Ground Motion Selection and Modification (GMSM) Working Group
Summary of Working Group Meeting
10am – 3pm March 2, 2007

PEER Headquarters,
Davis Hall

Participants: Jack Baker, Christine Goulet, Curt Haselton, Erol Kalkan, Nico Luco, Colleen McQuoid, Polsak Tothong, Jennie Watson-Lamprey and Tony Yang

Deterministic Event Update

It was decided that the original deterministic event (i.e., M7, ε=2) would be used for the study going forward. The main reason for this was that the increased epsilon leads to a larger difference between those methods that take epsilon into account and those that don't. Furthermore, the ground motions for this event tend to be larger than those for the M7.5, ε=1 event (e.g., Sa(T=1s)=1.08g vs. 0.70g, respectively), which allows us to look at higher levels of nonlinear response. Lastly, epsilon values larger than 1, and as large as 2, are not uncommon. Nevertheless, it is still beneficial to have an M7.5, ε=1 comparison study, so we will complete both scenario for the 4-story modern concrete frame building. **It is requested that those participants who have submitted suites in the past please submit your M7.5 suite to Curt by March 26.**

Next Steps

This year's PEER/COSMOS meeting November 9th is the target date for getting the next round of comparisons done. To that end, Curt has put together an email to forward to those people who submitted suites last time and anyone else who may be interested in taking part [e-mail sent by Curt on 3-15-07]. The group is asked to please review this email by our next meeting (on 4-4-07); we then will finalize the solicitation and send it out shortly after the 4-4-07 meeting.

The next round of comparisons will focus on response conditioned on M, R and the 98th percentile Sa(T1) (i.e., ε=2). Curt has provided Jack with T1 for the three structures to be considered (see summary of January 25th meeting), and Jack has in turn calculated the conditional mean spectrum for each case. The spectra will be sent with the solicitation email.

We are requesting four sets of seven time series. We will use each set of seven records to estimate the median and see how the median varies between sets. In addition, the combined set of 28 records will be used to estimate both the median and standard deviation of response conditioned on our event. Accordingly, we are requesting that the 7-record sets be non-overlapping so that they can be combined. Ultimately we want to determine which GMSM methods are unbiased, with low standard error, and understand why.

The suites for the three new structures are to be submitted by June 4th for inclusion in the PEER/COSMOS meeting. One of the comments that was received about the last comparison

was that it was not blind, since suites were submitted after Jennie's analysis of the structural responses had begun. For the next comparison Jennie will not start her analysis until the suites have been submitted completely. **This makes the June 4th deadline a real one**.

Summary of Planned Comparisons and Findings

Based on the proposed work, we plan to produce the following comparisons and findings:

- M7 scenario ($\varepsilon = 2$) –
  - Compare predictions and "true" response for four buildings (4-, 12-, and 20-story modern RC frame, 4-story non-ductile 1967-era concrete frame). Use this to show how selection method accuracy changes with building height and building deformation capacity.
  - Use the above comparisons to make general conclusions about "good" and "bad" selection approaches. Specifically, this M7 scenario should show the clear difference between the approaches that do and do not consider spectral shape.
  - For each building and record selection method: (a) compare median response predictions for each set of 7 records, (b) compare sets of 7 to the combined set of 4x7 = 28. Use this to show what we need to predict the median (for an engineering audience) and what we need to predict median and sigma (for a performance-based audience).
- M7.5 ($\varepsilon = 1$) versus M7 ($\varepsilon = 2$) scenario –
  - We will make this comparison for the 4-story modern concrete frame building.
  - The purpose of this comparison is to (a) show that findings are similar for the $\varepsilon = 1$ case (to address the concerns that people may have that $\varepsilon = 2$ is unreasonable), and (b) show that spectral shape issues are less important (but still important) for the $\varepsilon = 1$ case as compared to the $\varepsilon = 2$ case.

Calculating "True" Structural Response

Some results for the M7.5 event. For this event two statistical models were developed: one assuming a lognormal distribution and another assuming a power normal distribution. Results for both models are shown below.

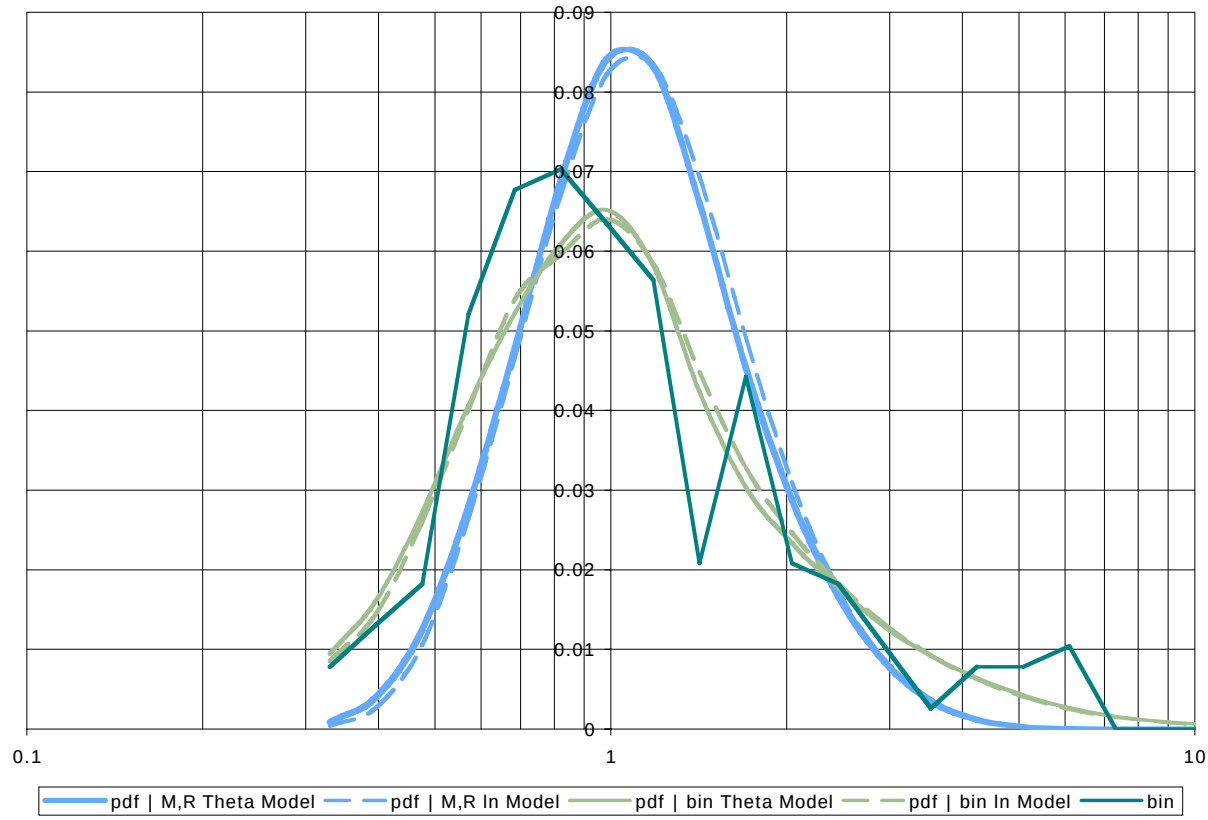

Figure 1. Trying to predict the empirical bin pdf of structural response (MIDR). The blue curves are the predictions for the M7.5 event, the greyish curves are the predictions that reflect the variability within the bin of the Sa pairs, and the green line is the pdf of the bin. There is fairly good agreement between the greyish and green lines. An analogous plot of cdf's will be prepared in order to facilitate comparisons of the medians and standard deviations. Predictions that reflect the variability within the bin of the M's and R's (and other GMPE parameters considered) may also be prepared.

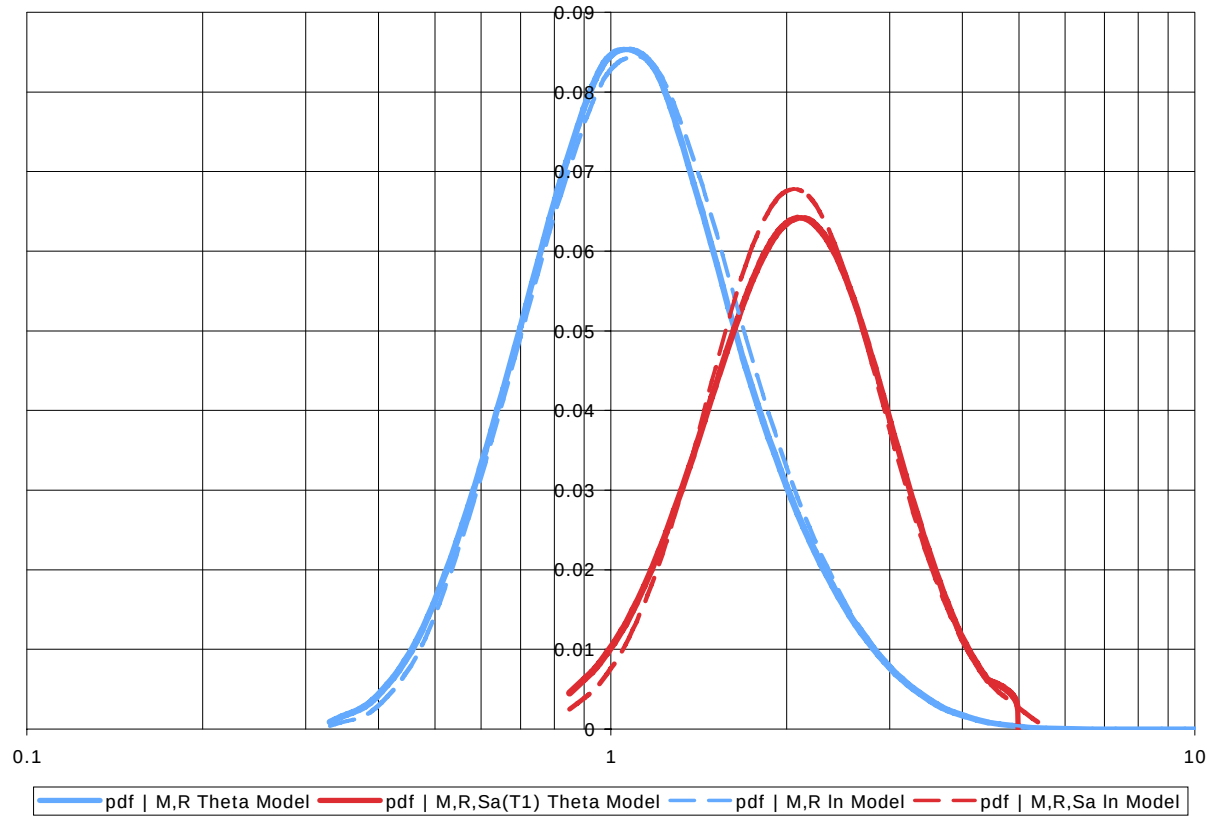

Figure 2. PDF of MIDR conditioned on M and R (blue) and 84th percentile Sa (T1) (red).

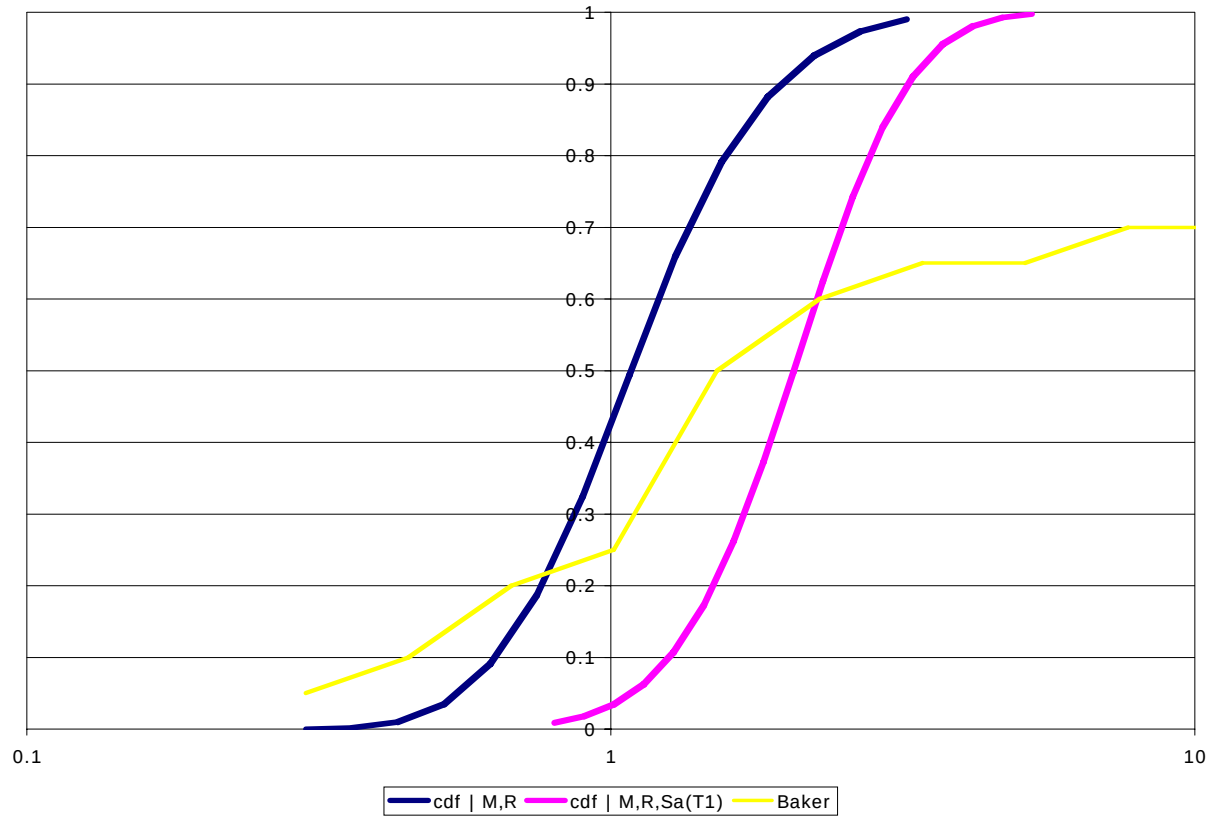

Figure 3. Comparison with suite of records submitted by Jack (suites for other GMSM methods were not yet available). The differences observed are under investigation [note that 5/20 records caused collapse and this was unexpected; Curt will look into this].

Status of summary pages for various GMSM methods

Summaries have been submitted by Curt, Jack, Jennie, Nico, and Polsak. Christine has prepared a summary that she will submit as well. Erol will prepare a summary for Dr. Praveen K. Malhotra's method, and the working group member who will be responsible for Prof. Ghaboussi's method will be determined at the next working group meeting. Soon afterwards the completed summaries will be distributed to the working group for review.

Future Meetings

Next working group meeting: April 4th

A joint COSMOS/PEER meeting similar to last year was discussed.
Large Working Group Meeting: Wednesday, October 17th
COSMOS Annual Meeting: Friday, November 9th