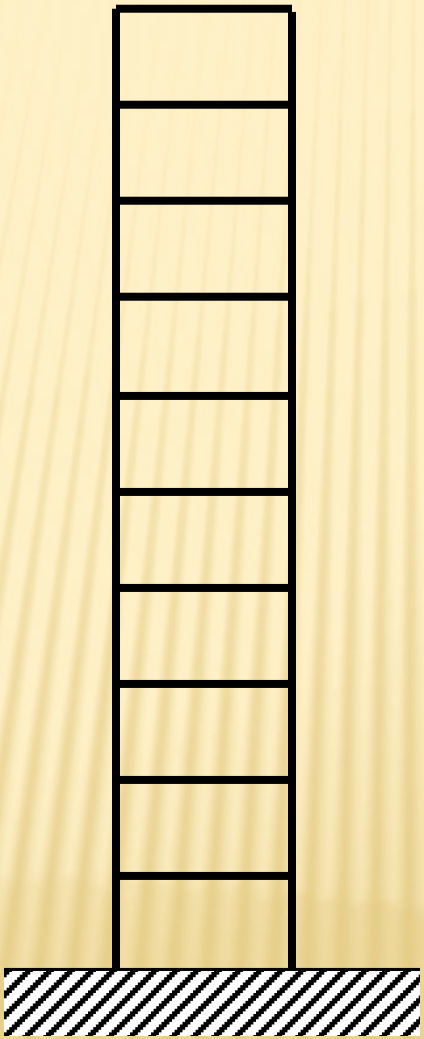
Anil K. Chopra Symposium

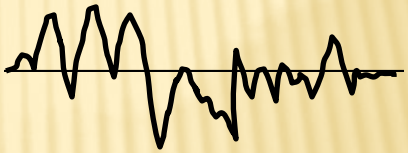
Oct 2, 2017

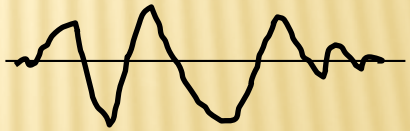
By Neal Simon Kwong

A GENERALIZED CONDITIONAL MEAN SPECTRUM FOR INTENSITY-BASED ASSESSMENTS OF TALL BUILDINGS

SEISMIC DEMANDS OF TALL BUILDINGS



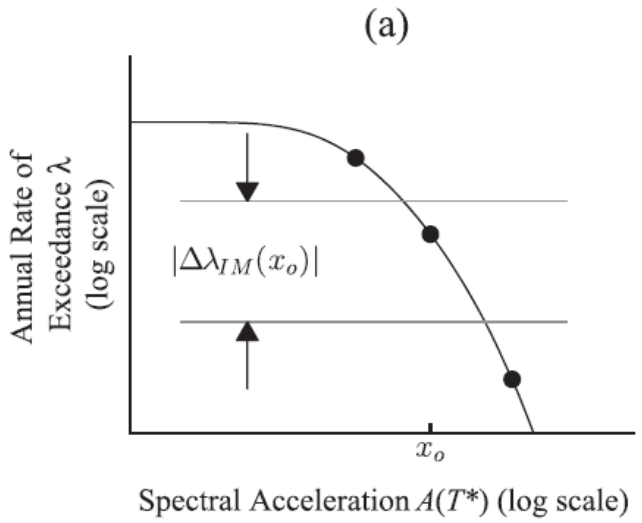


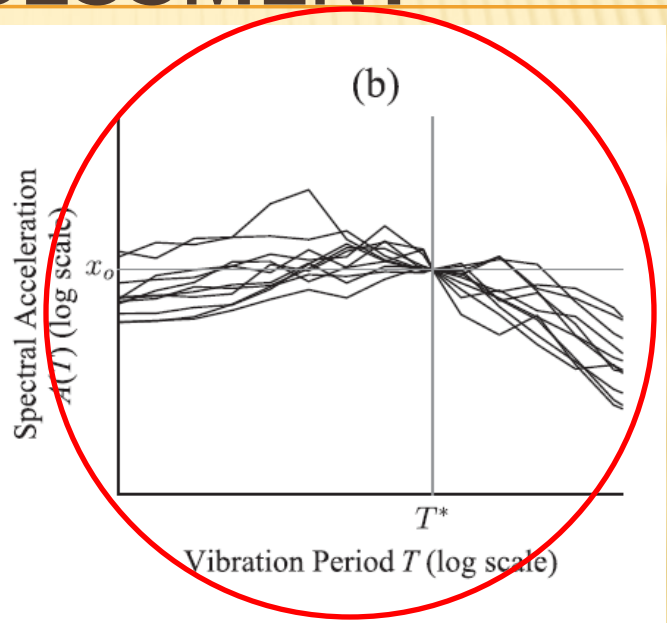


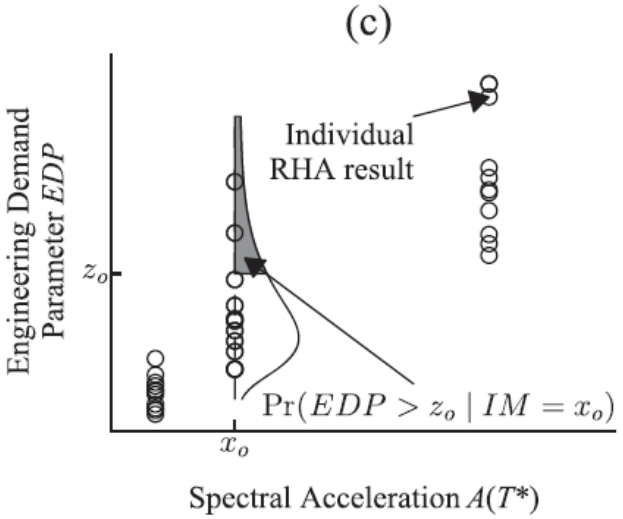
Engineering Demand Parameter (EDP)

Intensity Measure (IM)

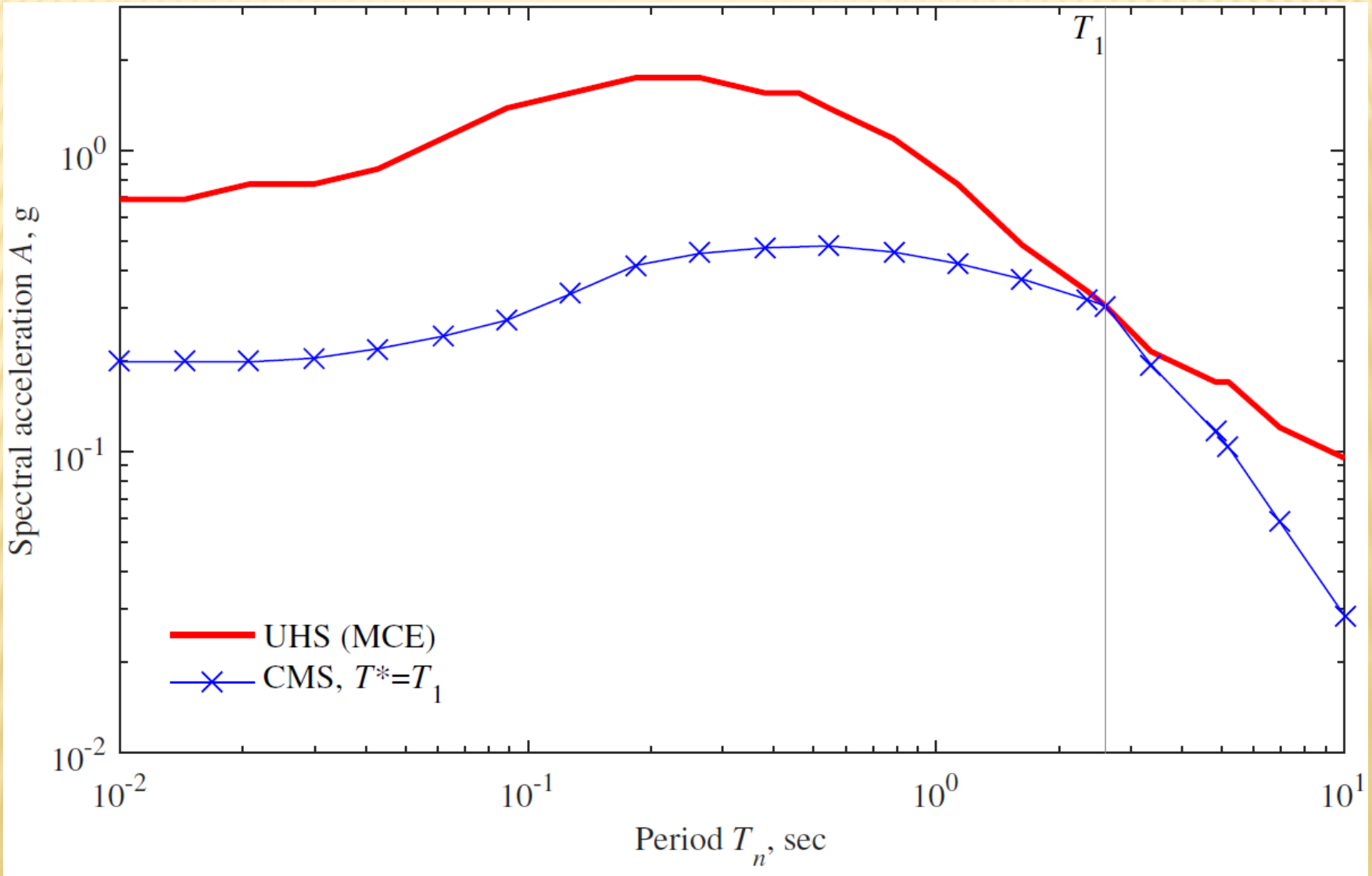
INTENSITY-BASED ASSESSMENT







TARGET SPECTRUM FOR GM SELECTION



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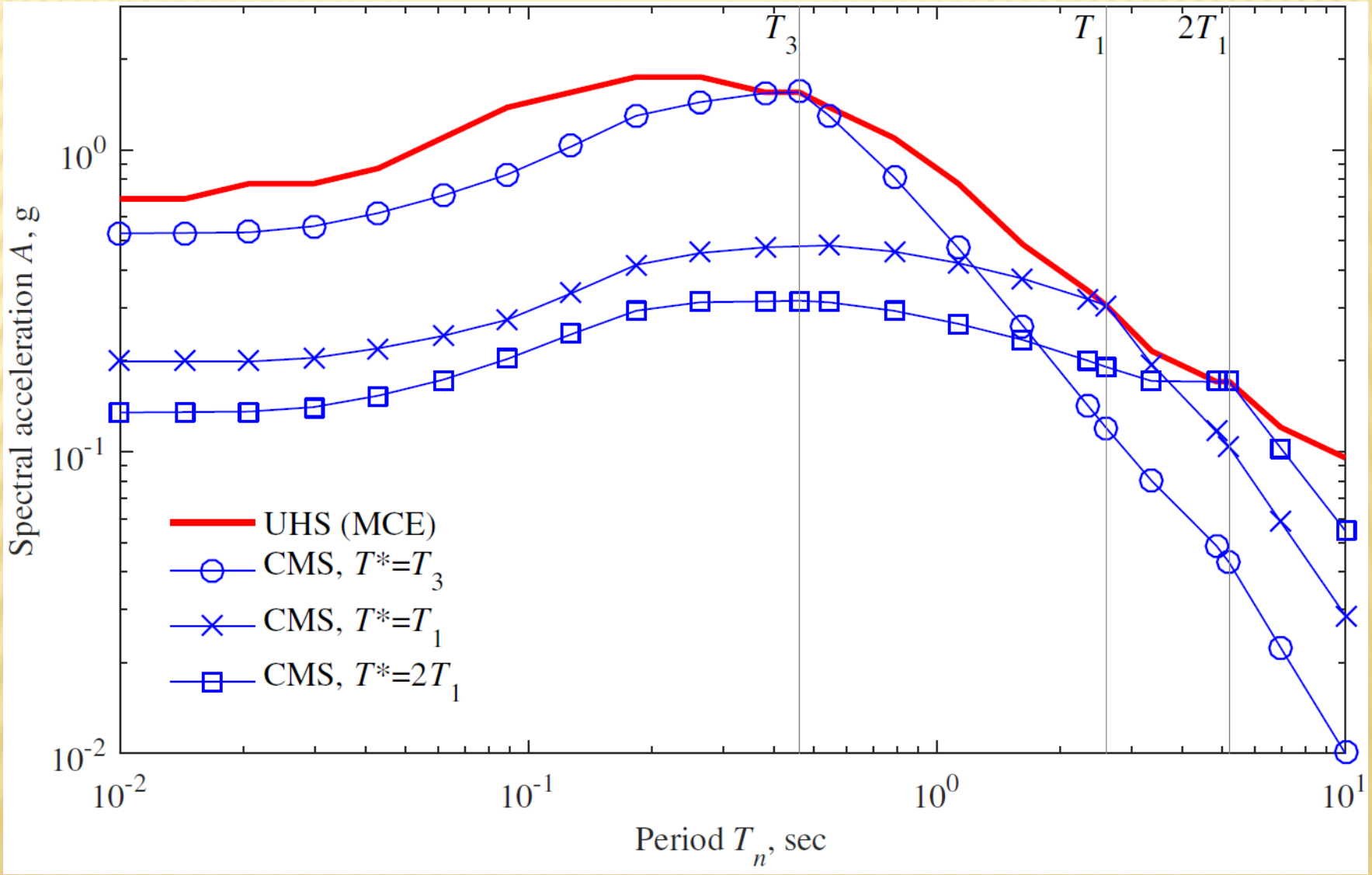
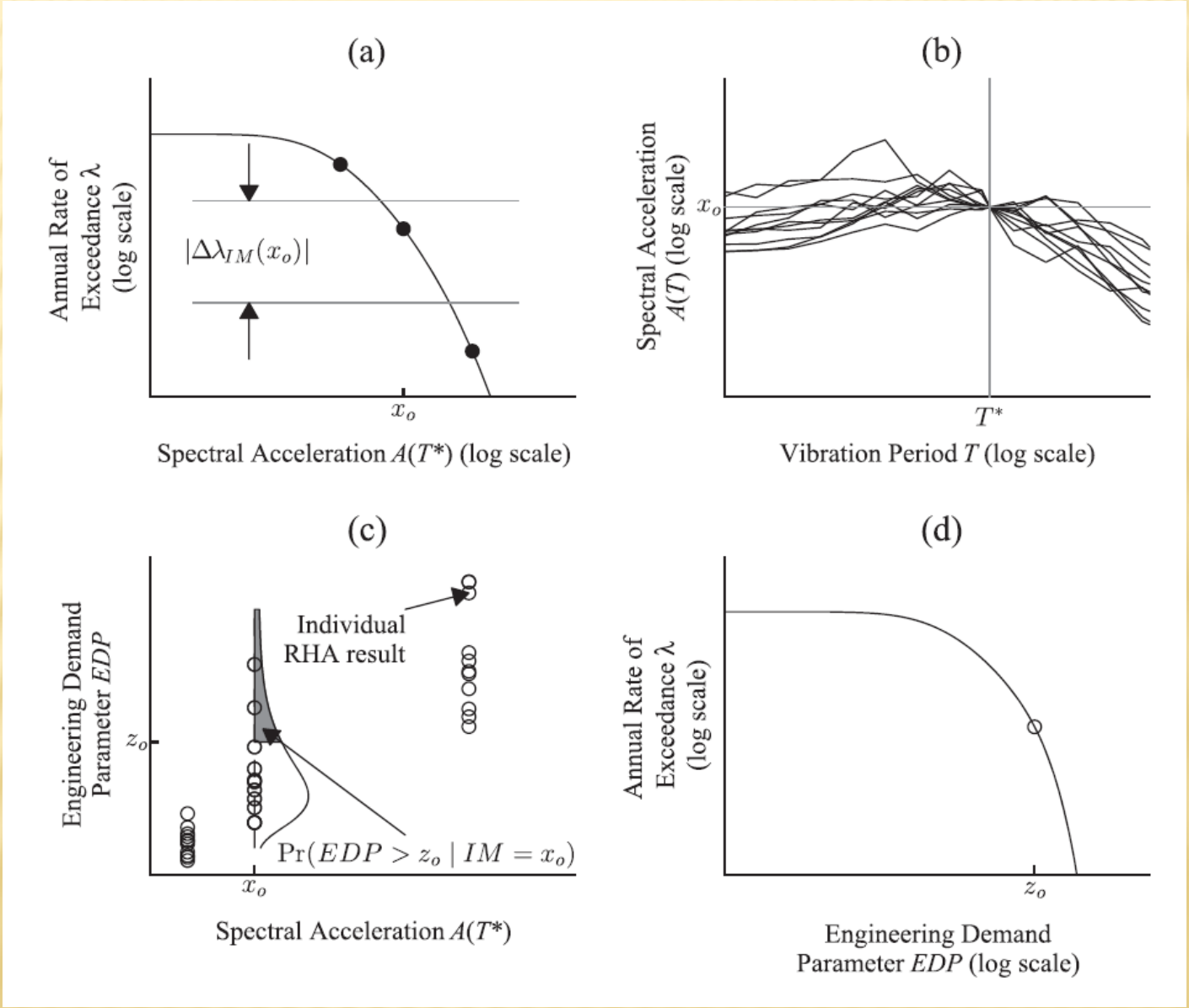


UNCONSERVATIVE RELATIVE TO?

- Specified return period is for EDP or for IM?
- Benchmark or point-of-comparison?

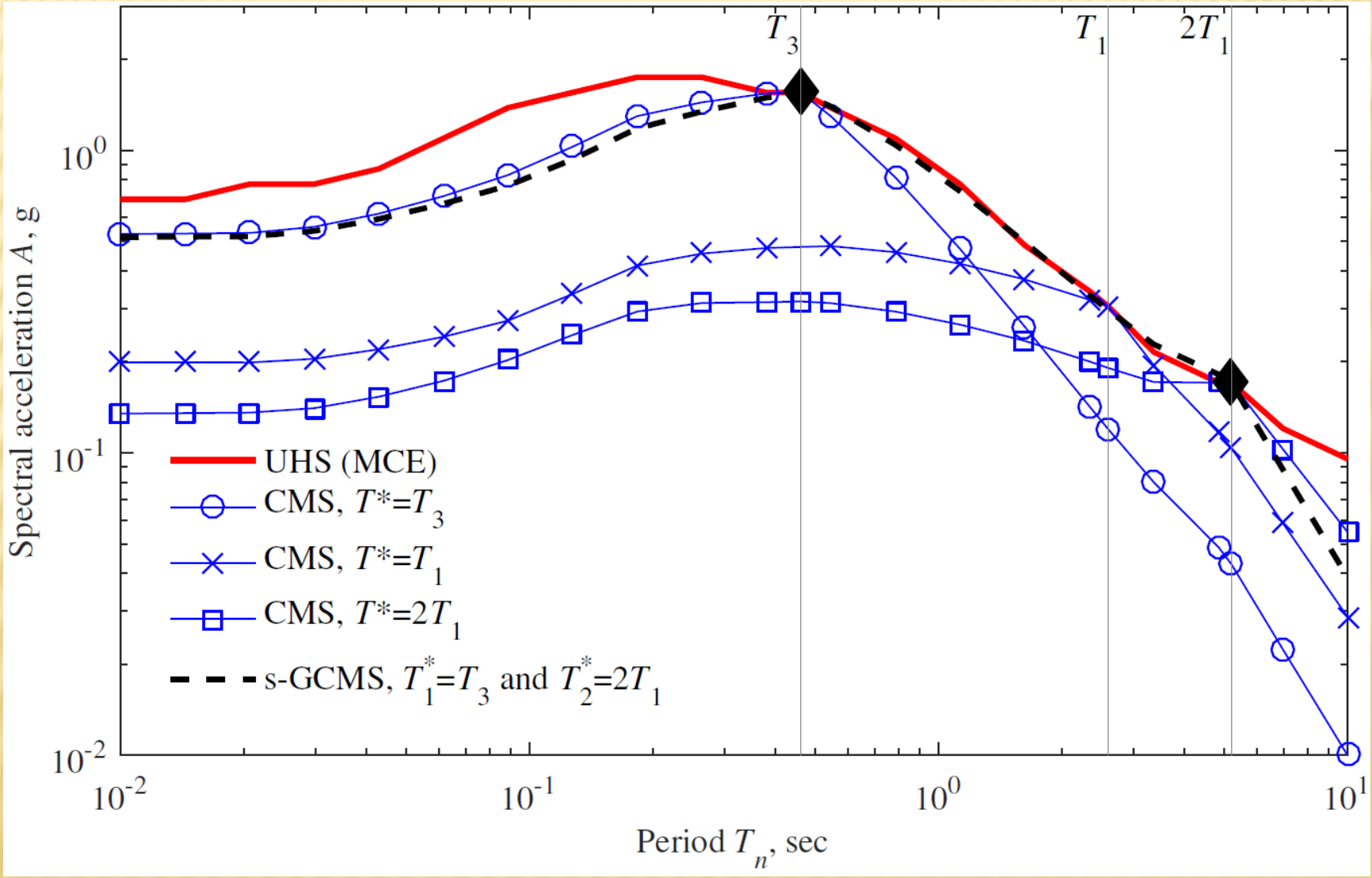
RISK-BASED ASSESSMENT



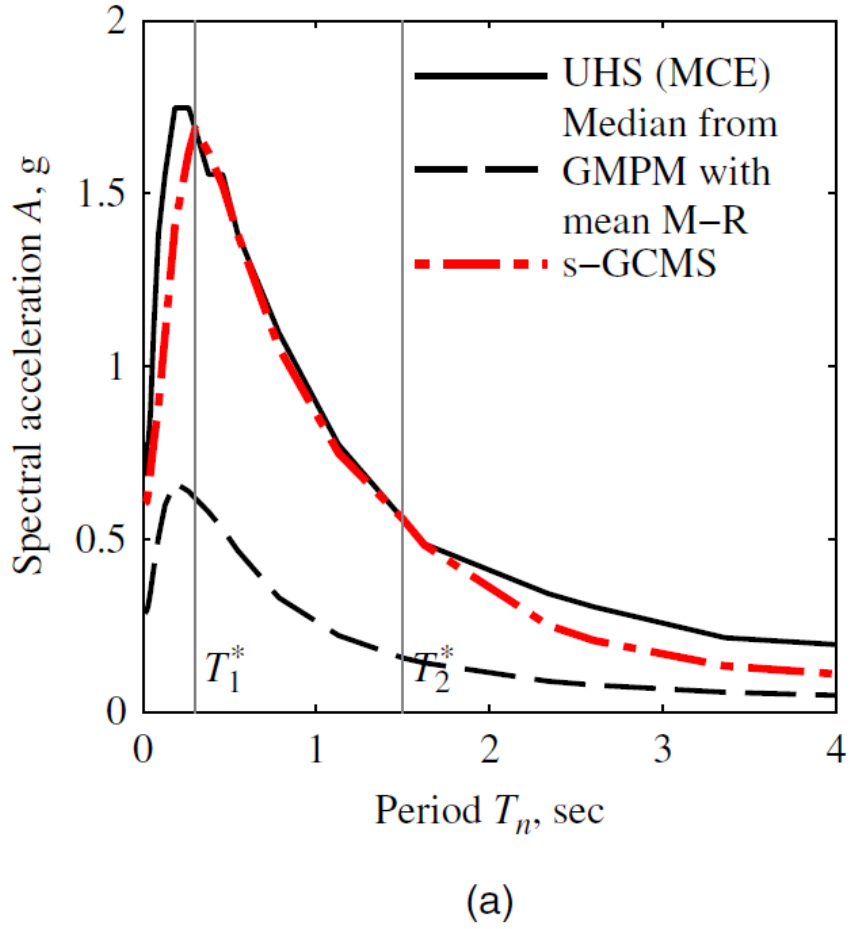
CURRENT OPTIONS FOR TALL BUILDINGS

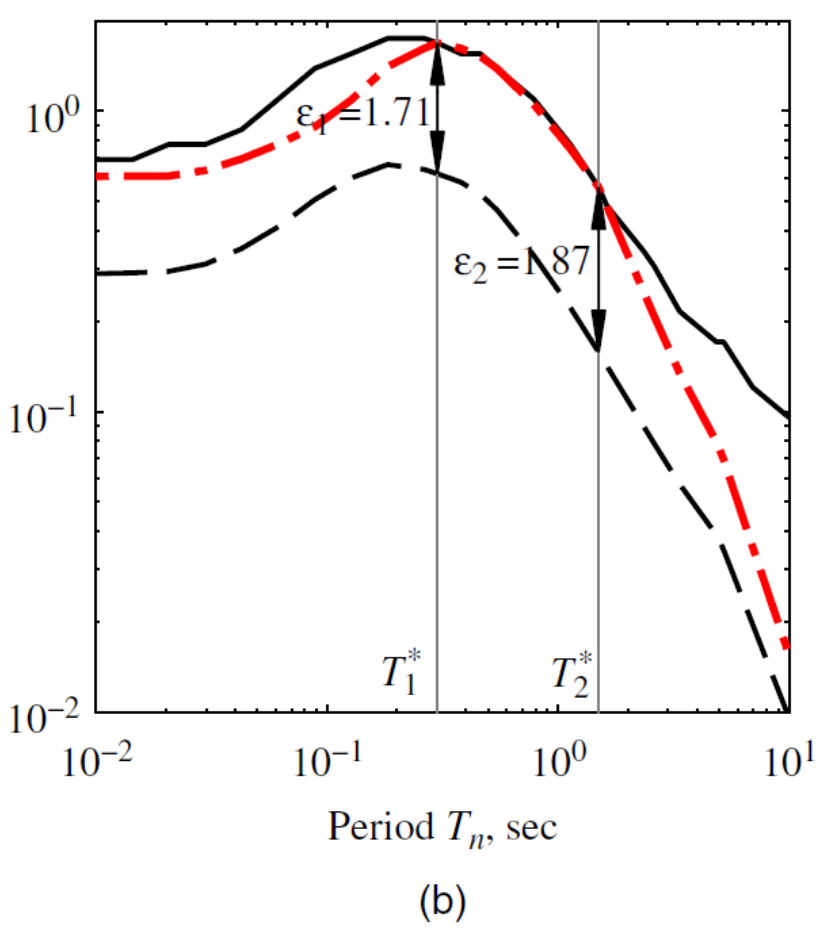
1. Risk-based assessment
2. Multiple CMSs
3. Single UHS
4. Single CMS

A GENERALIZED CMS



THE S-GCMS; EPSILONS





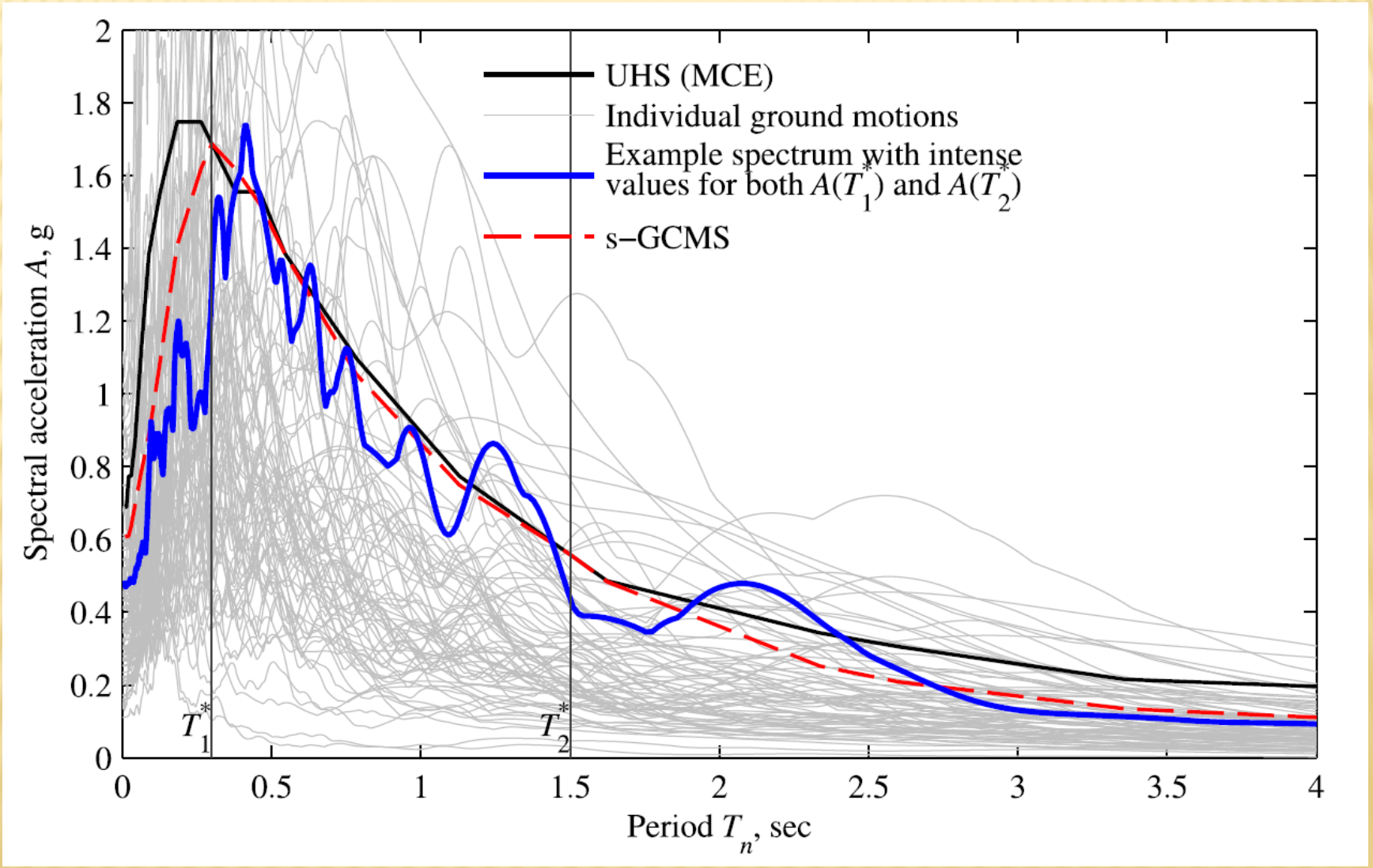
THE S-GCMS; FORMULAE

$$A_{sGCMS}(T_j) = A_{GMPM}(T_j) \times \exp(\sigma_j \varepsilon_j^*)$$

$$\varepsilon_j^* = c_{j1}\varepsilon_1 + c_{j2}\varepsilon_2$$

$$c_{j1} = \frac{\rho_{j1} - \rho_{12}\rho_{j2}}{1 - \rho_{12}^2} \qquad c_{j2} = \frac{\rho_{j2} - \rho_{12}\rho_{j1}}{1 - \rho_{12}^2}$$

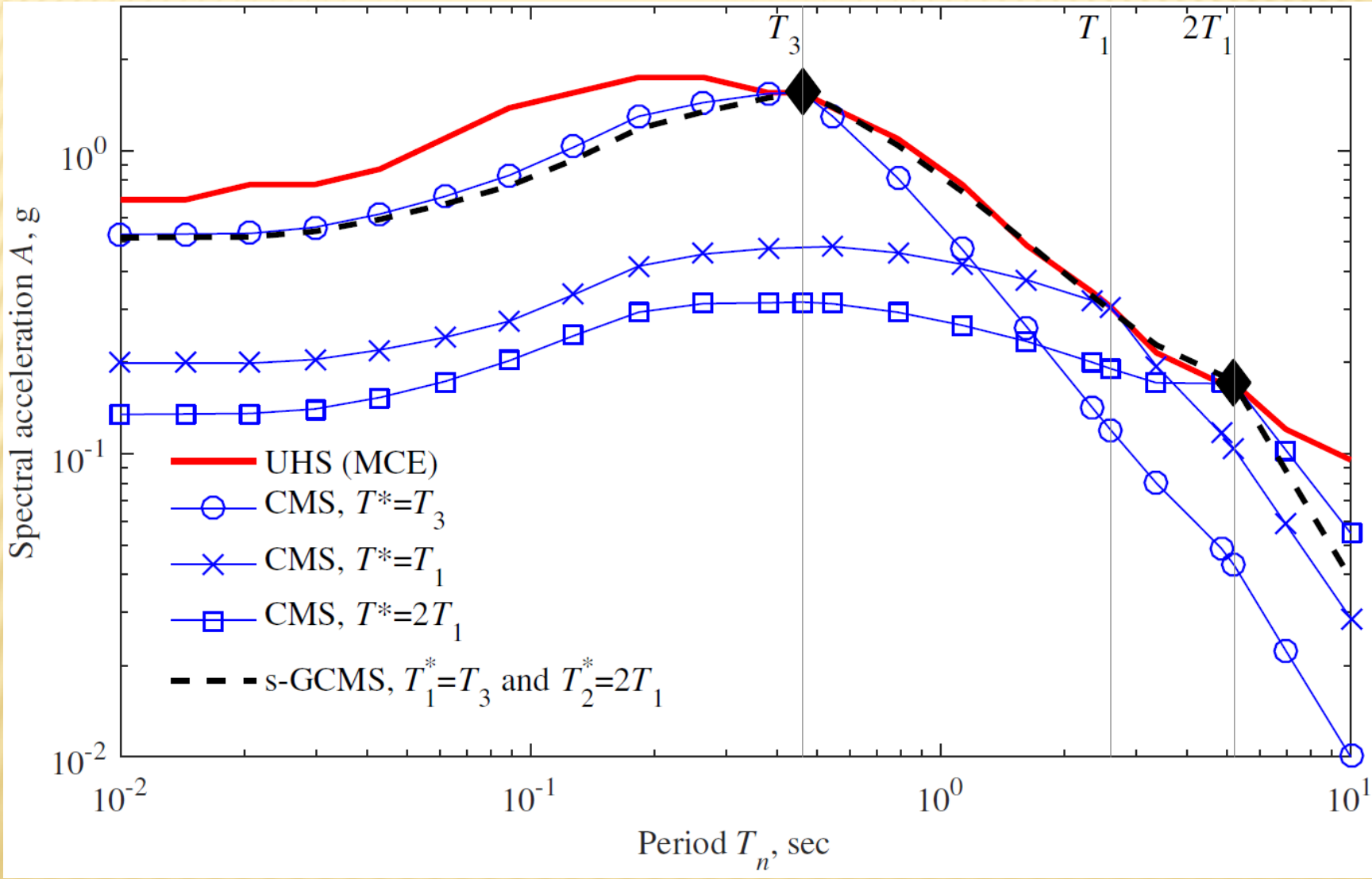
"REALISM" OF S-GCMS?



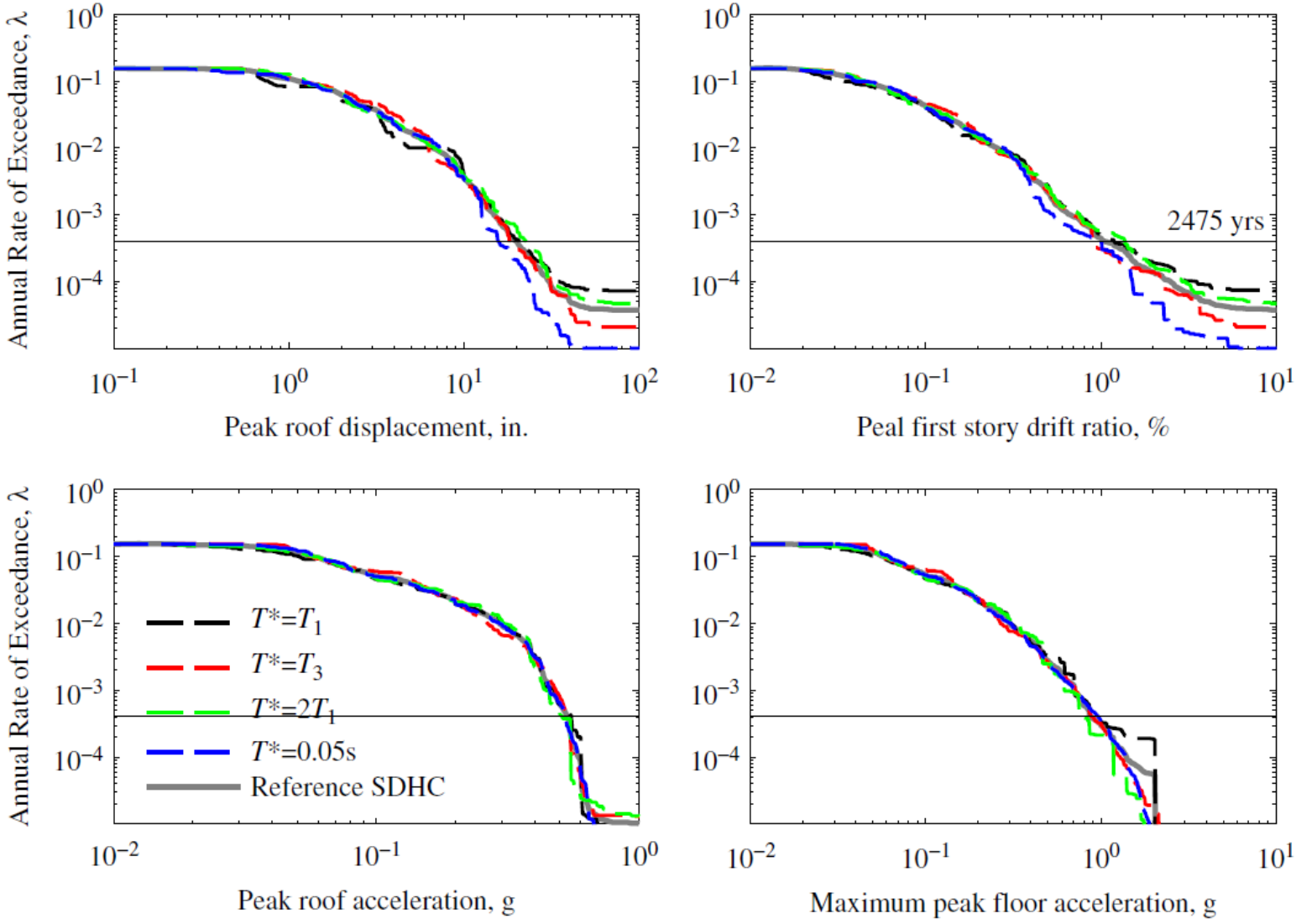
EVALUATION OF S-GCMS: A CASE STUDY

- Los Angeles, CA
- 20-story RC SMRF
- Target return period of 2475 years
- EDPs include drifts and accelerations
- Estimates from IBAs compared against POC

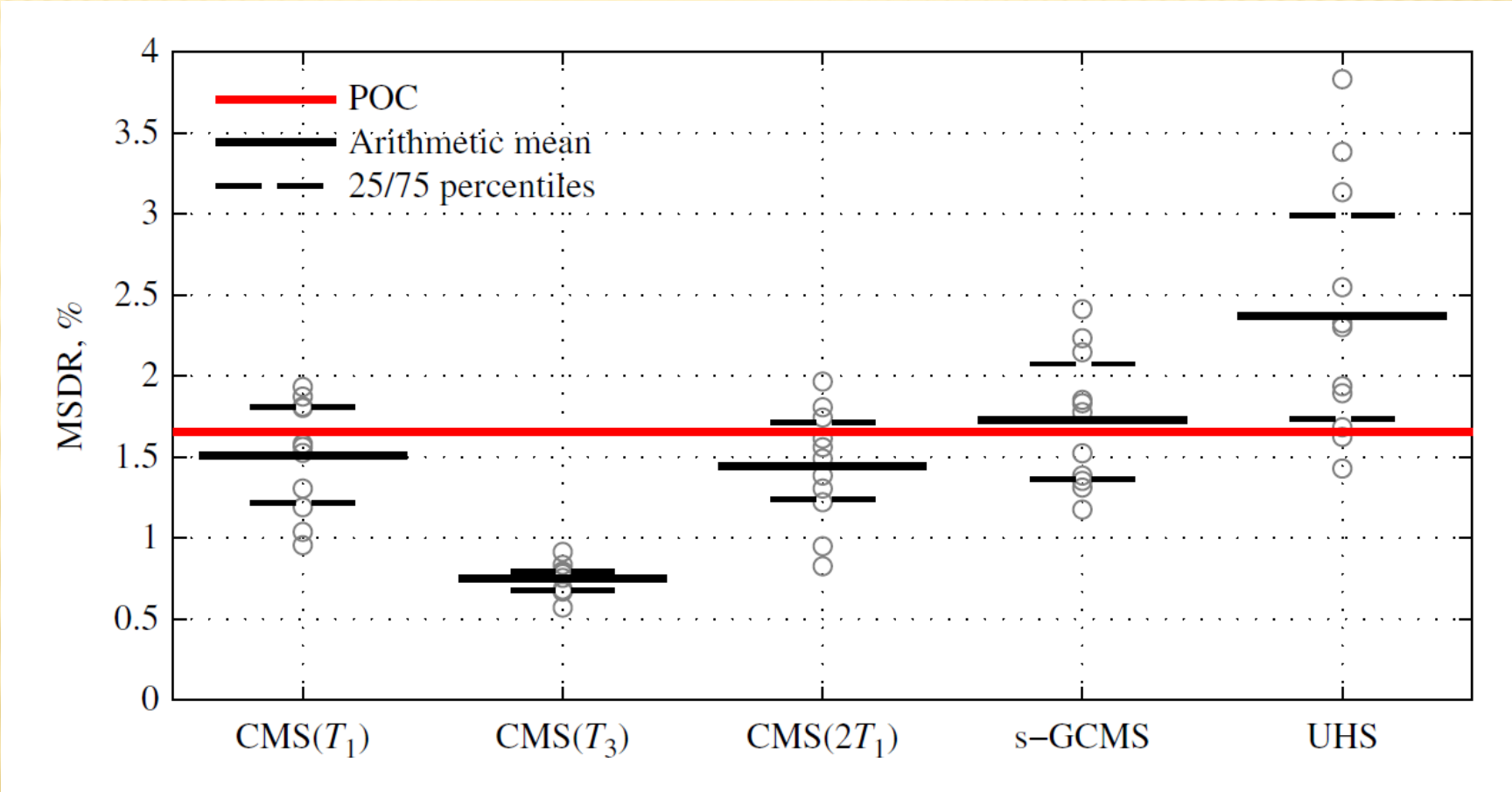
TARGET SPECTRA CONSIDERED



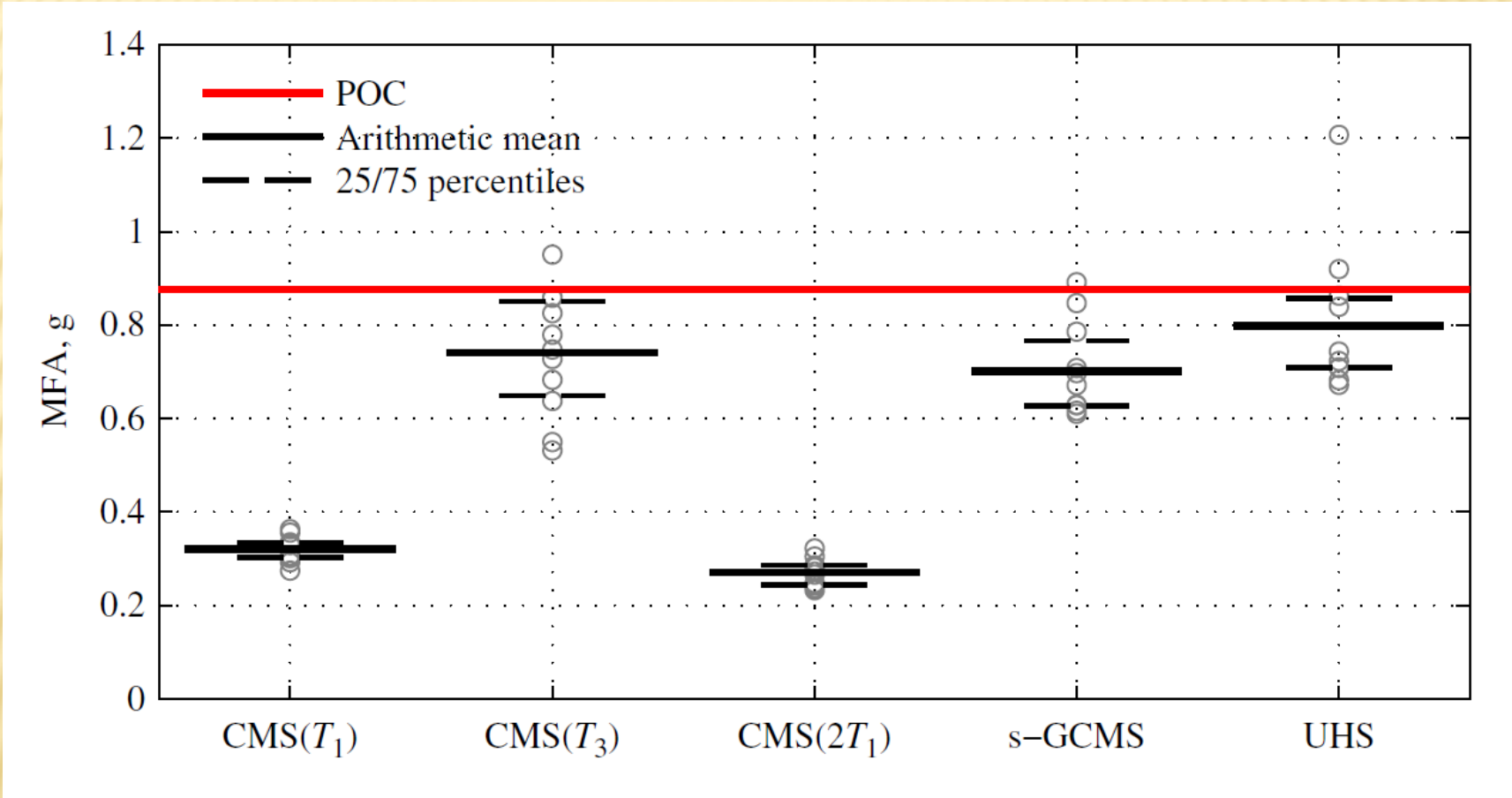
THE POINT-OF-COMPARISON



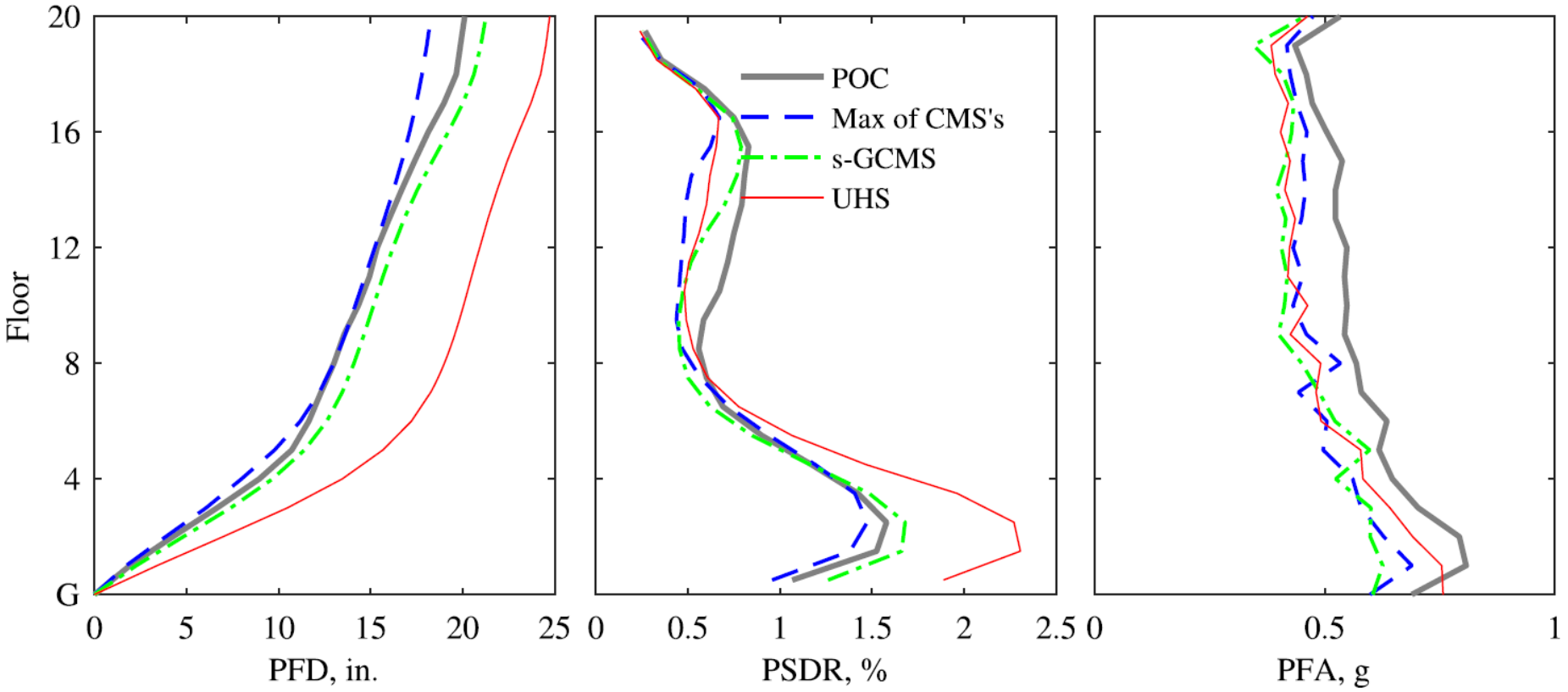
RESULTS


POC
Arithmetic mean
25/75 percentiles
MSDR, %
4
3.5
3
2.5
2
1.5
1
0.5
0
CMS(T_1)
CMS(T_3)
CMS($2T_1$)
s–GCMS
UHS

RESULTS


1.4
1.2
1
0.8
0.6
0.4
0.2
0
MFA, g
POC
Arithmetic mean
25/75 percentiles
CMS(T_1)
CMS(T_3)
CMS($2T_1$)
s–GCMS
UHS

RESULTS


Floor
20
16
12
8
4
G
0
5
10
15
20
25
PFD, in.
0
0.5
1
1.5
2
2.5
PSDR, %
POC
Max of CMS's
s-GCMS
UHS
0
0.5
1
PFA, g

TECHNICAL CONCLUSIONS

1. s-GCMS offers flexibility in developing a target spectrum that is somewhere between a CMS and a UHS
2. Provides estimates of demands nearly as accurate as multiple CMSs but with less effort

FINAL REMARKS ON PROF. CHOPRA

1. The importance of balance
2. The ideal mentor
3. An inspirational role model

End