WP5
CAN WE MAKE THE PSHA STUDIES MORE RELIABLE?

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SUMMARY

1. **Challenges in making PSHA results more reliable**

2. **Overview of WP5 tasks**

3. **Conclusions**

KEY POINTS

- **Develop and apply PSHA Testing and updating procedures**
- **Implement state of the art methods for uncertainty quantification and propagation**
- **Allow for spatially dependent GMPEs and time dependent SSC models**
- **User-friendly and efficient PSHA codes**

Verification and validation of PSHA

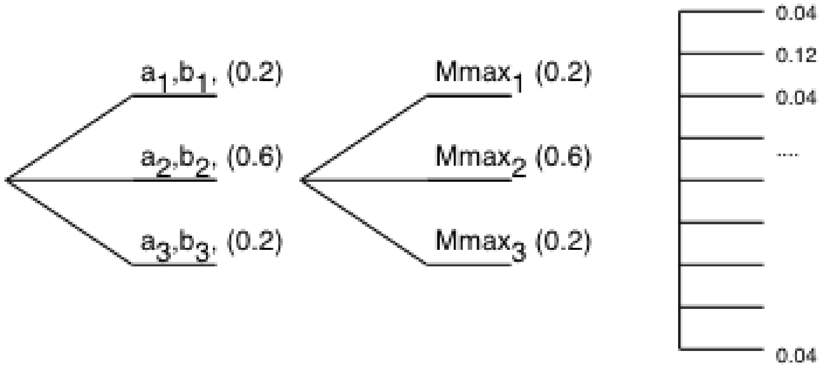
- How to asses whether the model provides meaningful results?
  - V&V procedures are becoming state of the art in engineering and science
  - Verification: benchmarking of new capabilities
    - Should have more than one program: Haz45, Openquake, CRISIS, …

Verification and validation of PSHA

- How to asses whether the model provides meaningful results?
  - A consistent method for Testing PSHA results has not yet been fully established
    - Testing has focused on the mean hazard curve, but should consider the **epistemic range** of the hazard curves
      - Identify hazard curves that are rejected by the testing
    - Need to develop comprehensive data bases and methodologies in order to assess the adequateness of the PSHA models (zonation, GR, GMPE, …) and results

Verification and validation of PSHA

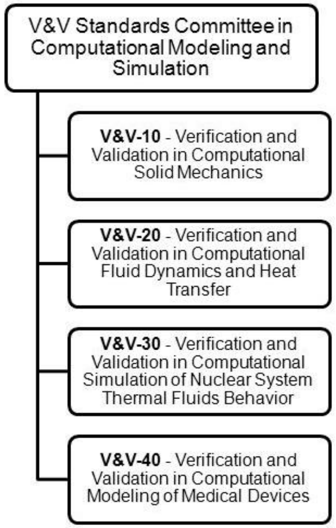
- How to update the model with regional or new data?
  - Methods to update the models (parameters) used in PSHA and their likelihood (weights in logic tree)
  - Update end branch and individual branch weights considering correlations



Verification and validation of PSHA

- Guide on PSHA Testing

- Standards Subcommittee
  - Provide procedures for assessing and quantifying the accuracy and credibility of computational modeling and simulation



Example: ASME

Challenges in PSHA methodology

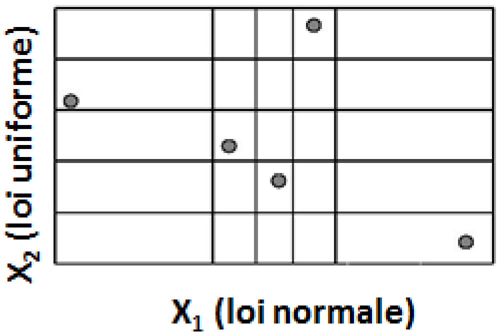
- Introduce new models in PSHA
  - Use CAV filter as an alternative to M_{min} in order to exclude nondamaging earthquakes?
  - Other shapes of the magnitude frequency distribution

Challenges in PSHA methodology

- Advanced models allowing for space and time dependency
  - Non ergodic GMPEs
    - Epistemic uncertainty for nonergodic GMPEs involves spatially correlated logic trees
    - Need to adapt PSHA codes
  - Non Poisson recurrence
    - Equivalent Poisson rates are used
    - Need to introduce spatial correlation of Non Poisson effects for area zones

PSHA software

- Uncertainty propagation remains time consuming
  - Efficient methods for global sensitivity analysis instead of cumbersome parametric analysis
    - Sobol indices, Morris method, derivatives ….
  - Are there better, state of the art methods for uncertainty quantification and propagation – alternatives to adding thousand of branches in logic trees ?
    - LHS, correlation between variables, maximum entropy distributions



PSHA software

- Avoid inefficient calculations
  - Due to filling zones with virtual faults (analytical approximation)
  - Due to too many branches of logic trees: everything is discrete
- (Graphical representation of in & output via GUI)

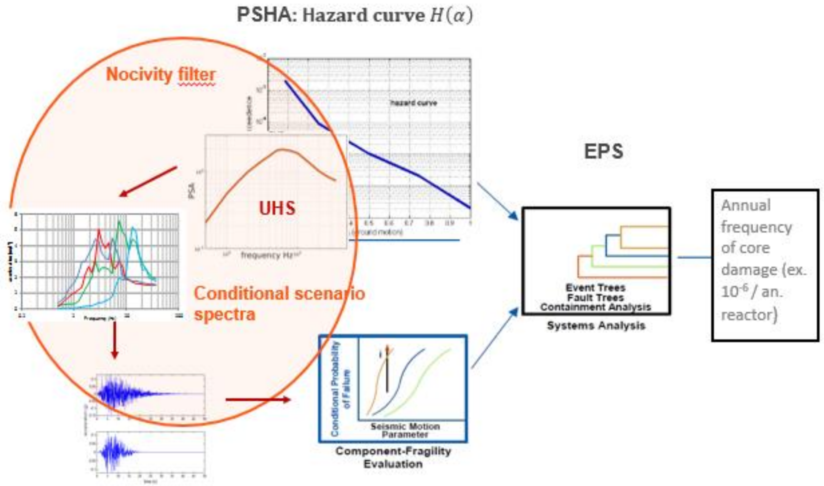
Ground motion for engineering

- Last but not least

  Work with risk assessment team in order to produce most useful & meaningful output

  Consistency of hazard curves and fragility curves

  ⇔WP 6



WP 5

Task	Title
5.1	Recurrence models
5.2	PSHA methodology & Software (CAV filtering, faults, PSHA in areas of low and high seismicity, PSHA for faults, epistemic uncertainty, PSHA practice in different countries)
5.3	PSHA Testing and Bayesian updating
5.4	Site specific case studies and evolution of hazard maps

WP 5

- Recurrence models
  - Non-poisson recurrence models for zones
  - Recurrence models for low seismicity areas
    - Alternative models to truncated GR, less sensitive to Mmax - Hybrid models distinguishing moderate and high magnitudes
    - Correlation of seismicity parameters (Mmax and GR parameters): compare PSHA output to geologic and geodesic data (deformation tensor)
    - Extreme value statistics to assess and update Mmax

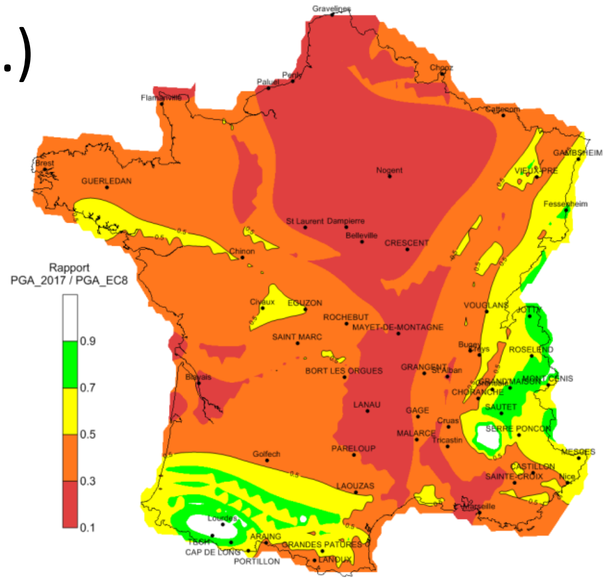
WP 5

- PSHA methodology & software
  - Develop nocivity filtering methodology (CAV filter) & implementation in PSHA software (Haz45, OQ)
  - Fault specific PSHA in low seismicity areas: uncertainty vs precision
  - Implementation of non ergodic GMPEs (spatially varying path and site scaling effects in the GMPEs)
  - Uncertainty quantification and propagation in PSHA
  - Compare PSHA practice in different countries: France, Japan, USA

WP 5

- PSHA Testing and Updating
  - Weights for GMPE: Sammon's maps, Bayesian model Averaging, information criteria
  - Testing hazard maps at DCPP (precarious rocks)
  - PSHA Testing & Updating methodology using instrumental and historical data + application to French PSHA
  - Produce a guide on PSHA Testing (data and results) > IAEA working group

- Evolution of hazard studies
  - Evaluate and validate SIGMA2 output through applications and highlight the improvements
    - Updated hazard maps (France),
    - Apply methodologies to compute hazard for test sites (CA, France, …)



THANK YOU