

Probabilistic Hazard Assessment Approaches

Transferable Methods from Seismic Hazard

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Common Challenges Among Natural Hazard Assessments



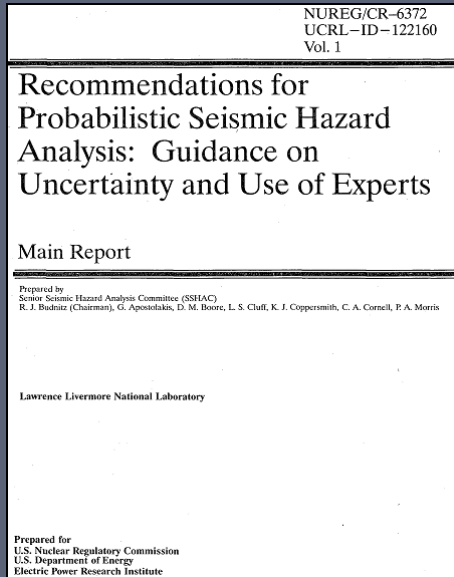
- Need for both best estimate and uncertainties
- Limited data and long return periods
 - 10^{-4} for seismic design & larger range for risk assessment
- High uncertainty in rates of rare events
- Complex and sometimes contradictory data sets require the use of expert judgment
- Data permissive of alternate interpretations
- Needs to separate and address natural (aleatory) variability from epistemic (model) uncertainty

Senior Seismic Hazard Analysis Committee (SSHAC) Guidelines

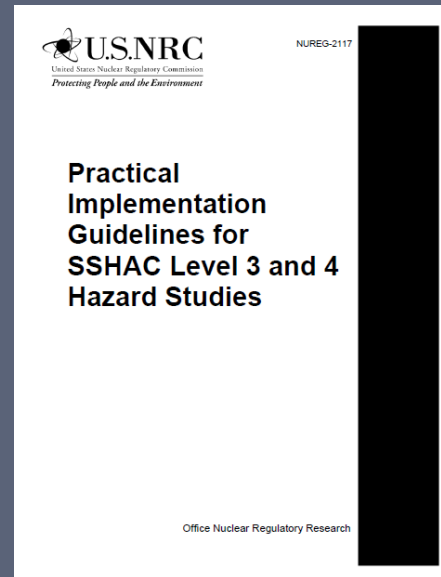


- NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts"
- Developed in the 1980s as a result of differing NRC and EPRI Seismic Hazard Assessment Studies - the *method* used to engage experts differed more than the *technical input*
- SSHAC provides a framework for incorporating experts into scientific assessments through structured processes and interactions

Senior Seismic Hazard Analysis Committee (SSHAC) Guidelines



NUREG/CR-6372
(1989)



NUREG 2117
(2012)

Original report provides framework. New report provides additional details. Both describe how to undertake studies that develop hazard assessment models

Objective of a SSHAC Study



- Objective is to develop a model that represents the center, body and range of technically defensible interpretations of the available data
 - Center-best estimate
 - Body-shape of the distribution
 - Range-extreme values of the distribution
- Achieved through a process with well defined evaluation and integration phases

Essential Features of a SSHAC Study (Level 3)

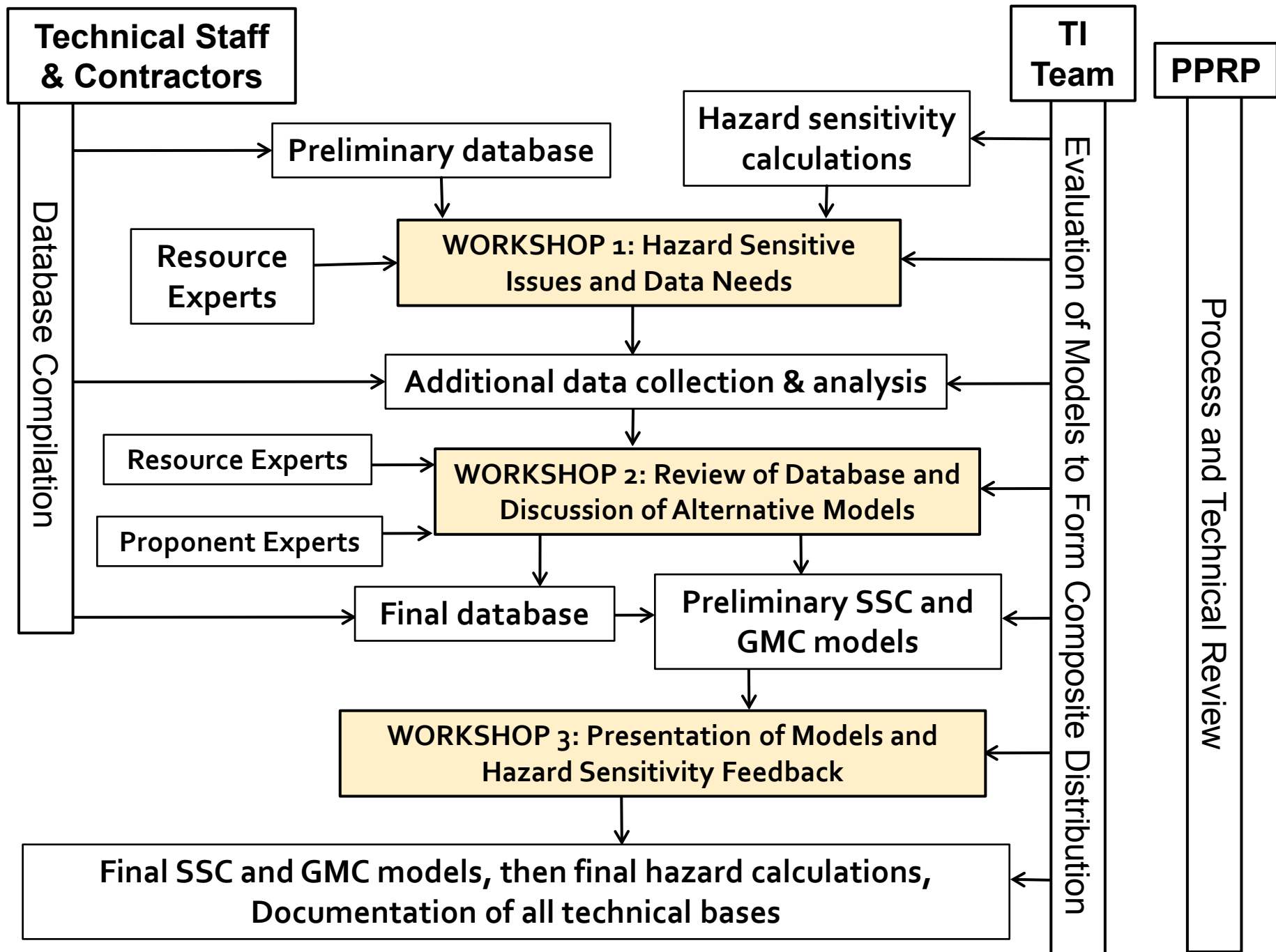


- Compilation of comprehensive databases
 - made available to all participants
- Defined roles and responsibilities for participants
 - Technical Integration (TI) Team: Evaluate data, methods and models and develop distribution capturing center, body and range of technically-defensible interpretations
 - Participatory Peer Review Panel (PPRP): Continuous process and technical review
 - Resource Experts (neutral experts a dataset or topic)
 - Proponent Experts (support an interpretation or model)

Essential Features of a SSHAC Study (Level 3)



- Structured sequence of steps, including 3 formal workshops
 - WS1: Data needs and critical issues
 - Probe the datasets available, identify and other data, and identify and discuss the critical issues
 - WS2: Proponent viewpoints and alternatives
 - Proponents experts go through a process of discussion, challenge and defense
 - WS3: Investigation of the preliminary model





Uncertainty

Aleatory

Natural variability

Not reducible

Addressed through integration
over parameter distributions

Epistemic

Modeling or knowledge
uncertainty

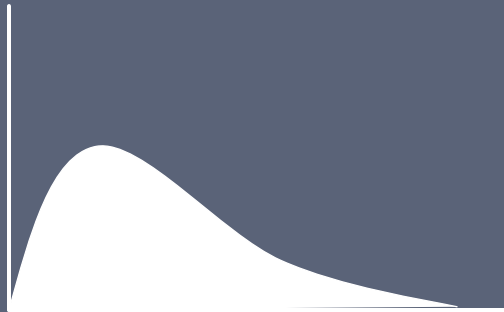
Reducible with more
information

Addressed through use of a
logic tree



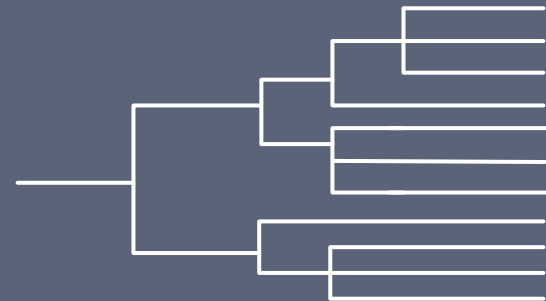
Uncertainty

Aleatory



Integration over distribution of
expected parameter values

Epistemic



logic tree of technically
defensible interpretations



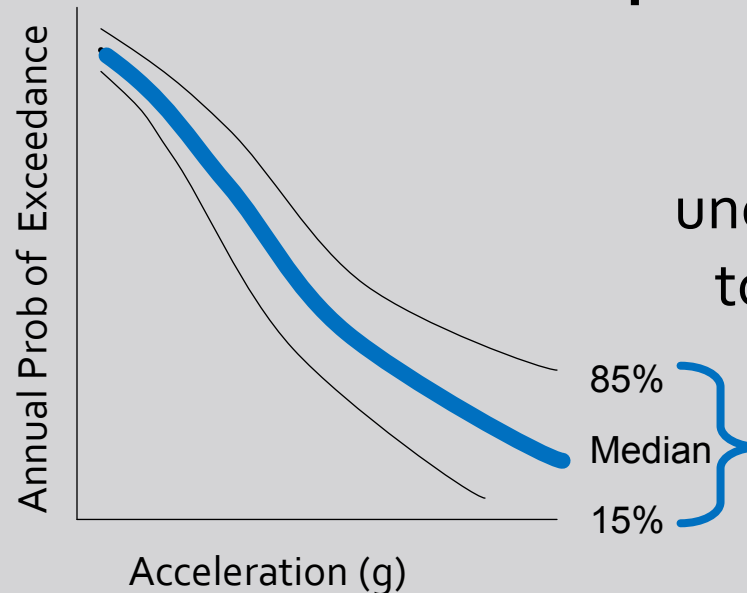
Uncertainty

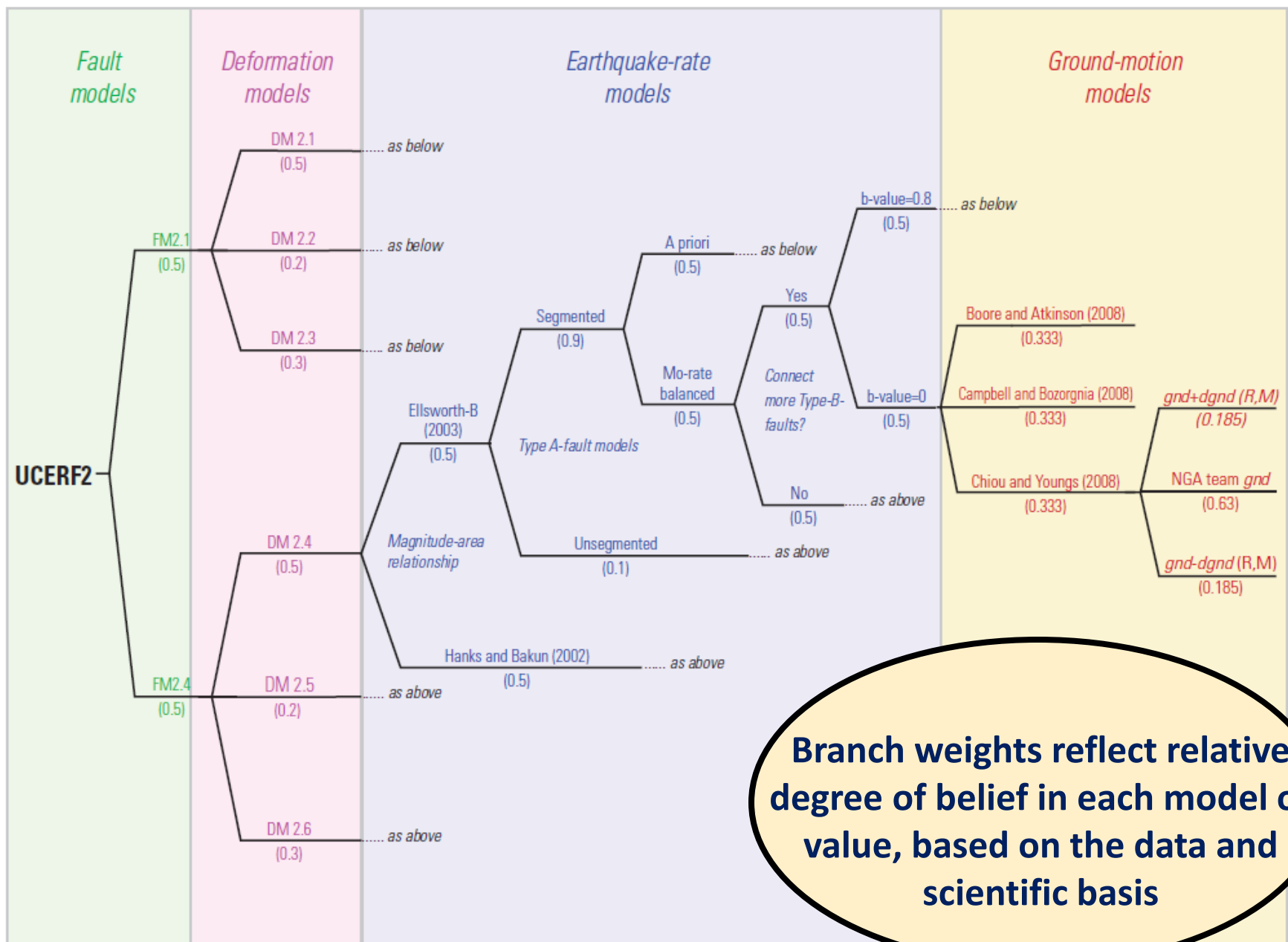
Aleatory

Aleatory variability gives the curve its shape.

Epistemic

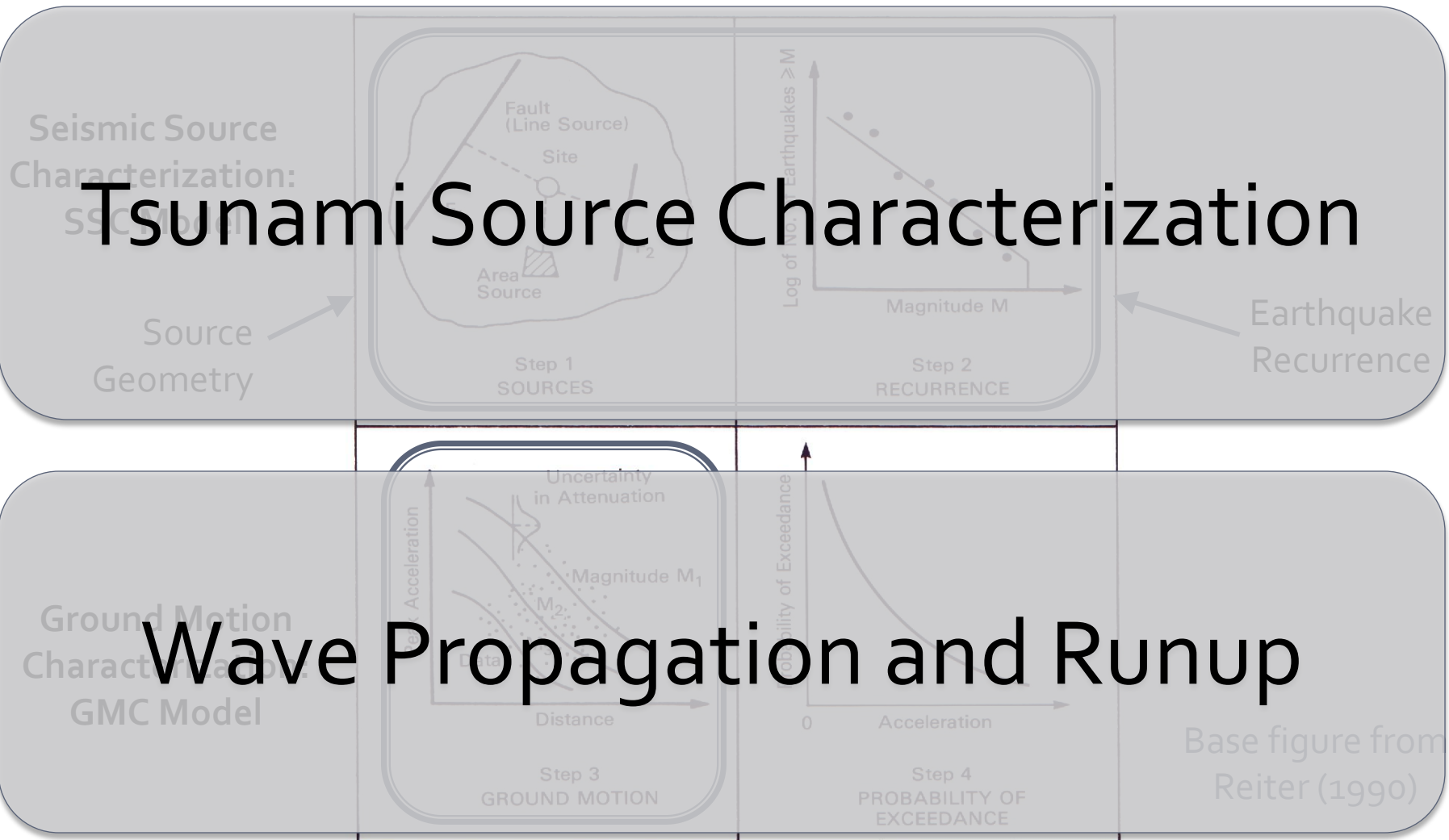
Epistemic uncertainty leads to uncertainty bands



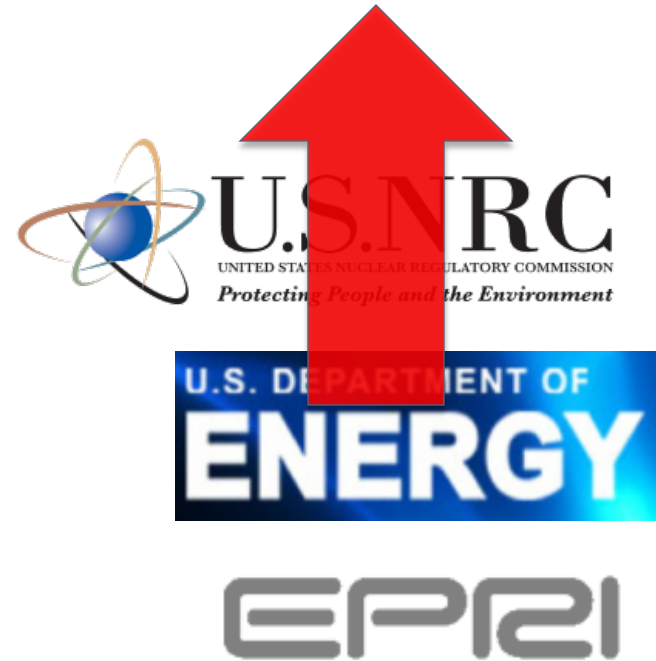
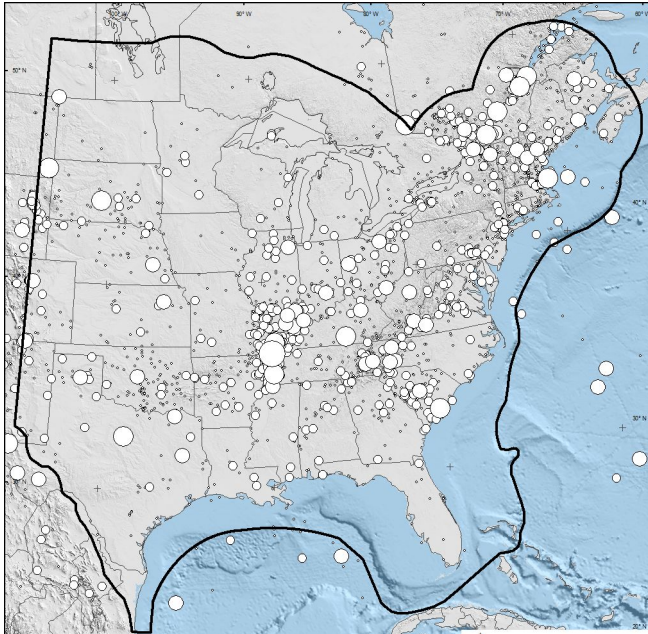


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The Central and Eastern United States Seismic Source Characterization for Nuclear Facilities Project (CEUS SSC Project 2008-2011, NUREG 2115)



NGA EAST

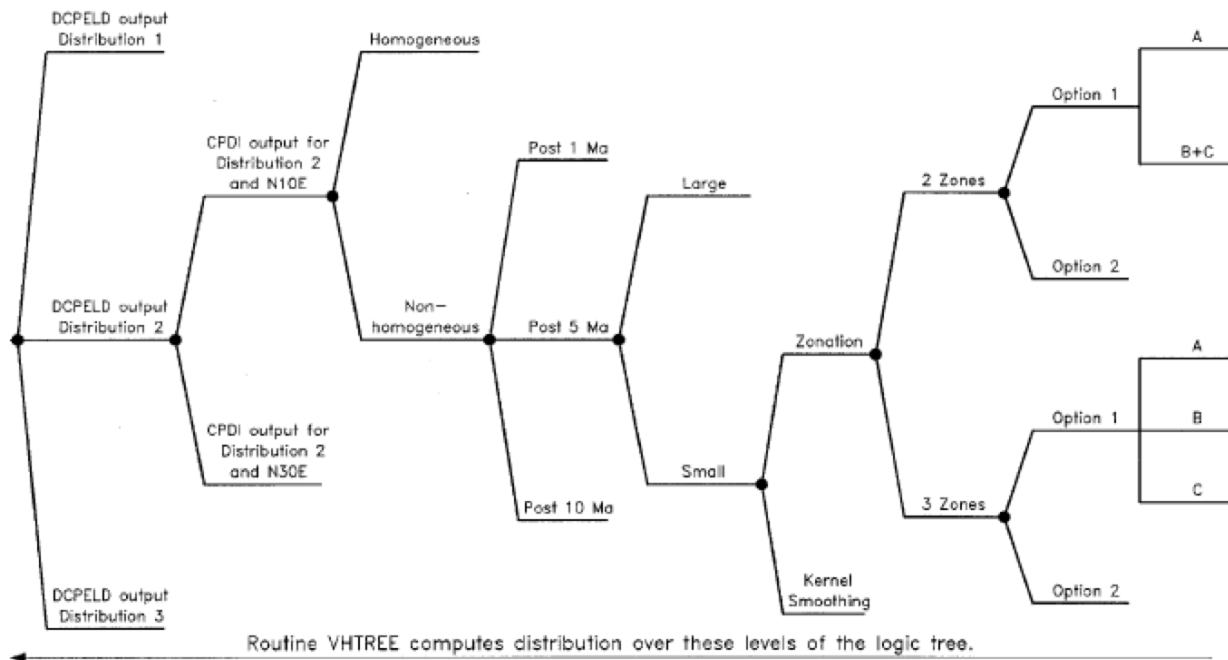
Pacific Earthquake Engineering Research Center



(NGA-East Project 2010-2014)

Logic Tree Structure to Characterize Uncertainty in Volcanic Hazard

<i>Event Length Distribution</i>	<i>Event Azimuth Distribution</i>	<i>Temporal Model</i>	<i>Time Period</i>	<i>Region of Interest</i>	<i>Spatial Model</i>	<i>Zonation Model</i>	<i>Zonation Boundaries</i>	<i>Sources</i>
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Thank you for your attention