Update of National Seismic Hazard Maps: *Insurance Issues*

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Cambridge, Massachusetts

May 9, 2006

One Hazard Modeler’s Perspective

- Bias
- Input data and models
- Aleatory uncertainty
- Epistemic uncertainty
- Time-dependent probability

Bias

- Bias bad! – No bias good!
- Bias distorts risk and makes portfolio management difficult
- Primary insurers must demonstrate that their residential catastrophe insurance rates are not biased high
- Primary insurers must set commercial insurance rates that balance premium income with competitiveness
- Reinsurers generally prefer high hazard, which support high reinsurance rates, but these rates must be competitive
- Capital market catastrophe bonds must not favor either the issuer or the investor
- Private catastrophe risk swaps must represent equal and unbiased risks in order to be equitable

Input Data and Models

- Hazard curves are not sufficient for modeling insurance risk
- Stochastic event sets, comprising individual event shake maps, along with their exceedance frequencies, are needed for most insurance applications
- Generating event shake maps requires implementing all of the input data and models that contribute to the hazard computation, much of which is currently buried in software
- Implementation would be much easier if:
  - All input data was included in the input data files or in tables
  - All model parameters were included in the input data files and the models themselves were documented in a report

Aleatory Uncertainty

- Aleatory uncertainty in hazard contributes to the median loss exceedance curve (% loss vs. return period)
- Aleatory uncertainty must be sampled and adequately represented in the stochastic event set
- Insufficient aleatory uncertainty causes a “lumpy” loss exceedance curve, especially at relatively long return periods or where characteristic events dominate
- Example where additional aleatory uncertainty is useful:
  - Magnitudes of large characteristic events (e.g. Cascadia subduction zone, New Madrid, Charleston)

Epistemic Uncertainty

- Epistemic uncertainty in hazard contributes to the confidence limits of the loss exceedance curve
- Epistemic uncertainty also contributes to the mean loss exceedance curve
- Epistemic uncertainty must be sampled and adequately represented in the stochastic event set
- Insufficient epistemic uncertainty causes a "lumpy" loss exceedance curve, especially at relatively long return periods or where characteristic events dominate
- Epistemic uncertainty model should be coordinated with aleatory uncertainty model so as not to double-count uncertainty
- Example where additional epistemic uncertainty is useful:
  - Recurrence frequency of characteristic events

Time-Dependent Probability

- Insurance industry has a short-term view of risk
  - Contracts are typically renewed every year
  - Portfolios are constantly changing
  - Need to react to watershed events (e.g. Katrina)
- Concept of time-dependent probability has already been accepted by the insurance industry
  - Non-Poissonian occurrence of earthquakes in California
  - Multi-decadal fluctuation of hurricane frequency
- Additional time-dependent probability assessments would be useful, for example:
  - Wasatch fault
  - New Madrid fault