

Uncertainties in Loss Modeling

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Potential Uses of Operational Earthquake Forecasting

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Earthquake risk products

Loss measures (3 Ds)

\$ Repair costs

☠ Life-safety impacts

🕒 Loss of functionality

Some risk measures

- Loss with exceed. prob. p (e.g., PML)
- Loss with exceed. freq. z (e.g., 250-yr loss)
- Expected annualized loss EAL
- Loss given a particular scenario

Decision-making with risk products

Decision-maker responsible for 1+ assets

- Locations
- Economic, human attributes
- Engineering attributes, uncertain vulnerability
- Subject to events {Q}

In decision analysis, information (e.g., OEF info) is worth the increased probabilistic outcome of a decision



Risk-management options with OEF

- Reduce risk (e.g., retrofit, secure, remove)
- Transfer risk (e.g., insure)
- Diversify risk (e.g., swap policies)
- Plan for remaining risk (e.g., DCHO training, warm a cold backup, refresh safety training)
- Each has cost; use risk info to estimate benefits

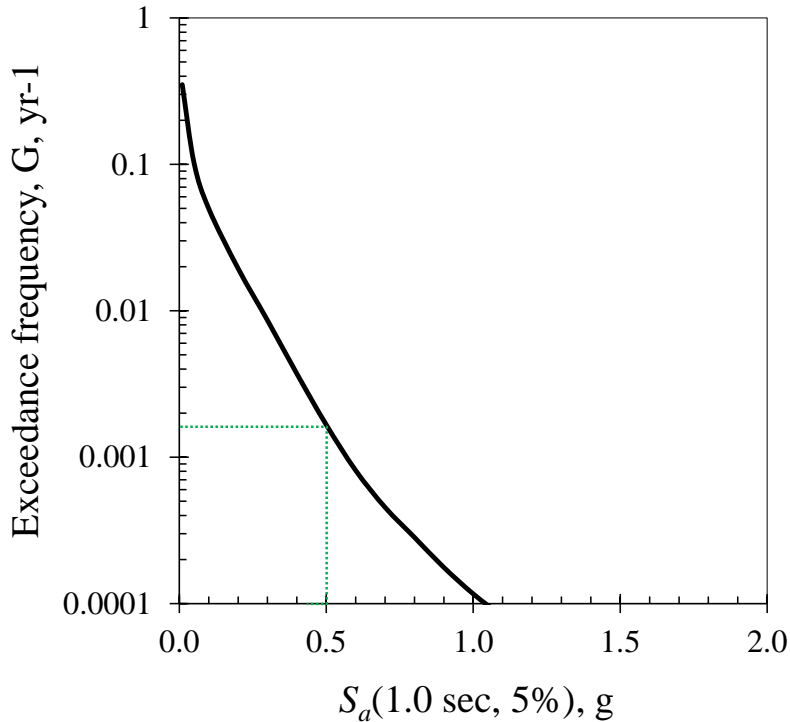
In decision analysis, information (e.g., OEF info) is worth the increased probabilistic value of a decision



Risk for 1 asset

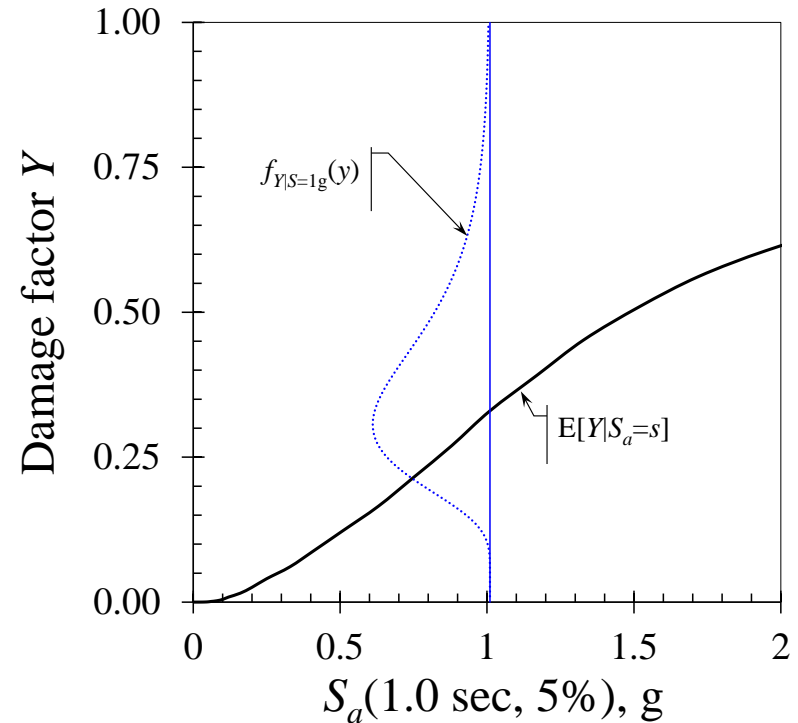
Hazard*

Probability or freq. that excitation $> x$



Vulnerability*

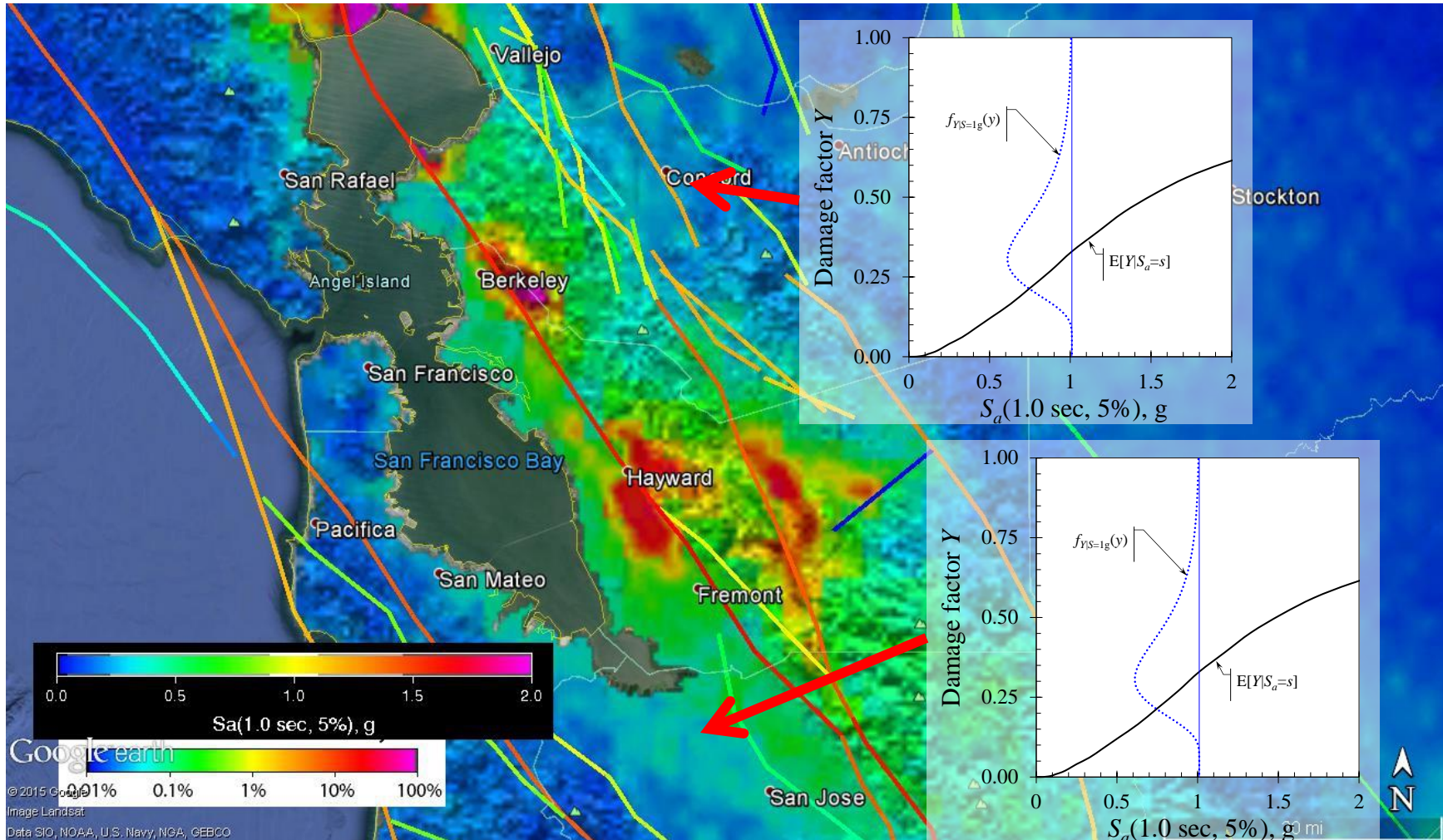
Probability that loss $> y$ given excitation x



* Both change in OEF environment

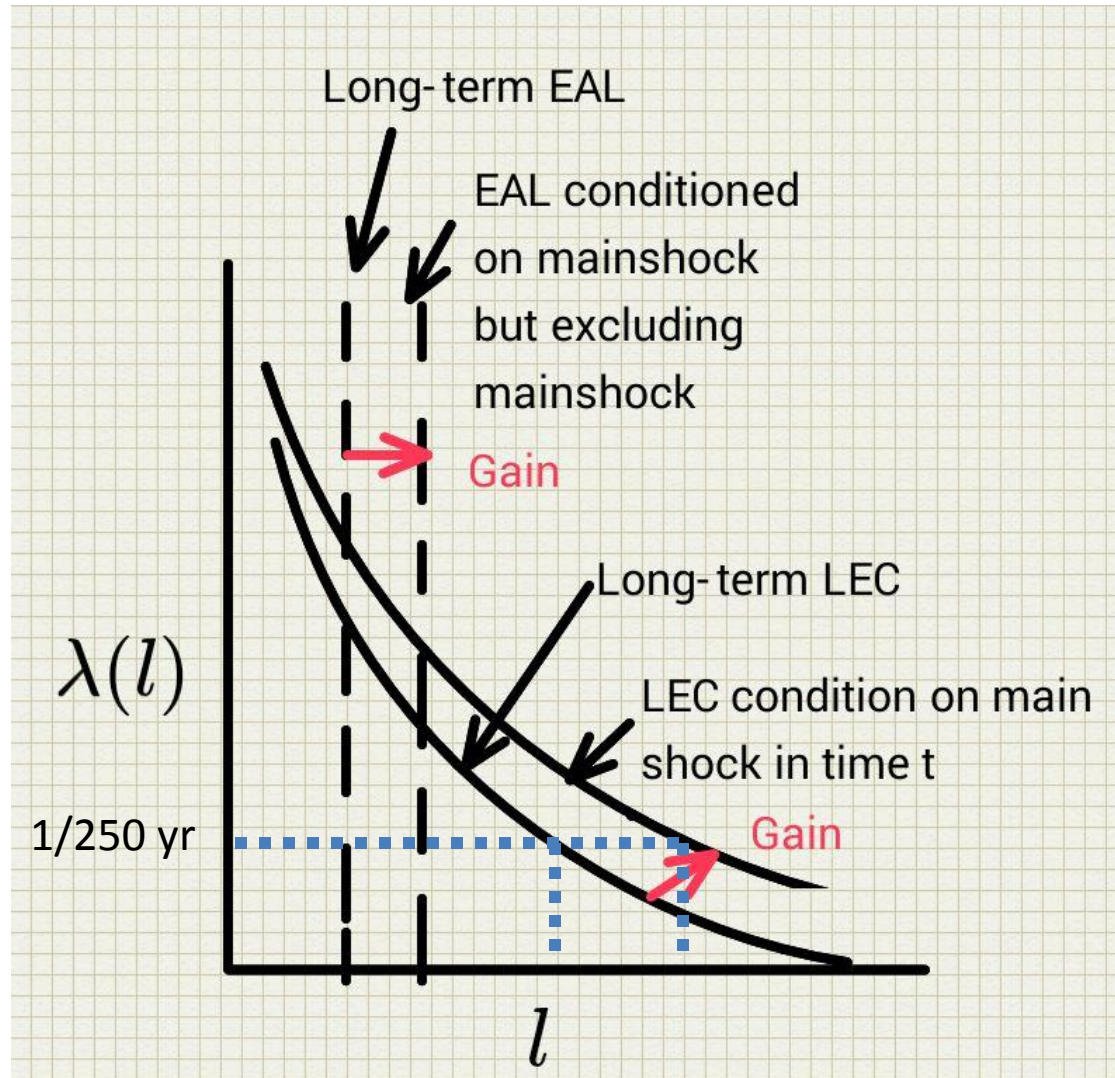


Risk for 2+ assets



❖ Vulnerabilities and event rates change in OEF environment

Loss exceedance curve



Uncertainties that contribute to LEC

Hazard

- ❖ ERF parameters
 - Slip distribution
 - Velocity & Vs30 models
 - Choice of GMPE
 - GMPE uncertainties τ , σ
 - ...

Loss

- ❖ Asset values (\$, people...)
- ❖ Asset vulnerability
 - Asset class of each asset
 - Vulnerability model

Other issues

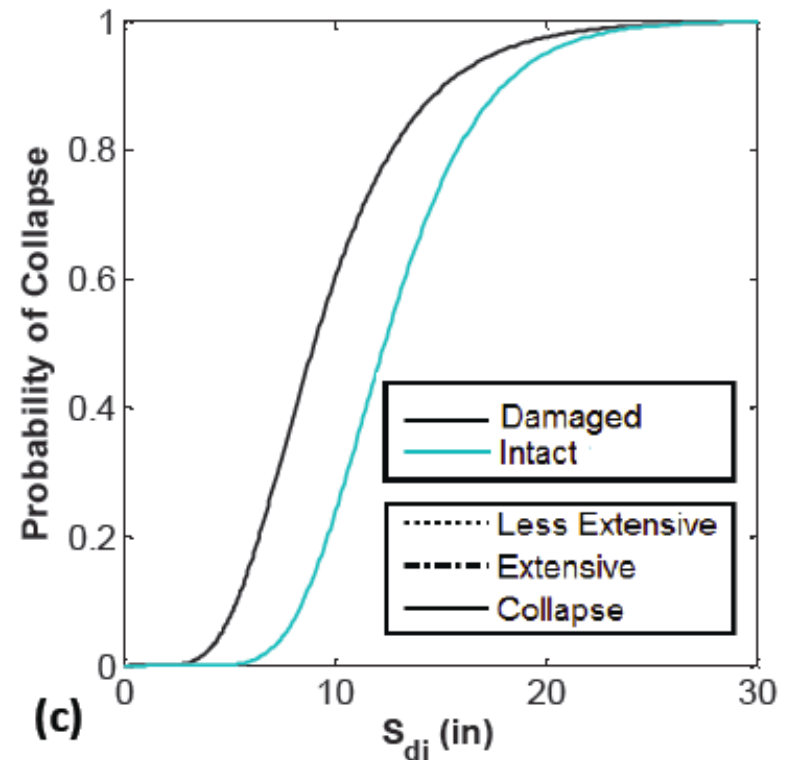
- ❖ Demand surge
- ❖ Policy changes (e.g., code)

❖ Change in OEF environment



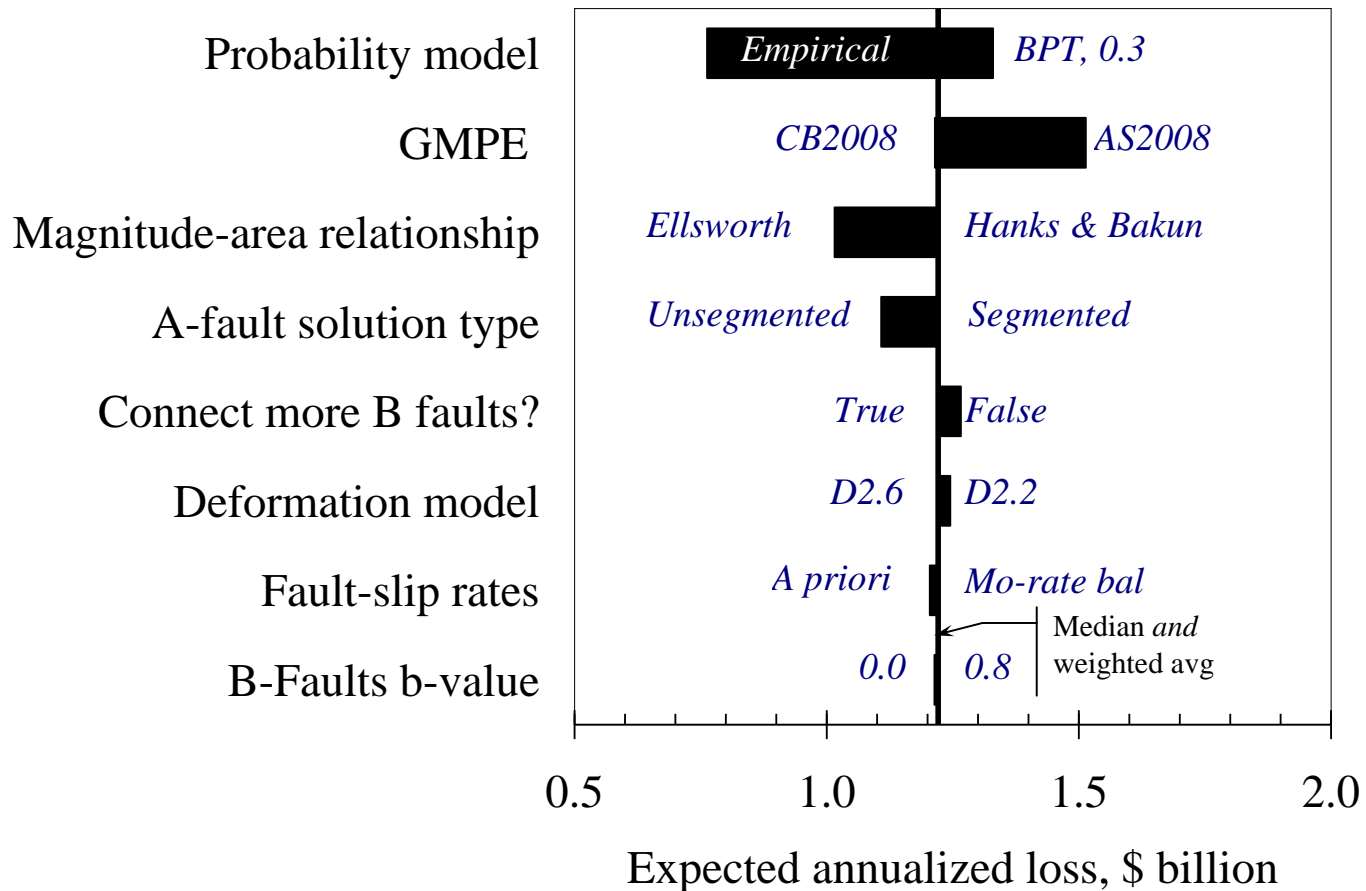
Loss uncertainties that change

- Values change, people leave
- Damage changes vulnerability
 - E.g., Bazzurro et al. (2004)
 - Not mature; apply judgment
- Demand surge can depend on number of events
 - E.g., Olsen & Porter (2011)
 - No public quake DS model
- Aftershocks remind policymakers of options
 - E.g., City of Moore (2014) increased design wind 50%



Raghunandan et al. (2015)

Determining which uncertainties matter



Conclusion: prioritize uses by VOI?

- Decision analysis offers a framework for determining which uncertainties matter
- And to estimate OEF's value of information (VOI)
- $VOI \approx EAL[\text{outcome with EOF}] - EAL[\text{without}]$
- The more distinct are pre- and post-OEF risk, the greater the VOI
- The higher the value exposed, the greater the VOI



Thanks

