



ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

Task 4: Individuazione di siti e di registrazioni "anomale"

RU2-INGV-RM1

**Identification of ITACA sites
and records presenting anomalies
in the seismic response
(Technical report) D8 (12 months)**



AIM OF THE WORK

ANOMALOUS AMPLIFICATIONS

ANOMALOUS RECORDS

Amplification vs. rock GMPE

Our reference:

Cauzzi & Faccioli, Journal of Seismology 2008

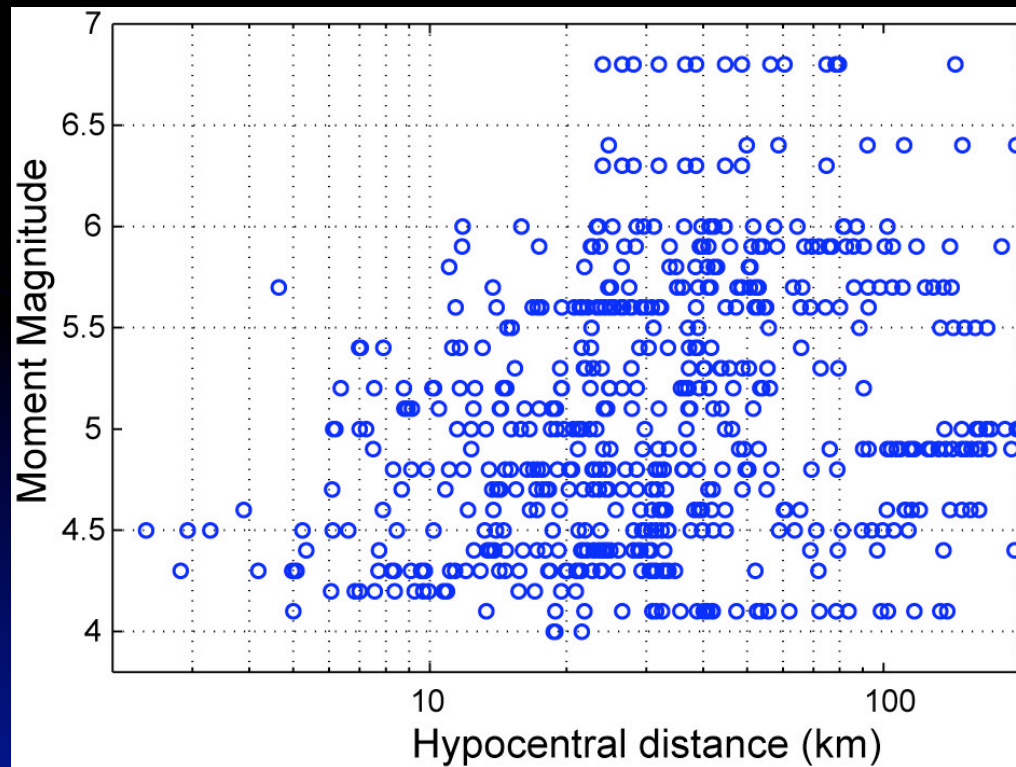


DATA-SET ANALYSIS

EVENTS SELECTION

156 Records **432 Records** **22 Records**
DPC-S5 (2005-07) **I.T.A.C.A.** **R.A.N.**
Digital **Digital and analog** **Digital**

1972 - 2004
Complete Selection
2005 - 2008
Arbitrary Selection



120 EVENTS

$4.0 < M_w < 6.8$

$2 < R_{Ipo} \text{ (km)} < 200$

610 RECORDS
(each with 3 components)

*M_w from Global CMT / RCMT-INGV
/ Pondrelli et al. (2001) e (2006)
/ Rovelli et al. (1988) / EMMA catlg*



DATA-SET ANALYSIS

SIGNALS CORRECTION

- VALIDATION requirements

P and S phase preserved

Good Signal/Noise Ratio

- PROCESSING

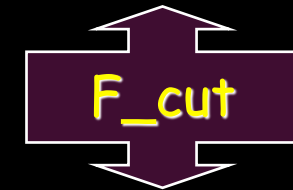
Linear trend Removal

Taper and Padding (Boore 2005)

High-Pass Acausal Butterworth Filter (4 poles)

up to 10 sec
up to 2 sec

0.07 Hz (Max)
DPC-S5 (2005-07)



0.35 Hz
I.T.A.C.A.

LIMITATION
to 2 seconds!!



DATA-SET ANALYSIS

RESPONSE SPECTRA - SA

- ALGORITHM

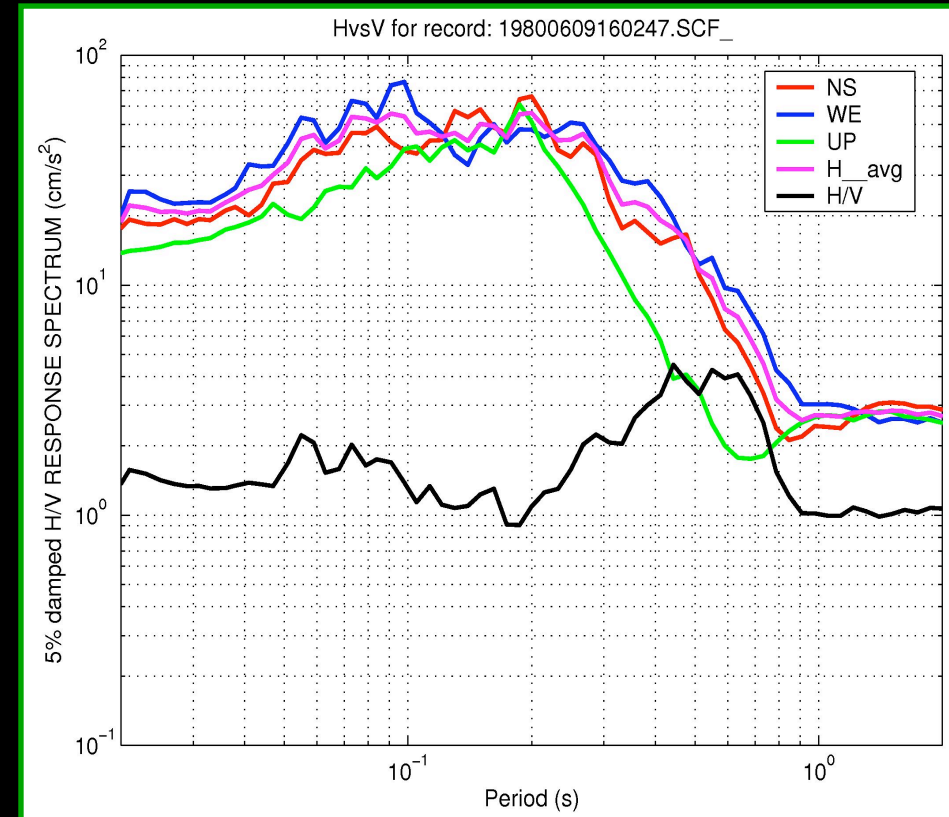
Computes absolute acceleration spectrum according NEWMARK's method (unconditionally stable with $\beta=0.25$ and $\gamma=0.50$)

- SAMPLED PERIODS

From 0.02 sec (PGA) to 10.53 sec with logarithmic increment

- H/V RATIO

Horizontal Components geometric mean
Vertical Component

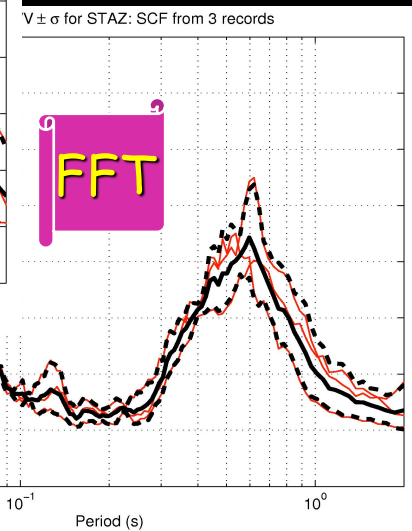
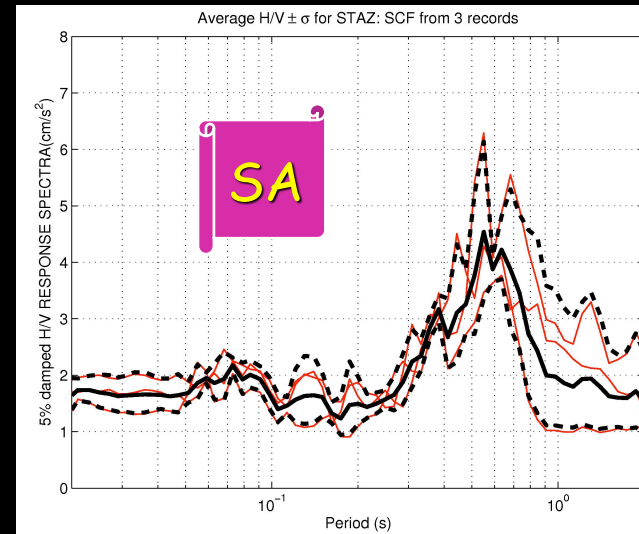
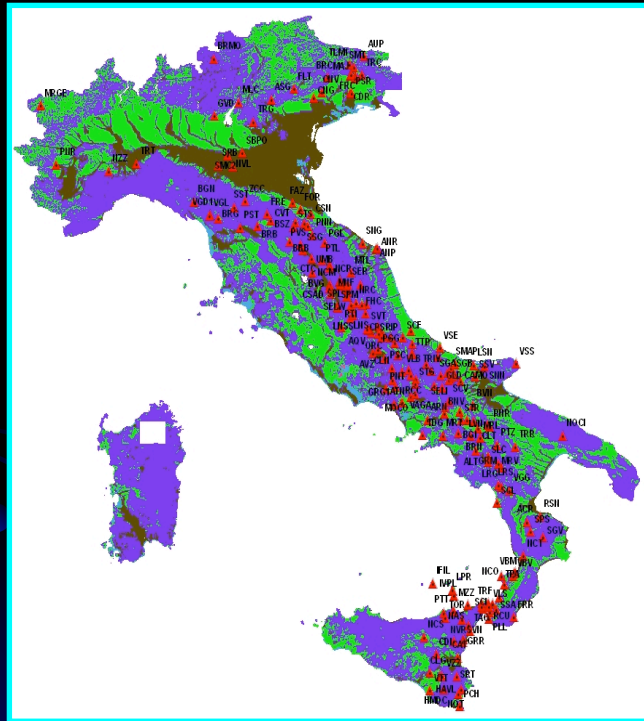




DATA-SET ANALYSIS

AVERAGE H/V FOR EACH STATION

241 INITIAL STAZIONS AVERAGE and STANDARD DEVIATION assuming log-normal distribution



Removal of stations without multiple events or suspect of soil-structure interaction



111 STATIONS



ANOM. SITE IDENTIFICATION

PREDICTED RESPONSE SPECTRA - PSA

- DISPLACEMENT ATTENUATION REGRESSION

Cauzzi & Faccioli (2008) Regression (2005-2007 DPC - S5 Project)
Including SITE CORRECTION TERM

$$\log_{10}(\text{SRS})(t) = a_1 + a_2 * M_w + a_3 * \log_{10}(R_{\text{ipo}}) + a_B * S_B + a_C * S_C + a_D * S_D \pm \text{stdev}$$

OUR ASSUMPTION: ROCK SITE IS B

- SAMPLED PERIODS

0.03 sec (PGA) | from 0.05 to 20 sec linear increment of 0.05

Passage to Spectral Pseudo - Accelerations

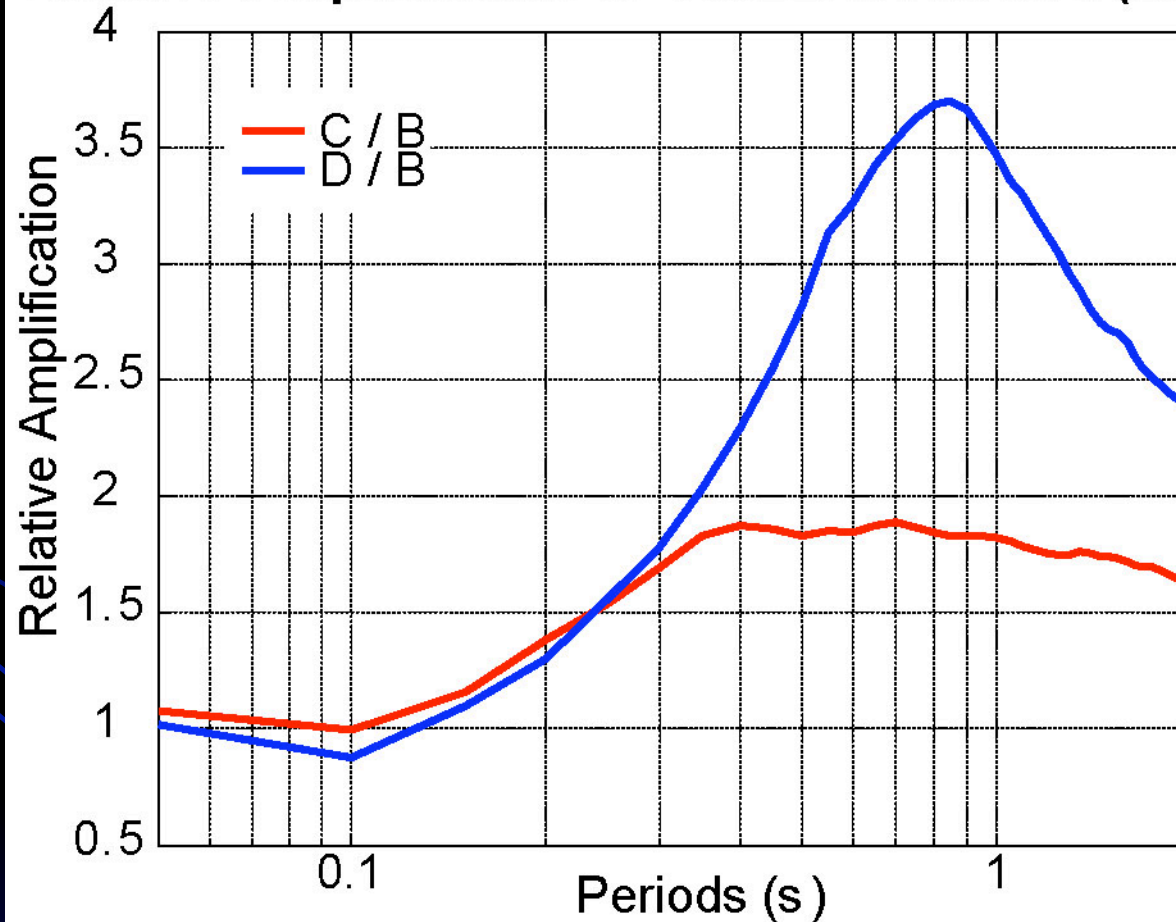
$$\text{DRS} * W^2 = \text{PSA}$$



ANOM. SITE IDENTIFICATION

PREDICTED AMPLIFICATION

Relative Amplification of Cauzzi & Faccioli (2008)



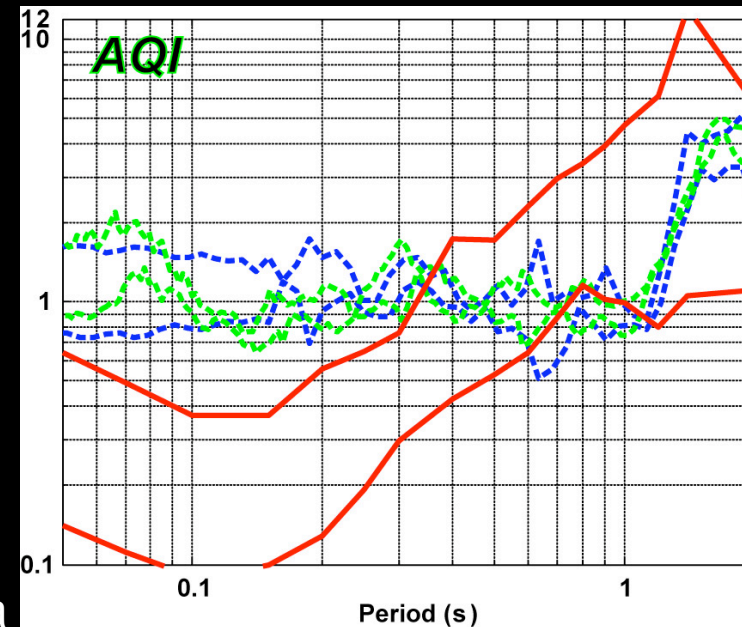
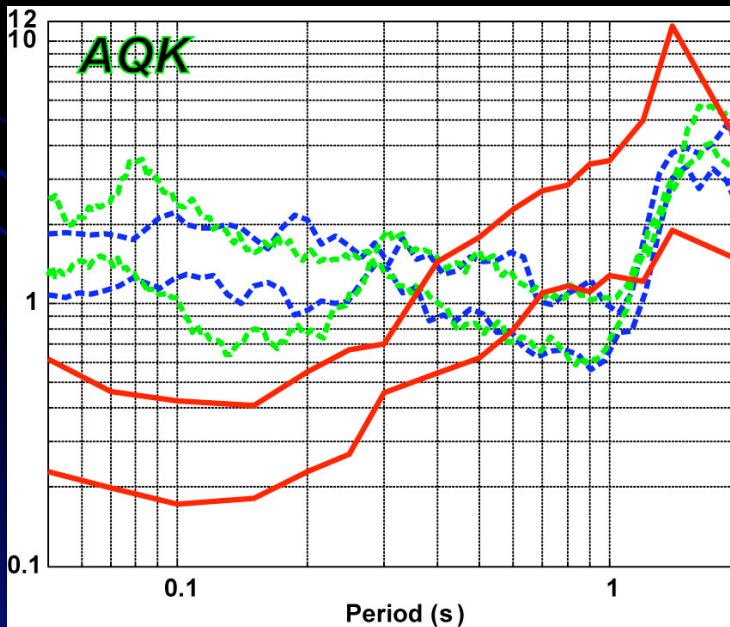
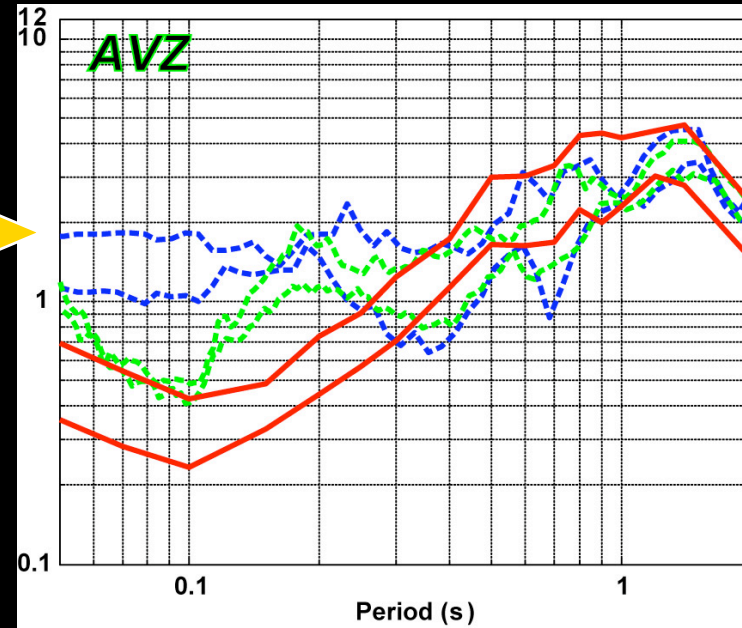


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If
 $SA/PSA_{rock} (\pm 1 \text{ Stdev})$
 > 2.5

H/V SA ($\pm 1 \text{ Stdev}$)

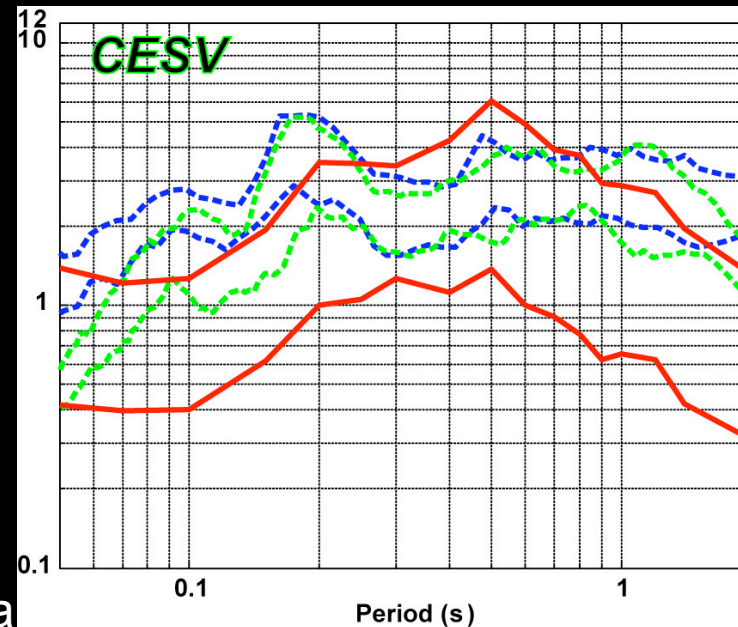
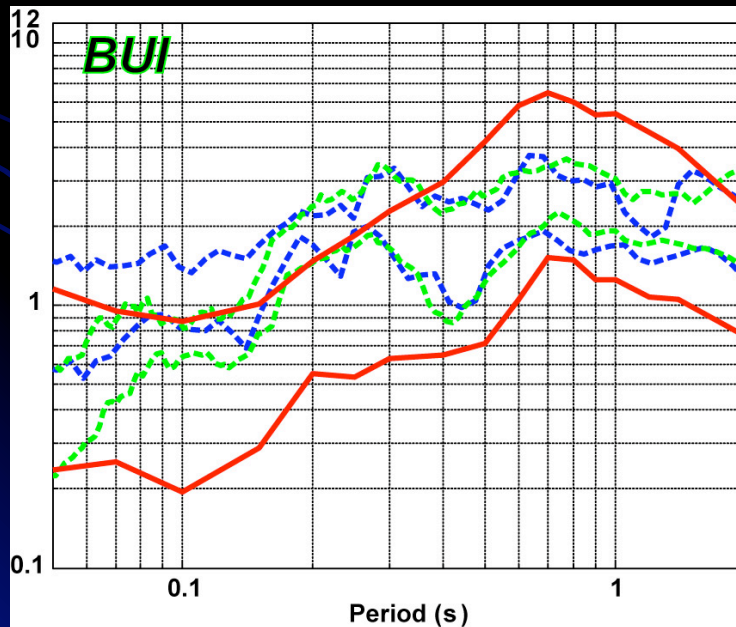
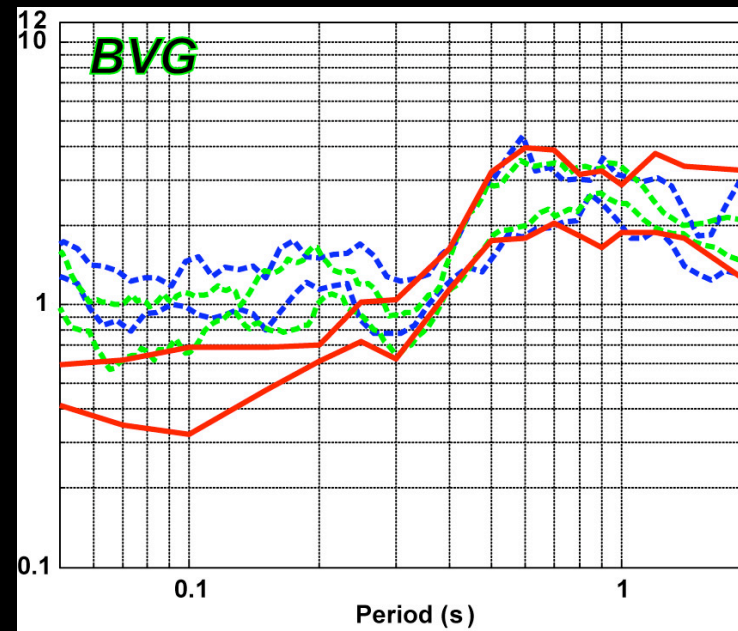
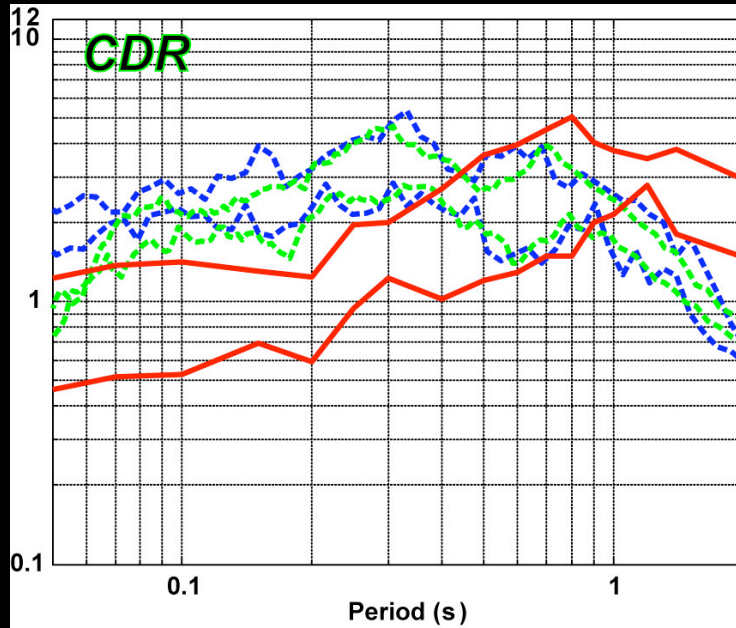
H/V FFT ($\pm 1 \text{ Stdev}$)



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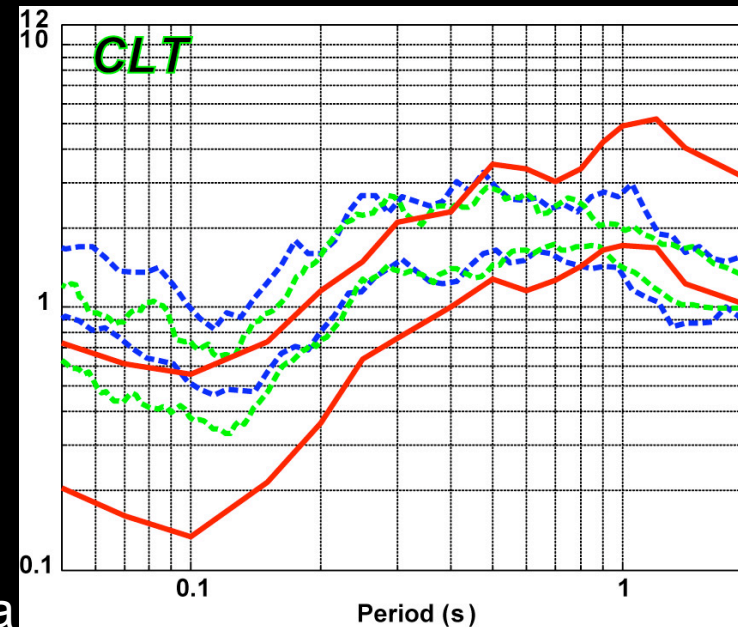
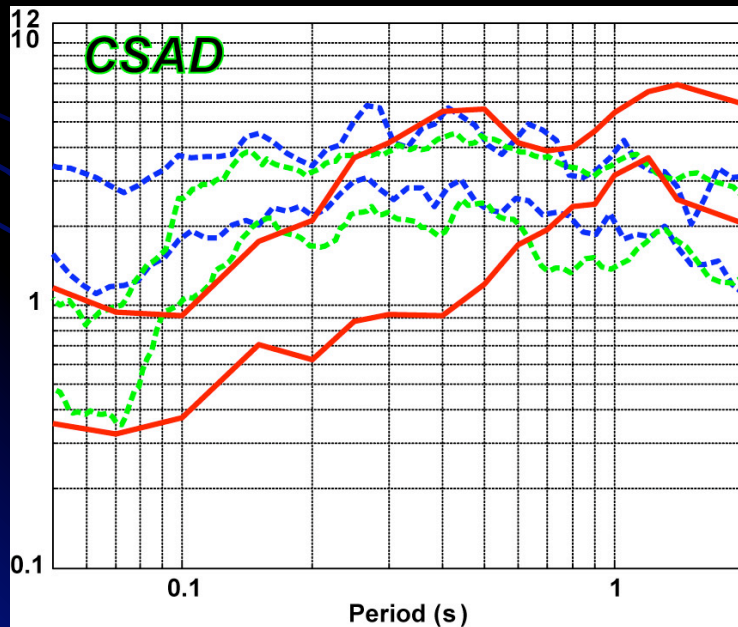
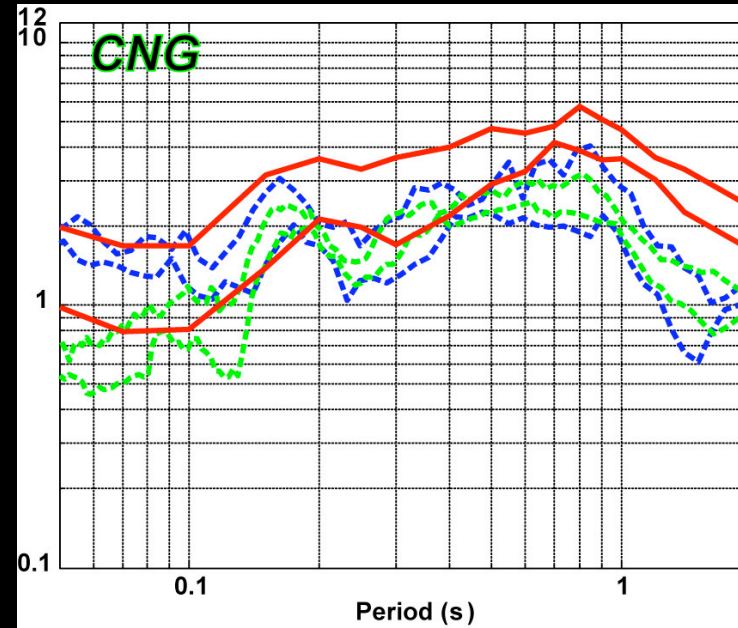
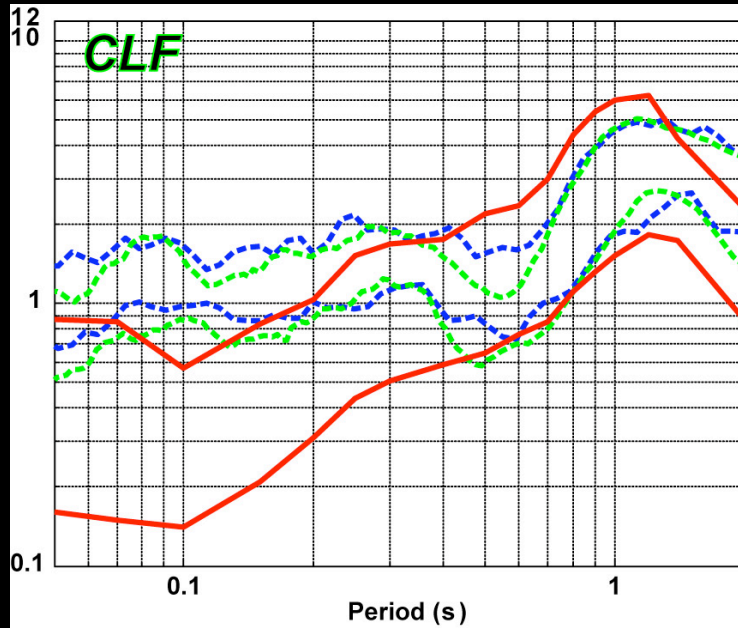
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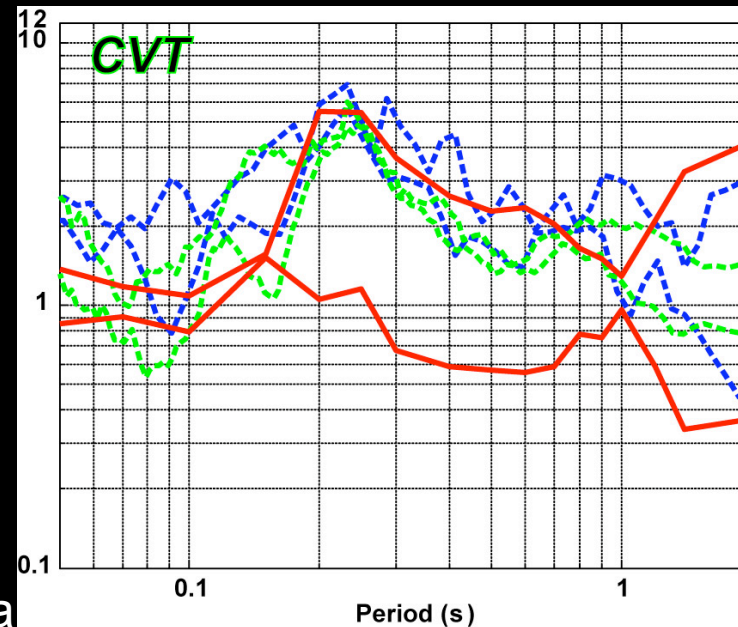
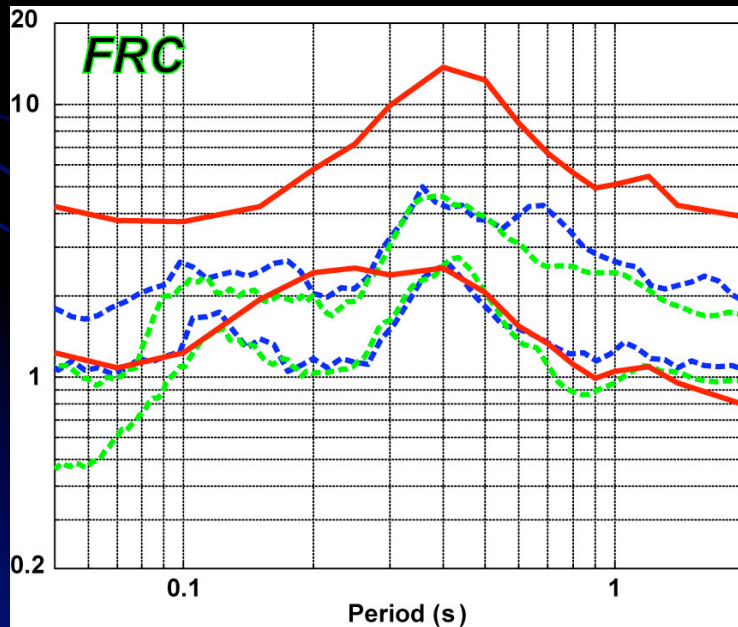
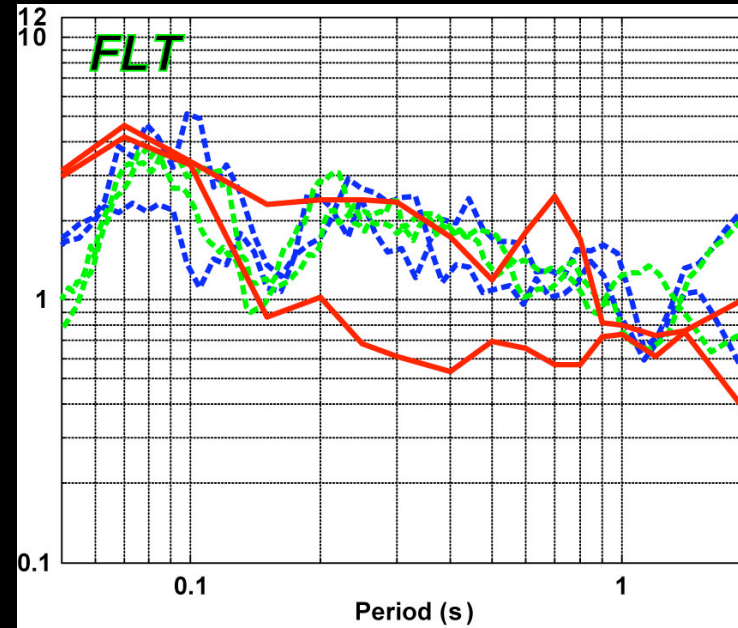
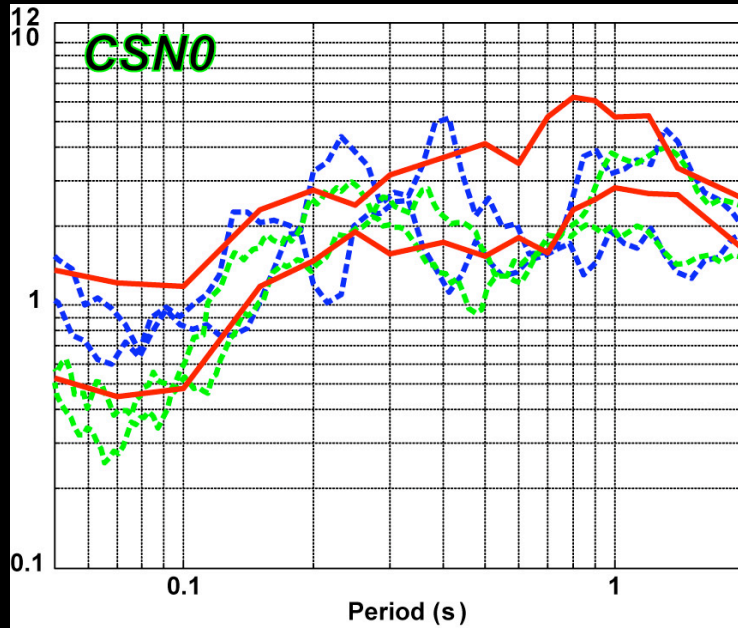
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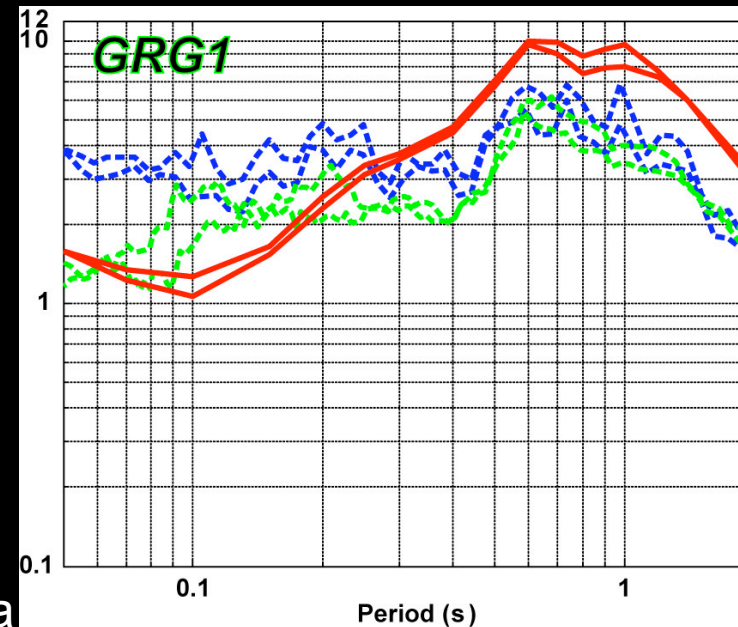
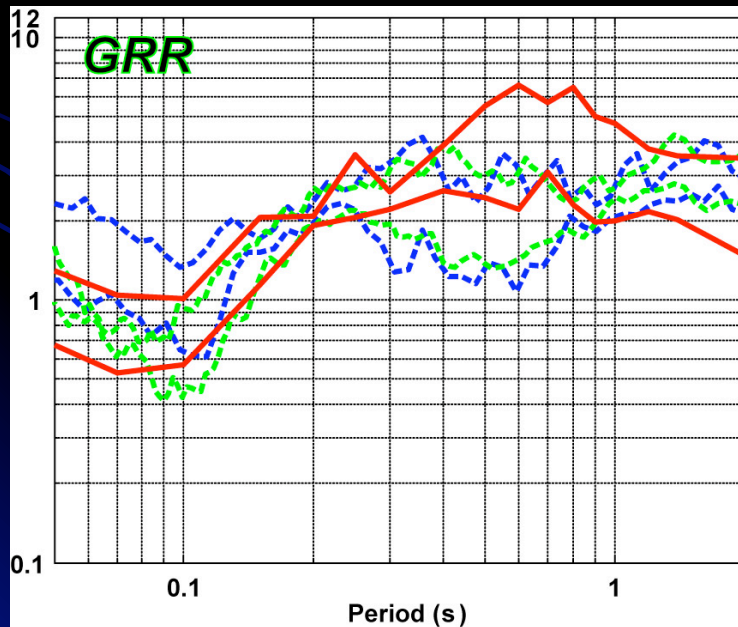
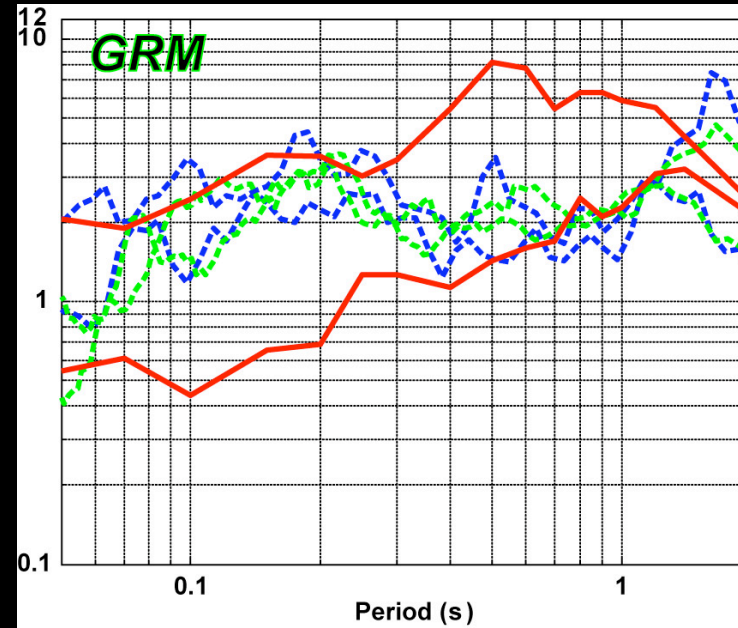
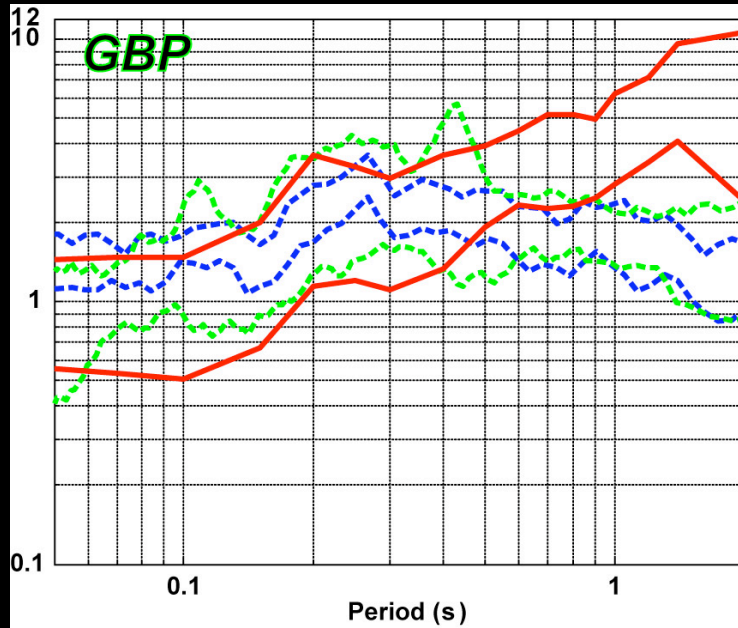


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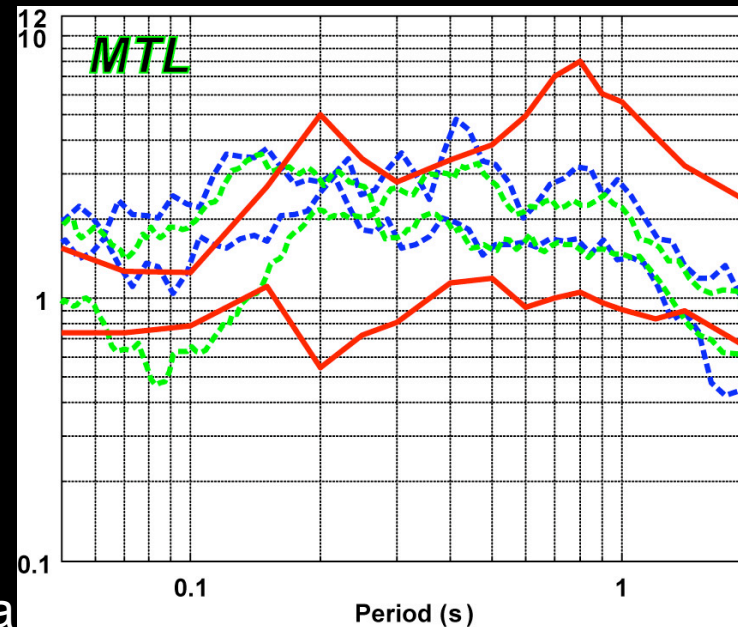
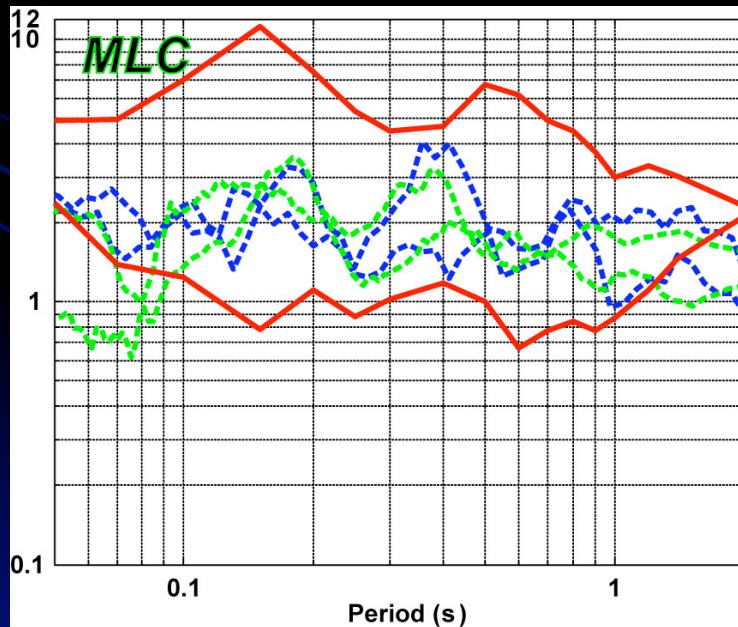
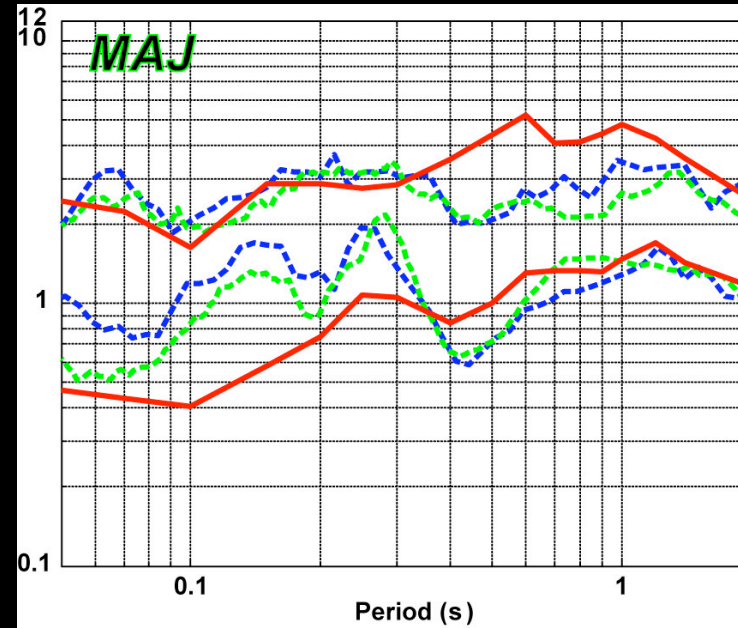
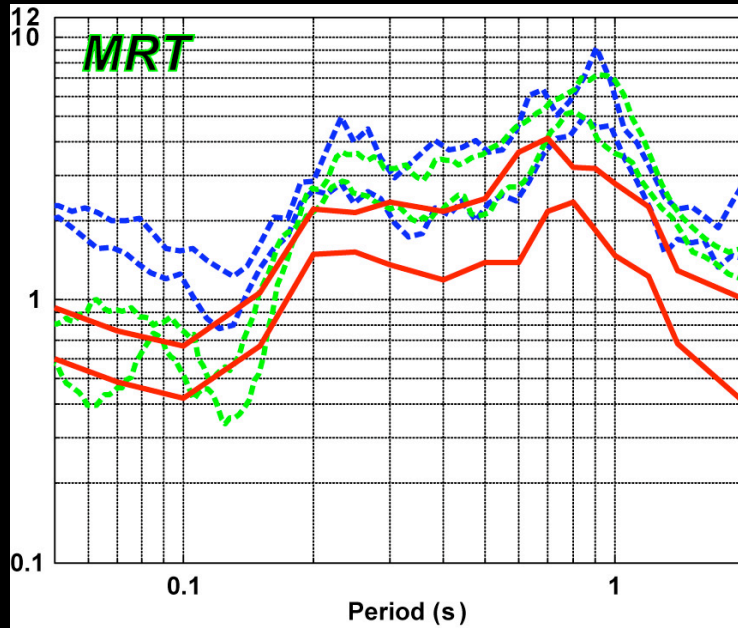
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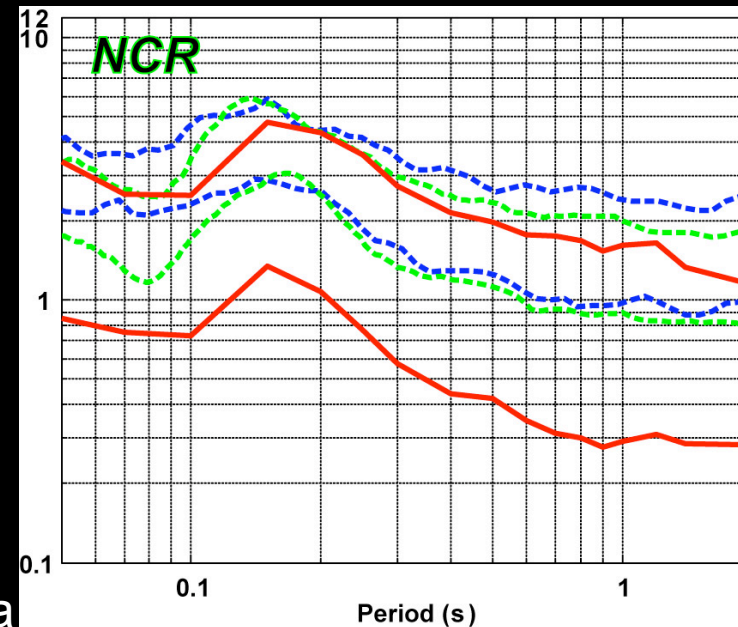
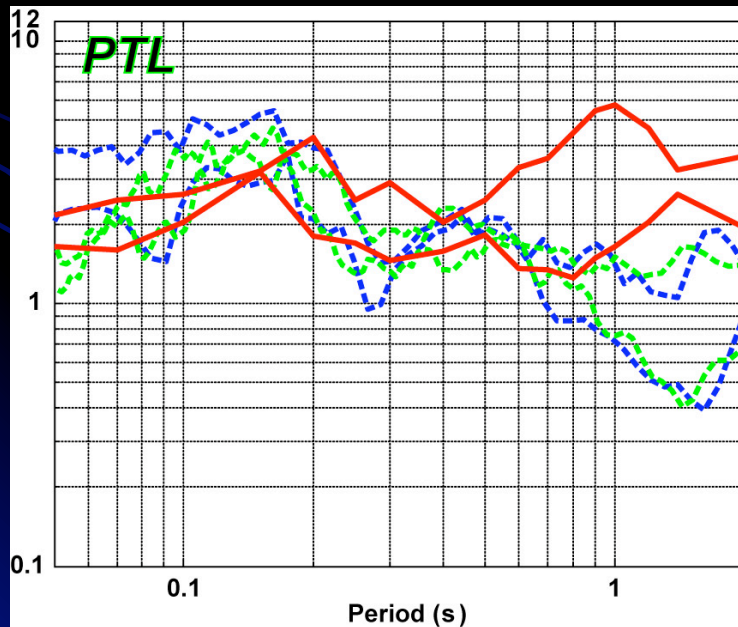
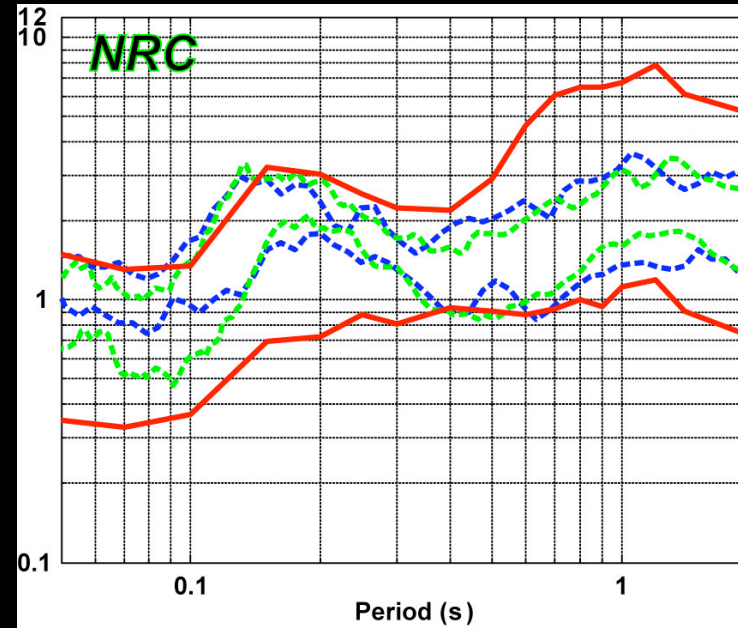
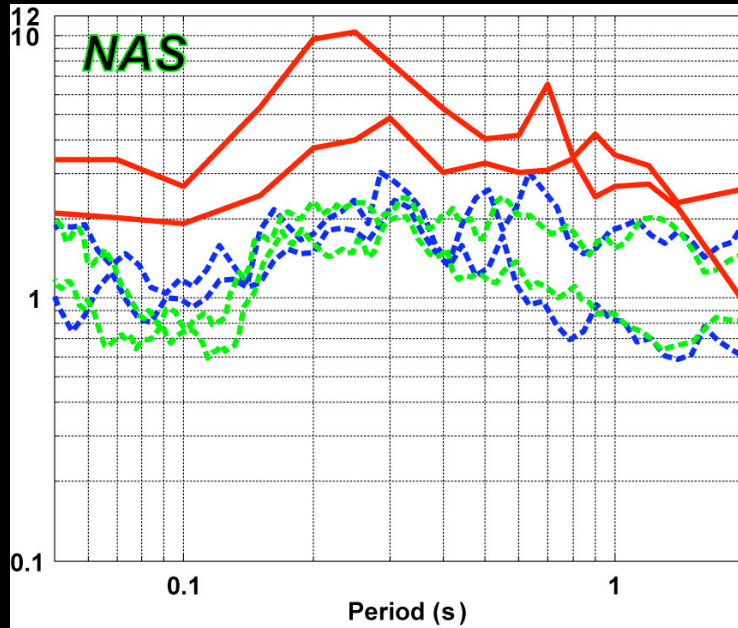
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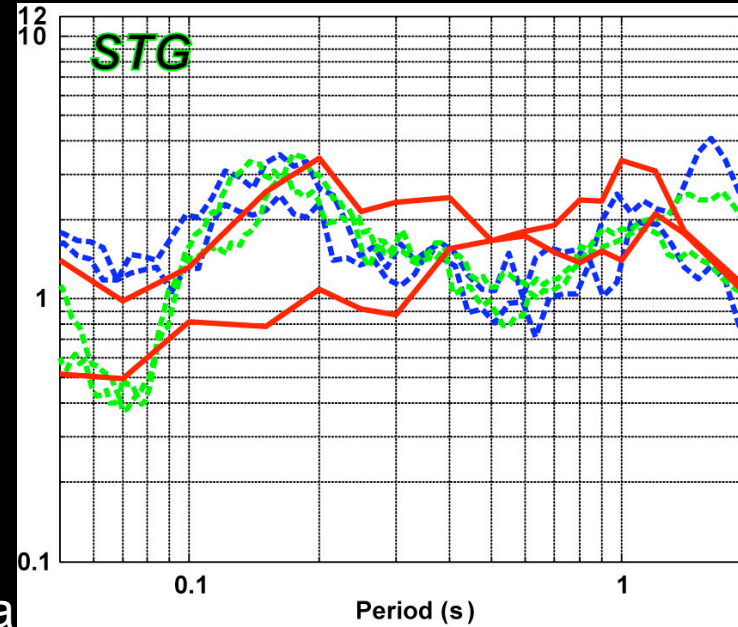
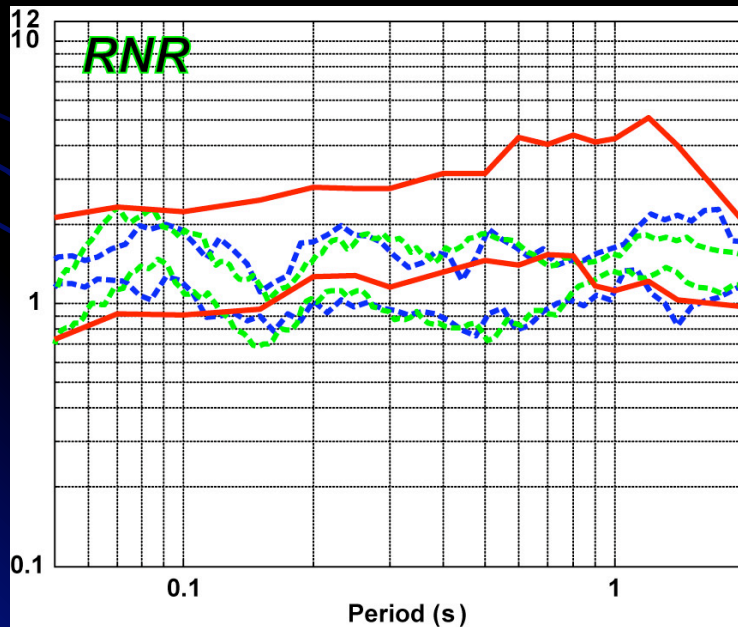
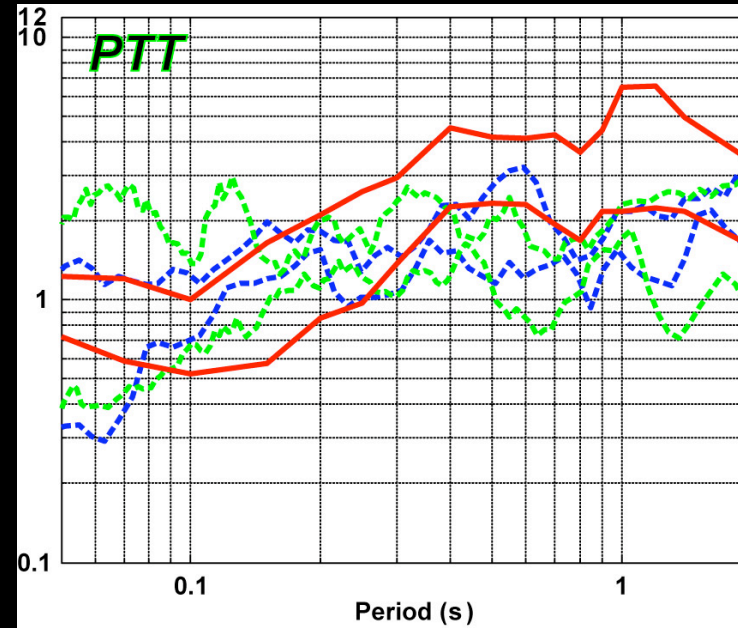
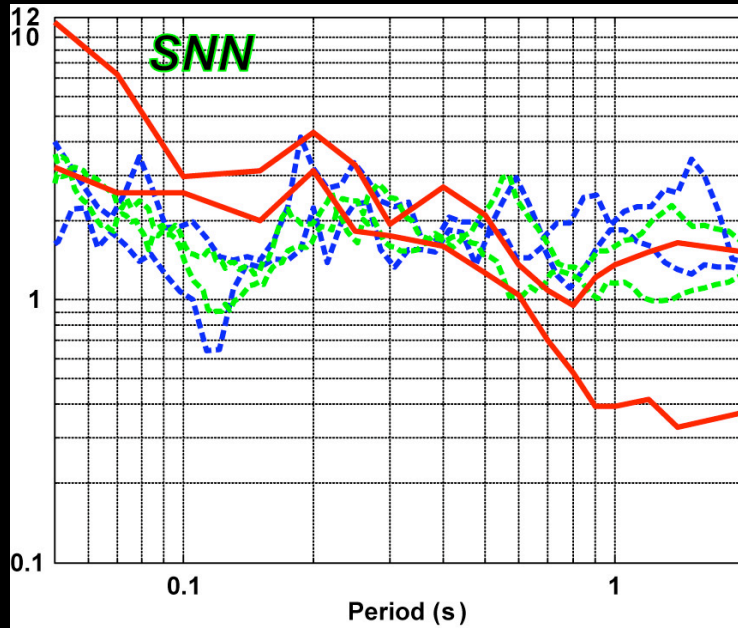
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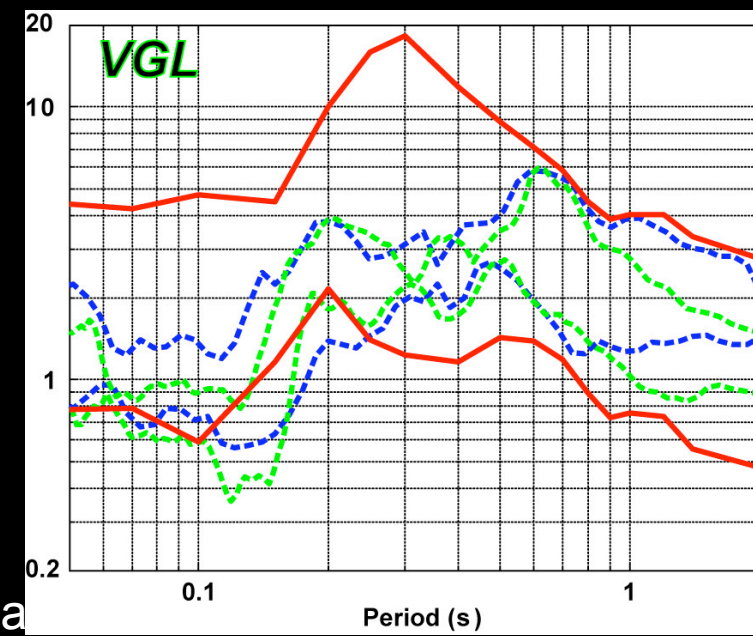
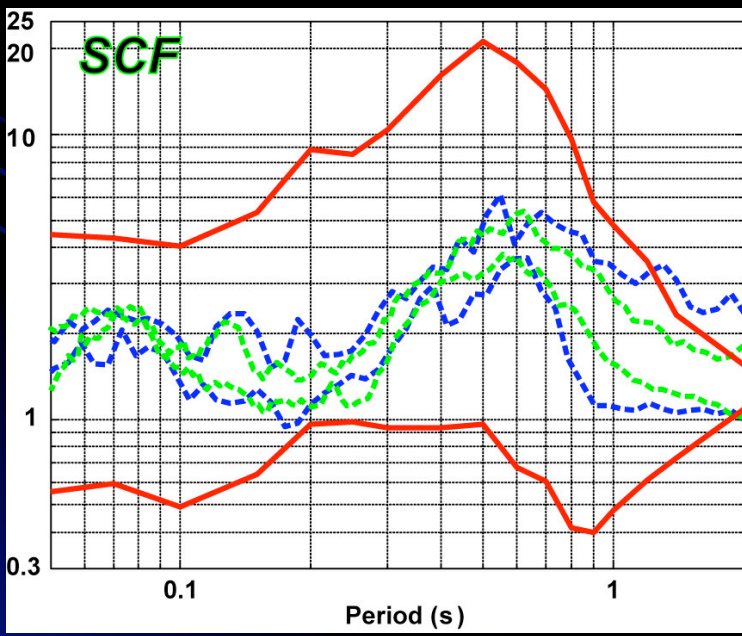
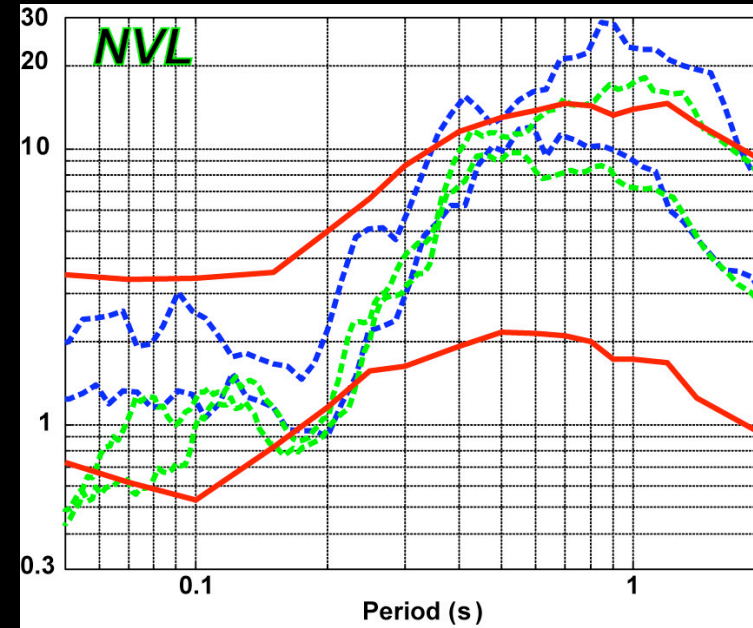
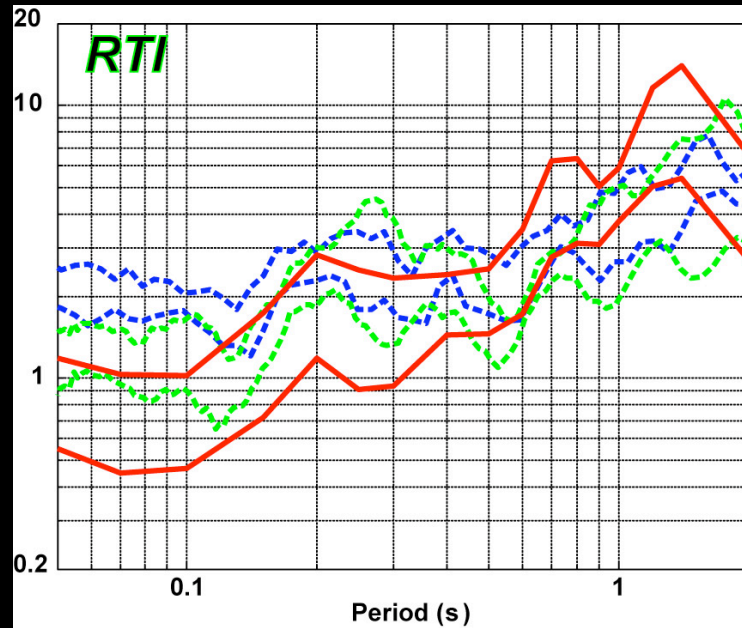
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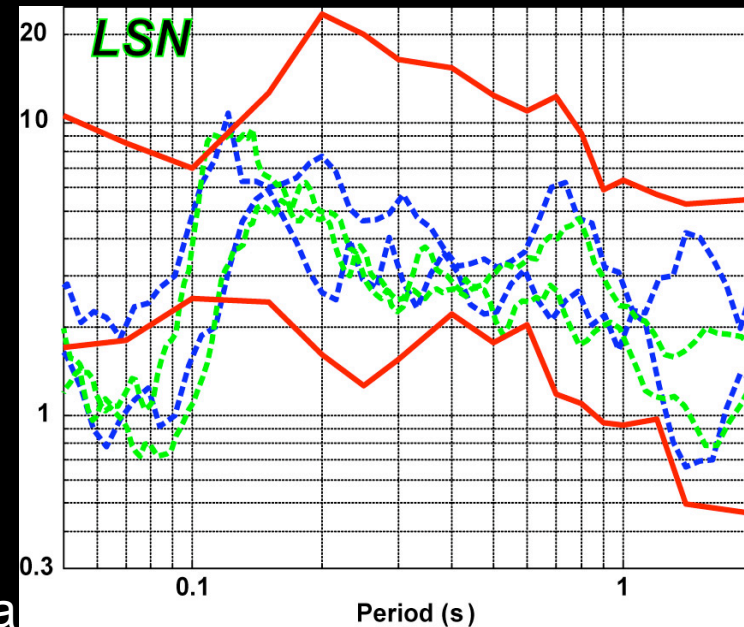
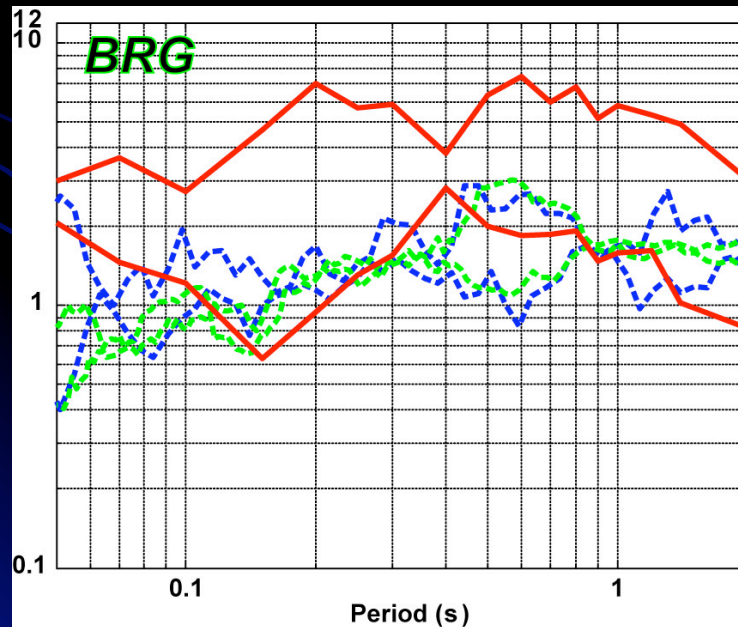
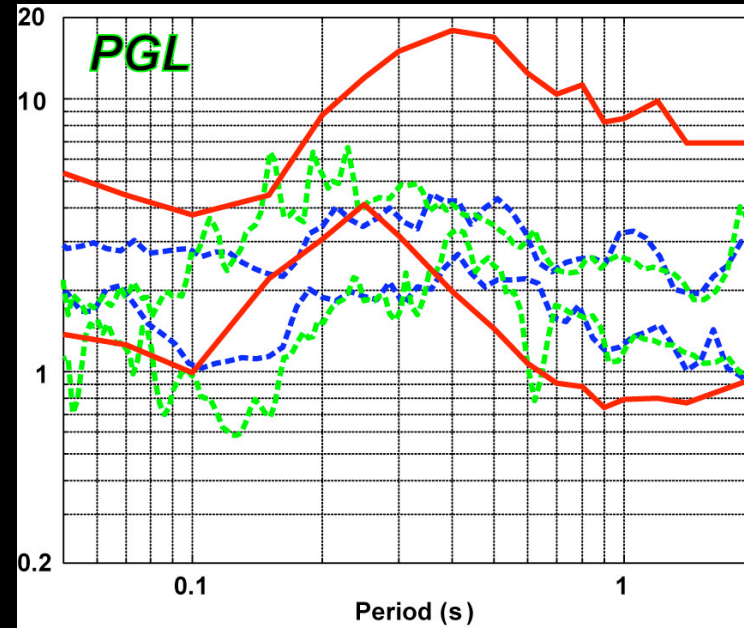
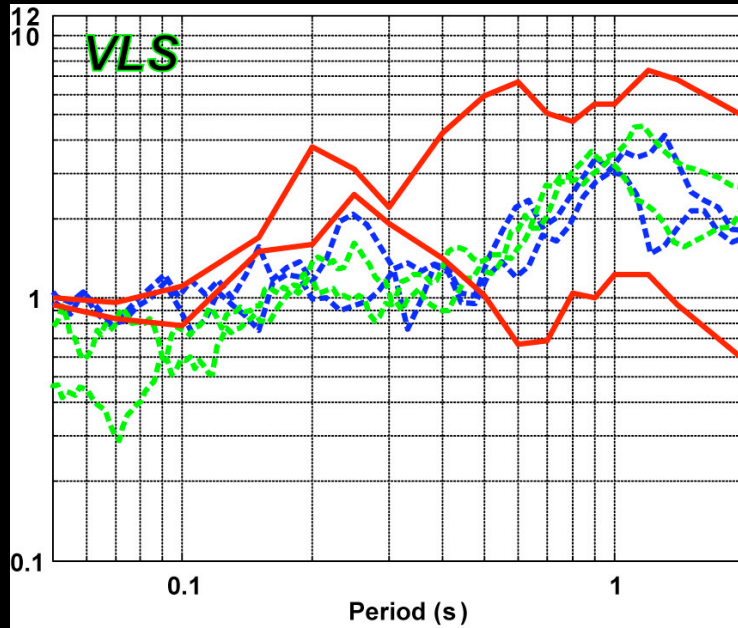


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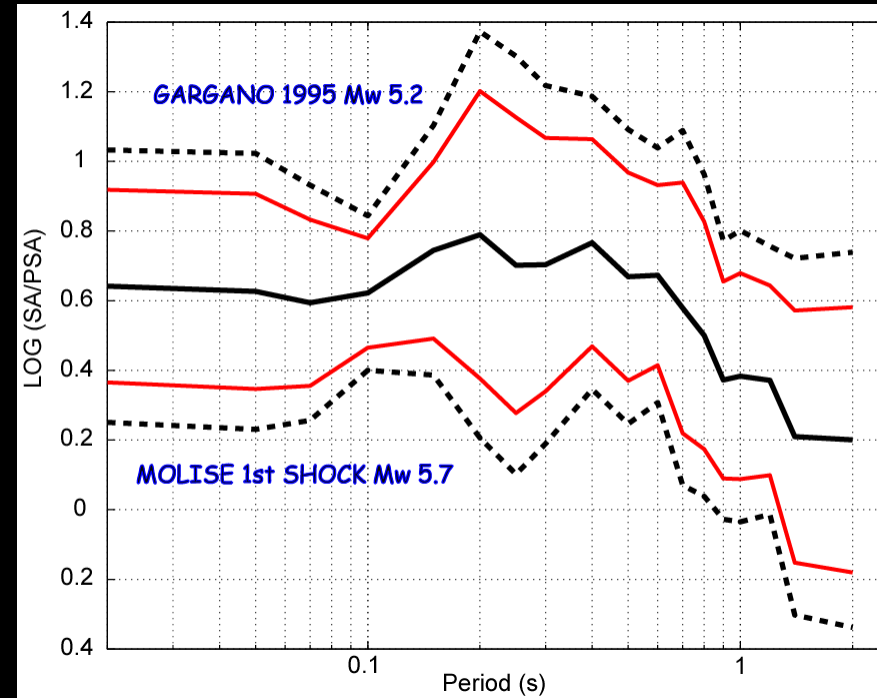
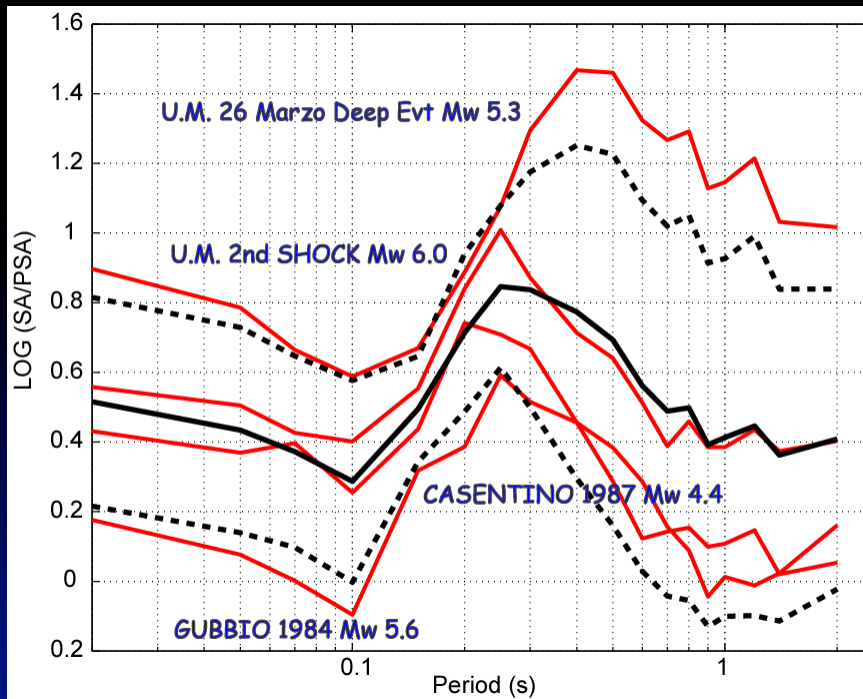
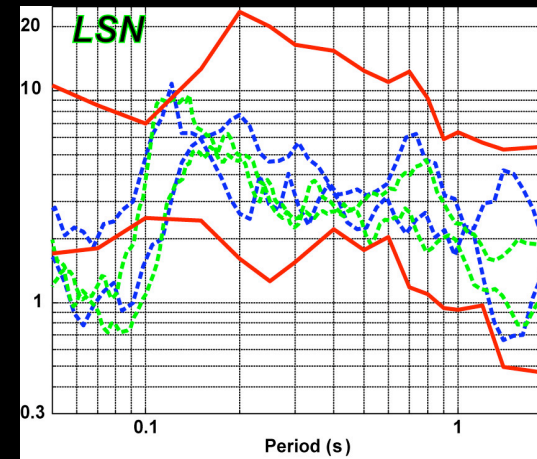
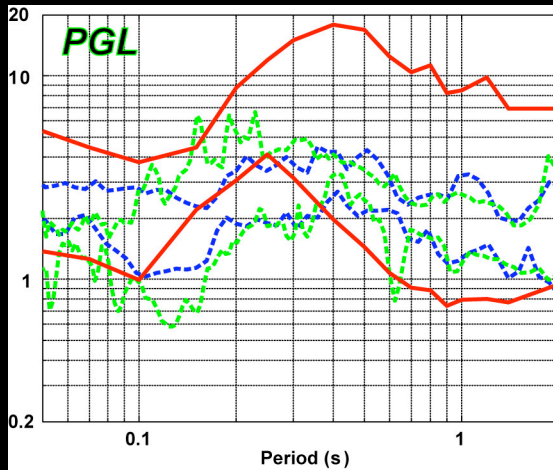
ANOM. SITE IDENTIFICATION



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ANOM. RECORD IDENTIFICATION



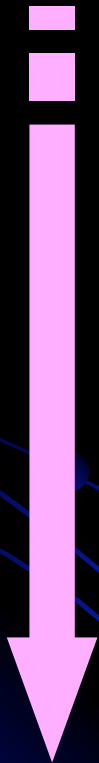


ANOM. SITE IDENTIFICATION

SITE CHARACTERIZATION

- SOURCES:

DEGREE of SUBJECTIVITY



I.T.A.C.A Database

EC8 / Vs30 / EHVSr / Stratigraphy

GIS (2004-2006 S4 Project)

Vs30 AB > 360 m/s Vs30 CD < 360 m/s

SERVIZIO SISMICO NAZIONALE (now DPC) info

Rock / Hard Soil / Soil

PERSONAL CHOICE based on GEOLOGIC MAPs

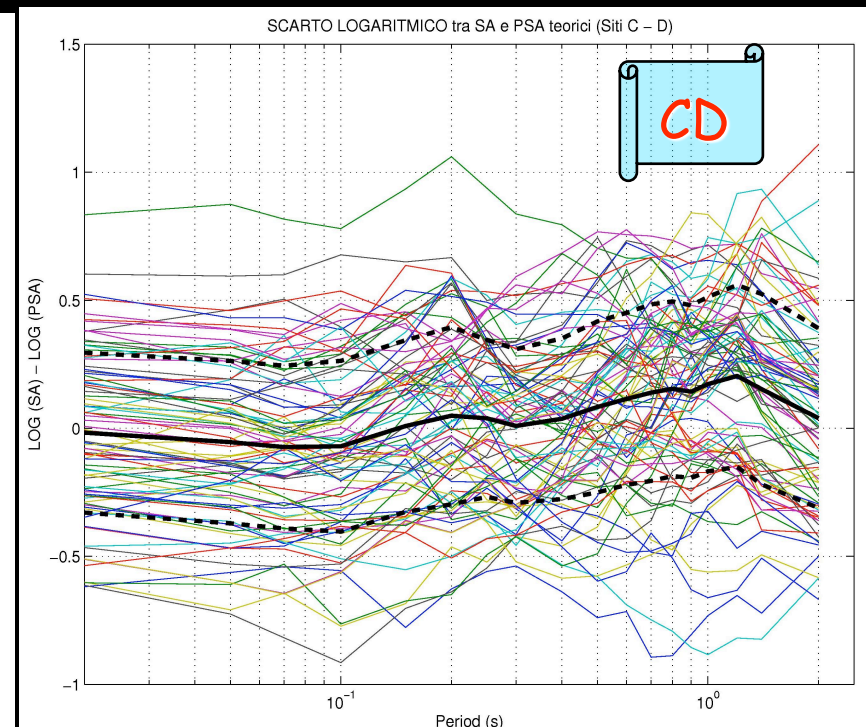
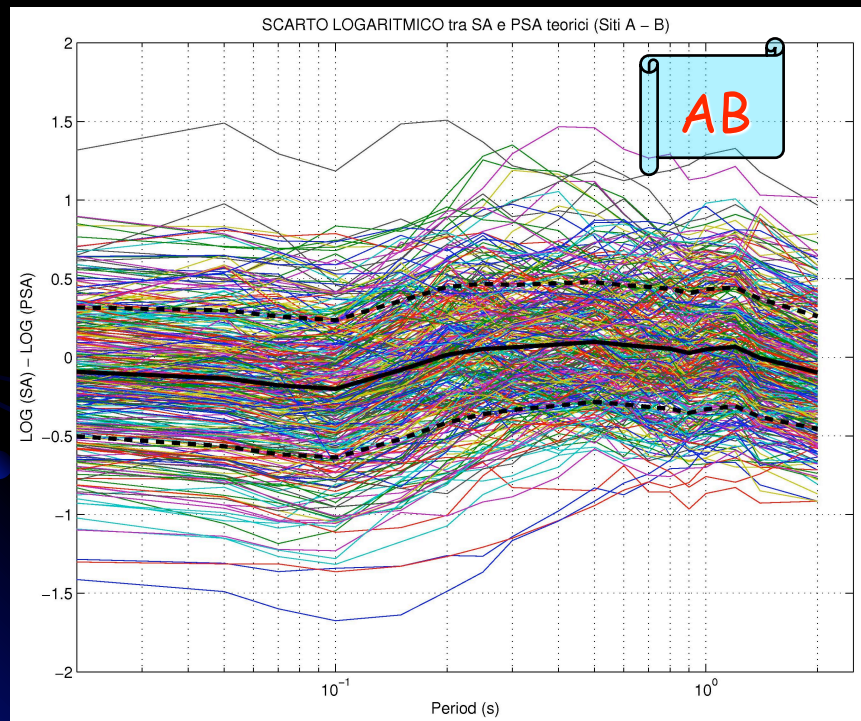


ANOM. SITE IDENTIFICATION

RESIDUALS SA - PSA

- LOGARITMIC RESIDUALS: $\text{Log}_{10} (\text{SA}/\text{PSA}_{\text{site}})$

1- For each record



2- Average for each station