Site characterization of accelerometer stations in Greece & Seismic Codes

Nikos Theodoulidis
ITSAK-EPPO, Thessaloniki, Greece

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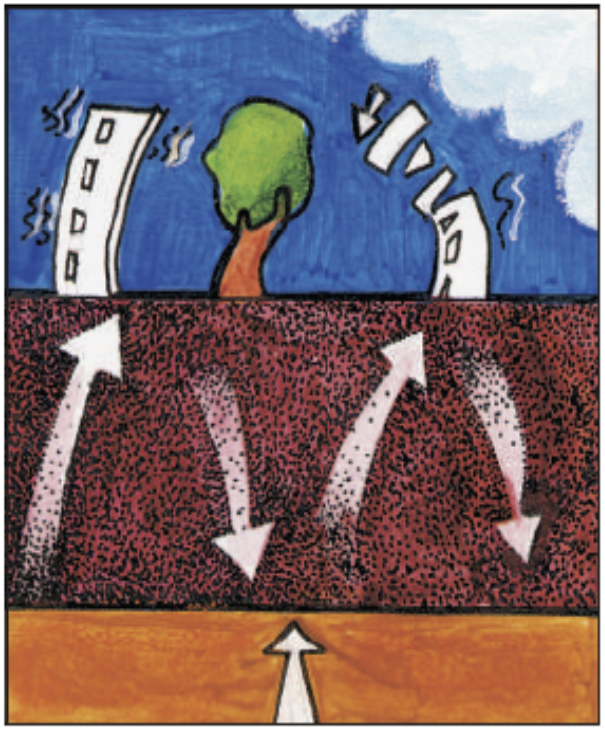
SciNet NatHaz Prevention
Black Sea CROSS BORDER COOPERATION
Common Borders. Common Solutions.

OUTLINE

- Why?
- Physics
- Parameters Measurement
- Use & Application

Why?



Source : Laurence Barret

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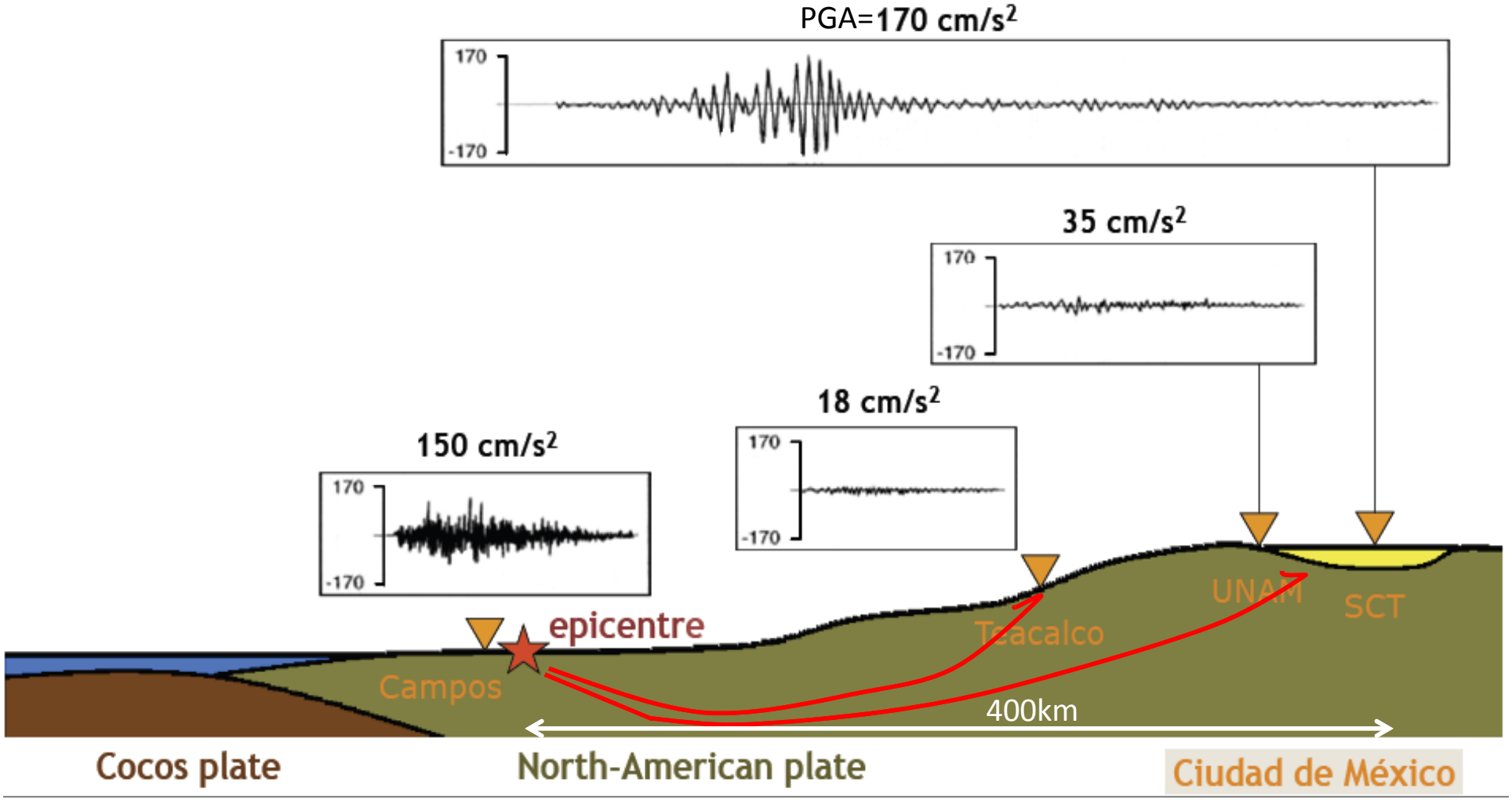
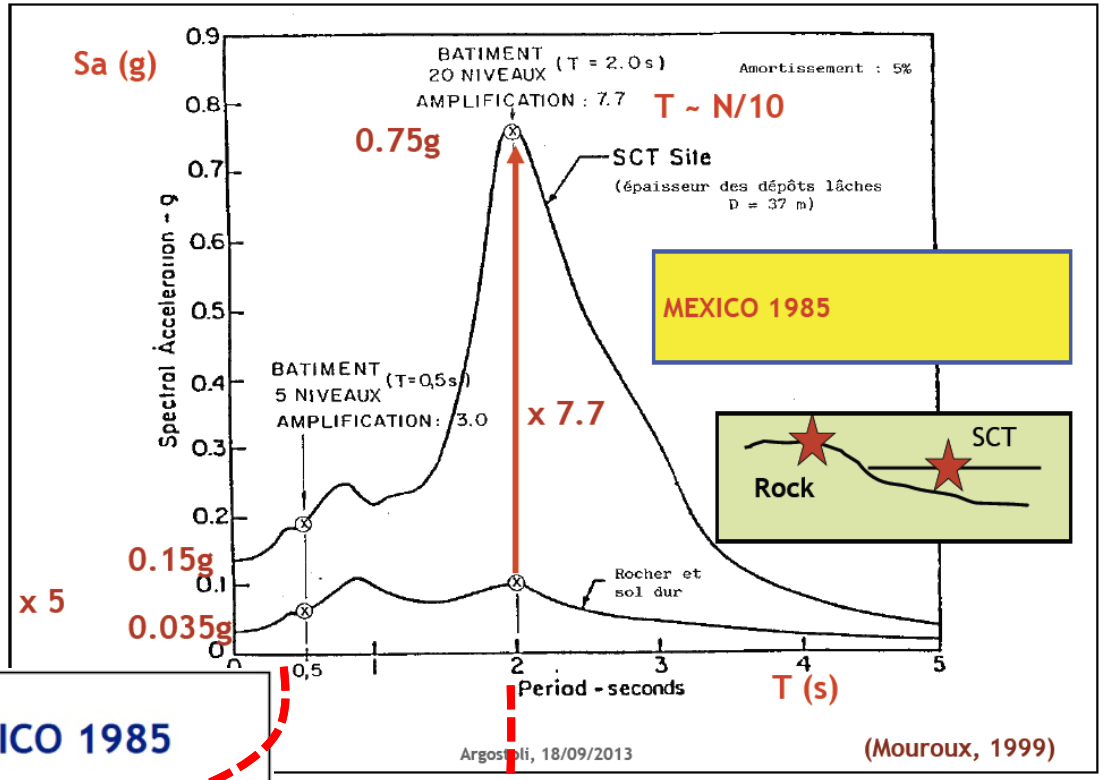
Mexico City lake-bed area: local site effects



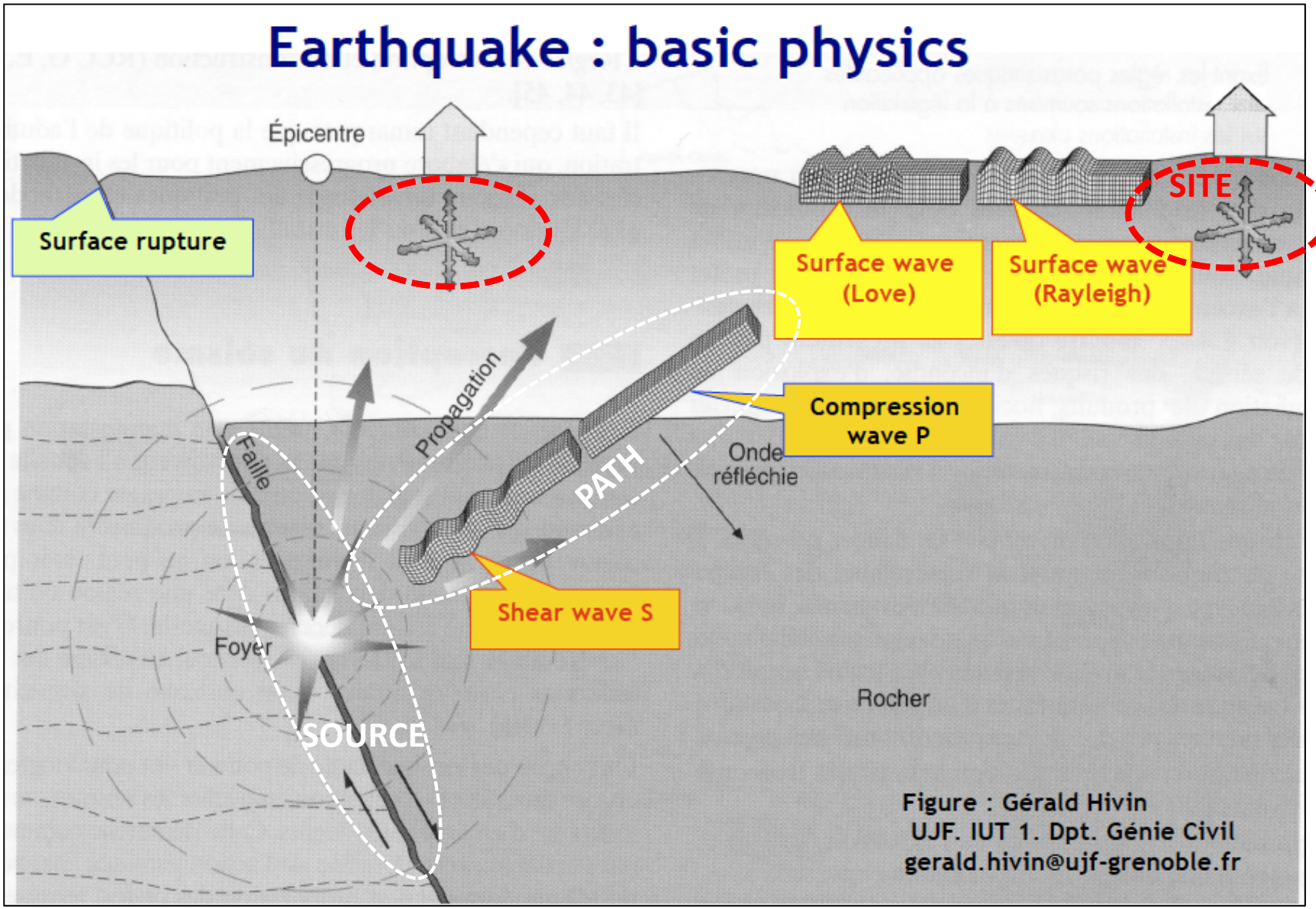


2-story (old) building : no damage

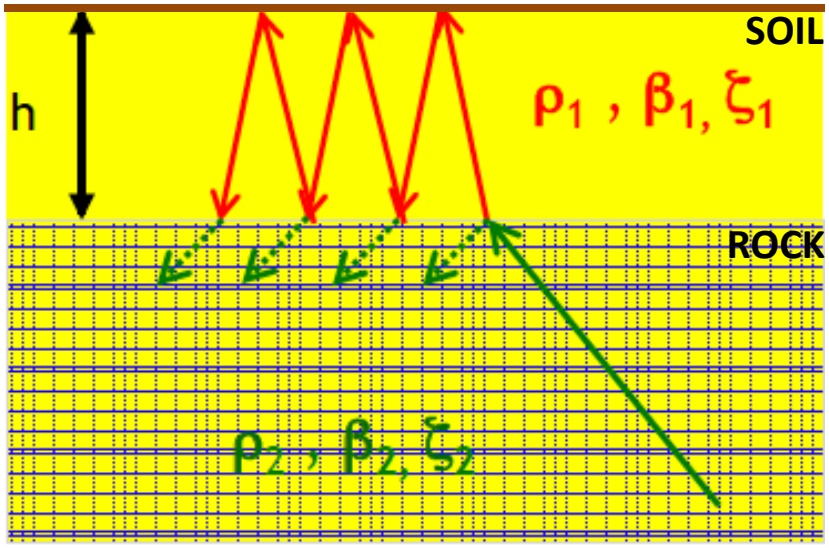
MEXICO 1985

10-20 story building (Hospital)

Physics


Earthquake : basic physics
Épicentre
Surface rupture
SITE
Surface wave (Love)
Surface wave (Rayleigh)
Propagation
Compression wave P
Faille
PATH
Onde réfléchie
Shear wave S
Foyer
SOURCE
Rocher
Figure : Gérald Hivin
UJF. IUT 1. Dpt. Génie Civil
gerald.hivin@ujf-grenoble.fr

1D Site Dynamic Response



Transfer function (Fourier)

$$H(f) = 2\,C \,/\, [C \,.\, \cos(2\pi fh/\beta_1) + i.\, \sin(2\pi fh/\beta_1)$$

Resonance frequencies

- Fundamental mode: $f_0 = \beta_1/4h$
- Harmonics $f_n = (2n+1)\, f_0$

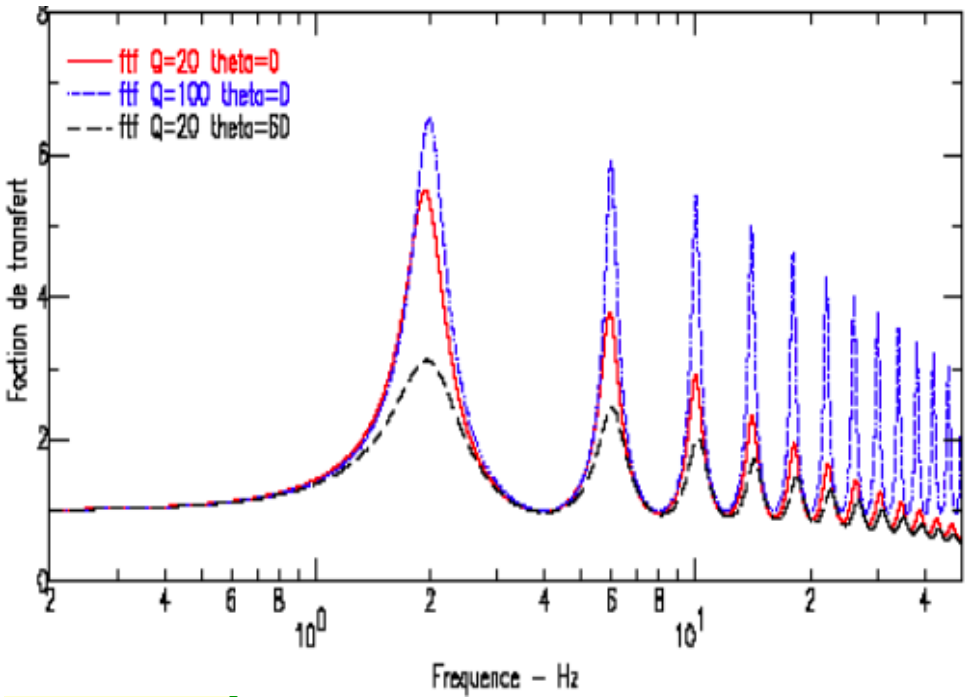
Amplification

- Elastic case

  $A_0 = |H(f_0)/2| = C = \rho_2.\beta_2/\rho_1.\beta_1$
- With damping ζ_1:

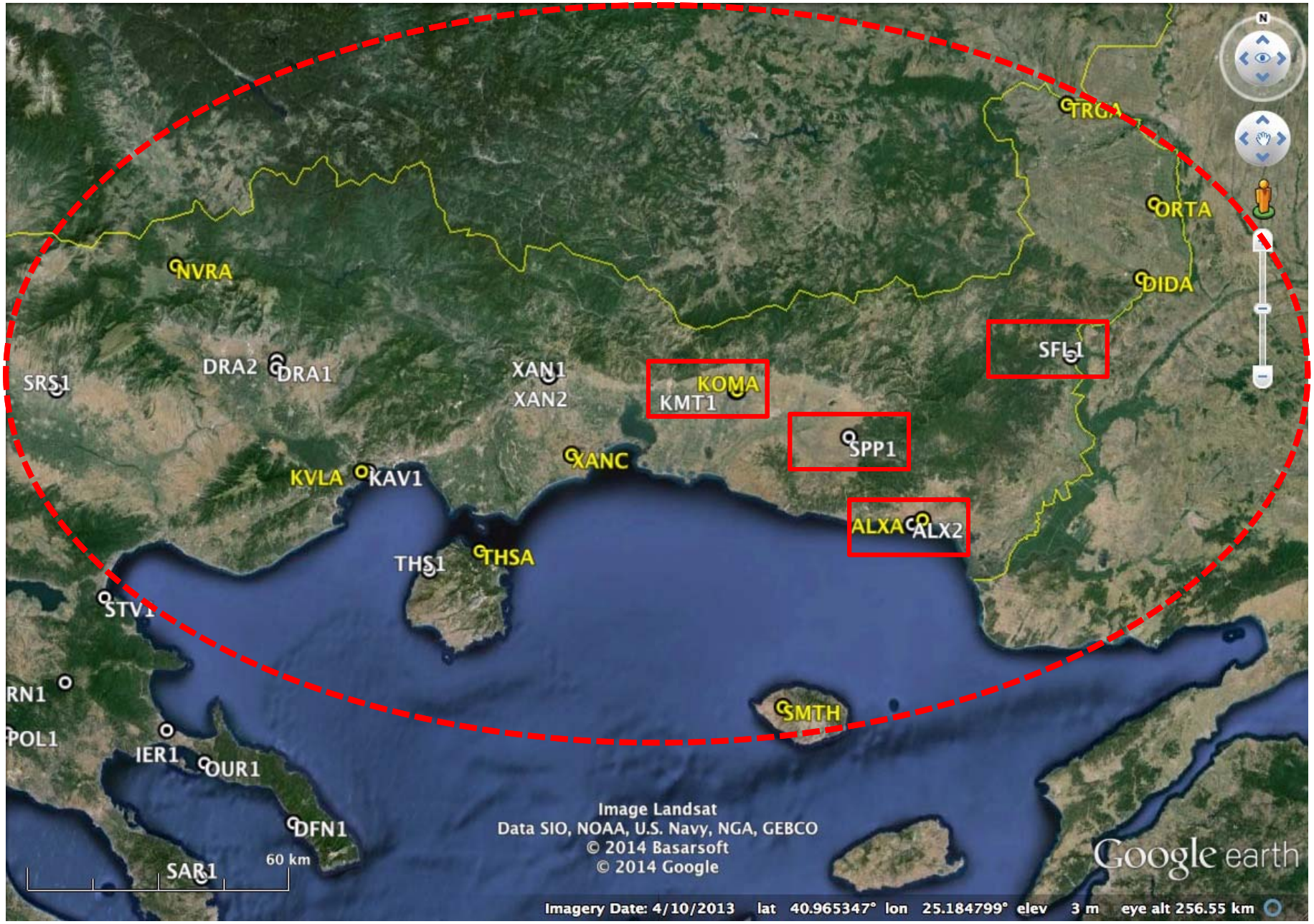
  $A_0 = C \,/\, (1 + 0{,}5\,\pi\,\zeta_1\, C)$

$$C = \rho_2\beta_2/\rho_1\beta_1$$



Parameters Measurement

Accelerometer Stations in the project Eligible Area



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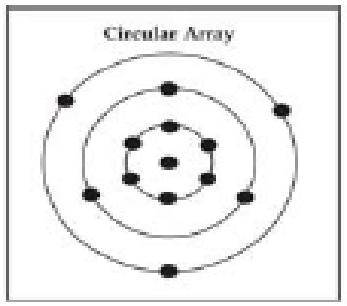
Simplified Procedure for Ambient Noise Analyses:

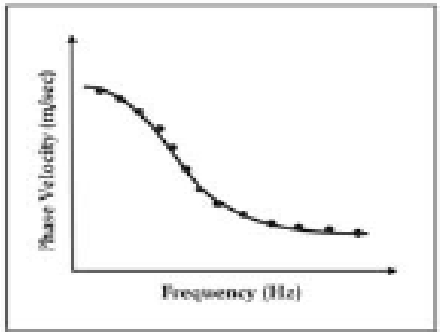
Seismometers Array Technique

Seismometers' Array



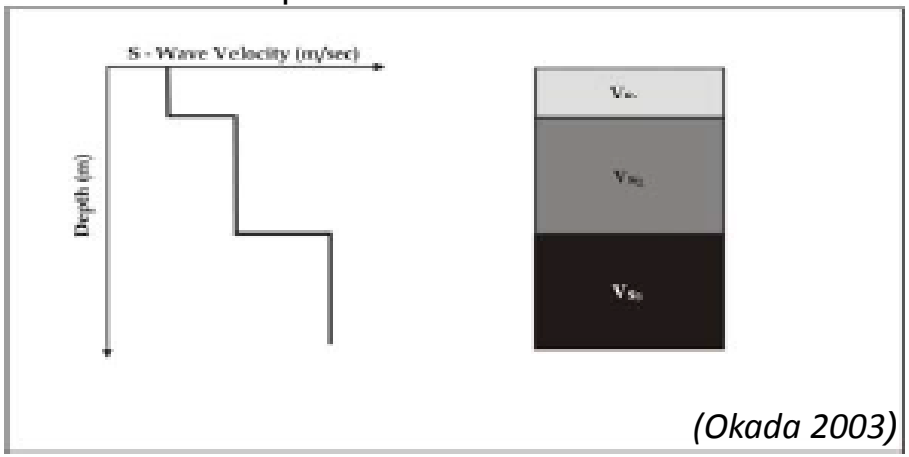
f-k Method

Dispersion Curve of Surface Waves



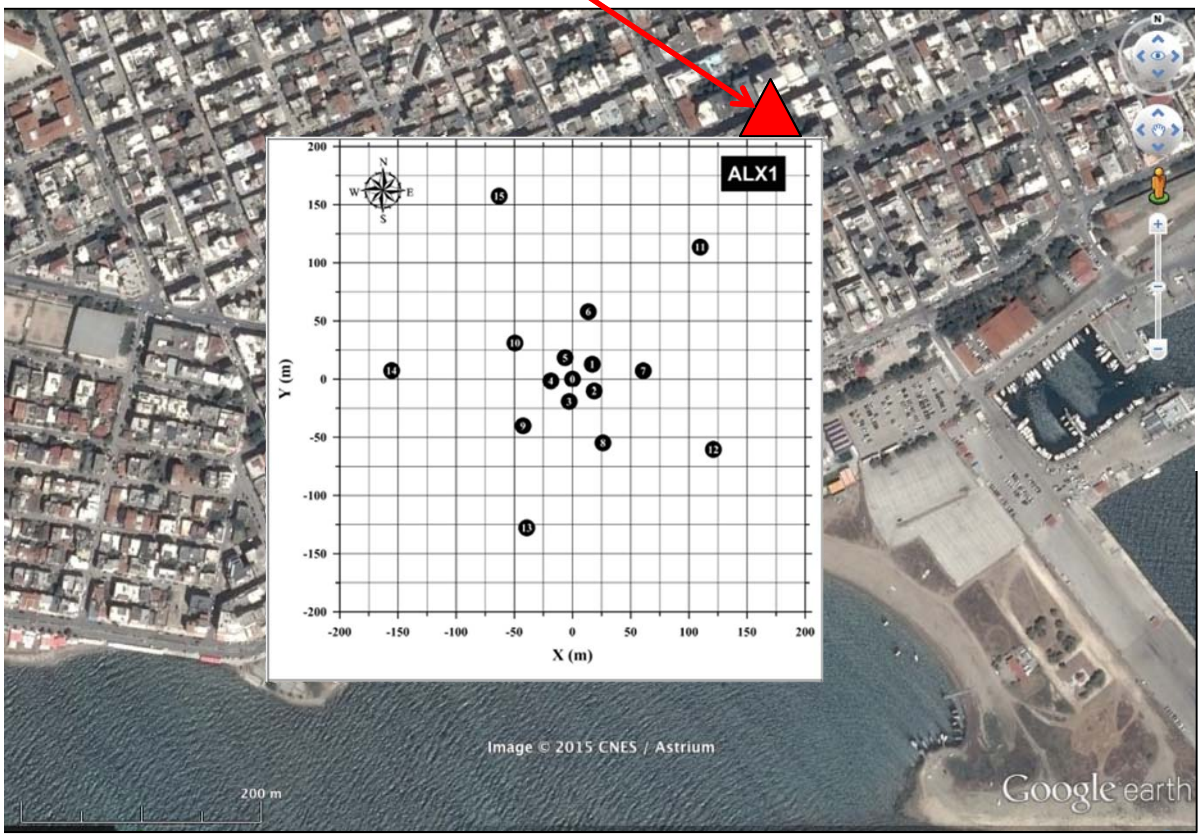
Inversion

Dispersion Curve's Inversion



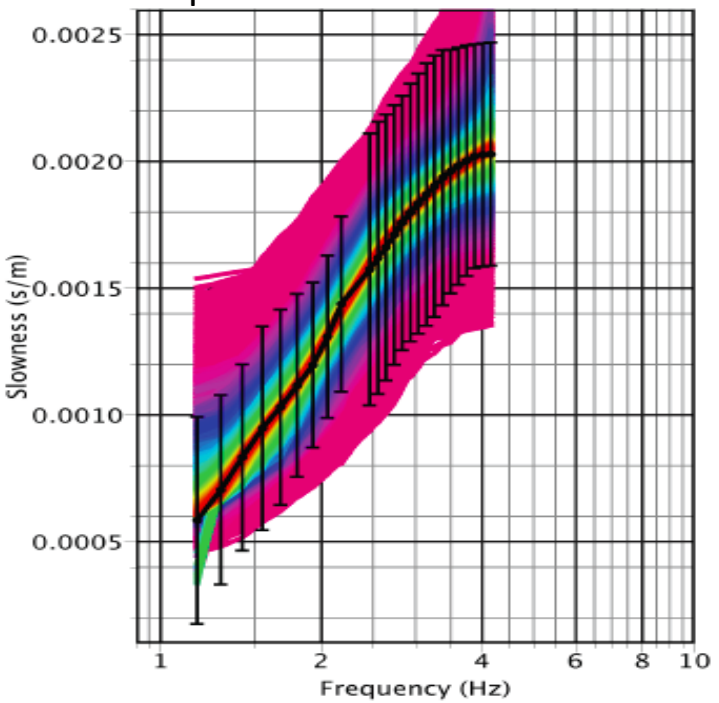
(Okada 2003)

ALEXANDROUPOLI

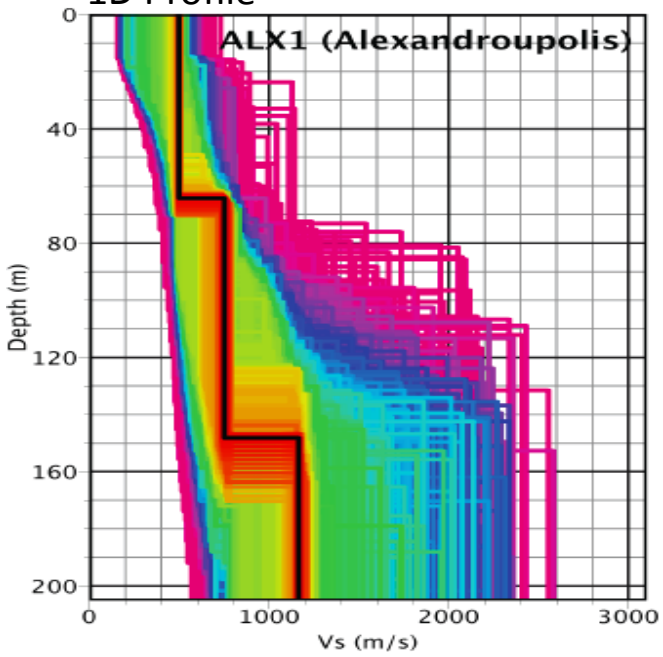


Savvaidis et al. (2015)

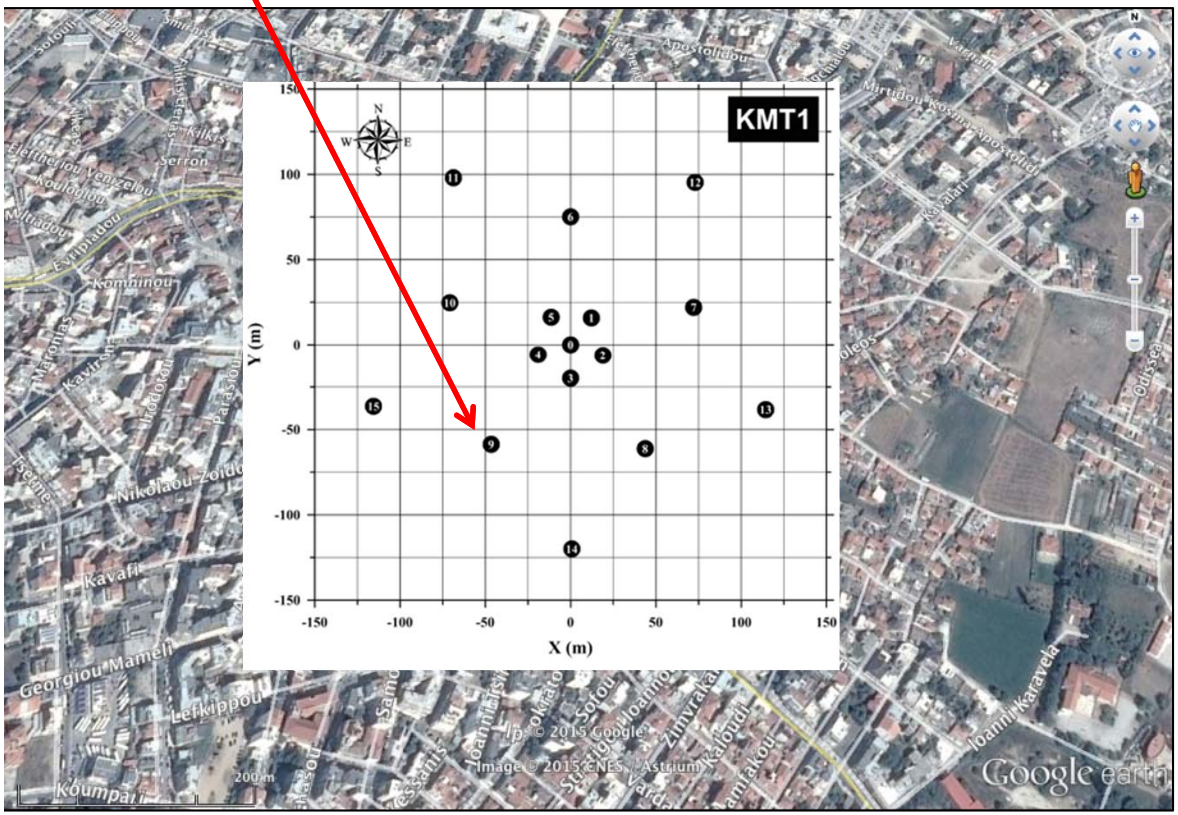
Dispersion Curve



1D Profile

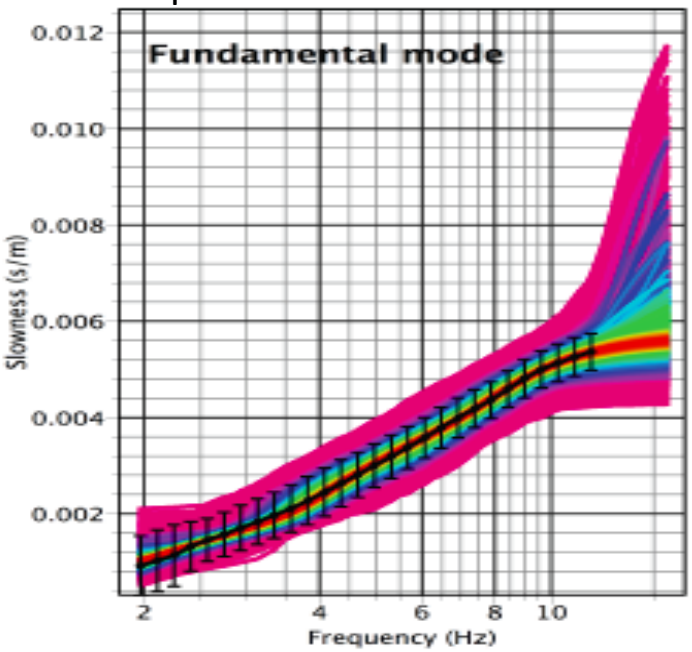


KOMOTINI

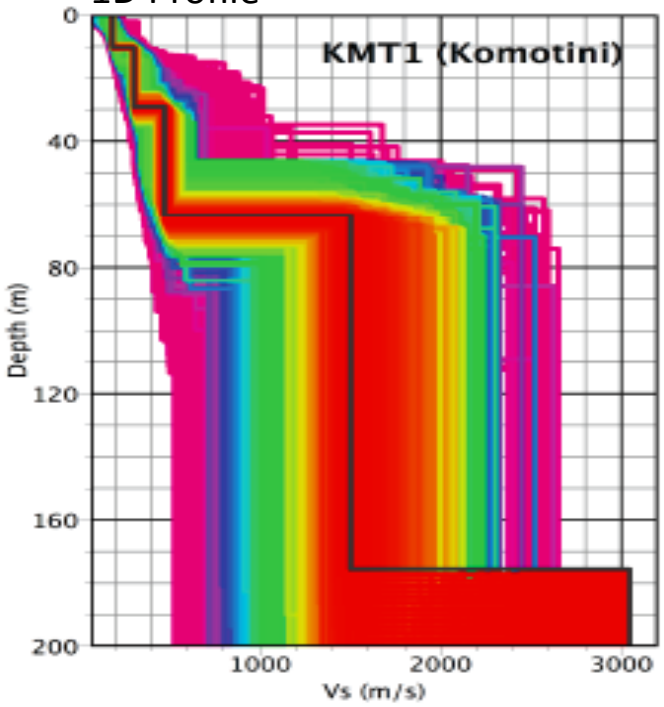


Savvaidis et al. (2015)

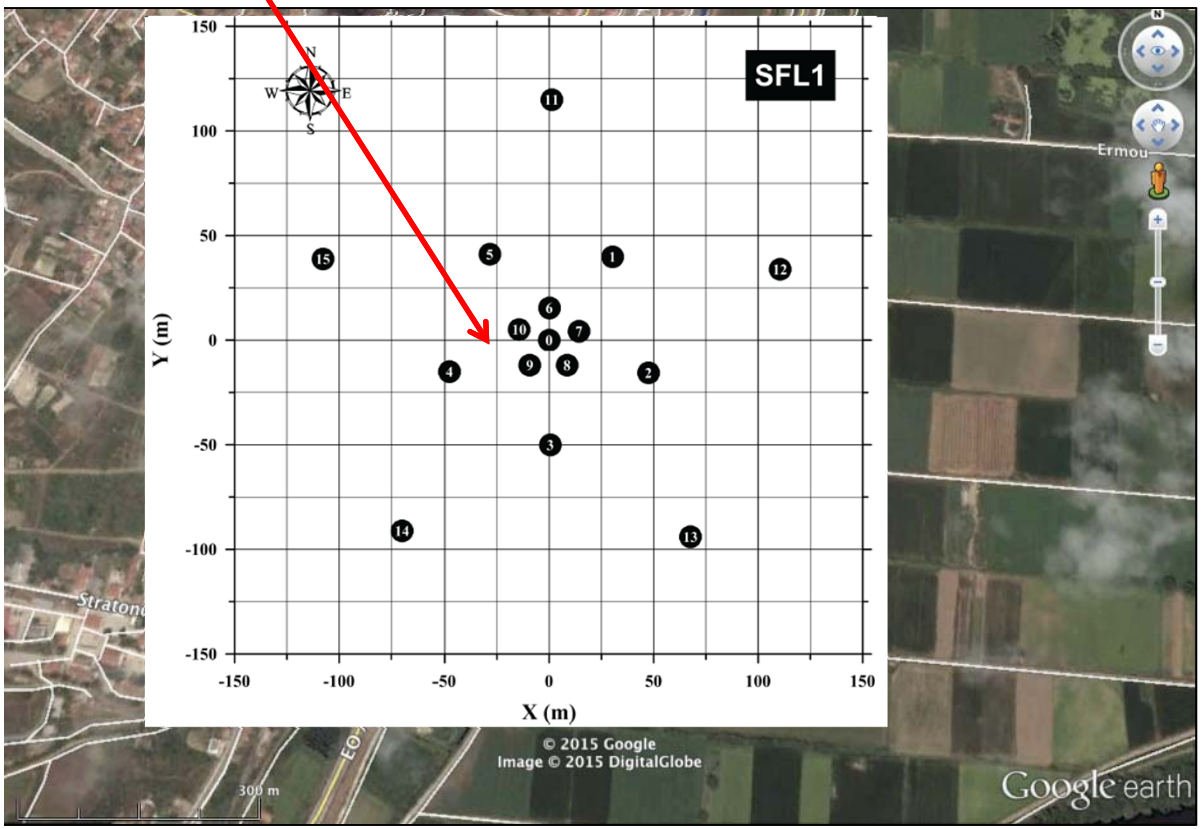
Dispersion Curve



1D Profile

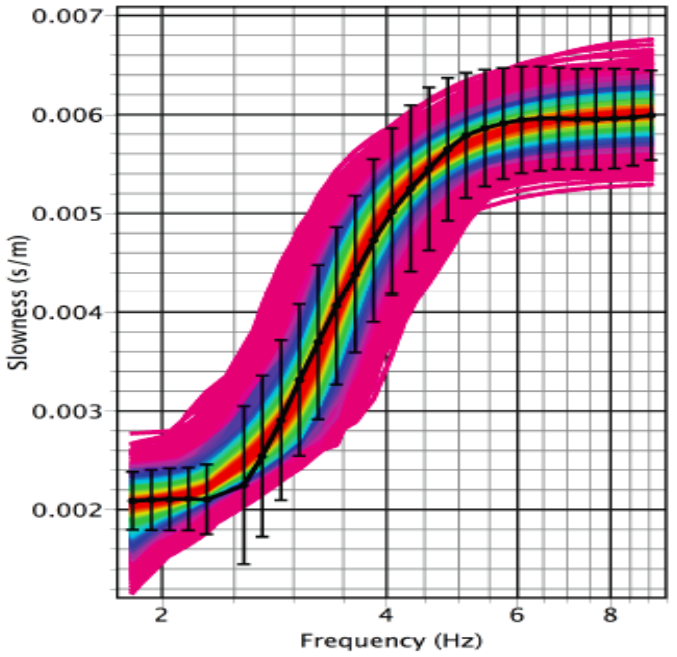


SOUFLI

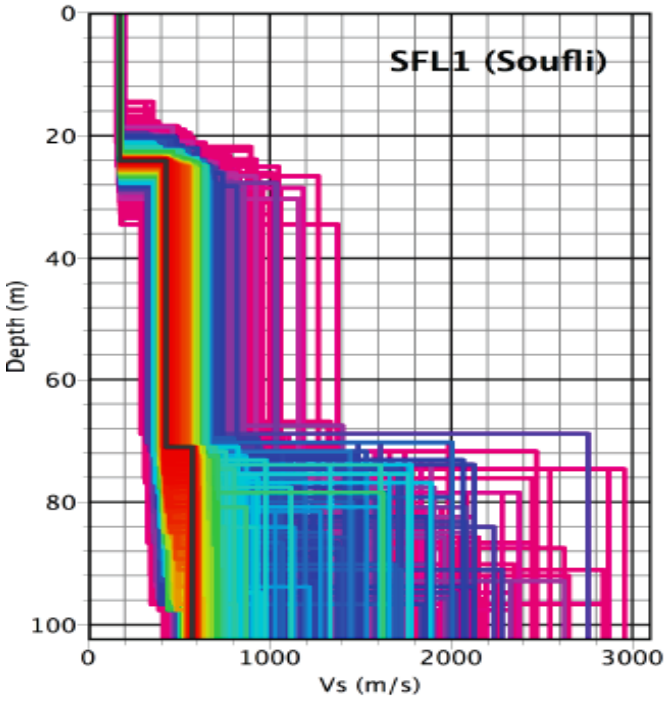


Savvaidis et al. (2015)

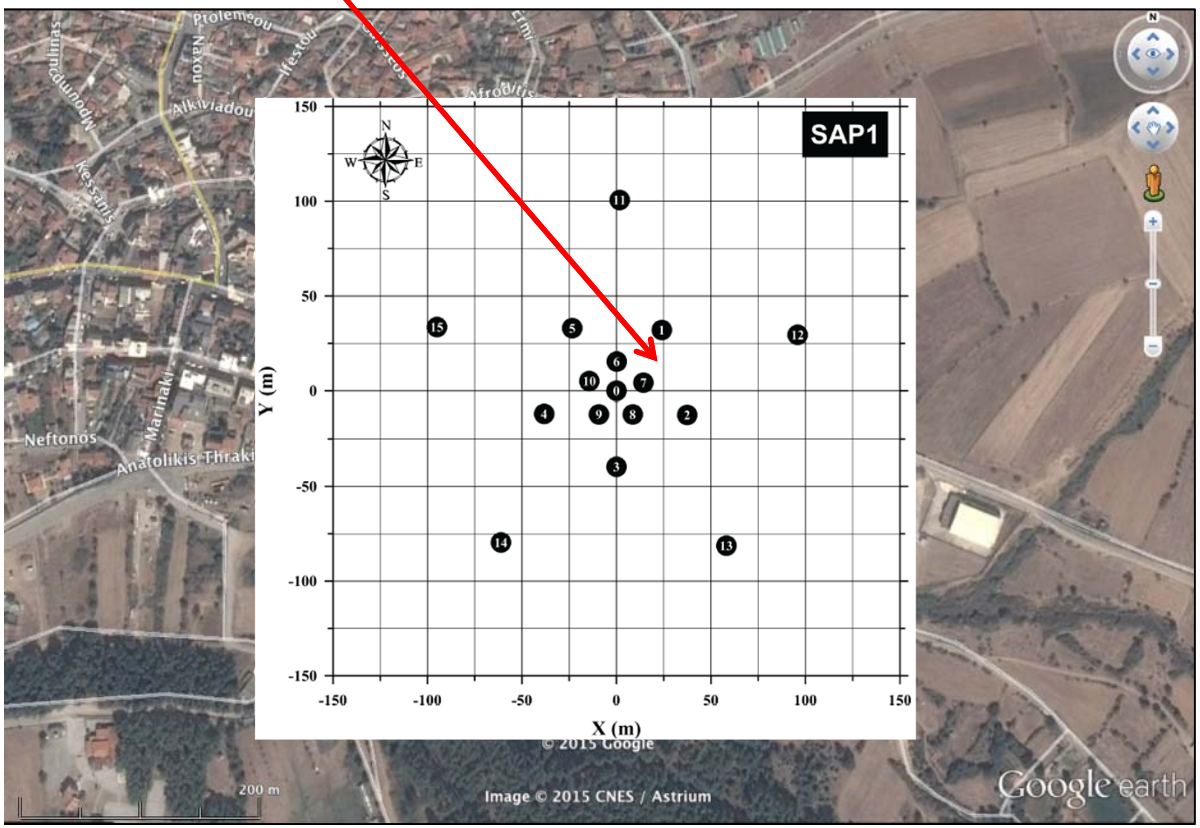
Dispersion Curve



1D Profile

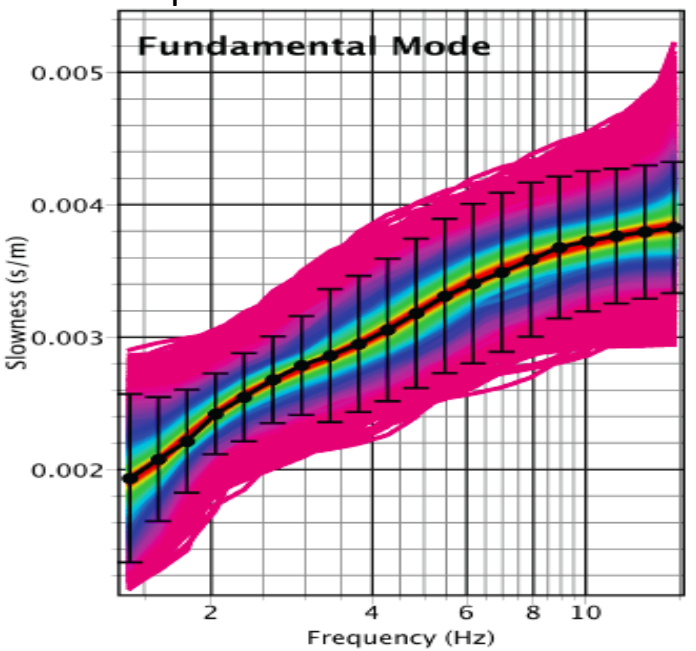


SAPPES

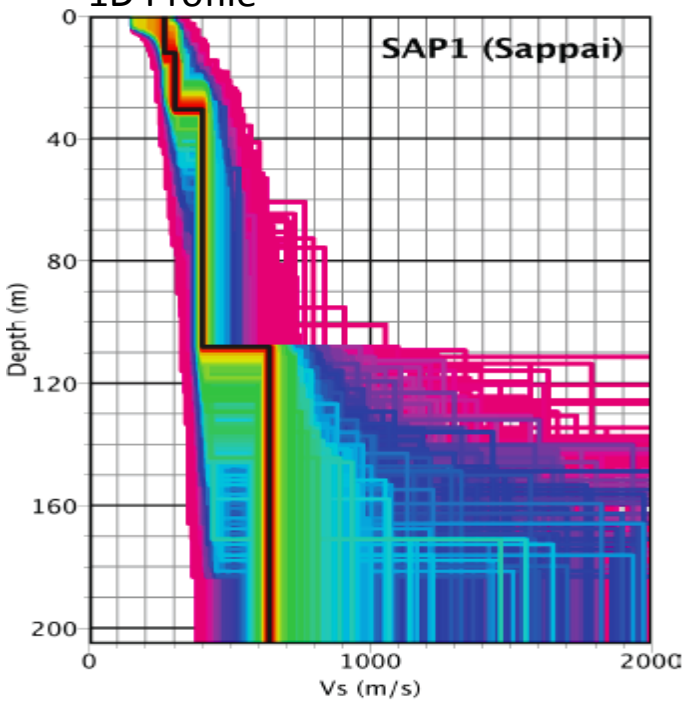


Savvaidis et al. (2015)

Dispersion Curve



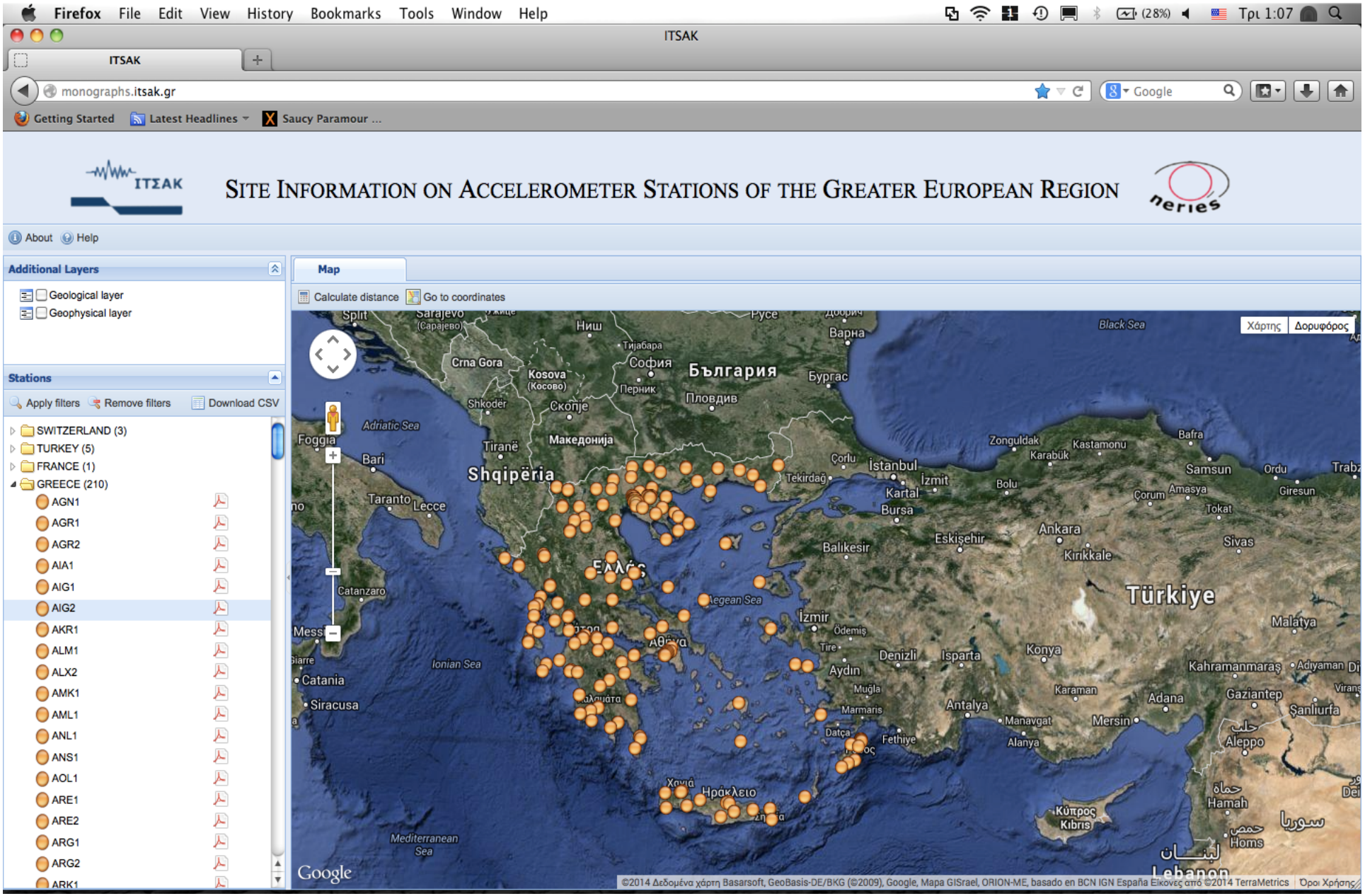
1D Profile



Use & Application

ACCELEROMETER NETWORK – ITSAK

web page: monographs.itsak.gr



ACCELEROMETER NETWORK – ITSAK

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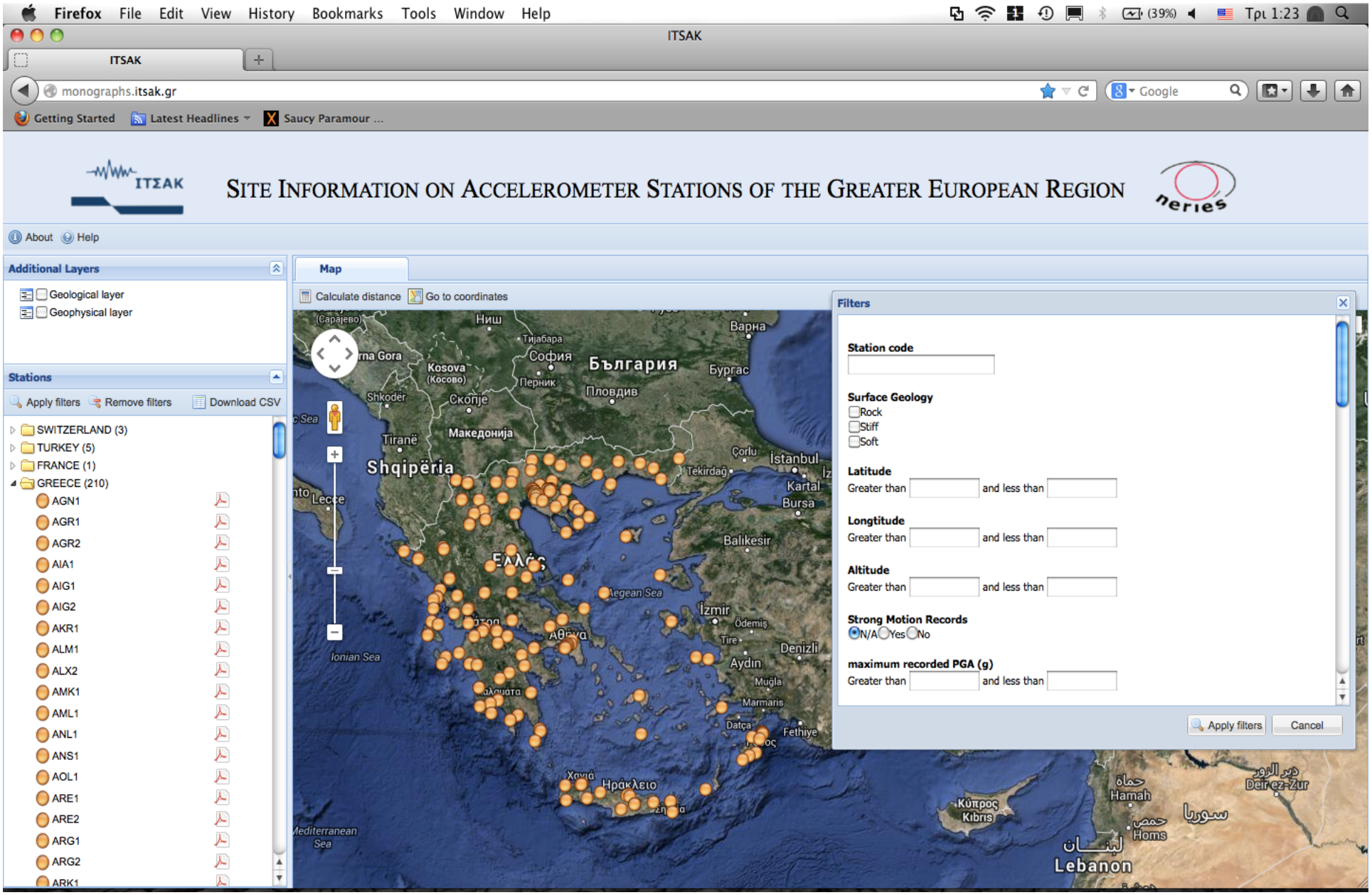

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ACCELEROMETER NETWORK – ITSAK

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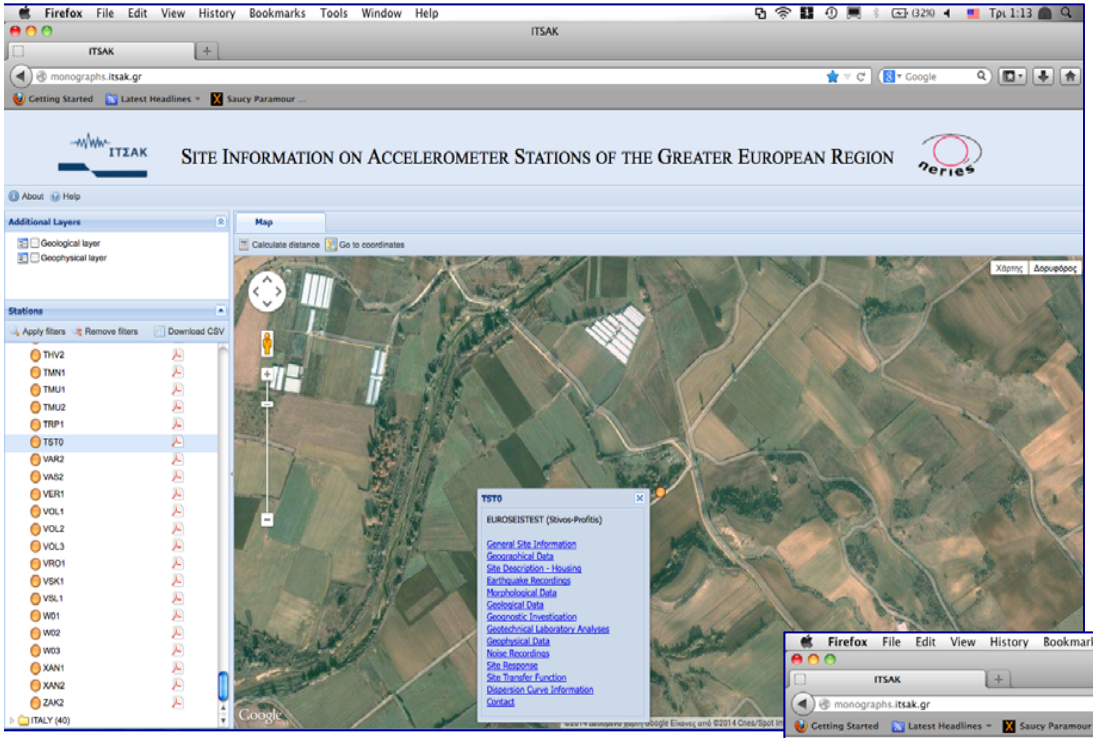

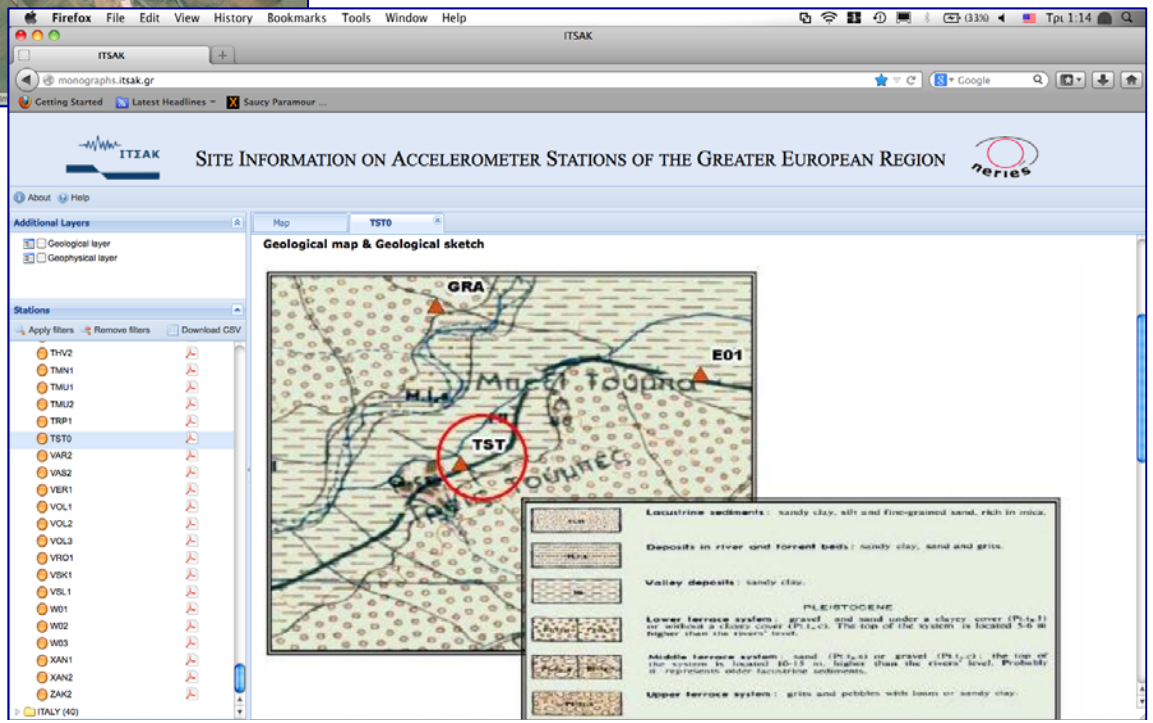

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ACCELEROMETER NETWORK – ITSAK

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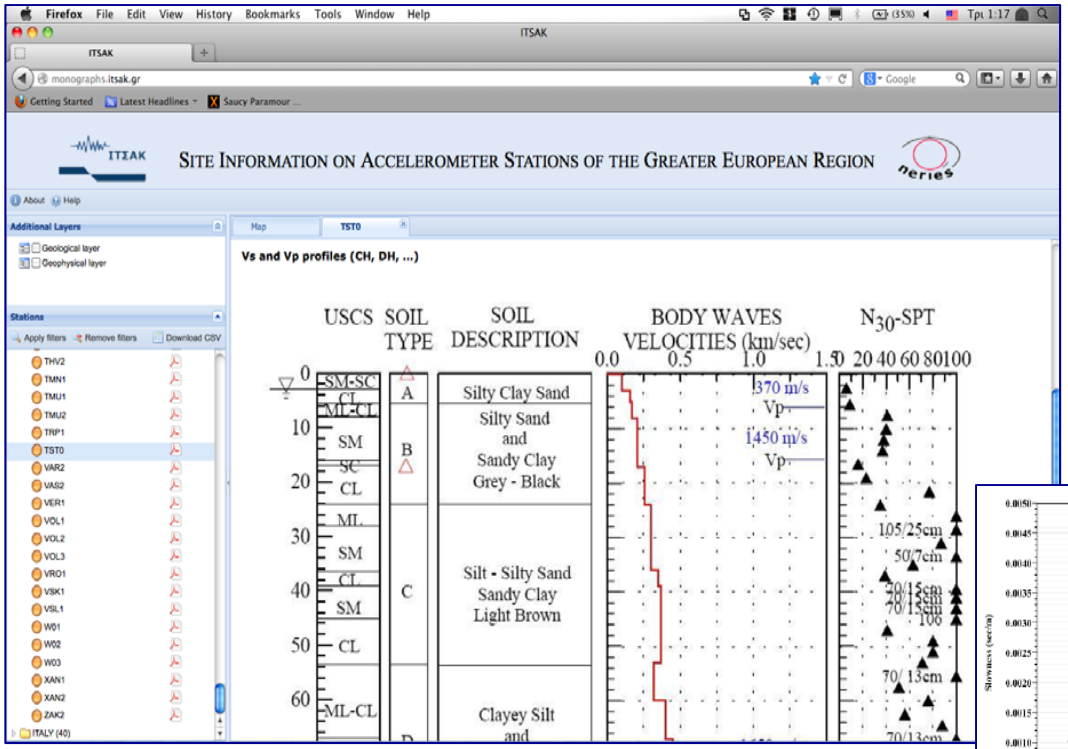

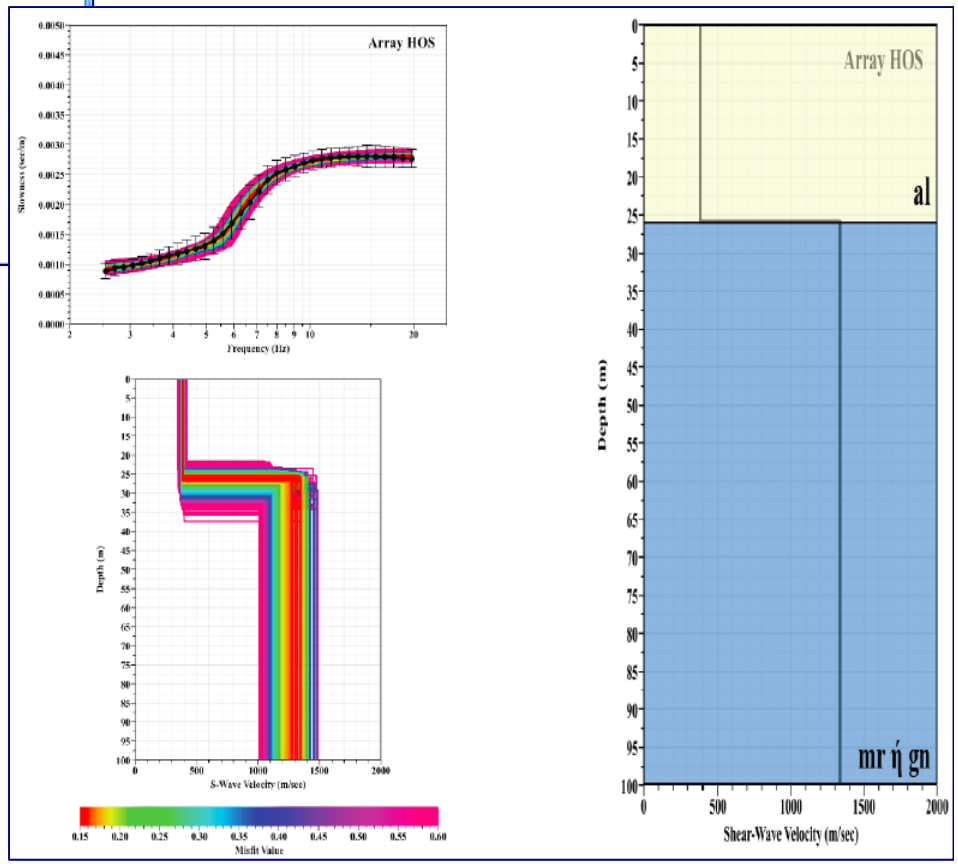

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EC8 DESIGN SPECTRA

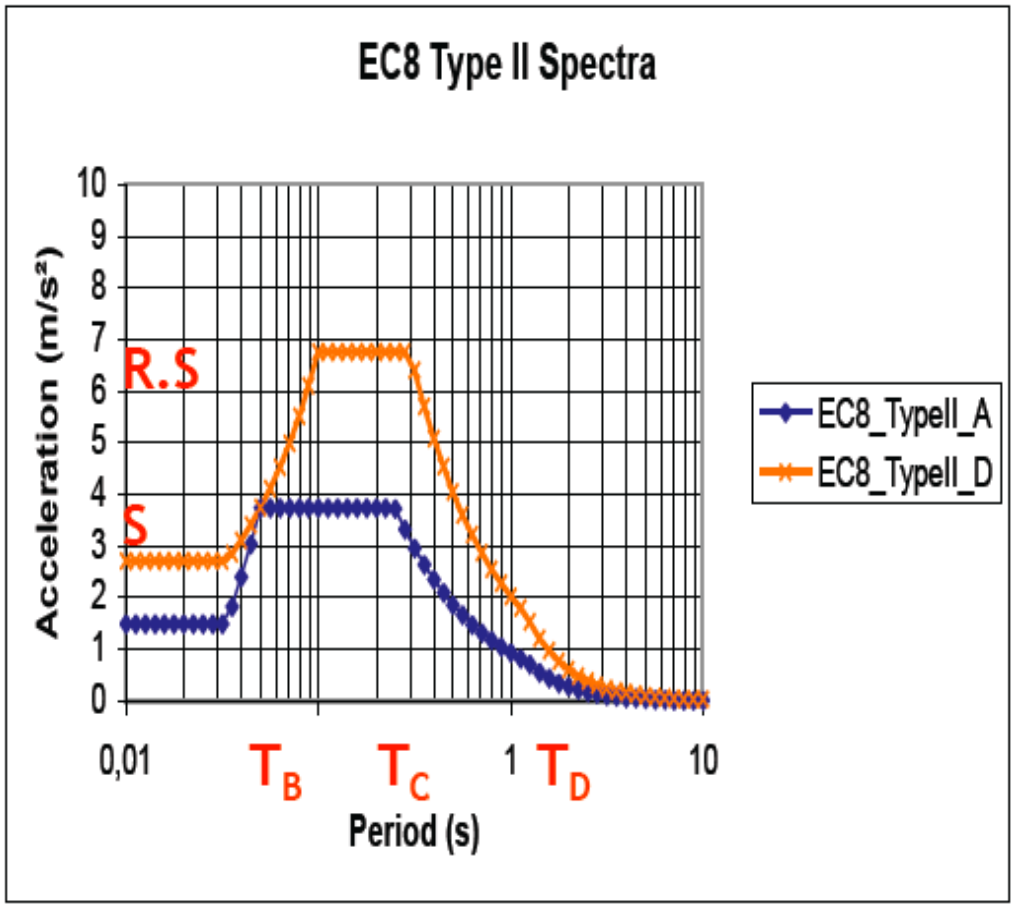
Spectral shapes : control parameters

- S : high-frequency amplification
- R : plateau level
- T_B, T_C : position and plateau width
- T_D : long period level

Dependency on site conditions

- Depends on site classes
- Today : V_{S30}

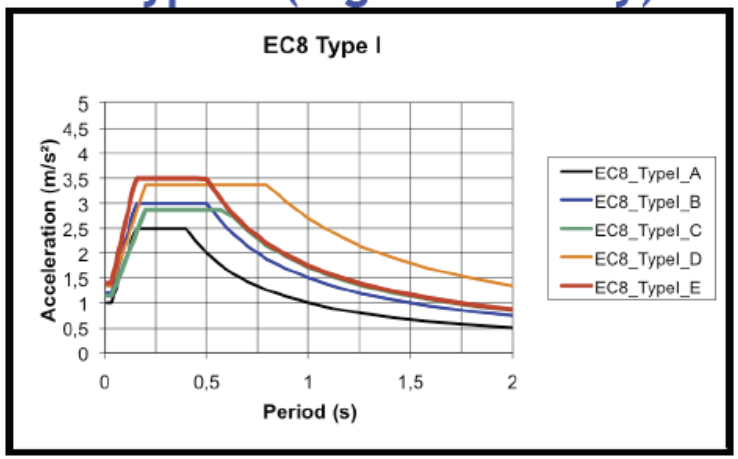
- A : V_{S30} > 800 m/s
- B : $V_{S30} \subset$ [360, 800 m/s]
- C : $V_{S30} \subset$ [180, 360 m/s]
- D : $V_{S30} \subset$ [100, 180 m/s]
- E : soft & thin layer (h < 20 m) over hard bedrock



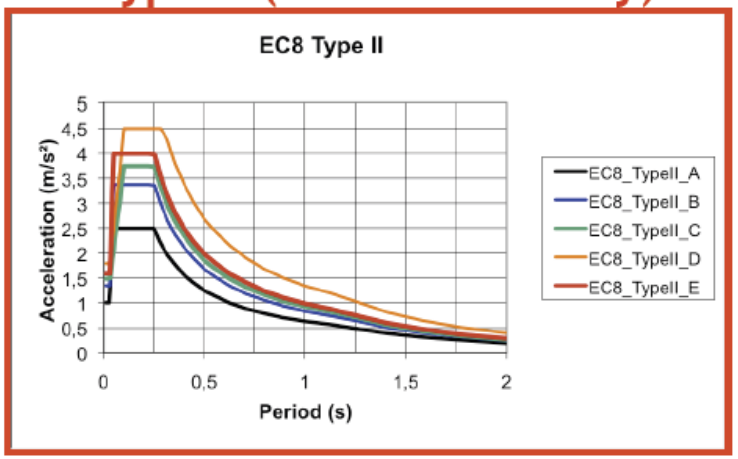
EC8 DESIGN SPECTRA

EC8 recommendations : 2 types

Type 1 (high seismicity)



Type 2 (weak seismicity)



Classe	S	T_B	T_C	T_D
A	1	0,15	0,4	2
B	1,2	0,15	0,5	2
C	1,15	0,20	0,6	2
D	1,35	0,20	0,8	2
E	1,40	0,15	0,5	2

Classe	S	T_B	T_C	T_D
A	1	0,05	0,25	1,2
B	1,35	0,05	0,25	1,2
C	1,50	0,10	0,25	1,2
D	1,80	0,10	0,30	1,2
E	1,60	0,05	0,25	1,2

CONTRIBUTION IN SEISMIC HAZARD ASSESSMENT

- Site characterization using measured values and proxies
- Exploitation of strong motion data to its full potential
- Incorporation of reliable site parameters in GMPEs

CONTRIBUTION IN PRACTICE TOWARDS ASEISMIC PROTECTION

- Seismic Codes & Design Spectra
- Microzonation Studies & Settlements Extension
- Site Specific Studies for Important Structures

Teşekkür ederim

Ευχαριστώ

Mulțumesc

Спасибі

благодаря

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Savvaidis A.
Theodoulidis N.
Zacharopoulos S.