Objective

• Develop of a set of GMPEs that are mutually exclusive and collectively exhaustive (MECE)

• Assign weights to the GMPEs that represent the probabilities
  – Discritize a continuous distribution
Main Issue

• Candidate GMPEs
  – Provide a small sample of the full range
  – GMPEs may be correlated (evaluation of similar data)
  – Not MECE

• Weighting of candidate GMPEs
  – Often a relative merit weight, not a probability

Defining MECE GMPEs

• Scaled Backbone approach
  – Select/develop a representative GMPE
    • Defines the backbone model
  – Scale the backbone model up and down
    • Only change the constant term
    • Does not address range of mag, dist scaling (or other effects)
    • MECE in terms of the amplitude at a given M,R

• Sammons map approach
  – Captures alternative in mag, dist scaling in addition to the constant term
  – MECE in sammons map space
General Approach

- Select Set of Candidate GMPEs
  - No weights (Pass / no pass)
  - May include limits on range of applicability for each model
- Expand the Set of Candidate GMPEs
  - Interpolate and extrapolate range from published GMPEs
  - Define the full continuous space of possible GMPEs
- Use Sammons maps to compare the GMPEs (one period at a time)
  - Continuous space of GMPEs
- Discritize the continuous space to a manageable number of models (cells in Sammons map)
- Select a representative GMPE for each cell
- Assign a weight to each cell (each representative GMPE)
  - TI team Evaluation
Select Candidate Set of GMPEs

- TI team evaluation
  - Evaluate available GMPEs
  - Select those that are considered applicable
  - Traditional evaluation

Expand Set of Candidate GMPEs

- SWUS approach
  - Fit each candidate GMPE to a common functional form for the FW only
  - Evaluate the covariance of the coefficients
    - Equal weight assigned to each candidate GMPE
  - Sample the covariance to generate 2000 new GMPEs for the FW
    - Extrapolates and interpolates
    - Restrict models to avoid non-physical models (e.g. don’t allow PSA to decrease with magnitude)
Use Sammons Maps to Compare GMPEs

- Compare the GMPEs in terms of their ground motions, not the method used to generate them.

Discritize the Continuous Space of GMPEs

- Set the subset of the range to consider
  - Generated set of GMPE should be too broad
- Define cells in the selected subregion
Select a Representative GMPE for each Cell in the Sammons map

- GMPE should be “Representative” in terms of impacts on hazard
- Approach
  - Use a simplified representative source model
  - Compute the hazard for each model (FW only)
  - Compute the mean hazard for the GMPEs in a cell
  - Select the GMPE that has the hazard that is closest to the mean hazard for the cell
- Add a HW model to the selected GMPE
  - Separately, 5 HW models were developed, each with equal weight.
  - Either use all 5 HE models or randomly select one of five
- These are the median GMPE branches on the logic tree

Assign a Logic Tree Weight to Each Cell

- Main TI Team evaluation
- Compare to Empirical Data Sets
  - Mean event term (average bias) by cell
  - Likelihood (bias and variability) by cell
  - Data sets
    - NGA-East data (pick M,R ranges)
    - MMI data (did you feel it)
- Prior (Equal weighting)
  - Proportional to number of GMPEs within a cell
Example: Comparisons to Data Sets

General Approach

- Select Set of Candidate GMPEs
  - TI team Evaluation
- Expand the Set of Candidate GMPEs
- Use Sammons maps to define the continuous space of GMPEs (one period at a time)
- Discritize the continuous space to a manageable number of models (cells in Sammons map)
- Select a representative GMPE for each cell
- Assign a weight to each cell (each representative GMPE)
  - TI team Evaluation