The epistemic uncertainties in the event-rate vector $\lambda$ of the time-independent Uniform California Earthquake Rupture Forecast (UCERF3-TI) are represented by a weighted logic tree with $K=7$ branching levels and $L=1440$ leaves (Field et al. 2014). At each branching level $k=1,\ldots,K$, the array of model-component choices, as well as their assigned weights, are the same for every vertex, so that the subtrees of the vertices at any given level are replications of a weighted subtree template. In this study, we use this replicated structure to investigate correlations between the rupture event sets. Each model component, $\lambda^m$, takes on one of two values (true or false). The uncertainty in the logic tree is represented by the weights $C_k$ for each leaf $\lambda^m$. The weights are assigned by a committee of experts and represent the relative importance of each choice in the logic tree.

**Methodology**
- Given the structure of the logic tree, there are 1440 branches with nonzero weights.
- We consider the fault models separately as they have different rupture event sets.
- For both fault models, we consider a rupture event that contains events represented in fault models FM3.1 and FM3.2 with $M > 7.5$ and mean annual rate $> 10^{-10}$.
- From these branches we place all the possible pairs into a class $k$ based on the level of the pair’s nearest common ancestor on the tree.
- For each class $k$, we define a method for sampling the class mean and covariance.
- We define a method to sample the mean for a given class below.
- We define the method for calculating the class covariance matrices.

For each covariance class matrix, we record the values on the diagonal to get the covariance for each rupture given the class. We compare the values of each rupture among the classes. Below this comparison is shown for 3.1 and 3.2 using a subset of events in our rupture set. For these comparisons, we divide all values by $C_0$ in order to better compare the differences between classes.

**Evaluation**
We define the relative differences of class correlation functions:

$$R_k = \frac{C_{k-1} - C_k}{C_{k-1}} = 1 - \frac{C_k}{C_{k-1}} \quad k = 1, \ldots, 6$$

- Below is a histogram of the $R_k$ values for the entire rupture set for FM3.1 (left) and FM3.2 (right).
- The further away the distribution of a classes $R$ values are from 0, the higher that level is contributing to the epistemic uncertainty.
- In other words, if a classes $R$ values are centered around 0, then on average that level is not contributing much to the net epistemic uncertainty.

**Summary/Conclusion**
- The $R_k$ histograms show a wide distribution of outliers that come from fluctuations of $C_{k-1}$ near zero, which are unregularized in our definition of $R_k$. (The exception is $R_6$, because $C_6$ is strictly positive.) We therefore rely on the median rather than the mean, because it is a more robust estimator of the distribution location.
- The median value of $R_k$ is the highest, indicating that UCERF3 branching level 1 (deformation models) is the most important in controlling the UCERF3-TI epistemic covariance. Its bimodality distinguishes two event sub-populations.
- Branching levels 3 (tapered or boxcar slip) and 5 (off-fault $M_{max}$) contribute little to the UCERF3-TI epistemic uncertainty at these magnitudes.

$R_k$ values are ranked by median values of $R_k$.

**References**

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