Simplifying Task G1.3

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G1.3: Terminology

- Sigma
  - Value of the standard deviation (natural log units)
- Epsilon
  - Number of standard deviations
  - Empirical estimates of epsilons are correlated with the value of sigma
  - If the estimate of sigma goes down in a new model, then the epsilon for the same recording will increase

Issues Addressed

- Can we justify a limit to epsilon?
  - Truncation of the log normal distribution
  - E.g. Max epsilon = 2
- What is the value of sigma for EUS?
  - Are the increased sigma values (ar short distances) appropriate?

Maximum Epsilon

- Use Empirical data
  - Need data sets with thousands of recording
  - Identified records with large epsilon values
    - Epsilon values observed up to 4
    - No statistical evidence for deviation from log normal
  - Can we exclude the high epsilon values as being not applicabale to the site conditions for power plants?
    - E.g. unusual topography, site condition, etc
    - No systematic explanation found

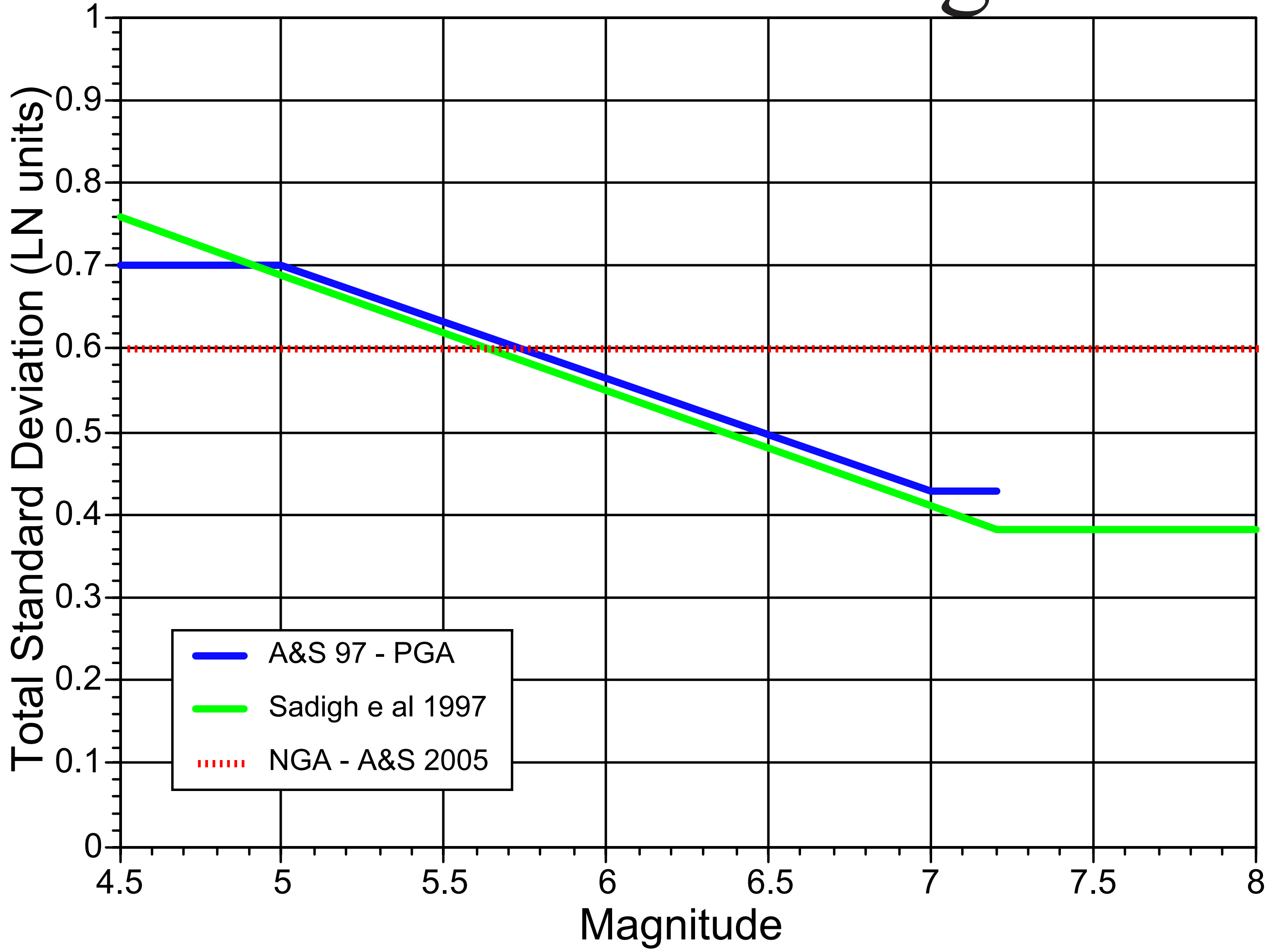
Maximum Epsilon

- Numerical Simulations
  - Using a simply site condition w/o topography in simulations, how large of epsilon values do we get from source and wave propagation in a 1-D structure?
  - Find epsilon greater than 4
    - Large epsilon values are not just
- Conclusion
  - No technical basis for truncating the lognormal distribution
  - Maximum ground motion due to physical limits of rocks is a separate issue being addressed by DOE Yucca Mtn in a 5-year program

Value of Sigma

- Major study of WUS ground motions through Pacific Earthquake Engineering Research (PEER) Center
  - Significant revision in sigma values
    - Improved meta data
    - More robust estimate of sigma
    - Sigma now independent of magnitude
  - Are these WUS sigma values from the PEER study applicable to EUS?

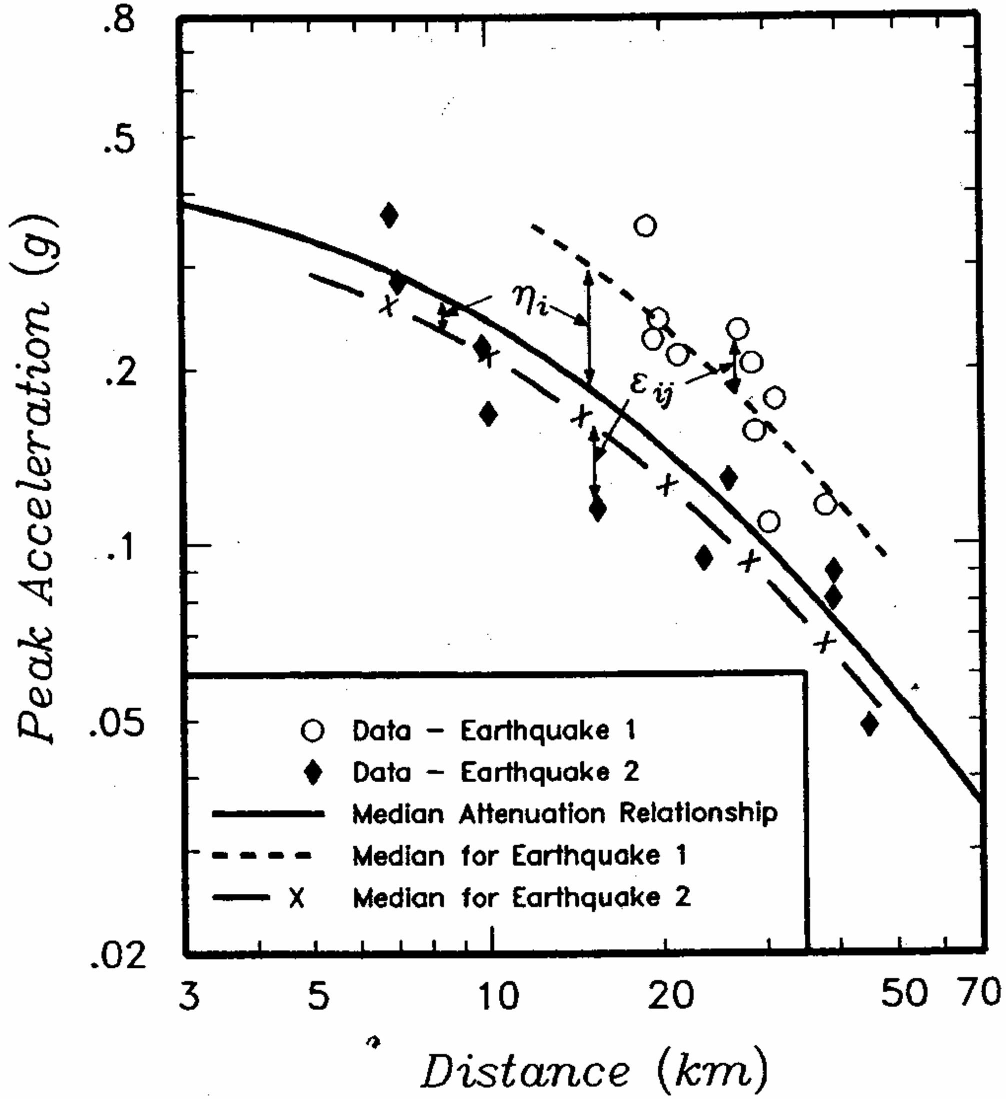
NGA Models for WUS Show Constant Sigma



Parts of the Sigma

- Inter-event variability
  - Variation of the average offset of ground motion from median for a given earthquake
  - Average offsets call “Event Terms”
- Intra-event
  - Variation of ground motion within a single earthquake (about its own median)

Inter-Event and Intra-Event Terms



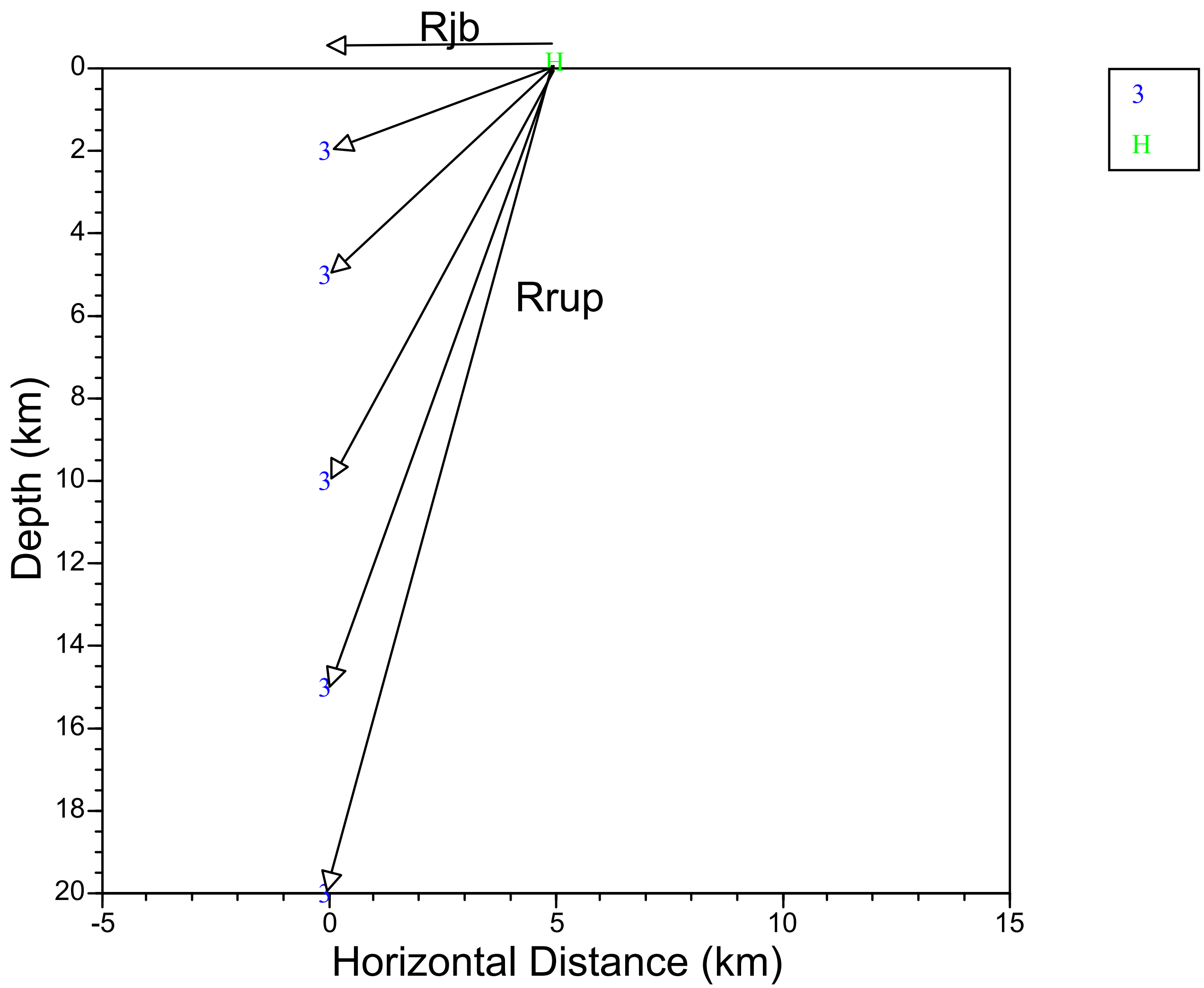
Evaluation of Applicability to EUS

- Checked causes for expected differences in inter-event and intra-event variability between EUS and WUS
  - Are sources (stress-drops more variable in EUS?
    - Used empirical data (network and catalog)
  - Is crustal structure (path) variability similar?
    - Considered crustal structure and depth distributions
    - Used numerical simulations
  - Is site variability similar?
    - Empirical site variability terms
- Conclusions
  - No basis for a significant difference in inter-event or intra-event variability between EUS and WUS

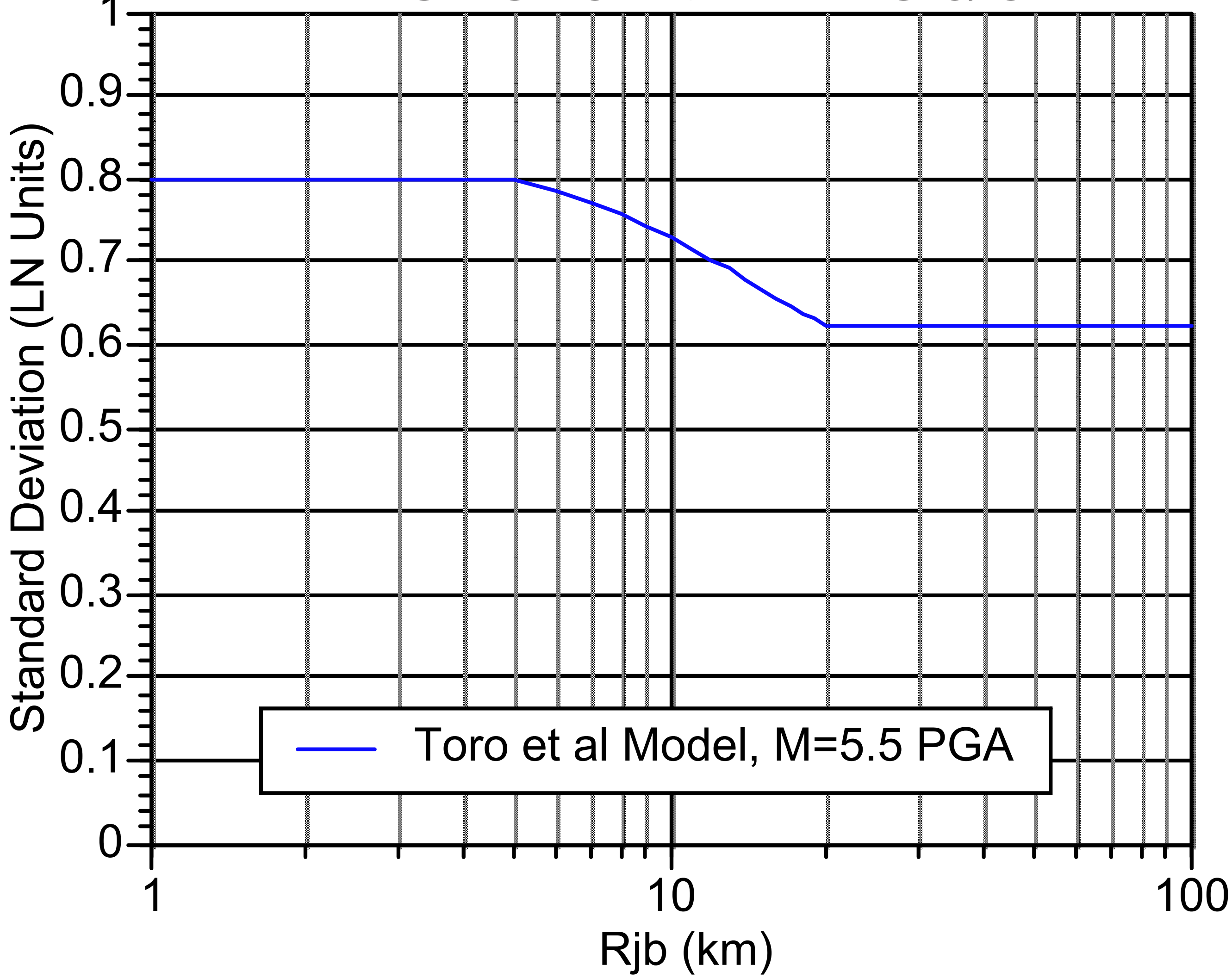
Increase in Sigma at Short Distances

- Ground motion models use JB distance metric which ignores depth
- Should sigma increase at short distances?

Use of Rjb can lead to increased variability for small R and small M

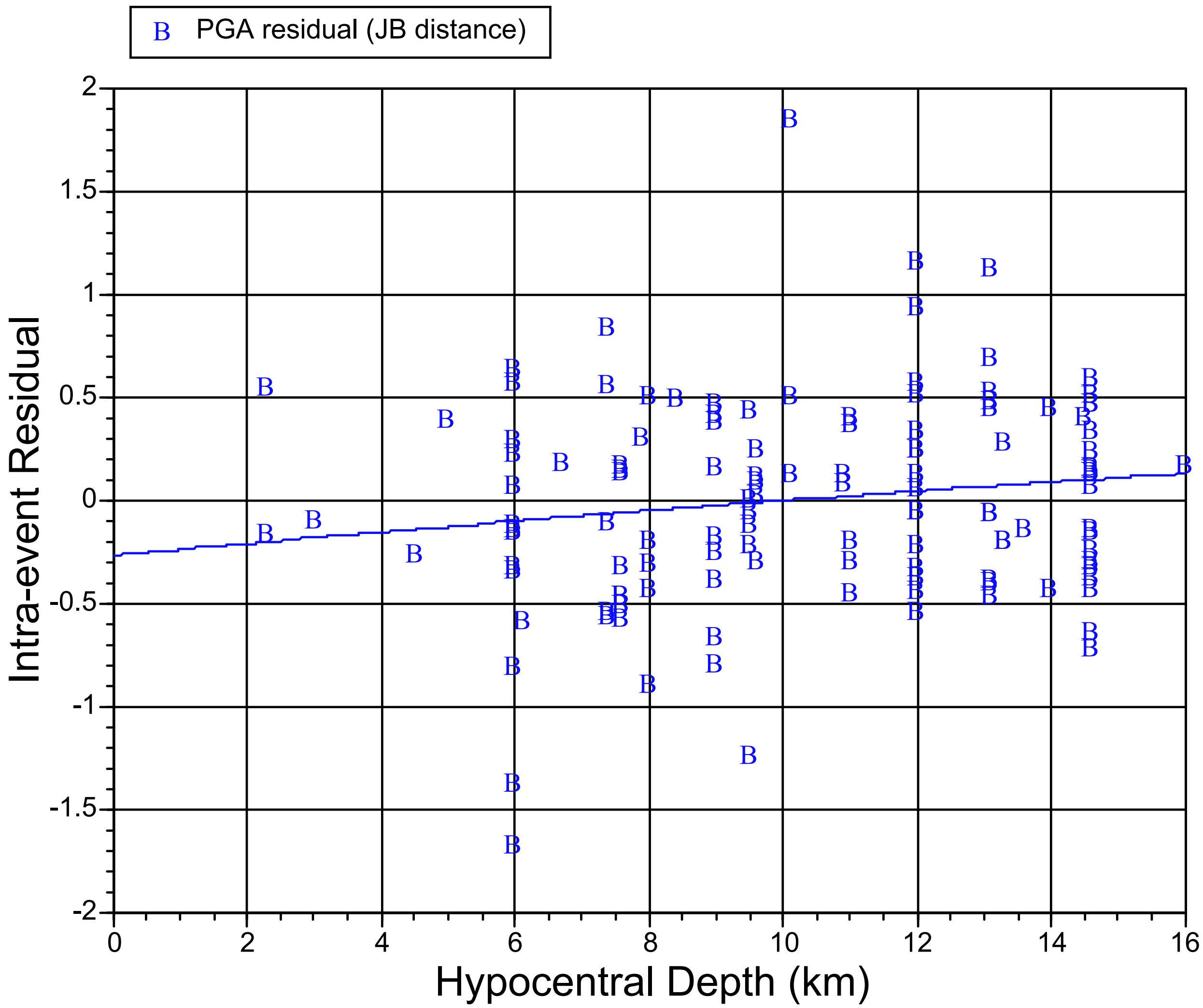


Distance Dependent Std Dev in Toro et al Model



WUS, M<6, Rjb<10

Model Based on Rjb



Short Distance Sigma

- Conclusion
  - No increase in sigma observed at short distances due to use of JB distance metric
  - Implies a correlation of stress-drop with depth
  - No need to increase sigma at short distances

Main Impact

- Reduced sigma for small magnitudes at short distances
- Increased sigma for large magnitudes
- Similar sigma for M6, R20-50 km
- Reduces contribution of M5 earthquakes to the hazard
  - Similar effect as the CAV filtering