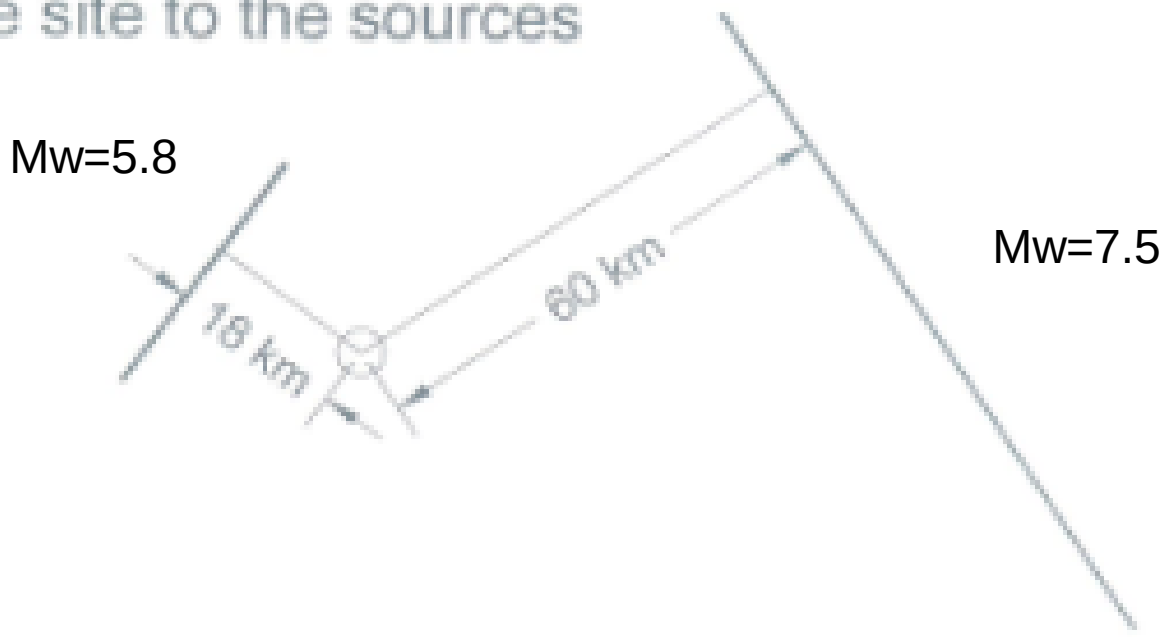
SEISMIC RECORDS SELECTION

Deterministic Seismic Hazard Analysis

STEP 2: Select ground motion prediction relation(s) and measure the distances from the site to the sources

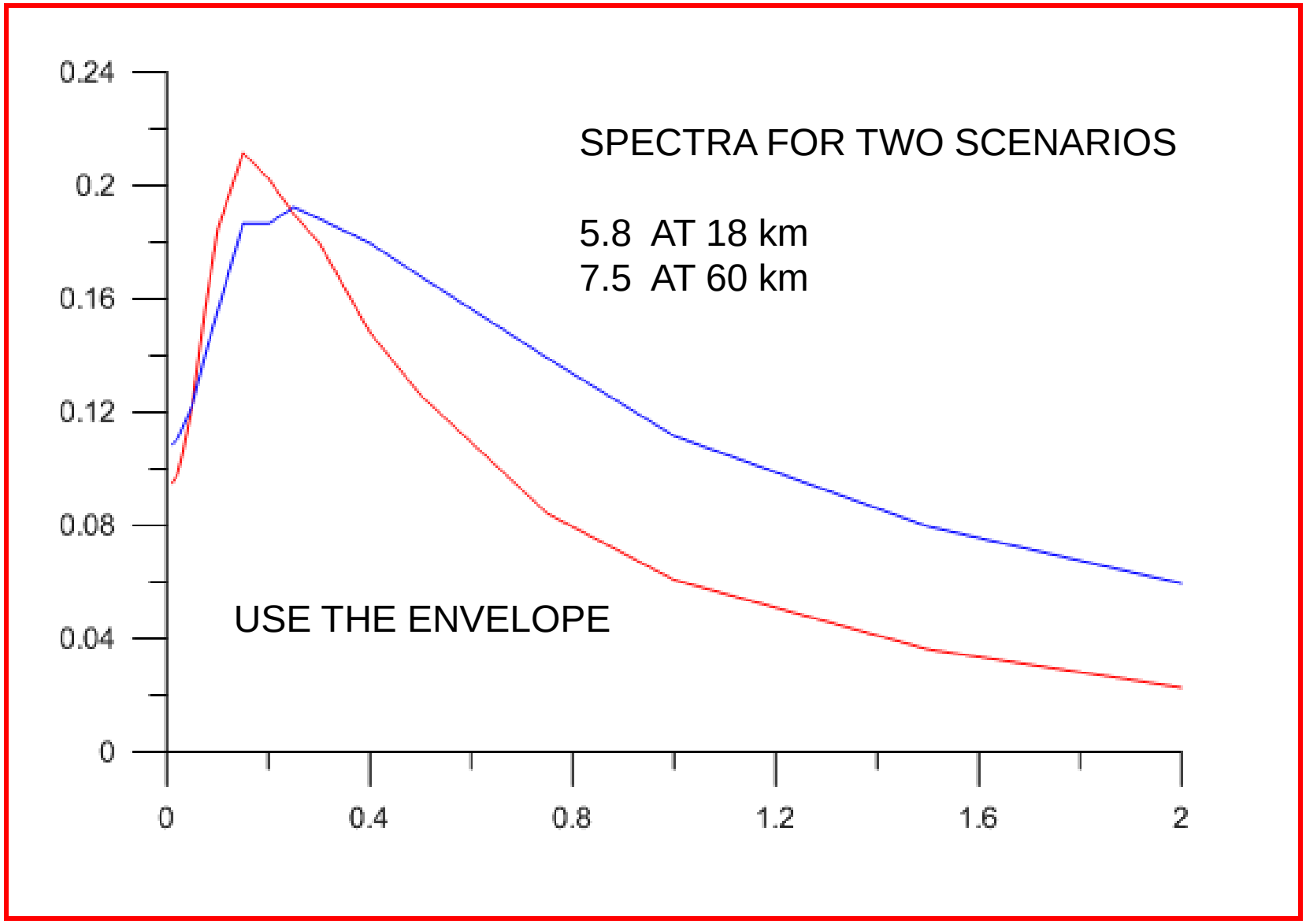


Boore-Atkinson model

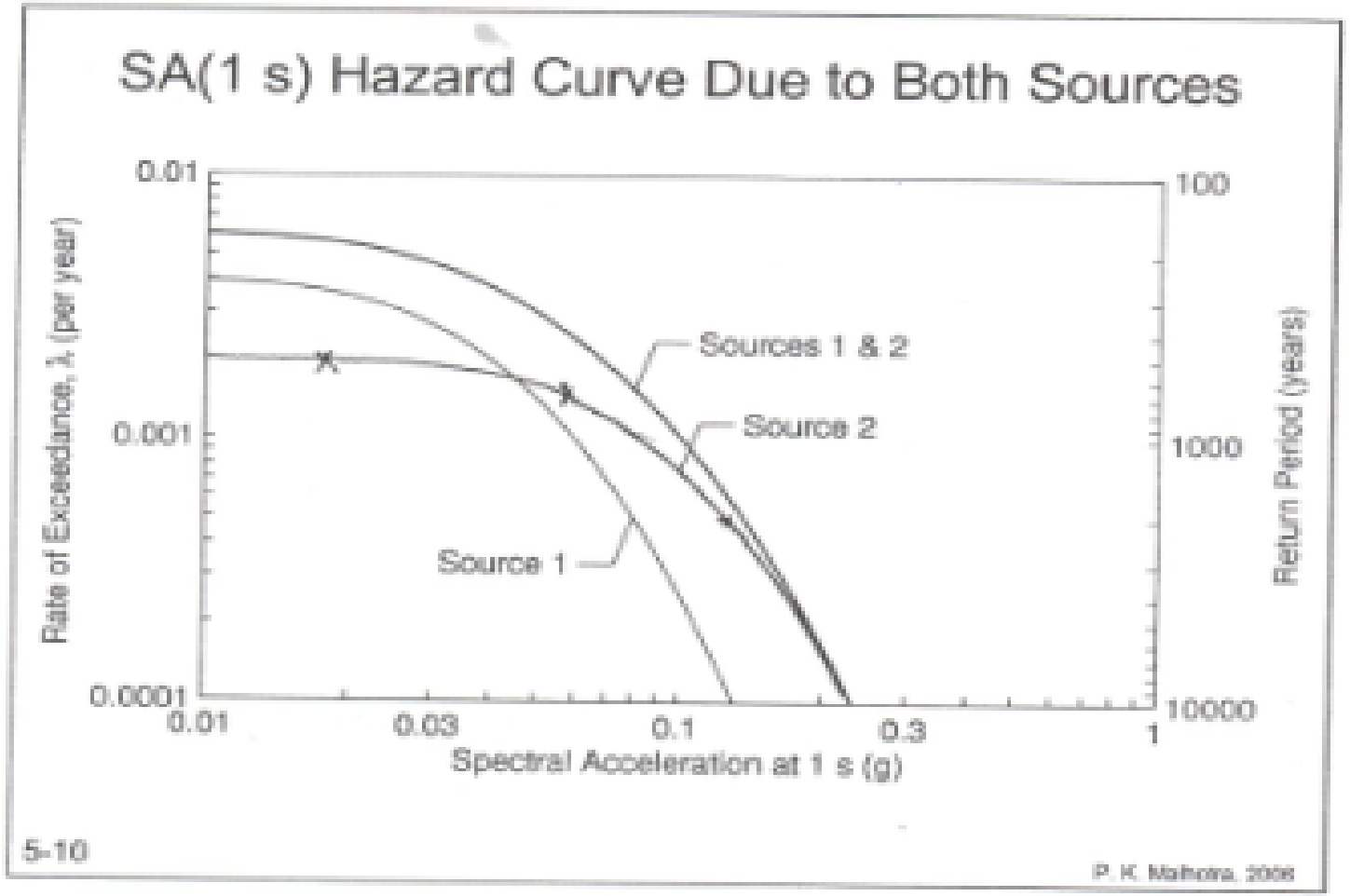
$$\ln Y = F_M(\mathbf{M}) + F_D(R_{JB}, \mathbf{M}) + F_S(V_{S30}, R_{JB}, \mathbf{M}) + \varepsilon\sigma_T,$$

IF ε IS TAKE INTO ACCOUNT Y IS A RANDOM VARIABLE

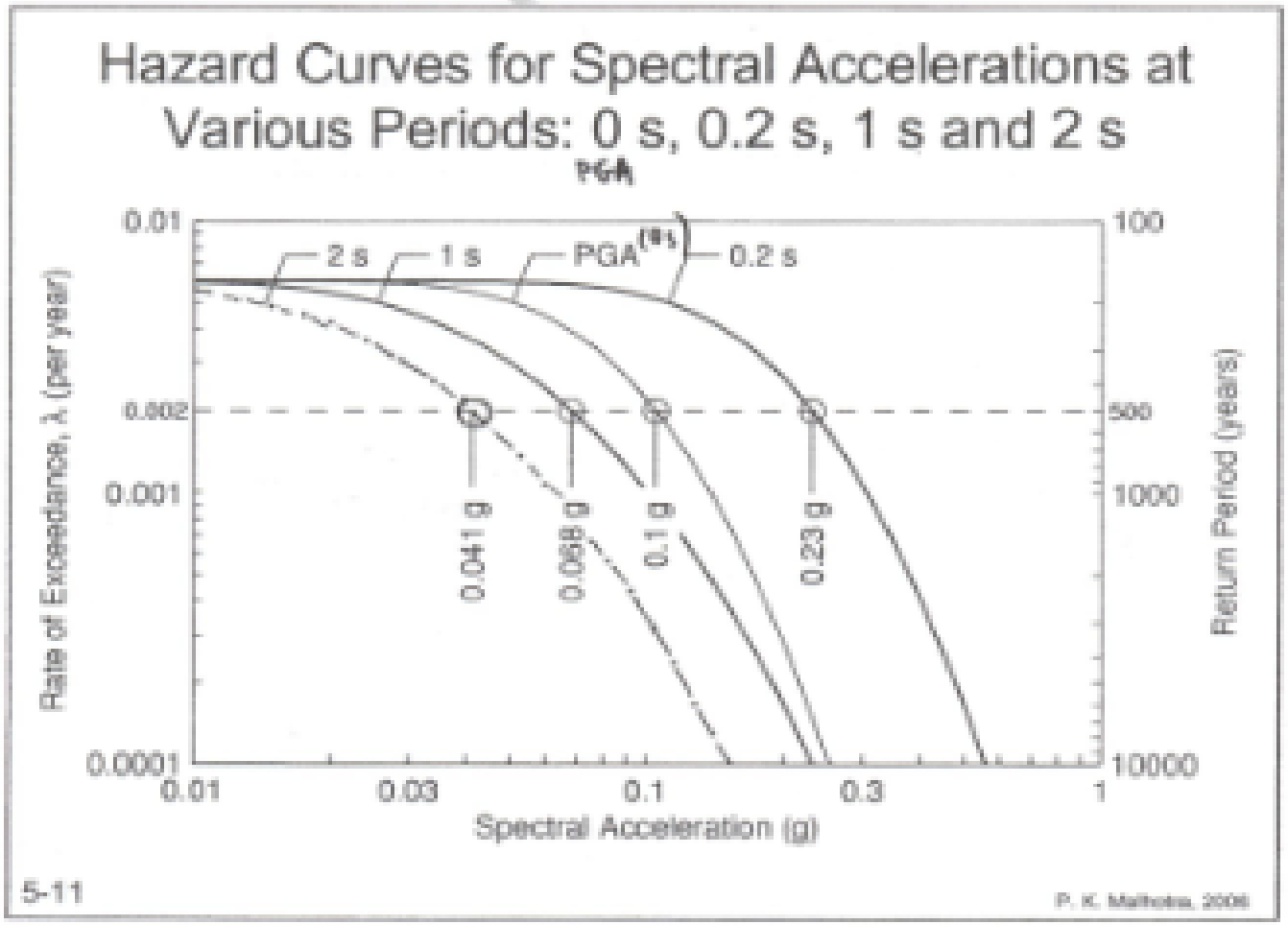
SCENARIOS 5.8 AT 18 KM , 7.5 AT 60 KM


SPECTRA FOR TWO SCENARIOS
5.8 AT 18 km
7.5 AT 60 km
USE THE ENVELOPE
0.24
0.2
0.16
0.12
0.08
0.04
0
0
0.4
0.8
1.2
1.6
2

PROBABILISTIC HAZARD ANALYSIS



UNIFORM HAZARD SPECTRUM



The Gutenberg-Richter statistics

Fortunately, there are many more small quakes than large ones. The figure below shows the frequency of earthquakes as a function of their magnitude for a world-wide catalog during the year of 1995.

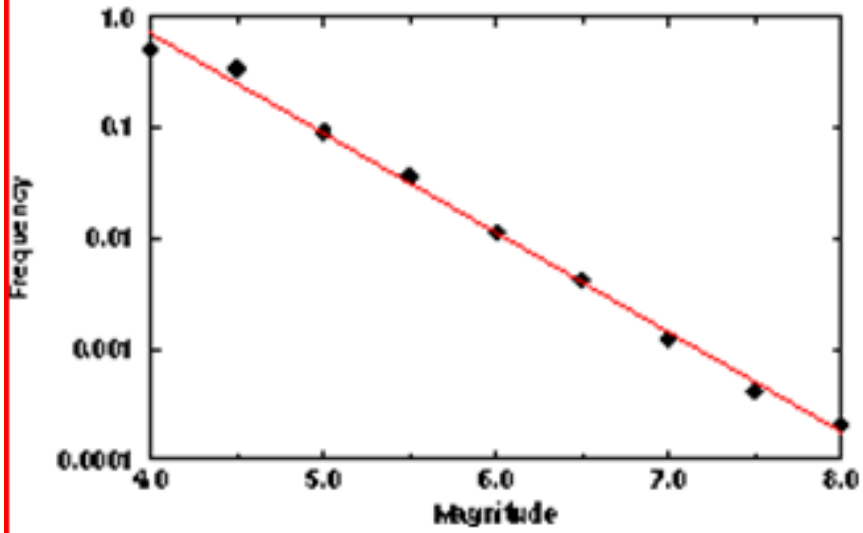


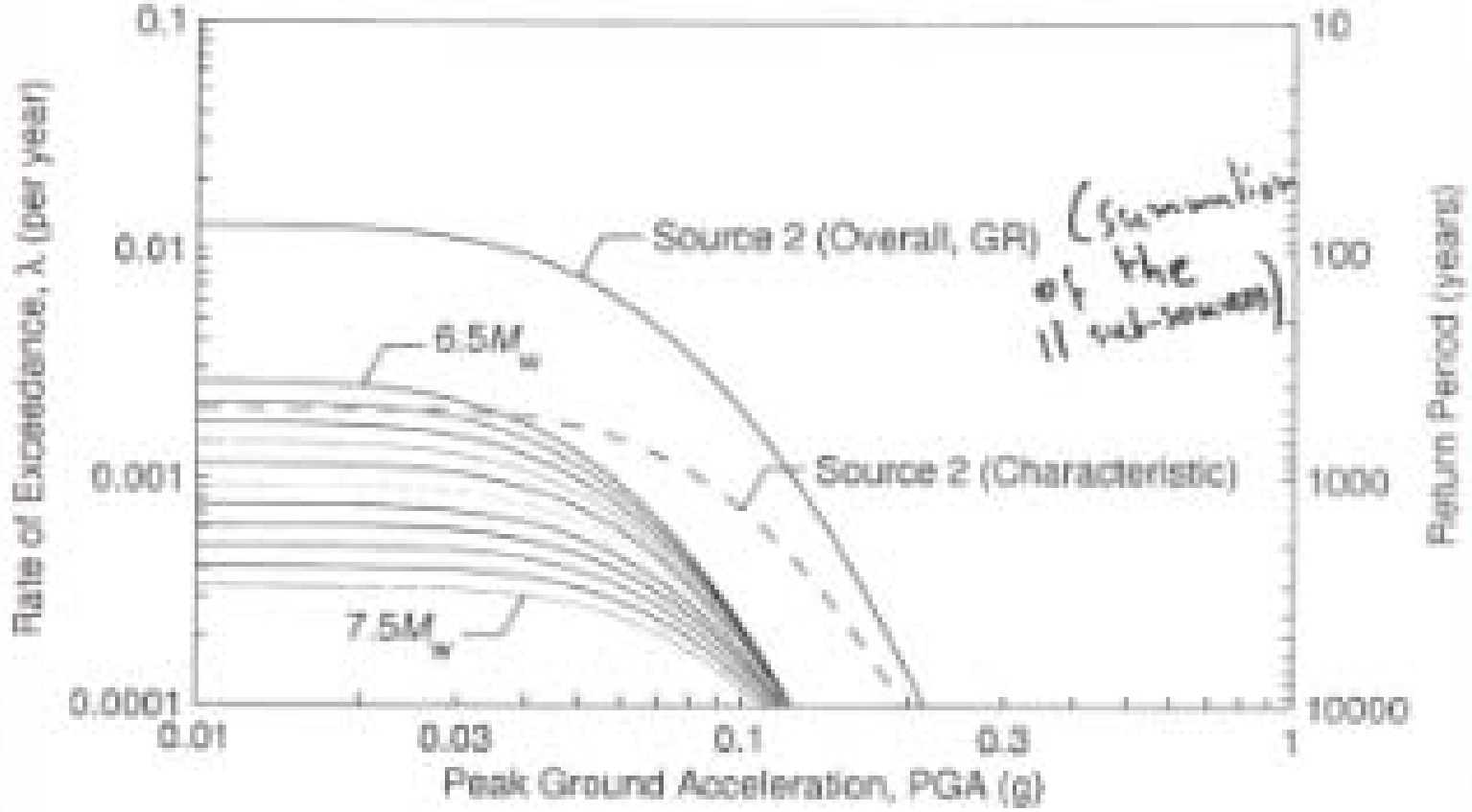
Figure from simscience.org

This distribution may be fitted with:

$$\log N(>M) = a - bM \ ,$$

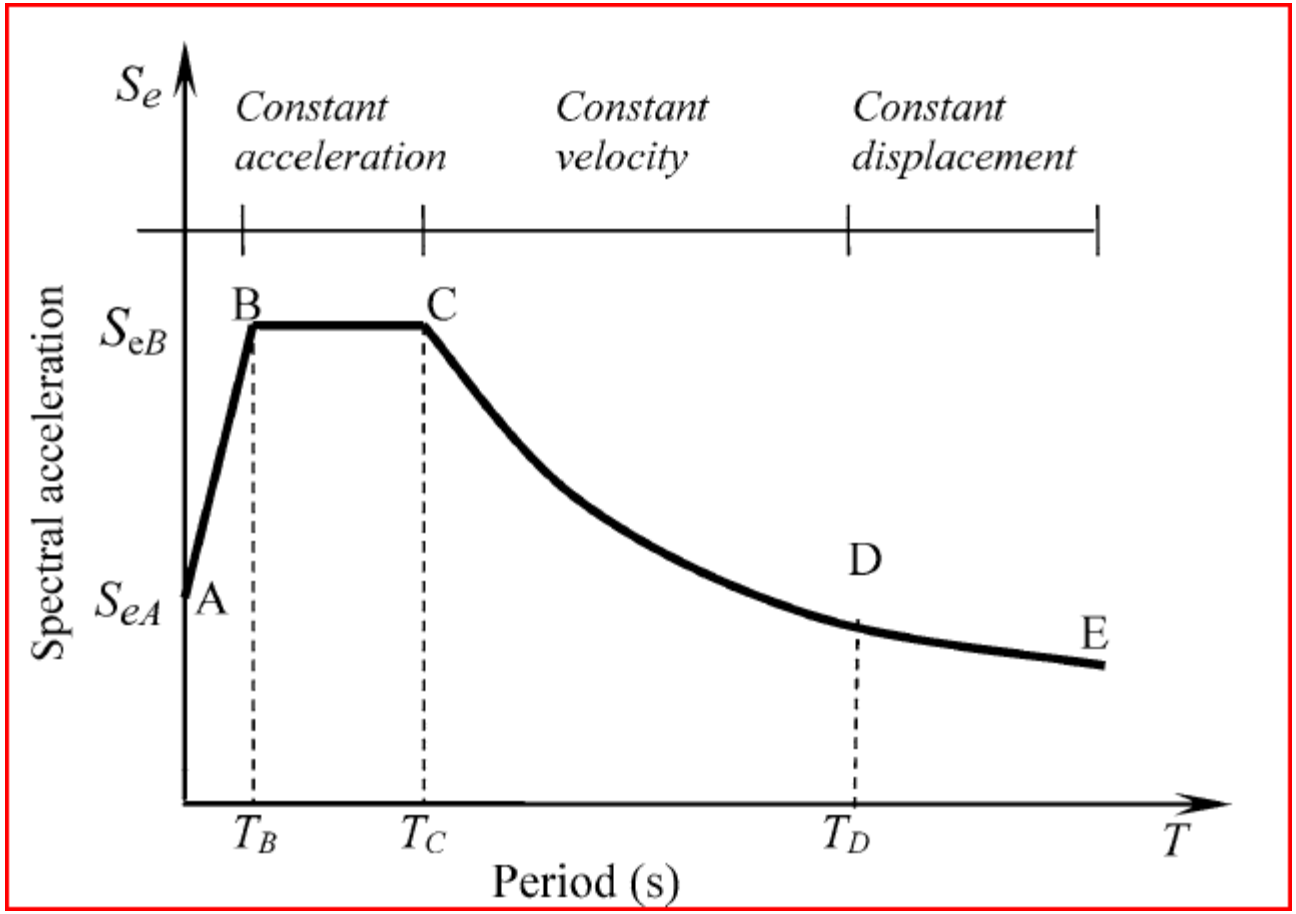
where n is the number of earthquakes whose magnitude is greater than M. This result is known as the Gutenberg-Richter relation.

Source 2 Hazard Curve for PGA

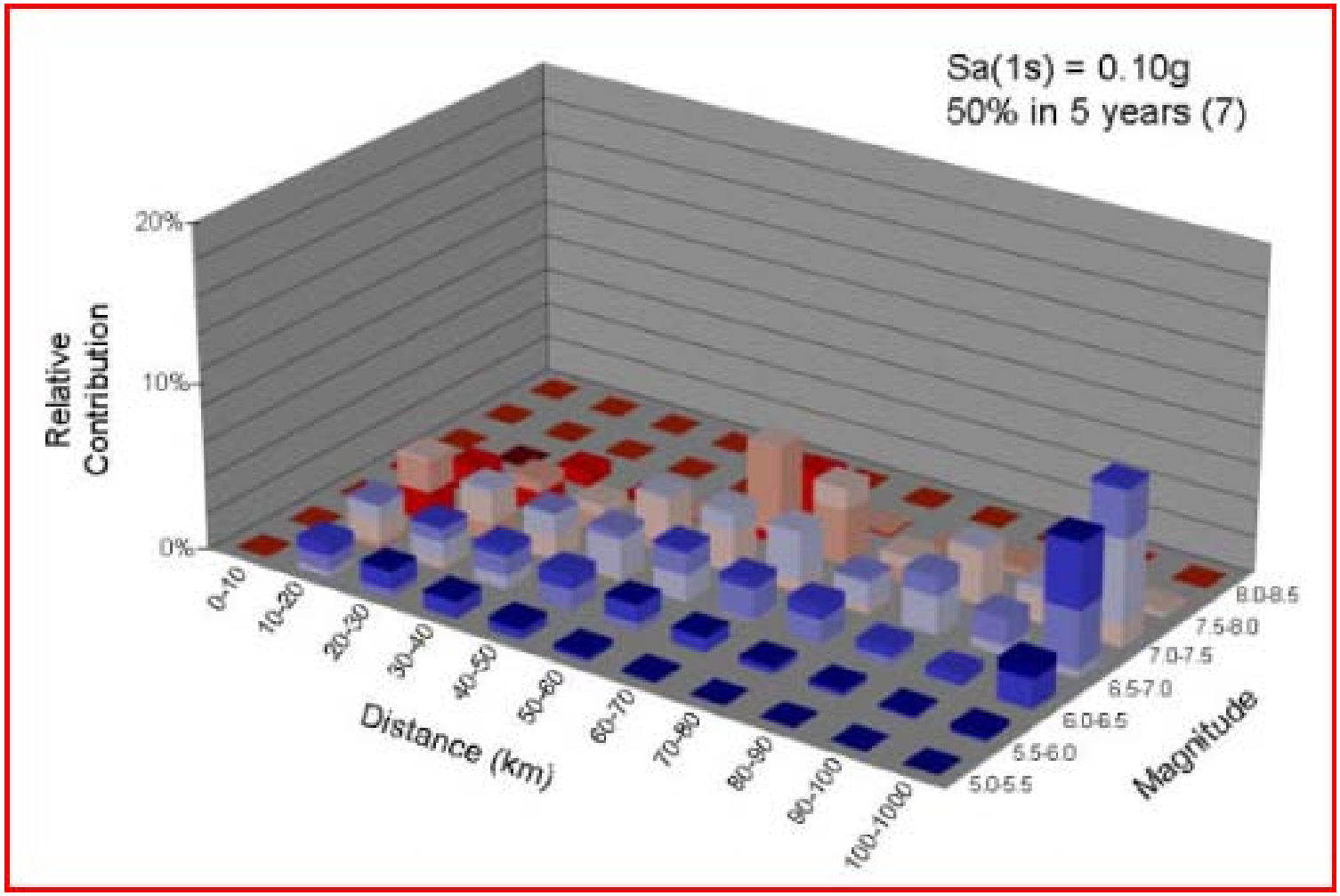


5-14

EC8 SPECTRUM



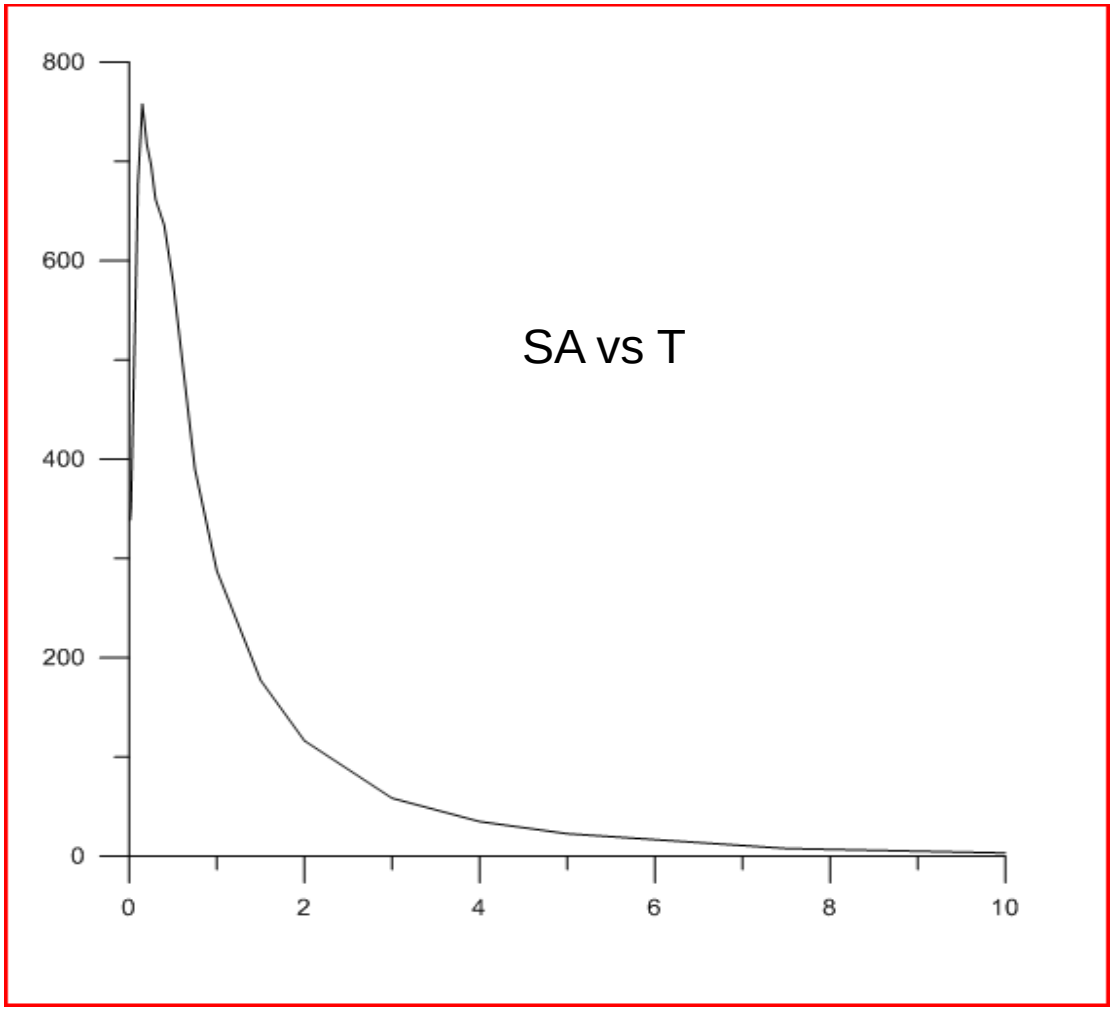
DEAGGREGATION



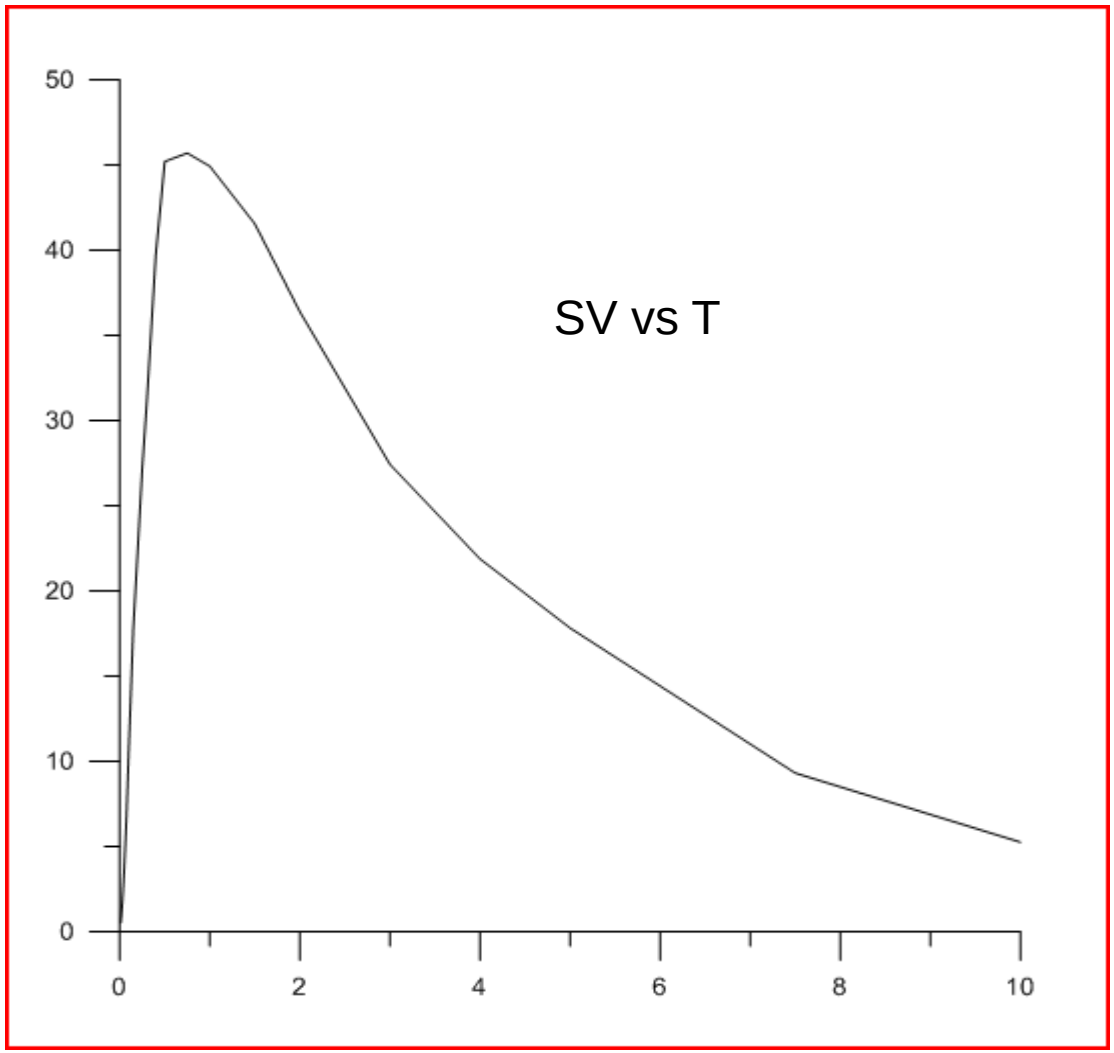
USE OF GROUND MOTIONS

- ARTIFICIAL WAVEFORMS
- SIMULATED ACCELEROGRAMS
- NATURAL RECORDS

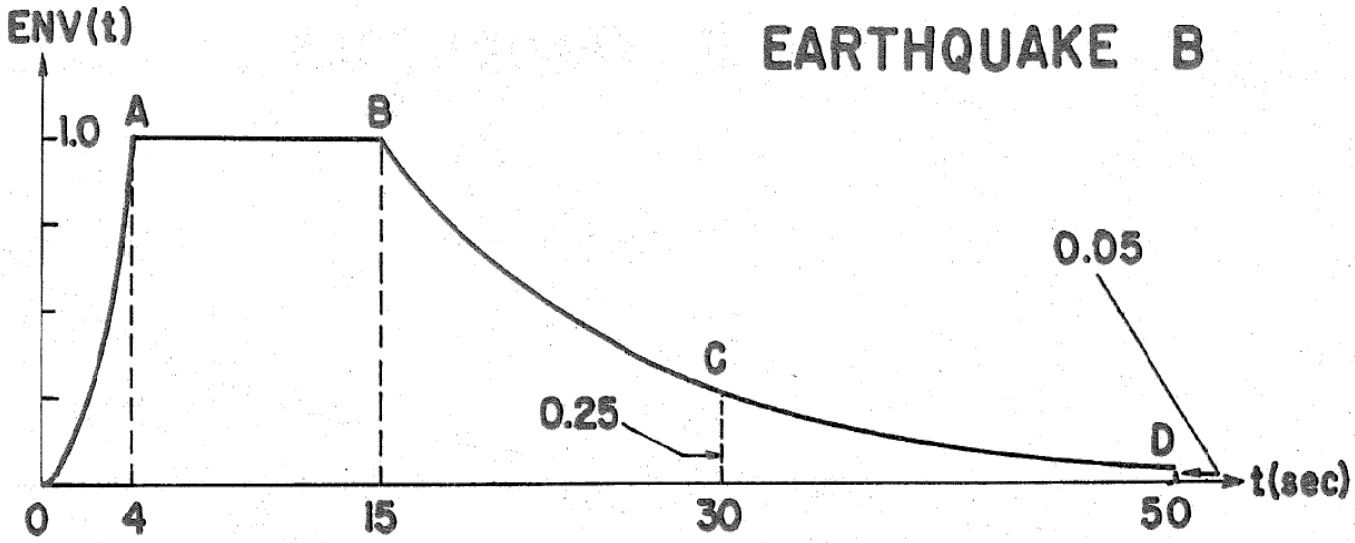
ARTIFICIAL WAVEFORMS
Target acceleration spectrum



ARTIFICIAL WAVEFORMS
Target velocity spectrum



TIME HISTORY ENVELOPE



OA : $ENV(t) = t^2/16$

AB : 1.0

BC : $\exp[-0.0992(t-15)]$

CD : $0.05 + 0.005(50 - t)^2$

Figure 2

Envelope function for earthquake type B

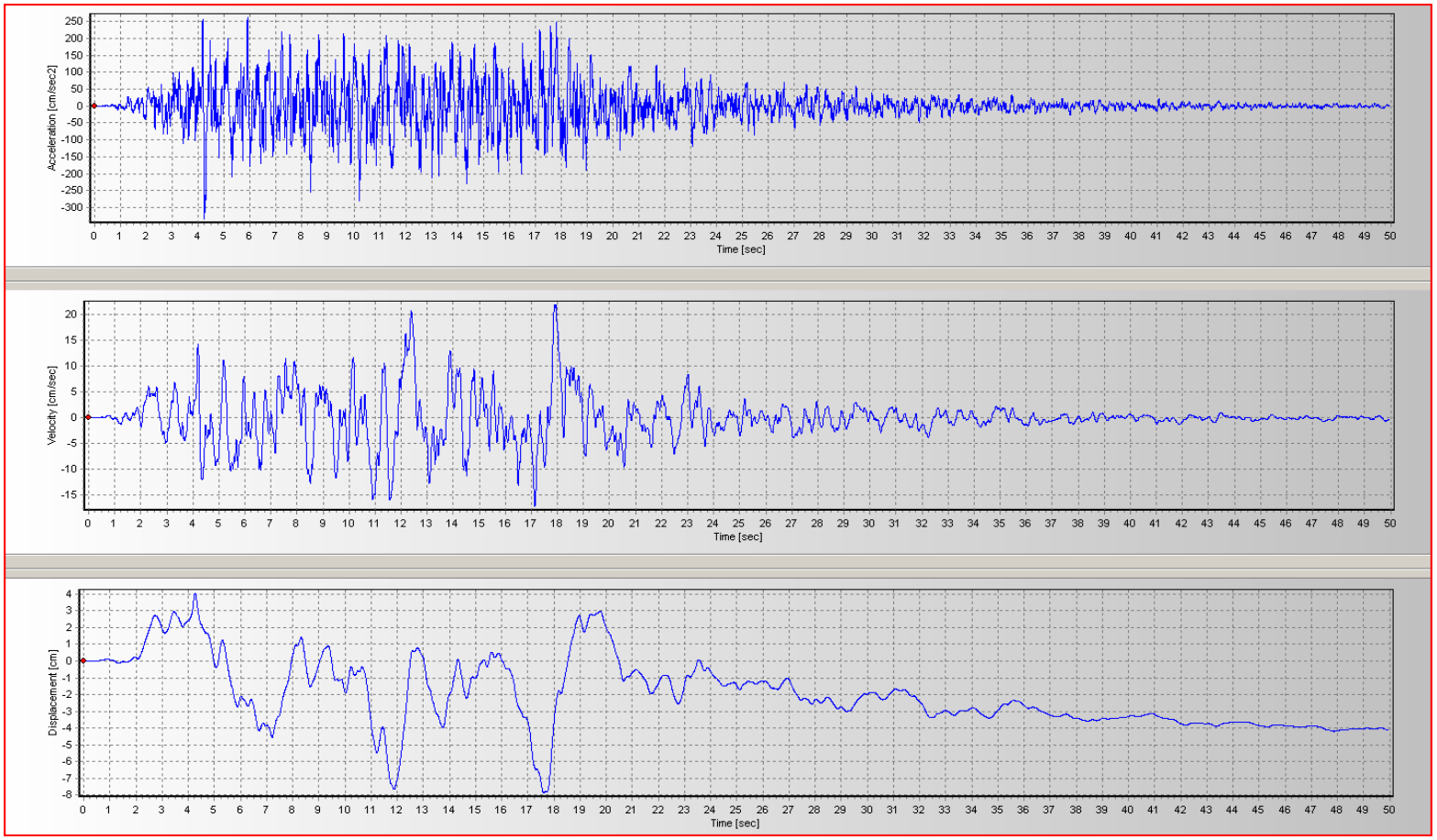
ΑΡΧΕΙΟ DATA

Δεν χρειάζεται αλλαγή στις δύο πρώτες γραμμές.

3η	I5, 6F10.4, I5	ICASE, TRISE, TLVL, DUR, A0, ALFA0, BETA0, IPOW
4η	3F10.4, 5I5	DELT, AGMX, FIX, NDAMP, NCYCLE, NPA, NKK, NRES
5η	8F10.0	DAMPING
6η	2F10.4	T, SV

ΑΡΧΕΙΟ ΑΠΟΤΕΛΕΣΜΑΤΩΝ ACCRES

ARTIFICIAL TIME HISTORY



SIMULATION RECORDS

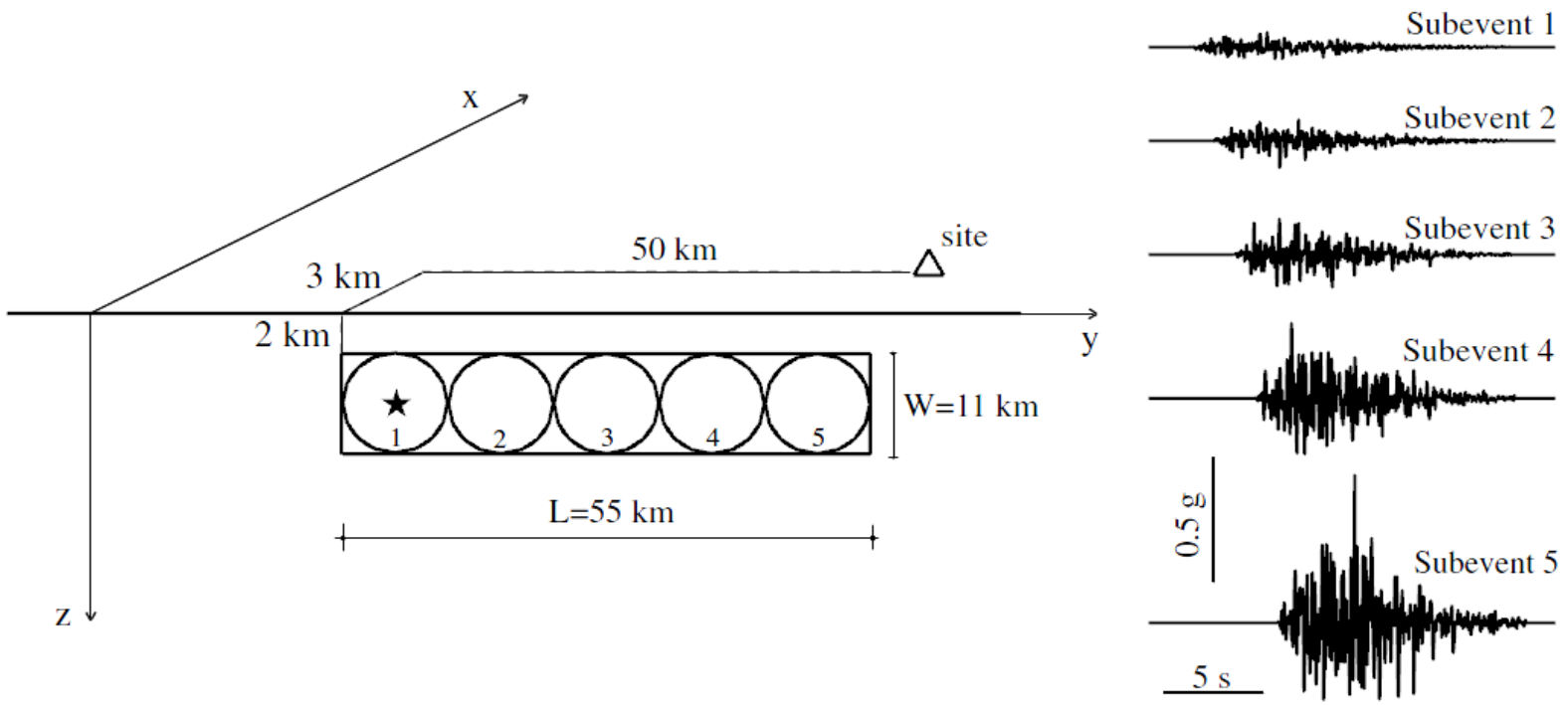
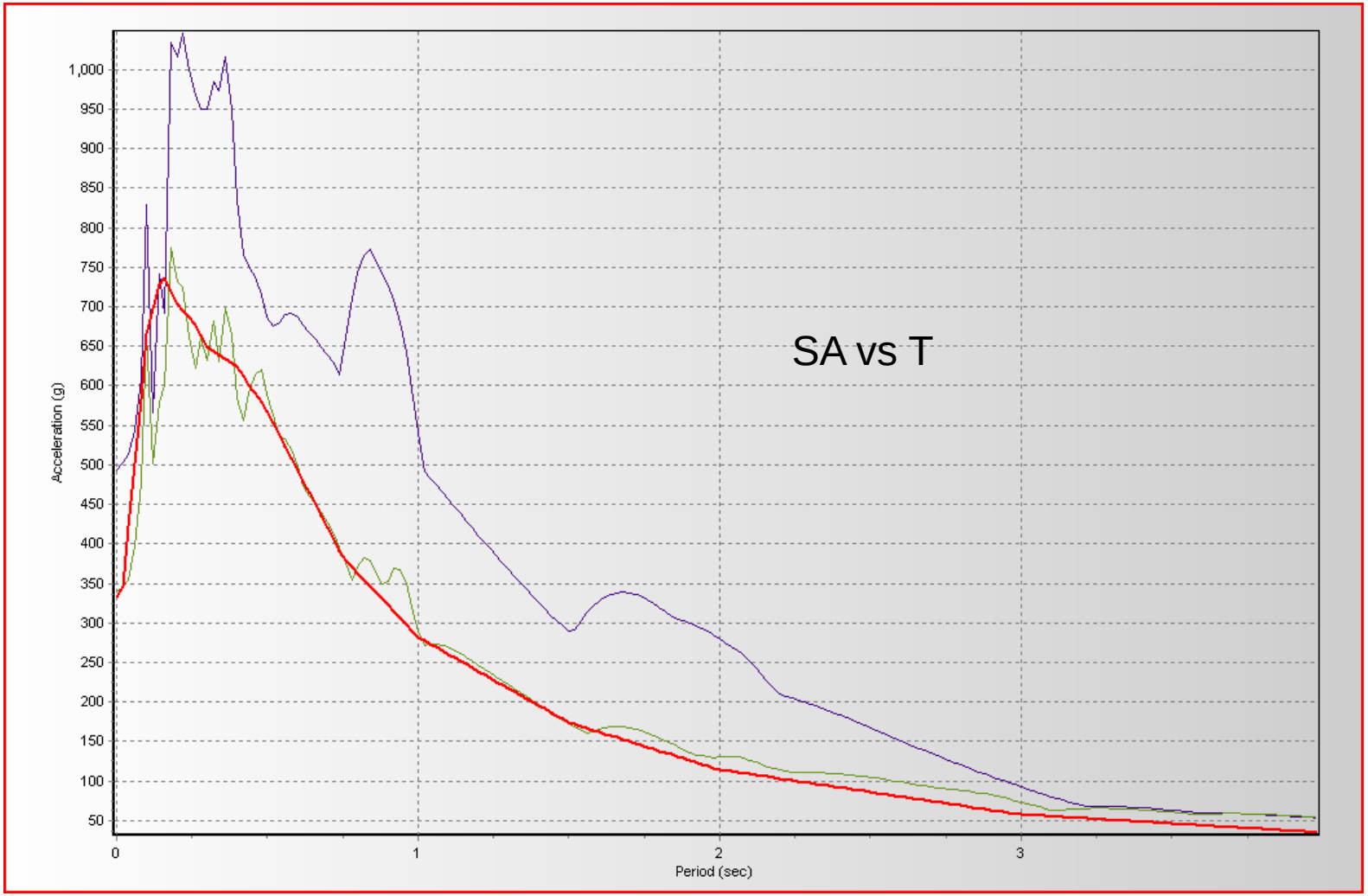
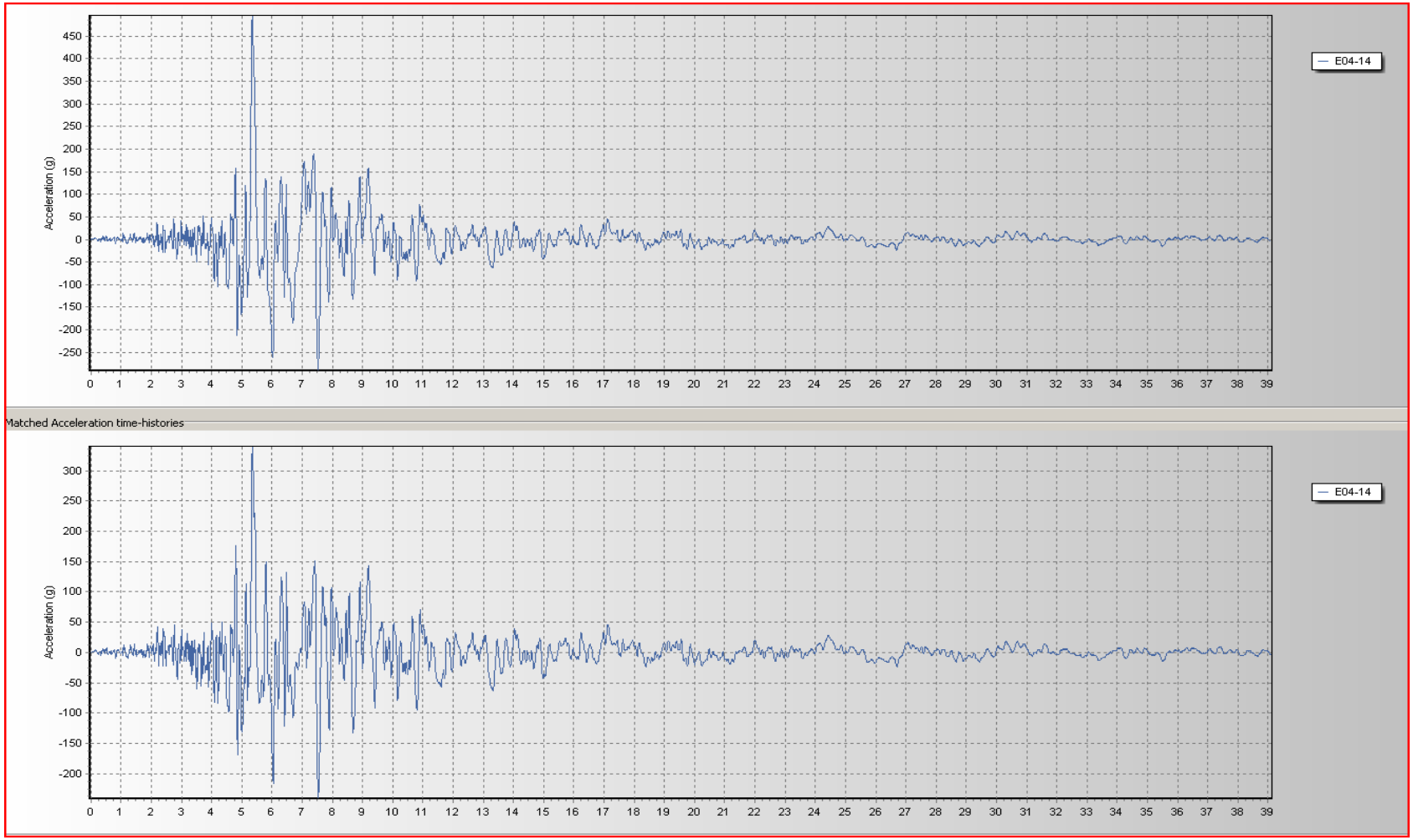


Figure 11. Stochastic simulation of high-frequency ground motion applied to the specific barrier model for a generic M_w 6.8 Californian earthquake with the fault–station geometry illustrated above.

SEMI-ARTIFICIAL
BASED ON NATURAL RECORDS



ORIGINAL AND SEMI-ARTIFIIAL RECORDS



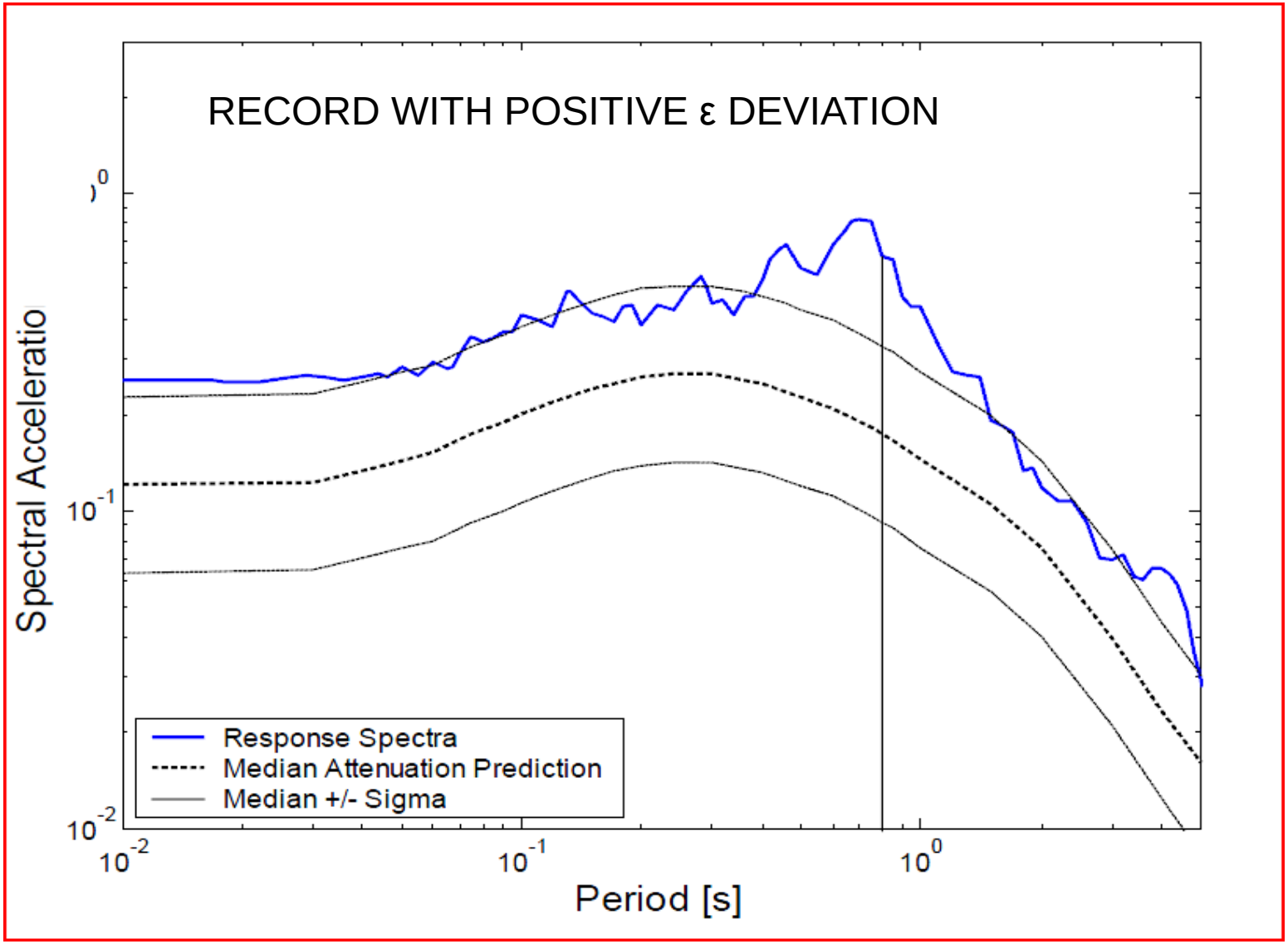
EC8 SCALING PROVISIONS

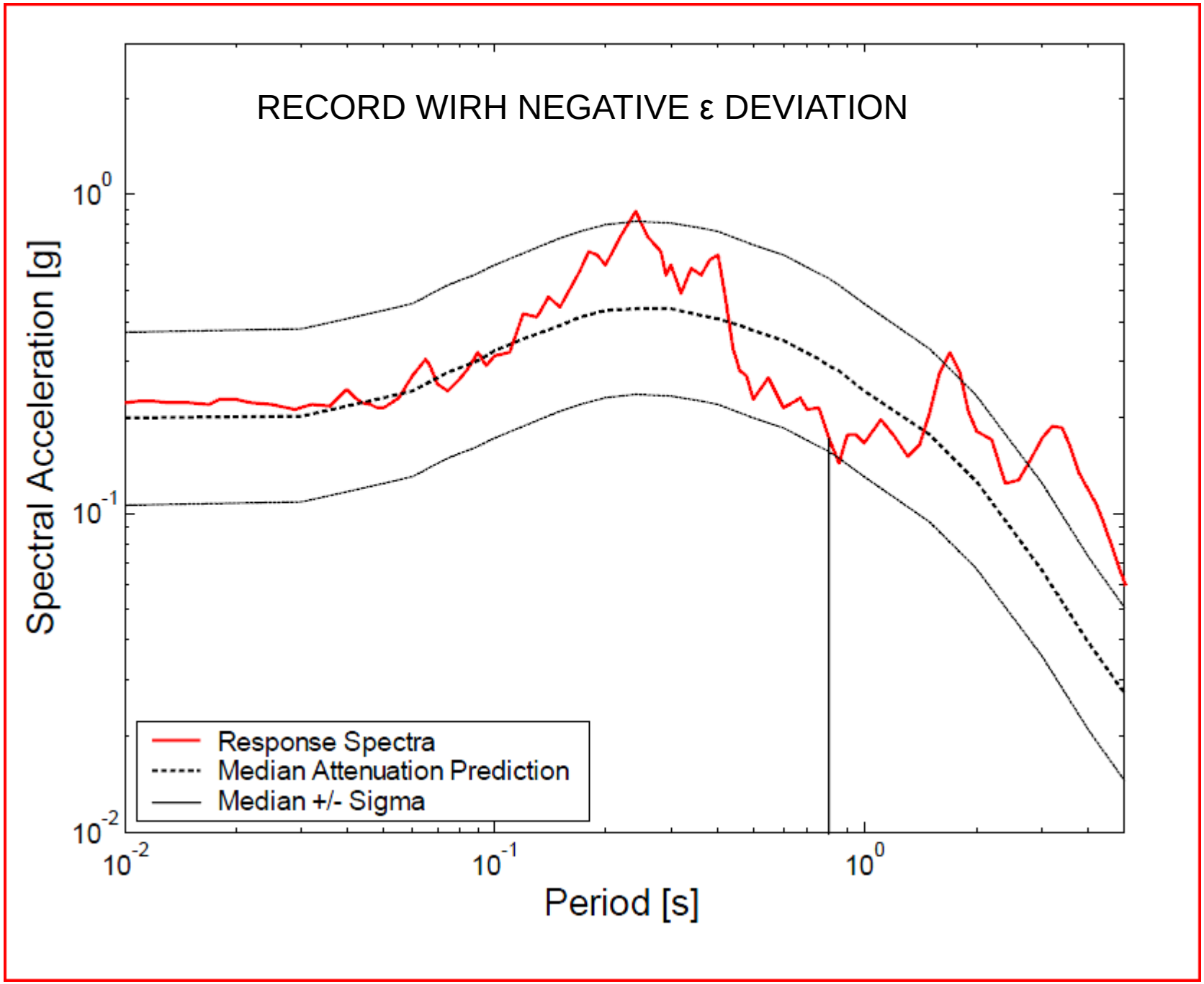
a. *a minimum of 3 accelerograms should be used;*

b. *the mean of the zero period spectral response acceleration values (calculated from the individual time histories) should not be smaller than the value of* $a_g S$ *for the site in question;*[6]

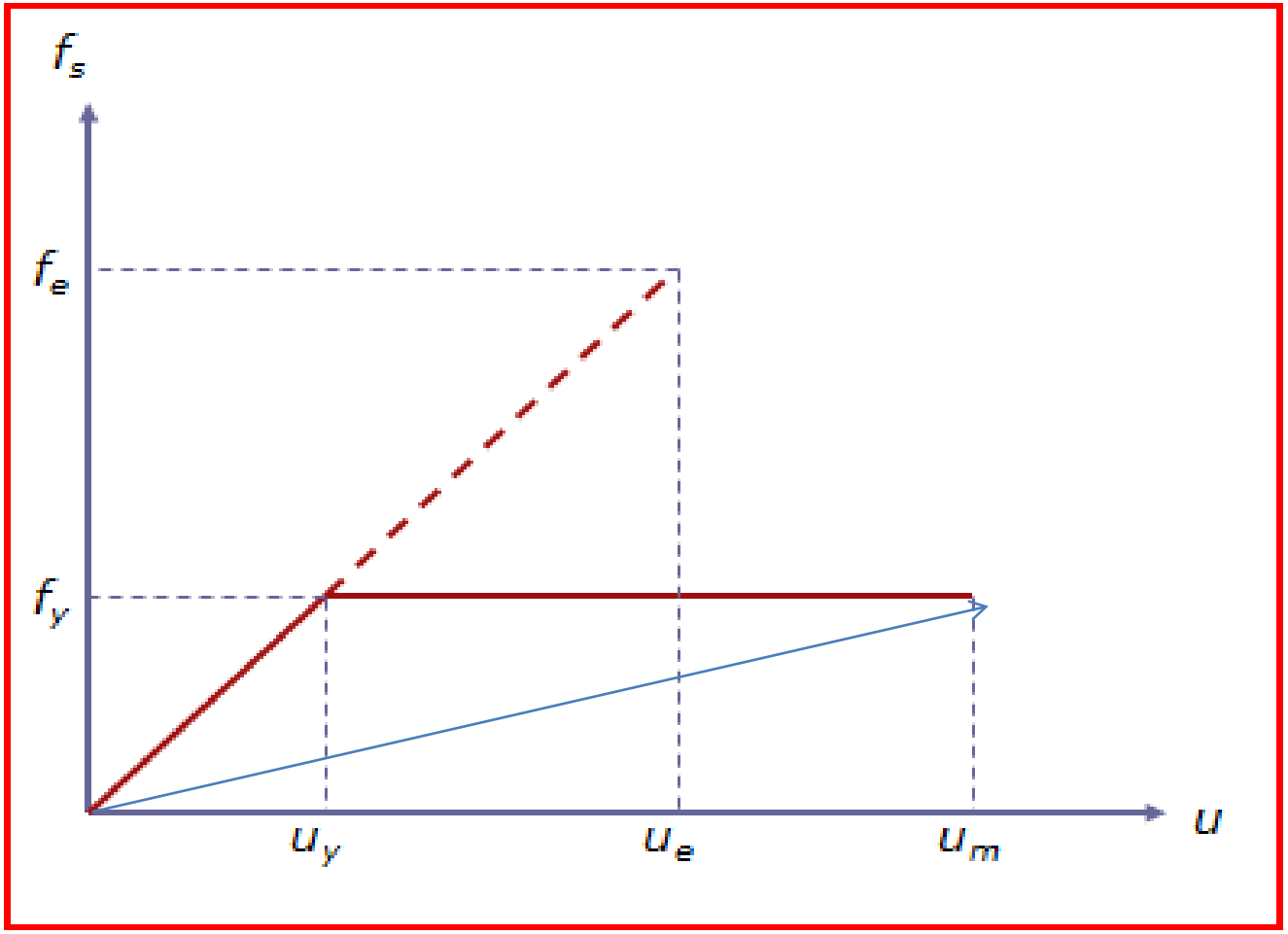
c. *in the range of periods between* $0{,}2T_1$ *and* $2T_1$*, where* T_1 *is the fundamental period of the structure in the direction where the accelerogram will be applied; no value of the mean 5% damping elastic spectrum, calculated from all time histories, should be less than 90% of the corresponding value of the 5% damping elastic response spectrum.*[7]

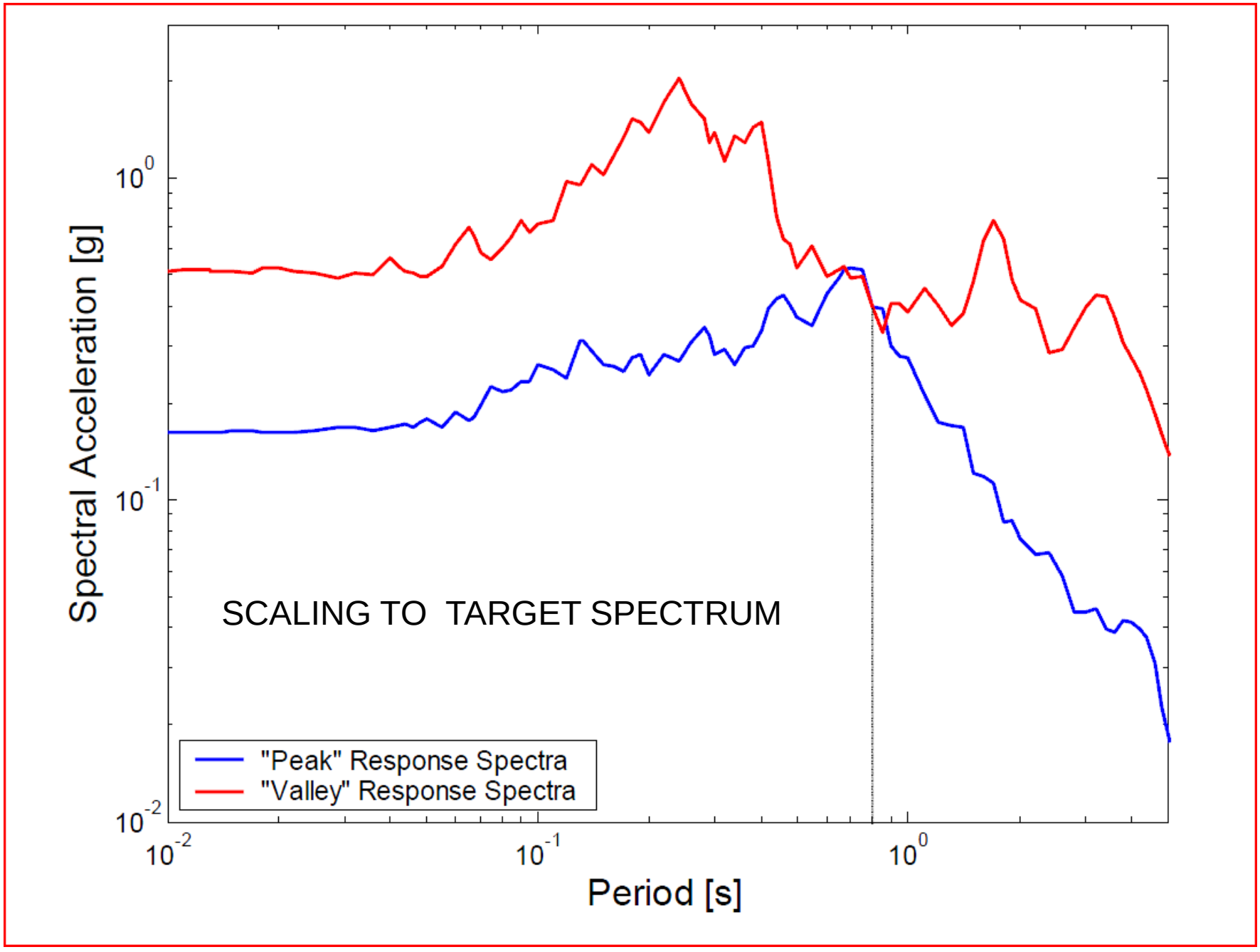
SCALED NATURAL RECORDS

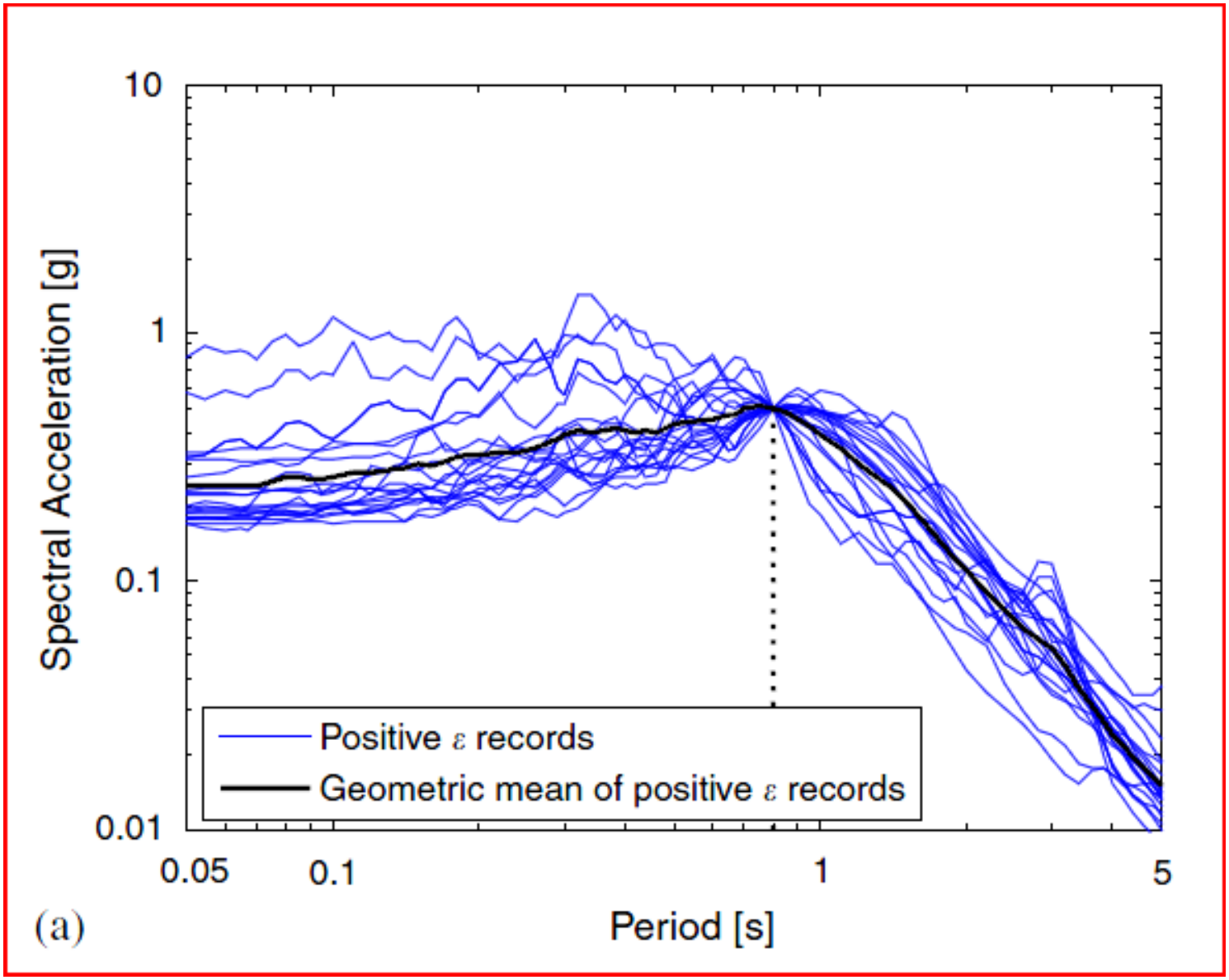


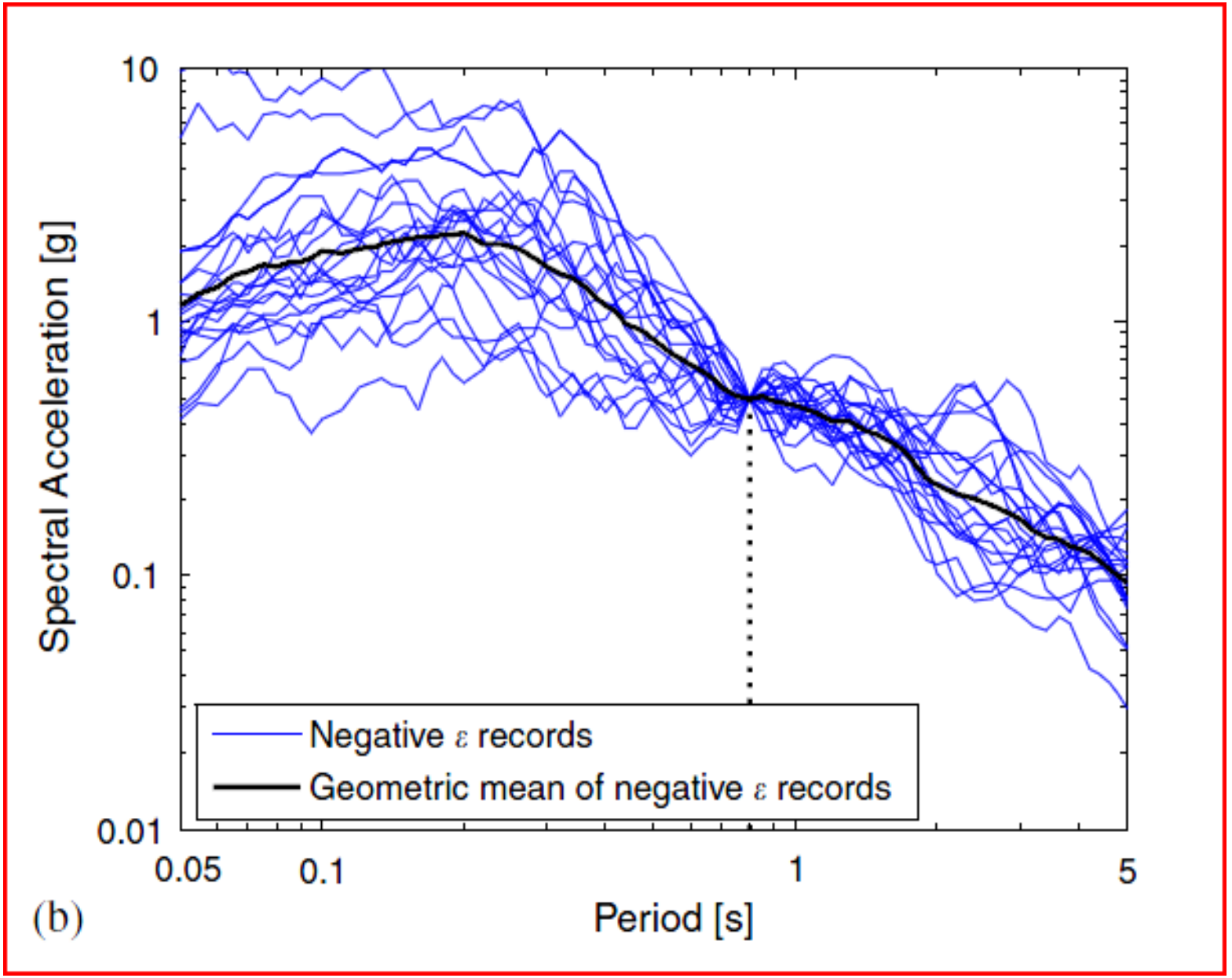

RECORD WIRH NEGATIVE ε DEVIATION
Spectral Acceleration [g]
Period [s]
Response Spectra
Median Attenuation Prediction
Median +/- Sigma

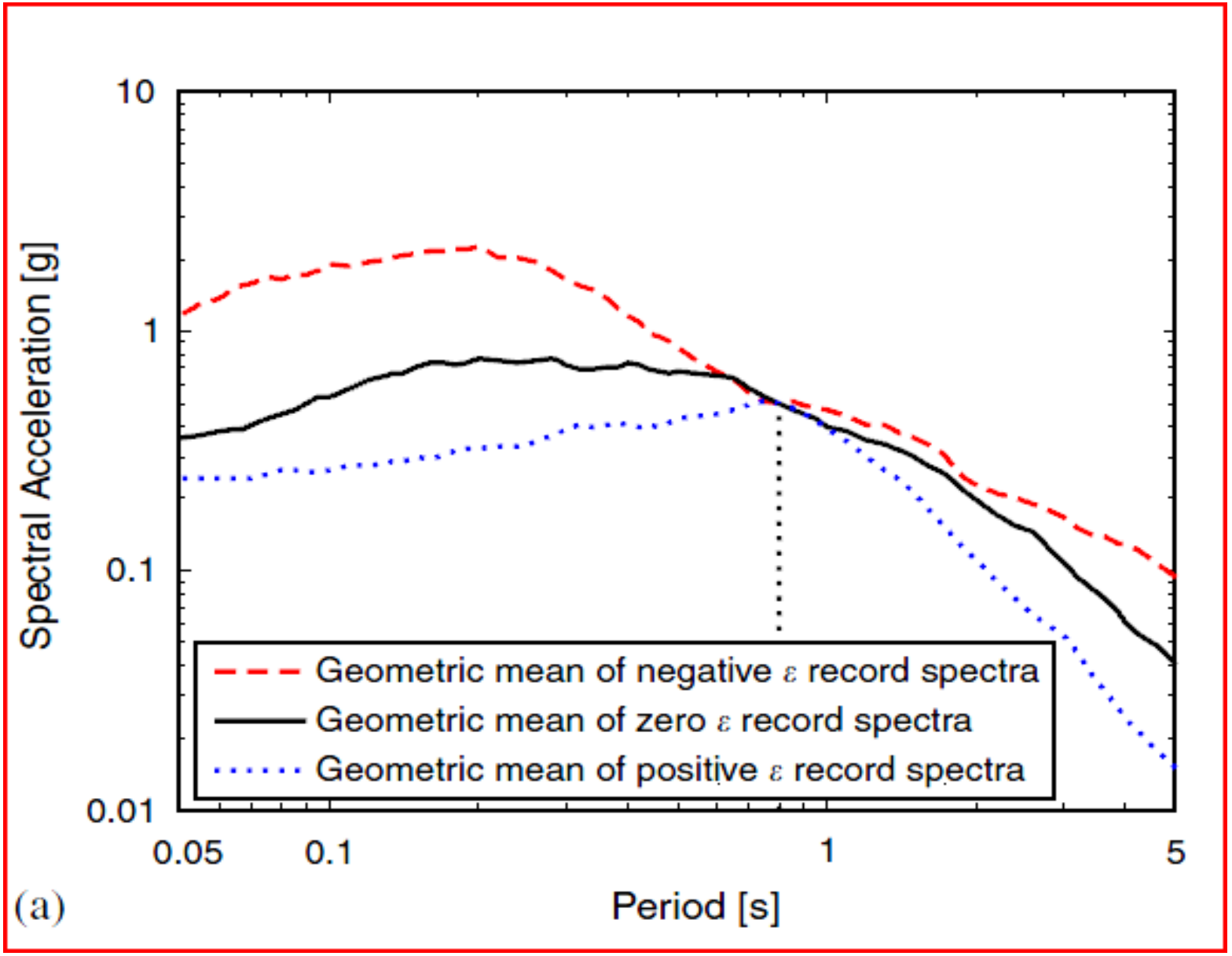
INCREASE OF EFFECTIVE PERIOD WITH INELASTIC BEHAVIOUR

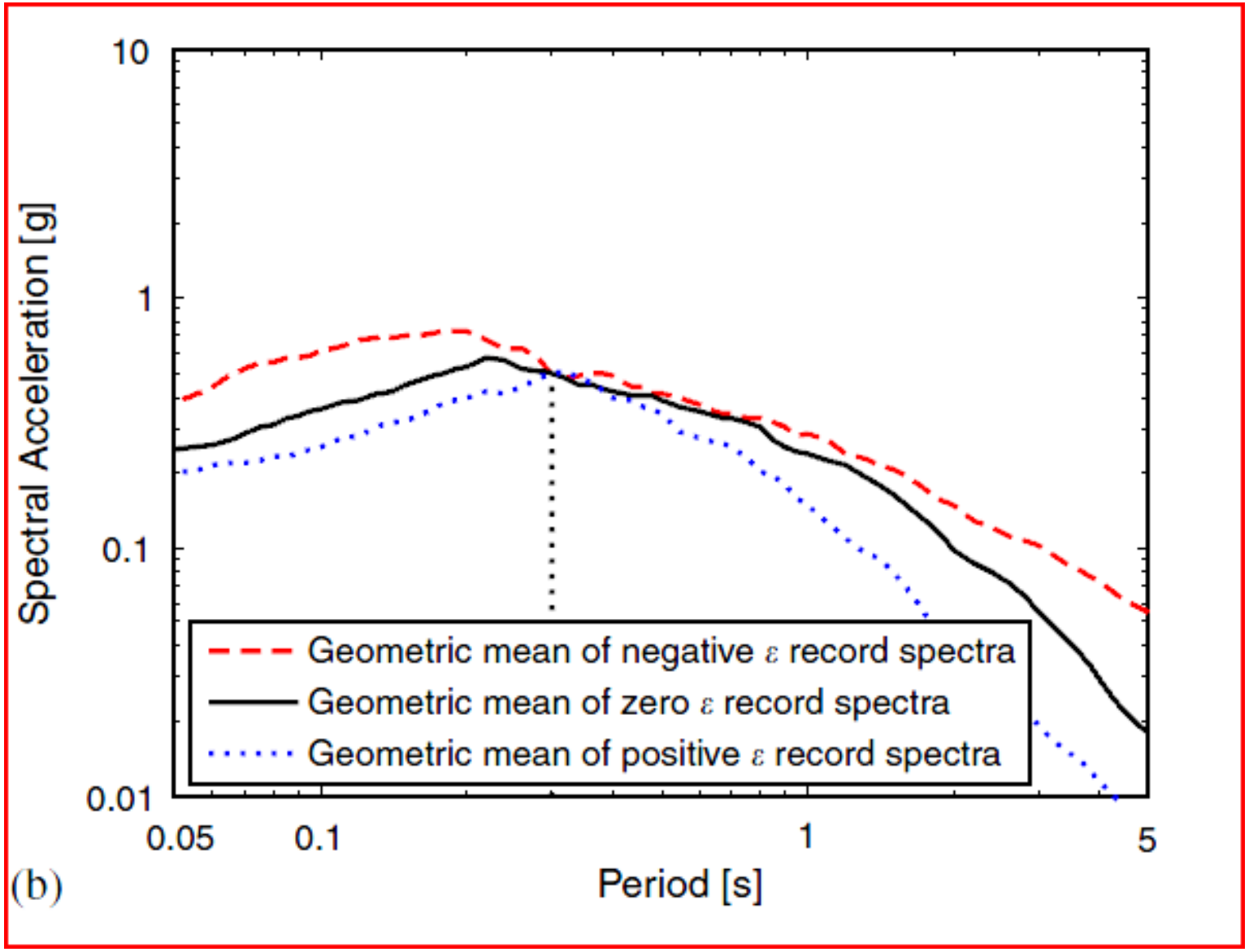



Spectral Acceleration [g]
10^{0}
10^{-1}
10^{-2}
SCALING TO TARGET SPECTRUM
"Peak" Response Spectra
"Valley" Response Spectra
10^{-2}
10^{-1}
10^{0}
Period [s]

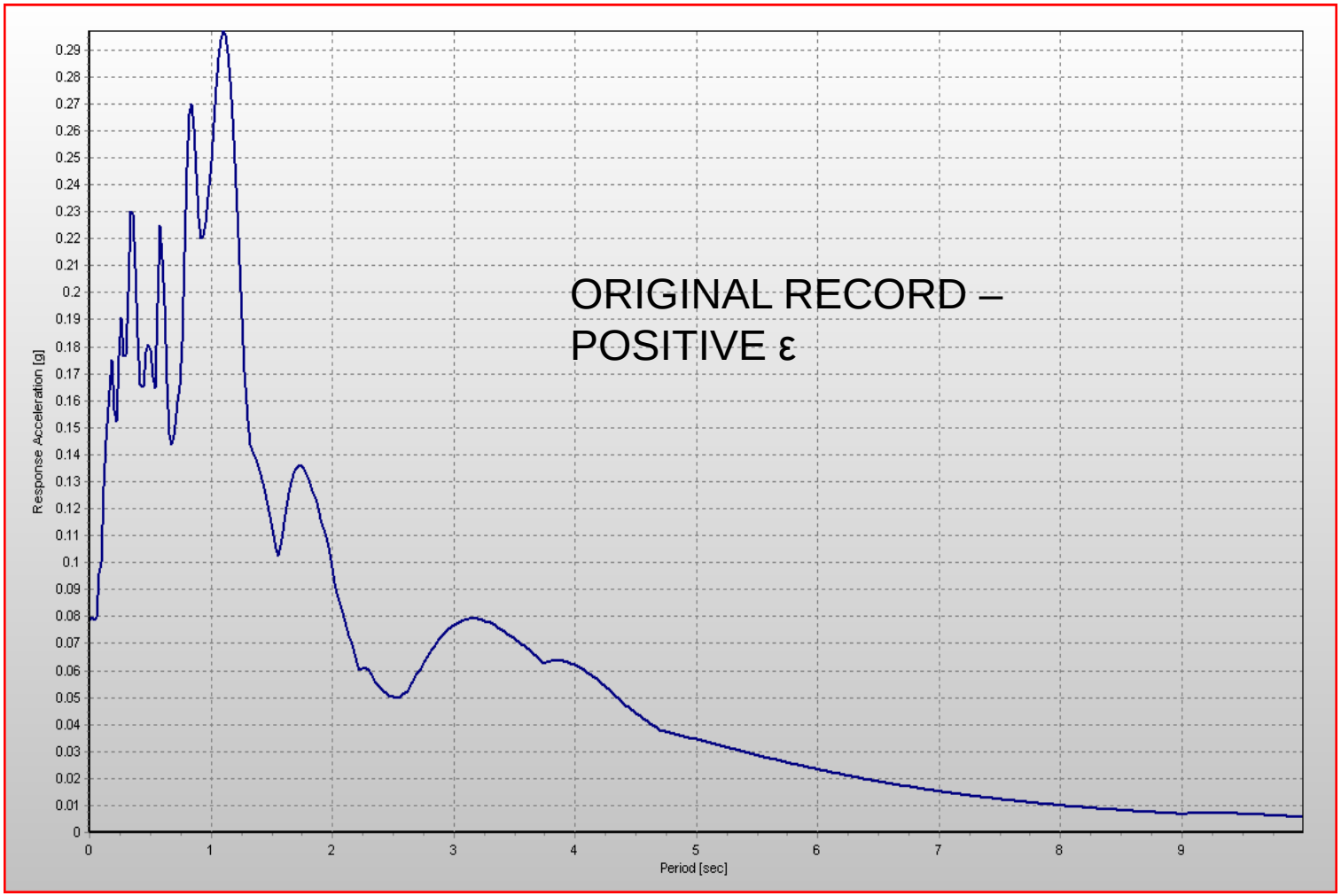

10
1
0.1
0.01
Spectral Acceleration [g]
0.05
0.1
1
5
Period [s]
Positive ε records
Geometric mean of positive ε records
(a)

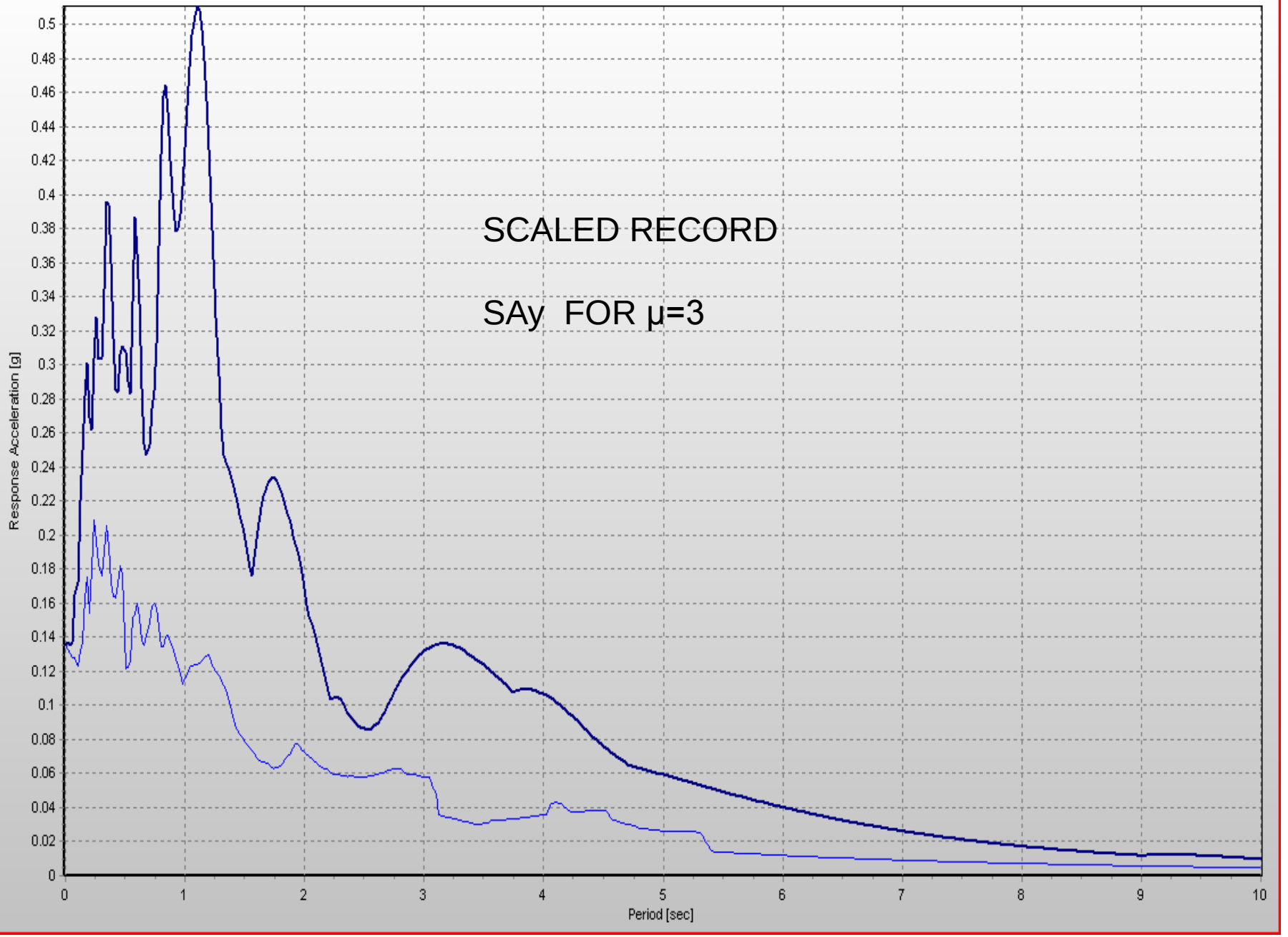

10
1
0.1
0.01
Spectral Acceleration [g]
0.05
0.1
1
5
Period [s]
Negative ε records
Geometric mean of negative ε records
(b)

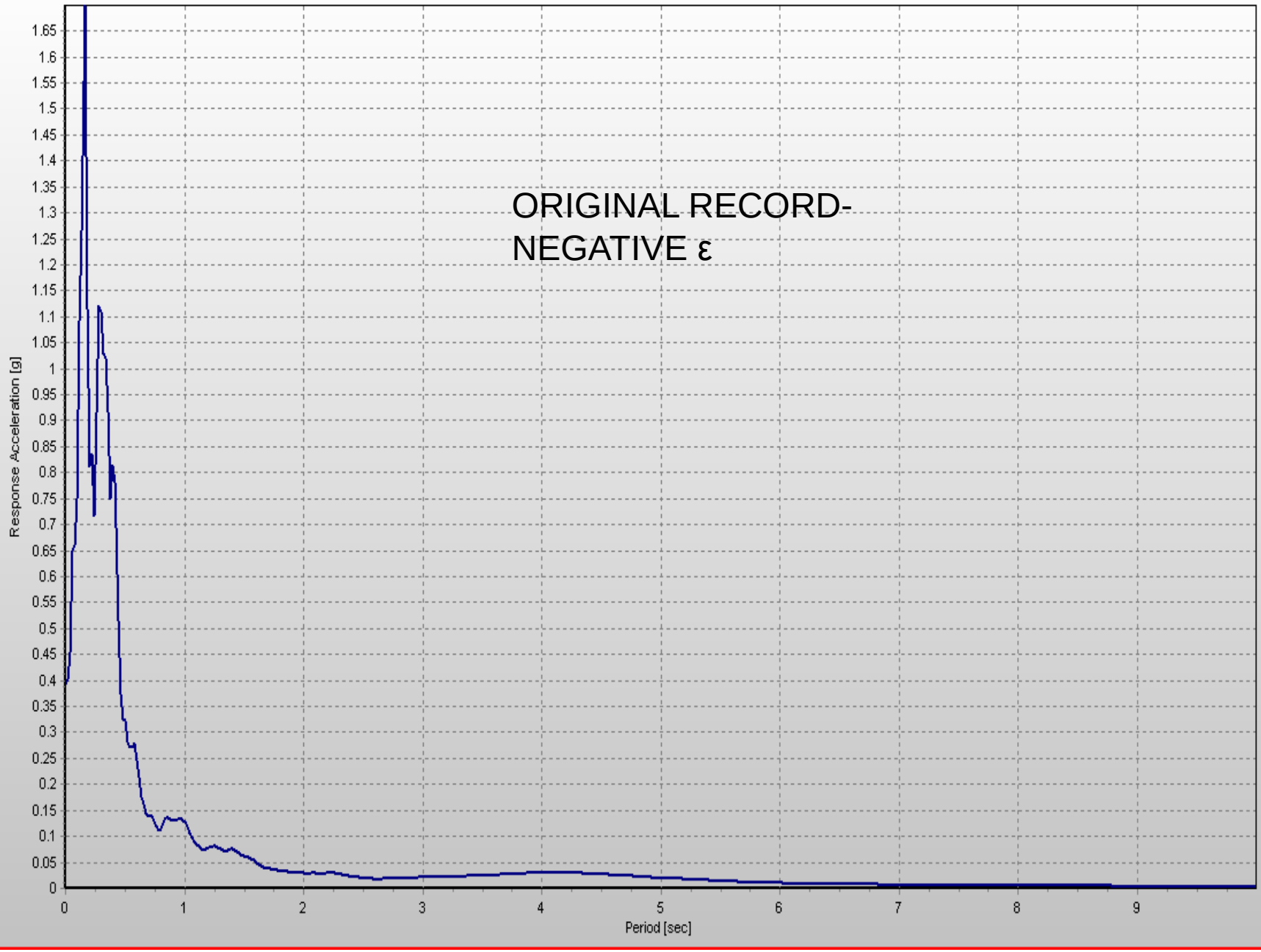

10
1
0.1
0.01
Spectral Acceleration [g]
0.05
0.1
1
5
Period [s]
Geometric mean of negative ε record spectra
Geometric mean of zero ε record spectra
Geometric mean of positive ε record spectra
(a)

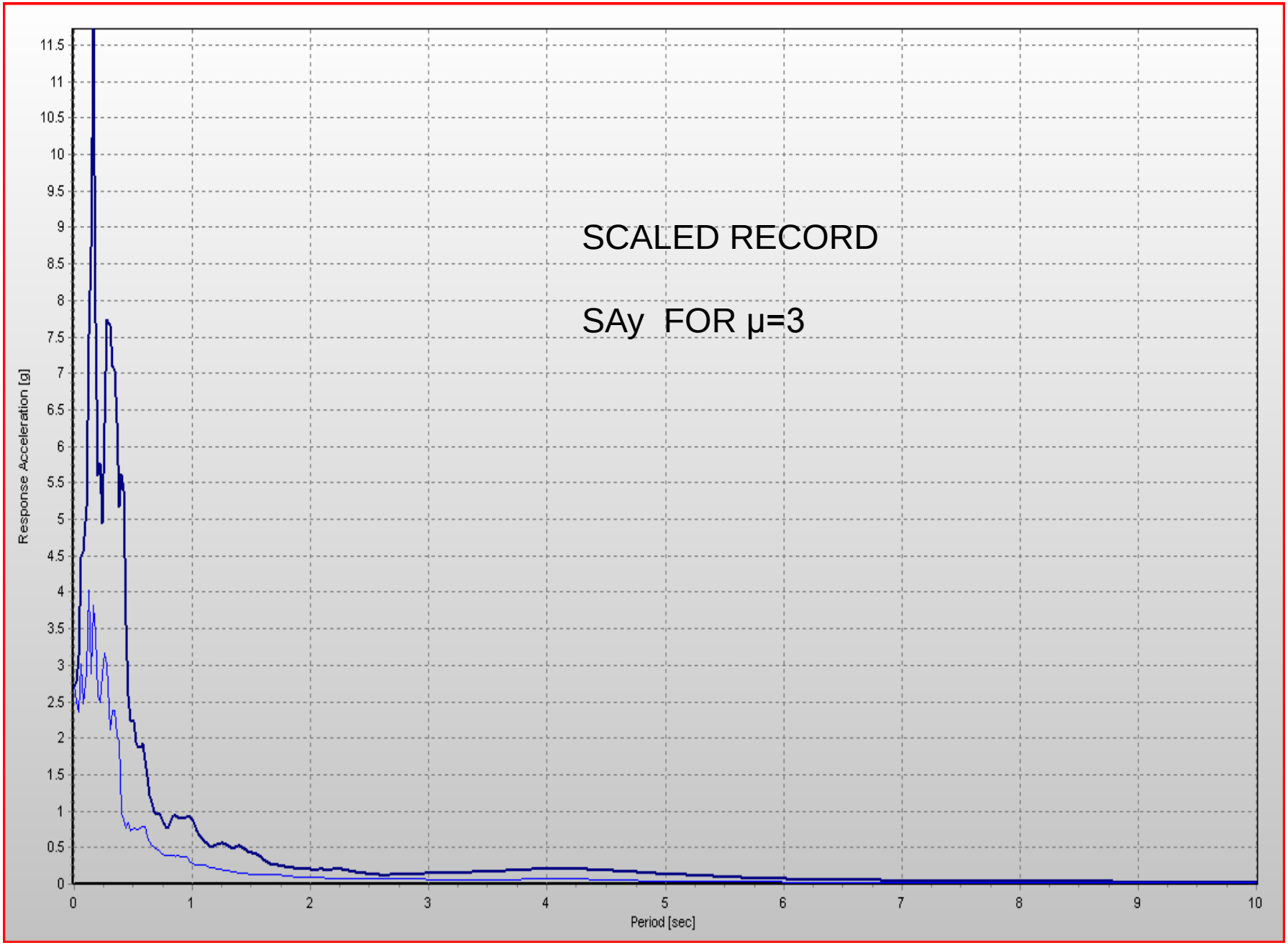

10
1
0.1
0.01
Spectral Acceleration [g]
0.05
0.1
1
5
Period [s]
Geometric mean of negative ε record spectra
Geometric mean of zero ε record spectra
Geometric mean of positive ε record spectra
(b)

EXAMPLE : SCALING AT 0.5 g , T=1.1 sec

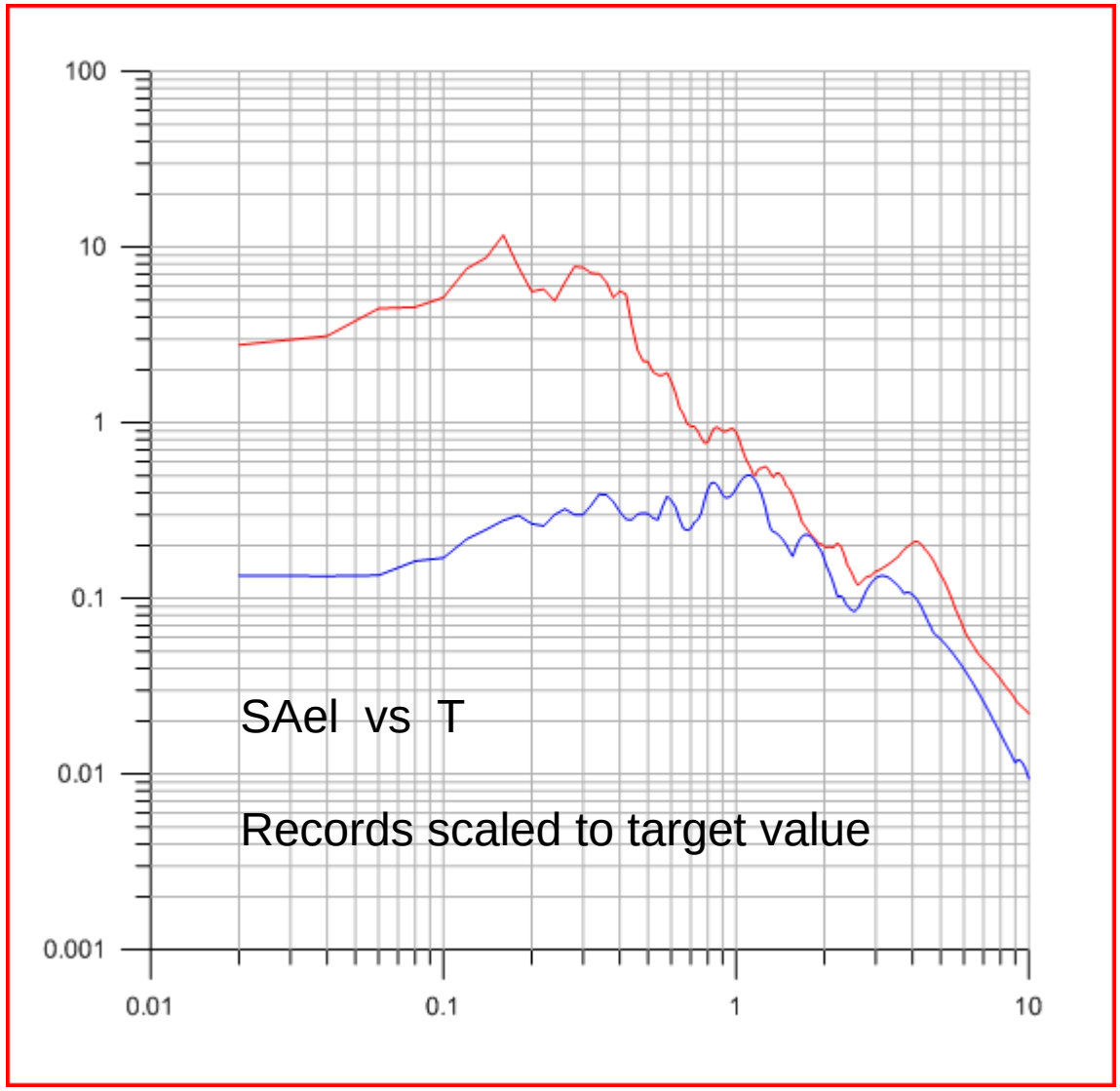



SCALED RECORD
SAy FOR μ=3
Response Acceleration [g]
Period [sec]
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
0.18
0.2
0.22
0.24
0.26
0.28
0.3
0.32
0.34
0.36
0.38
0.4
0.42
0.44
0.46
0.48
0.5
0
1
2
3
4
5
6
7
8
9
10

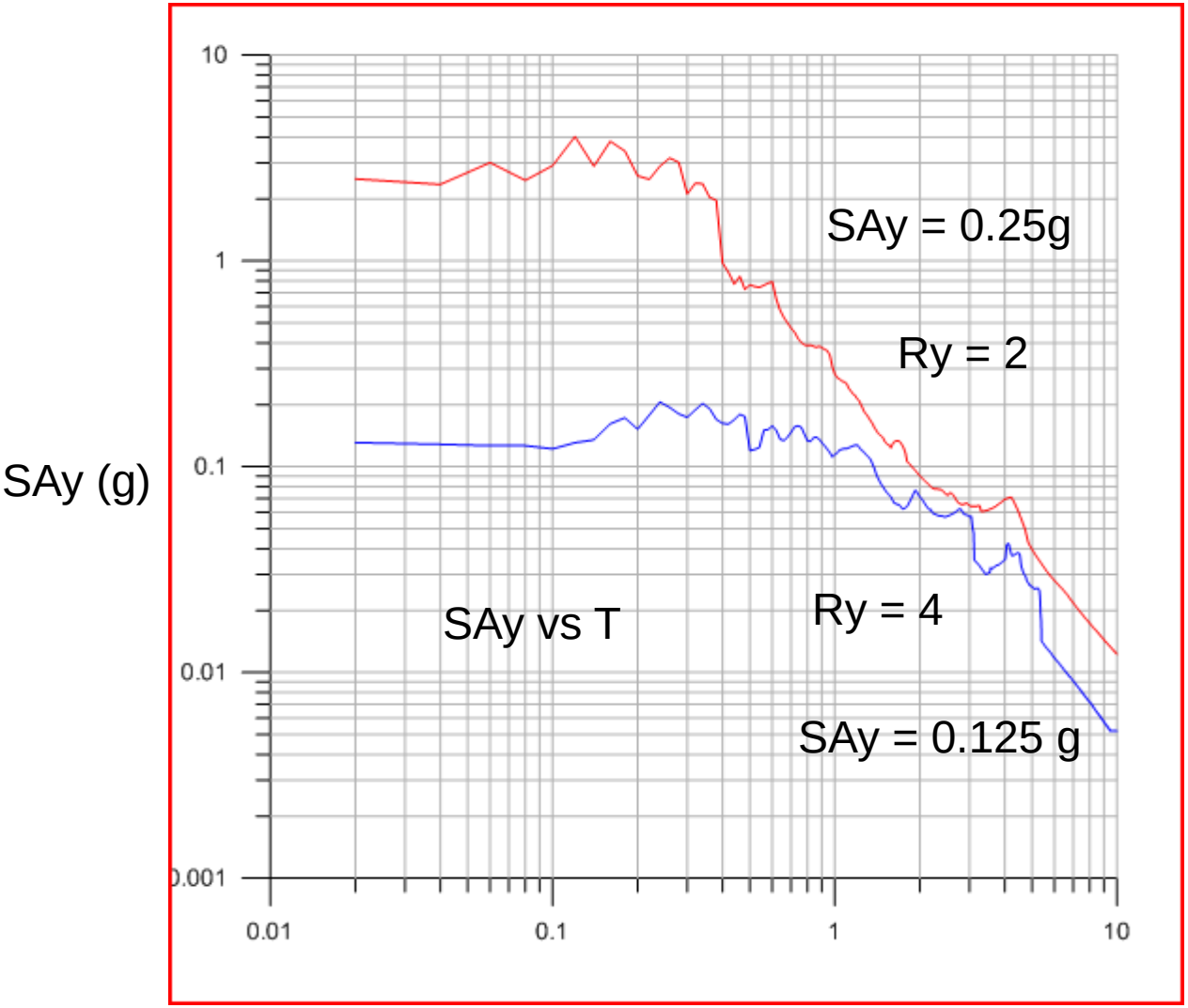

ORIGINAL RECORD-
NEGATIVE ε
Response Acceleration [g]
Period [sec]
1.65
1.6
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
1
2
3
4
5
6
7
8
9


SCALED RECORD
SAy FOR μ=3
Response Acceleration [g]
Period [sec]
11.5
11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
10

SA(g)


100
10
1
0.1
0.01
0.001
0.01
0.1
1
10
SAel vs T
Records scaled to target value

SAy for μ=3


SAy (g)
10
1
0.1
0.01
0.001
0.01
0.1
1
10
SAy = 0.25g
Ry = 2
Ry = 4
SAy = 0.125 g
SAy vs T