Questions from TI Team

• How were the event/source data established for the NGA-East database?
• How can we address and quantify uncertainty in magnitude, focal depth and mechanism?
Source Metadata (1 of 3)

• Epicentral Location
  – Taken from special studies on individual earthquakes published in the literature
  – otherwise from ANSS (in US) or NRCAN (in Canada) online catalogs
• Earthquake depth
  – Taken from moment tensor solutions if available
  – otherwise taken from special studies on individual earthquakes published in the literature
  – otherwise from ANSS (in US) or NRCAN (in Canada) online catalogs

Source Metadata (2 of 3)

• Earthquake magnitude
  – Computed from seismic moment using Hanks and Kanamori (1979) – $M = \frac{2}{3} \log_{10}(Mo) – 10.7$
  – Averaged magnitudes computed from available moments from SLU website, published literature, Alison Bent (written communication), Jack Boatwright (written communication)
  – If moments or reported moment magnitudes not available, used relationships in NUREG-2115 (EPRI/USDOE/USNRC, 2012) (typically small eqs.)
Source Metadata (3 of 3)

• Focal Mechanism
  – Taken from SLU website or published literature
  – If no preferred mechanism given, both planes used

Distance Calculations (1 of 5)

• Only 4 earthquakes have rupture models
• For remaining earthquakes, utilized simulation process developed in NGA-West and NGA-West2 to estimate $R_{RUP}$ and $R_{JB}$
Distance Calculations (2 of 5)

- Given hypocenter, simulate 101 potential rupture surfaces
  - Simulate rupture area using Somerville relationship developed for NGA-East
    \[ \log_{10}(RA) = M - 4.25, \sigma_{\log_{10}(RA)} = 0.2 \]
  - Simulation aspect ratio, along strike hypocenter location, and down dip hypocenter location using relationships presented in Appendix B of Chiou and Youngs (2008)

Distance Calculations (3 of 5)

- Place rupture plane on hypocenter using focal mechanism
  - If no preferred plane, randomly select one of the two
  - If no focal mechanism, select style of faulting based on location, assume random strike, set dip to 90 for SS, 40 for reverse, 55 for normal
Distance Calculations (4 of 5)

• Place rupture plane on hypocenter using focal mechanism
  – If no preferred plane, randomly select one of the two
  – If no focal mechanism, select style of faulting based on location, assume random strike, set dip to 90 for SS, 40 for reverse, 55 for normal

Distance Calculations (5 of 5)

• Construct grid of pseudo sites evenly distributed around epicenter in distance range 0 to 300 km
• Calculate $R_{\text{RUP}}$ to each pseudo site for each simulation
  – Calculate median distance to each pseudo site from simulations
  – Select single simulation $k$ that minimizes the squared difference between median distance and the distance for the $k^{\text{th}}$ simulated rupture across all pseudo sites.
  – Use selected $k^{\text{th}}$ simulated rupture to compute distances for actual sites.
Treatment of Uncertainty

- Uncertainty in distance is greatest where data are sparsest
- Can assess impact of uncertainty through simulation
  - Simulate data sets incorporating uncertainty and refit to see effect on model parameters
  - Increase uncertainty in metadata and refit process
  - Extrapolate mean parameters back toward zero error
One Approach to Dealing with Data Errors in Nonlinear Models

References (1 of 2)

References (2 of 2)


