Testing PSHA against accelerations and intensities

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Testing PSHA – method

• Comparison between observations and models

Consideration of all possible observations anterior/posterior to the hazard map to be tested
Testing PSHA – method

• Comparison between observations and models

Considering several sites, and the ground motion level A

Sampling in space – reduce the possible conclusions

Gerstenberger & Stirling 2010
Albarello et al. 2008
Testing against accelerations: two example applications

France

1st stations in 1995, 62 rock stations
Max time window at 1 site: 16 yrs
Total observation time: 449 yrs

Turkey

1st stations in 1973, estimated rock, 189 stations
Max time window at 1 site: 40 yrs
Total observation time: 892 yrs

Thorough work on the accelerometric databases, to provide the best accuracy and completeness of the data (not only large events are interesting)

Tasan et al. 2014
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Tasan et al. 2014
Testing against accelerations: France

3 models tested (PGA)  

Observed  
Predicted (mean, 2.5%, 97.5%)

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AFPS2006: Model rejected

MEDD2002

SHARE2013: best adapted
Testing against accelerations: France

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Part of the hazard curve which is not well constrained ($M_{\text{min}}$ dependent, at the limit of the GMPE magnitude validity limit)
Testing against accelerations: France

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Nothing can be said for accelerations of interest in earthquake engineering
Testing against accelerations: Turkey

Turkey

1st stations in 1973, estimated rock, 189 stations
Max time window at 1 site: 40yrs

Results for accelerations of interest in earthquake engineering (but T<475yrs)
Need to test another PSHA model to know if possible to discriminate

Tasan et al. 2014
Can we do better using an intensity database?
Testing PSHA against intensities in France

- ~1000 years of history, SisFrance database, intensity sequence per municipality

An intensity-acceleration equation must be selected

Faenza & Michelini (2010, FM2010): Italy

Take into account its σ

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Determining completeness periods

- Completeness in time: not possible to make simple assumptions based on the size/importance of the cities, as it changed a lot with time
- Method is relying on simple statistics on data

Ex: Strasbourg

=> Possible to work only at sites with a minimum number of data
=> Bias in the selection of the sites
Testing PSHA against intensities: results

Total $T_{OBS} = 3329$ years at 25 sites

AK2006, only acceleration levels > 0.077g

Observed (mean, 2.5%, 97.5%)
Predicted (mean, 2.5%, 97.5%)

Large uncertainty
Results for higher ground motions and longer return periods, do not contradict results based on accelerations
None of the models is rejected for $T \geq 475$ yrs

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Testing PSHA:

• Testing PSHA is more difficult than testing GMPEs/earthquake model forecasts
• The resolution power of the test seems to be rather low (difficult to discriminate between models) – only mean hazard values have been used

How to move on, improve the test on historical data:
• Apply historical methods to evaluate completeness
• To overcome the completeness issue, use an interpreted dataset: an atlas of intensity maps (isoseismal maps) for all earthquakes of SisFrance database provided by BRGM
Thank you