for the damaging features

(2) Scientific Uncertainty in Seismic Hazard
   (1) Need to identify the main sources of uncertainty in predicting the rate of damaging ground motions
      (1) Used to focus hazard component research
   (2) Need to develop a procedure for using hazard uncertainty in the PBEE