

Site characterization of accelerometer stations in Greece & Seismic Codes

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SeiNet NatHaz
Prevention



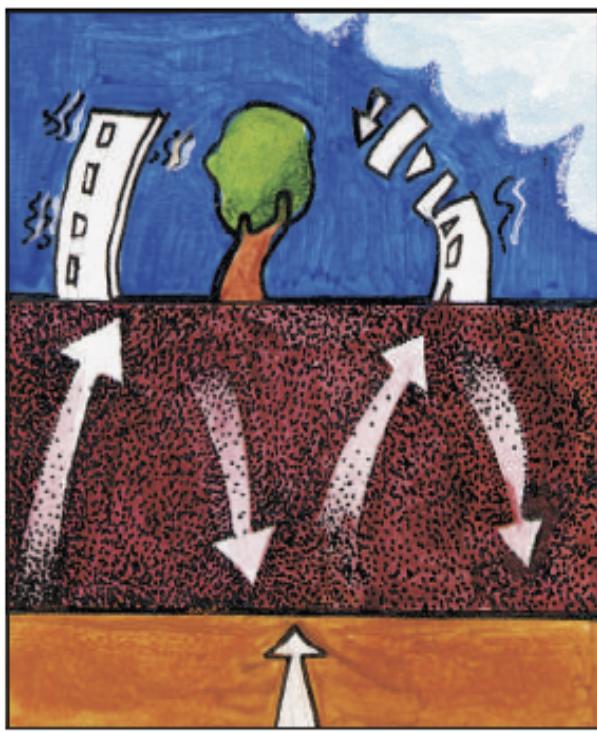
Black Sea
CROSS BORDER
COOPERATION

Common Borders. Common Solutions.

OUTLINE

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

Why?



Source : Laurence Barret

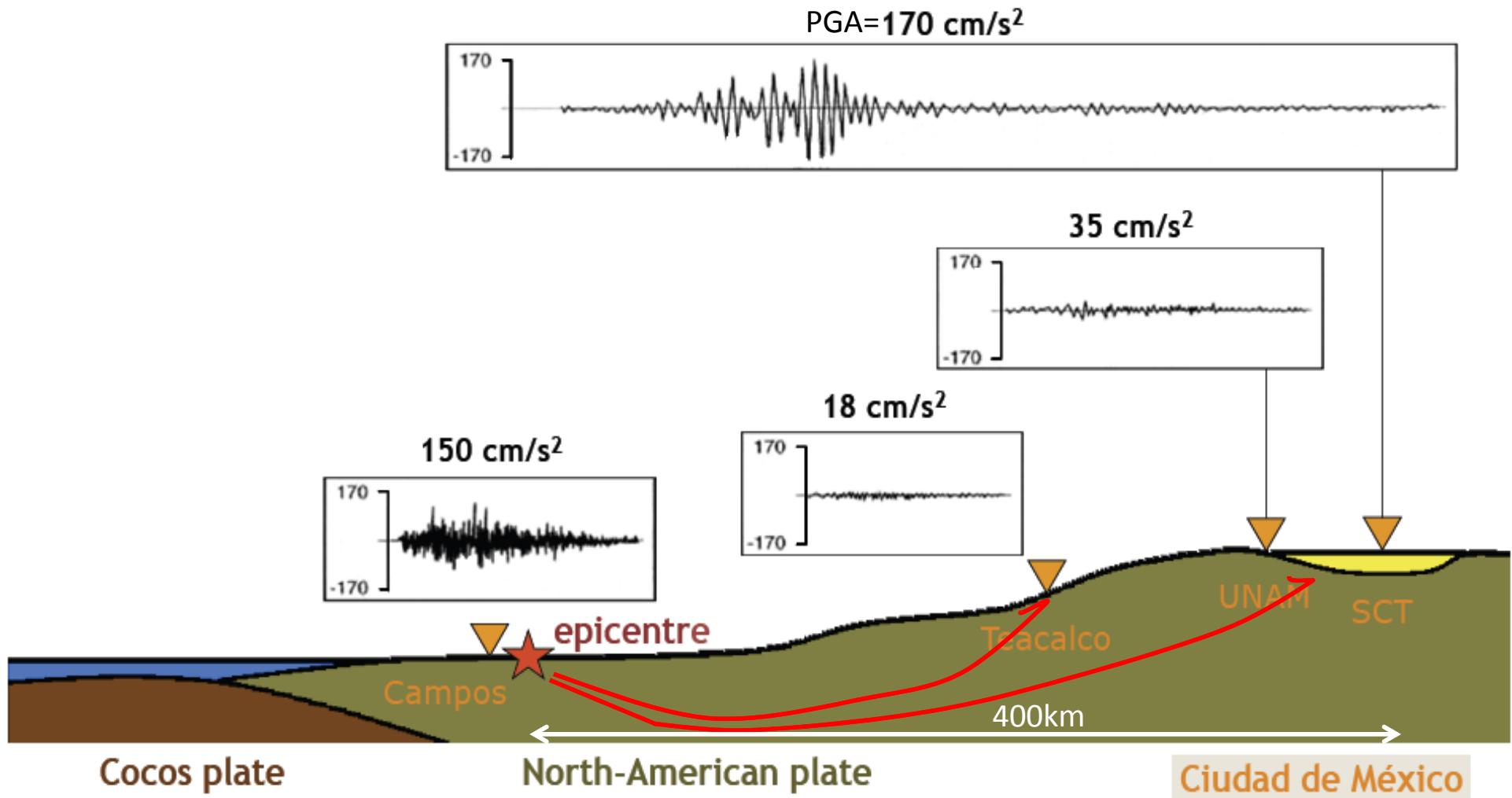


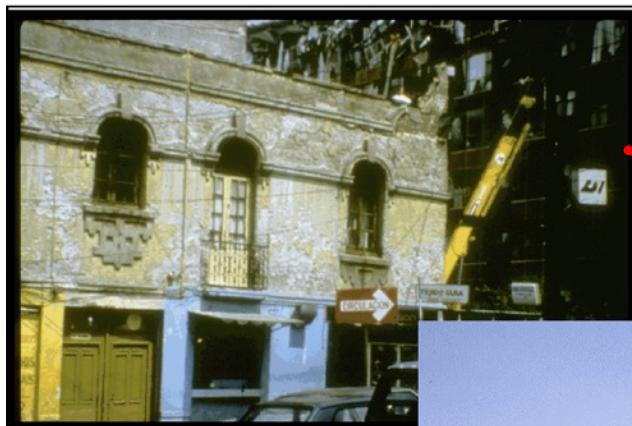
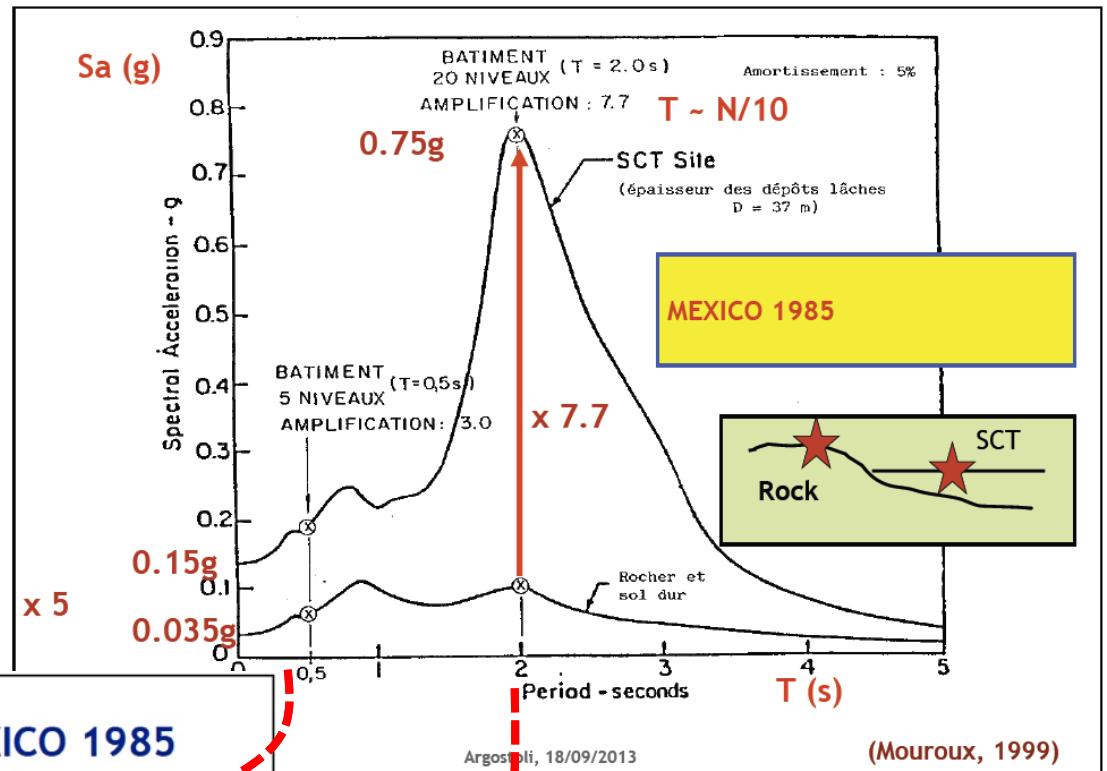
Source : Laurence Barret



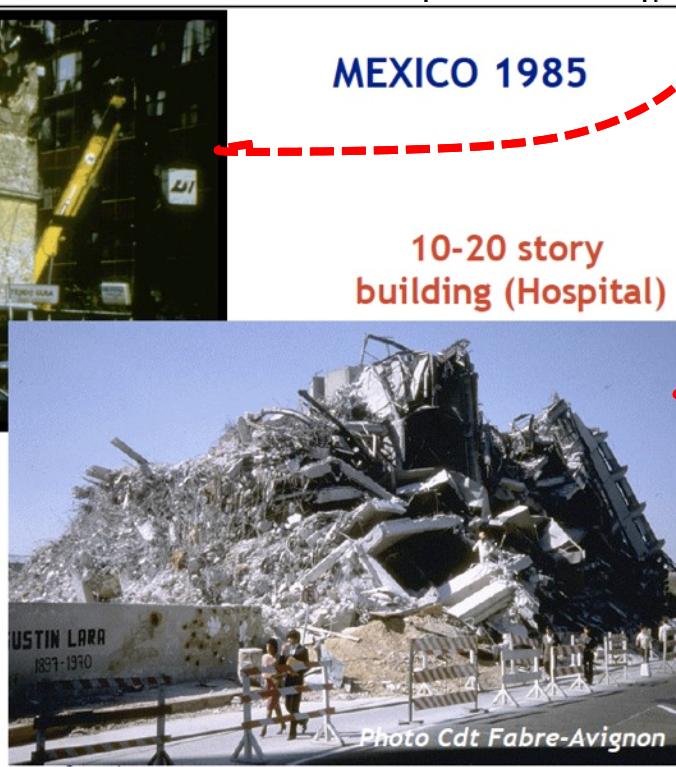
Source : Laurence Barret

Mexico City lake-bed area: local site effects





2-story (old) building :
no damage



Physics

Earthquake : basic physics

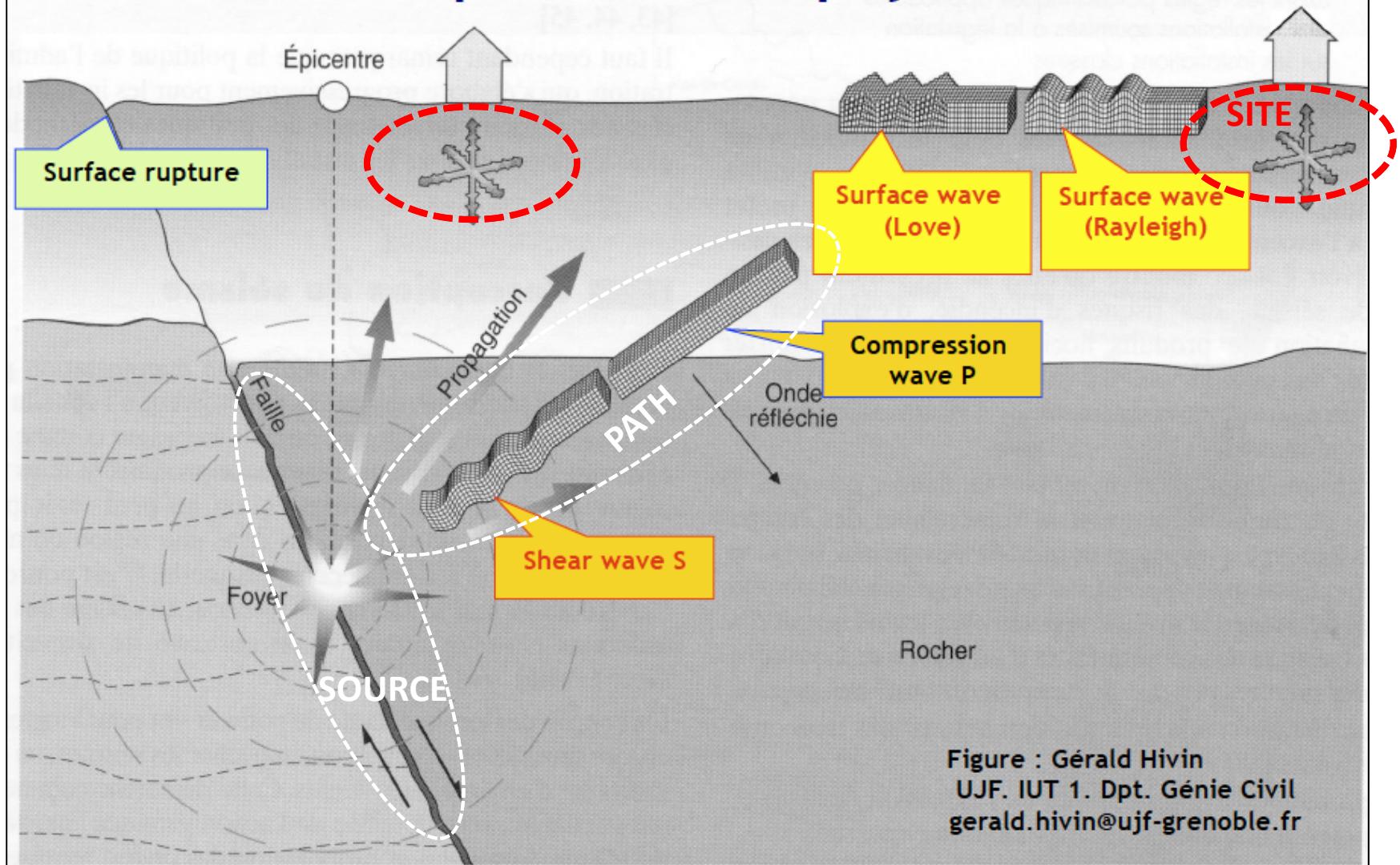
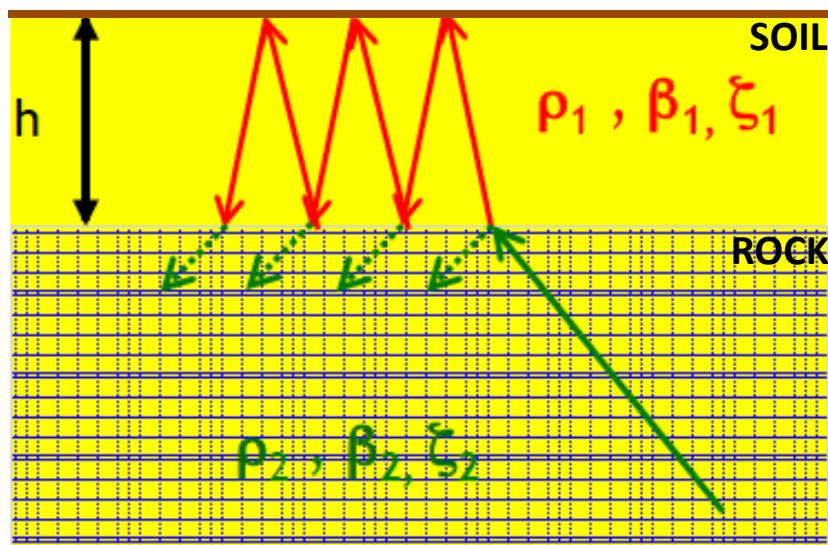


Figure : Gérald Hivin
UJF. IUT 1. Dpt. Génie Civil
gerald.hivin@ujf-grenoble.fr

1D Site Dynamic Response



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

Transfer function (Fourier)

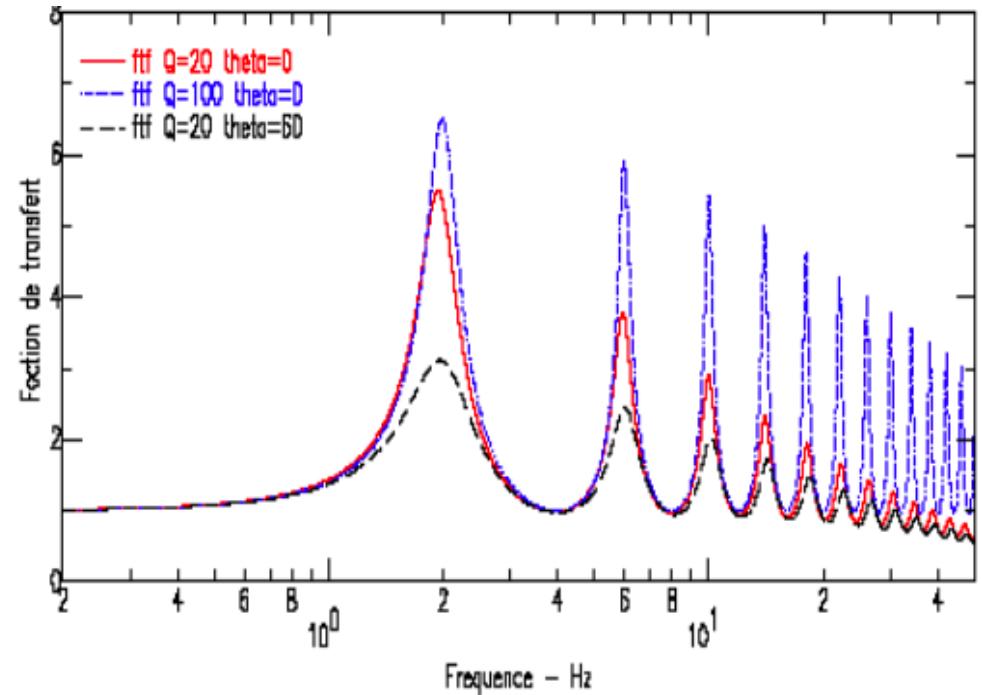
$$H(f) = 2 C / [C \cdot \cos(2\pi f h / \beta_1) + i \cdot \sin(2\pi f h / \beta_1)]$$

Resonance frequencies

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

Amplification

- Elastic case
 $A_0 = |H(f_0)/2| = C = \rho_2 \cdot \beta_2 / \rho_1 \cdot \beta_1$
- With damping ξ_1 :
 $A_0 = C / (1 + 0.5 \pi \xi_1 C)$



Parameters Measurement

Accelerometer Stations in the project Eligible Area

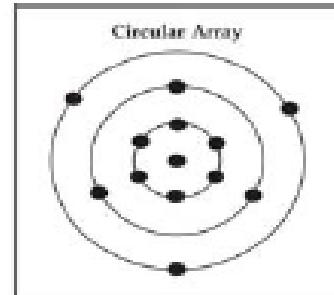


Simplified Procedure for Ambient Noise Analyses:

Seismometers Array Technique

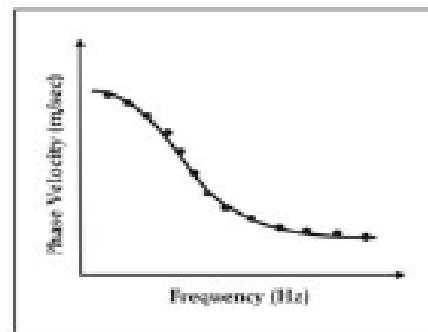


Seismometers' Array



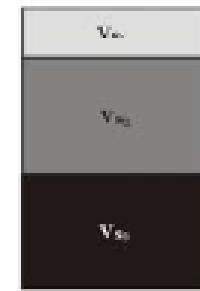
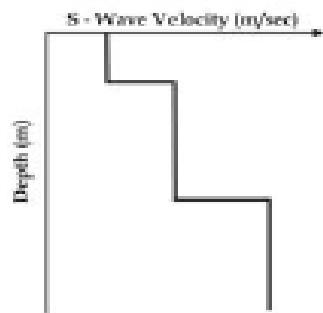
↓
j-k Method

Dispersion Curve of Surface Waves



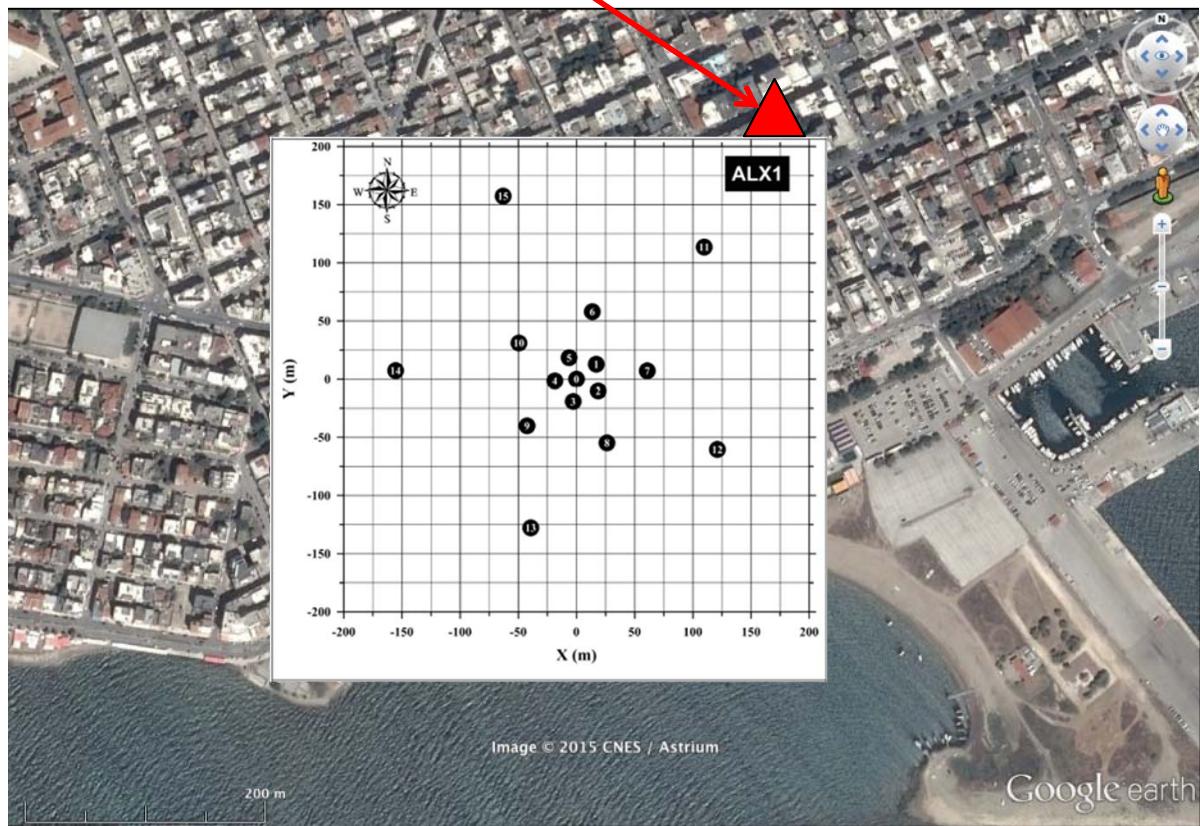
↓
Inversion

Dispersion Curve's Inversion

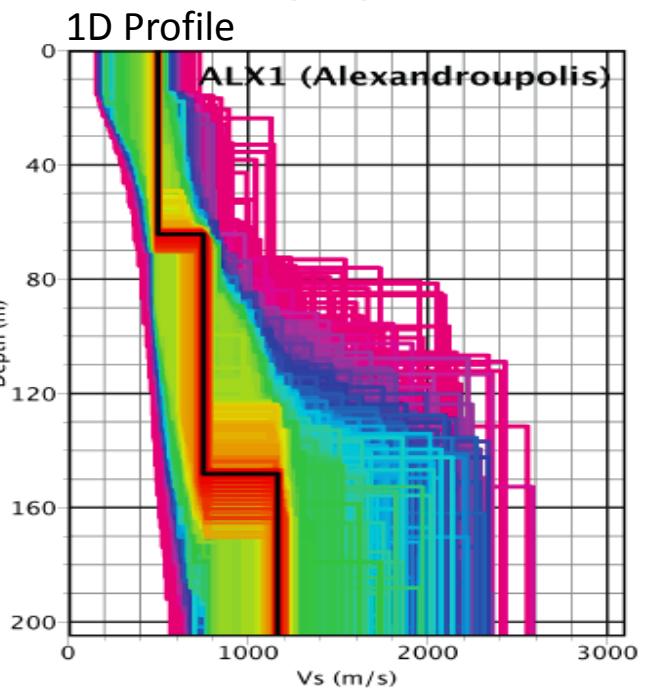
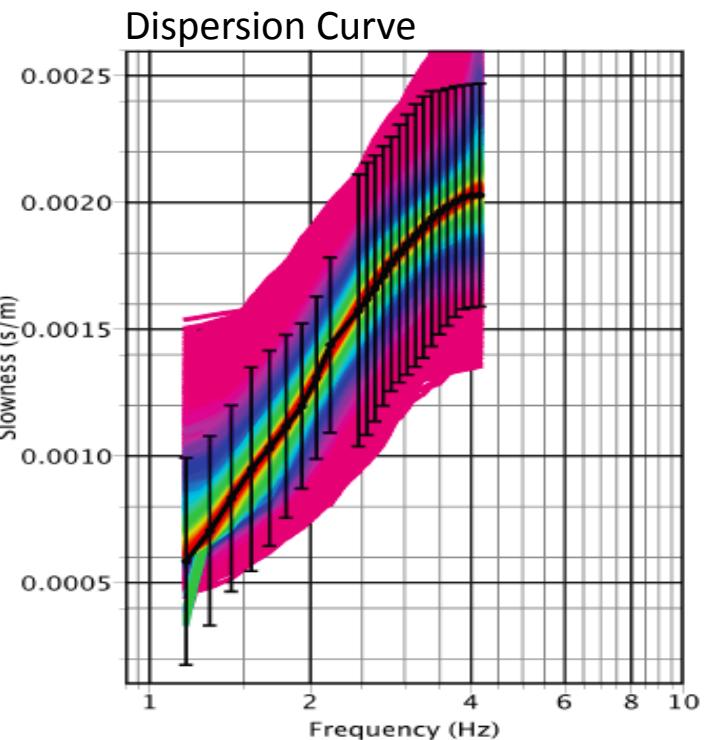


(Okada 2003)

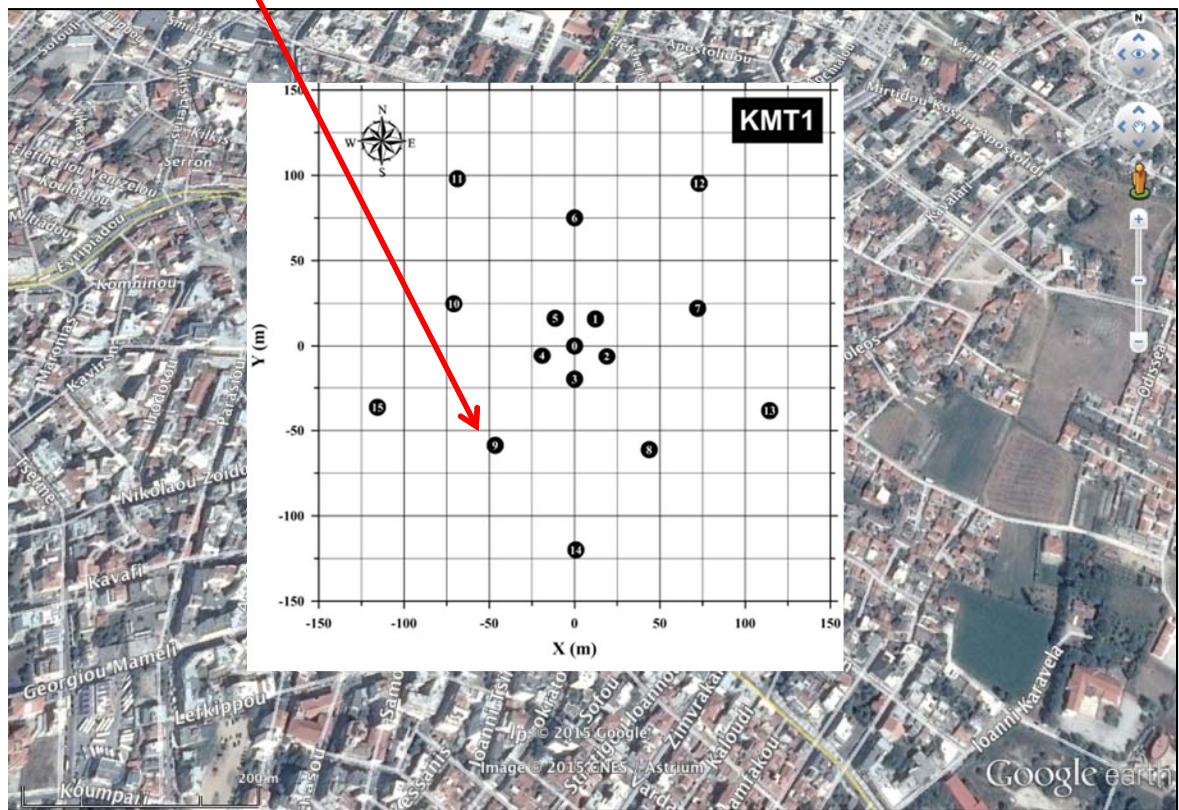
ALEXANDROUPOLI



Savvaidis et al. (2015)

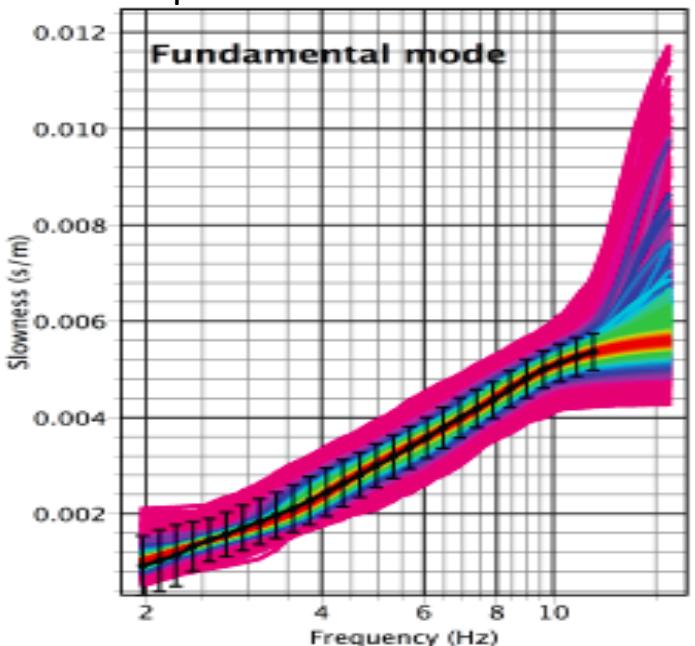


KOMOTINI

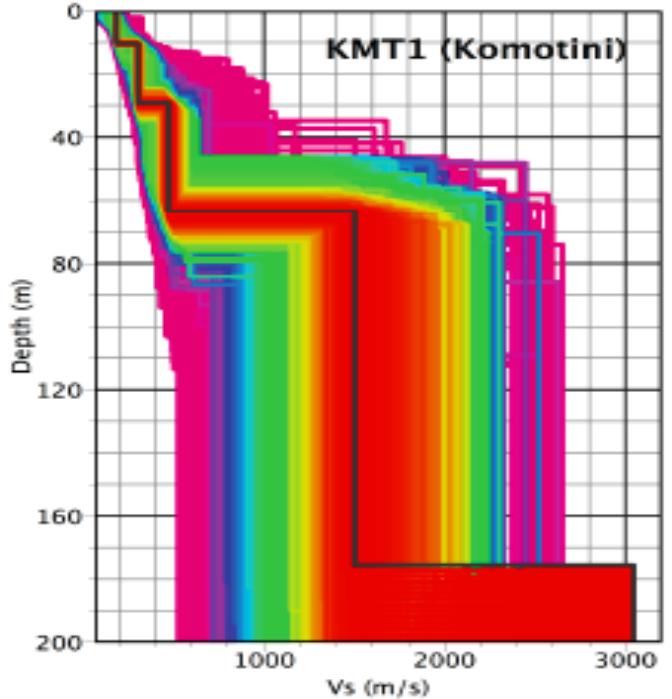


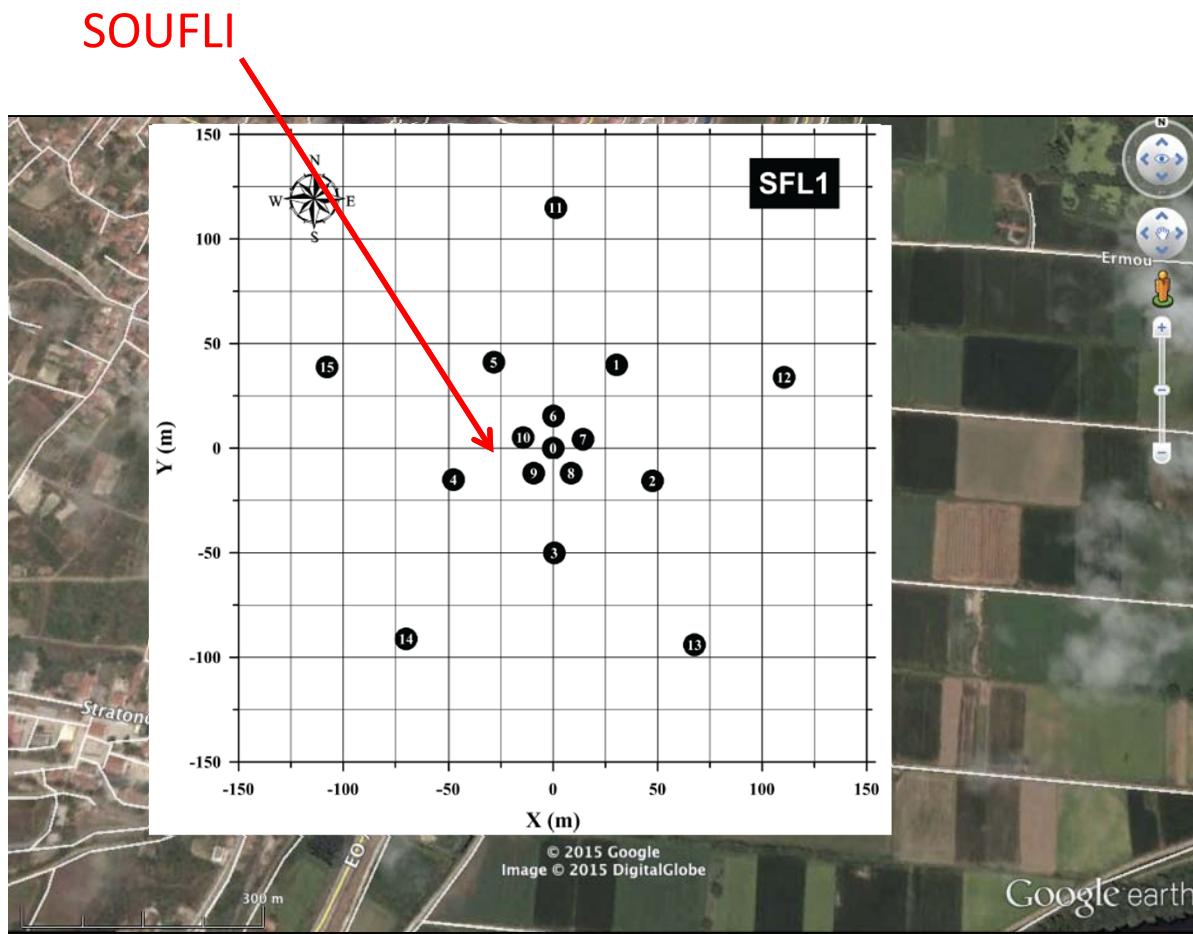
Savvaidis et al. (2015)

Dispersion Curve



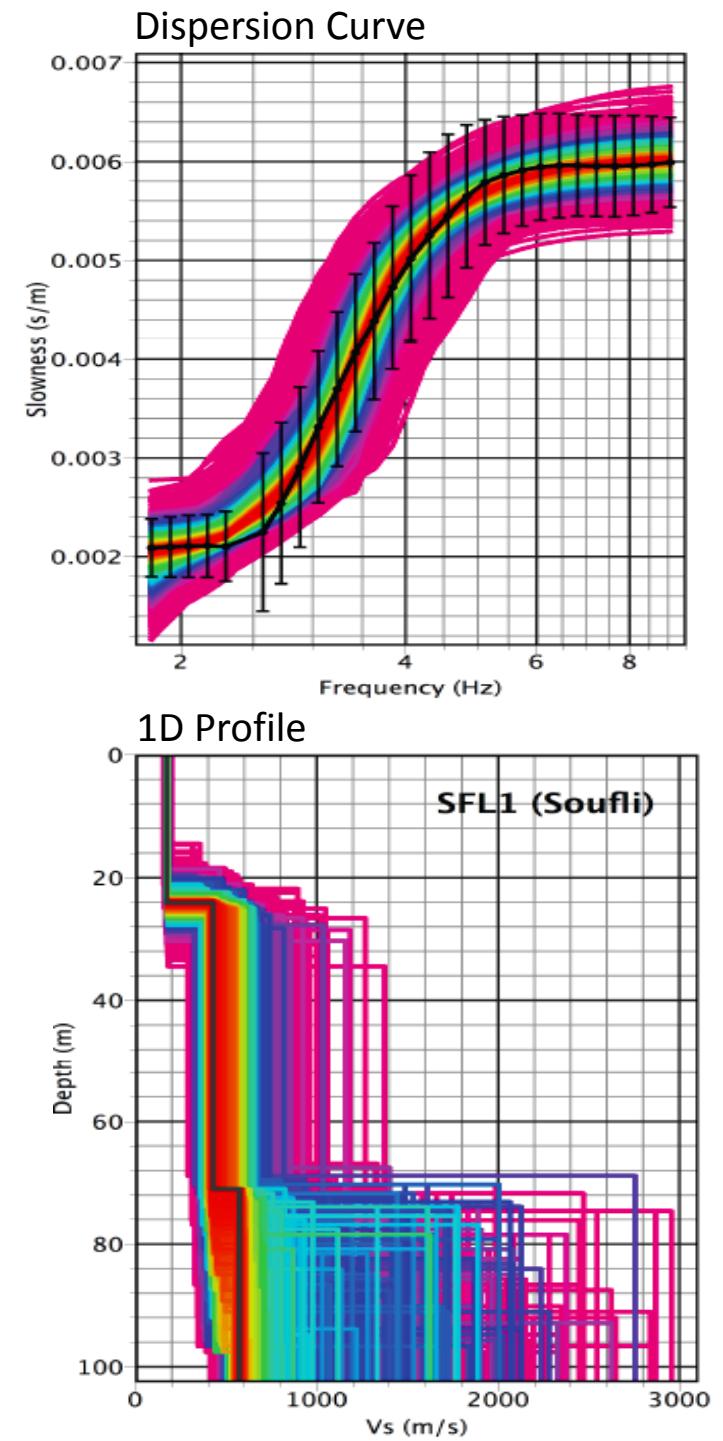
1D Profile

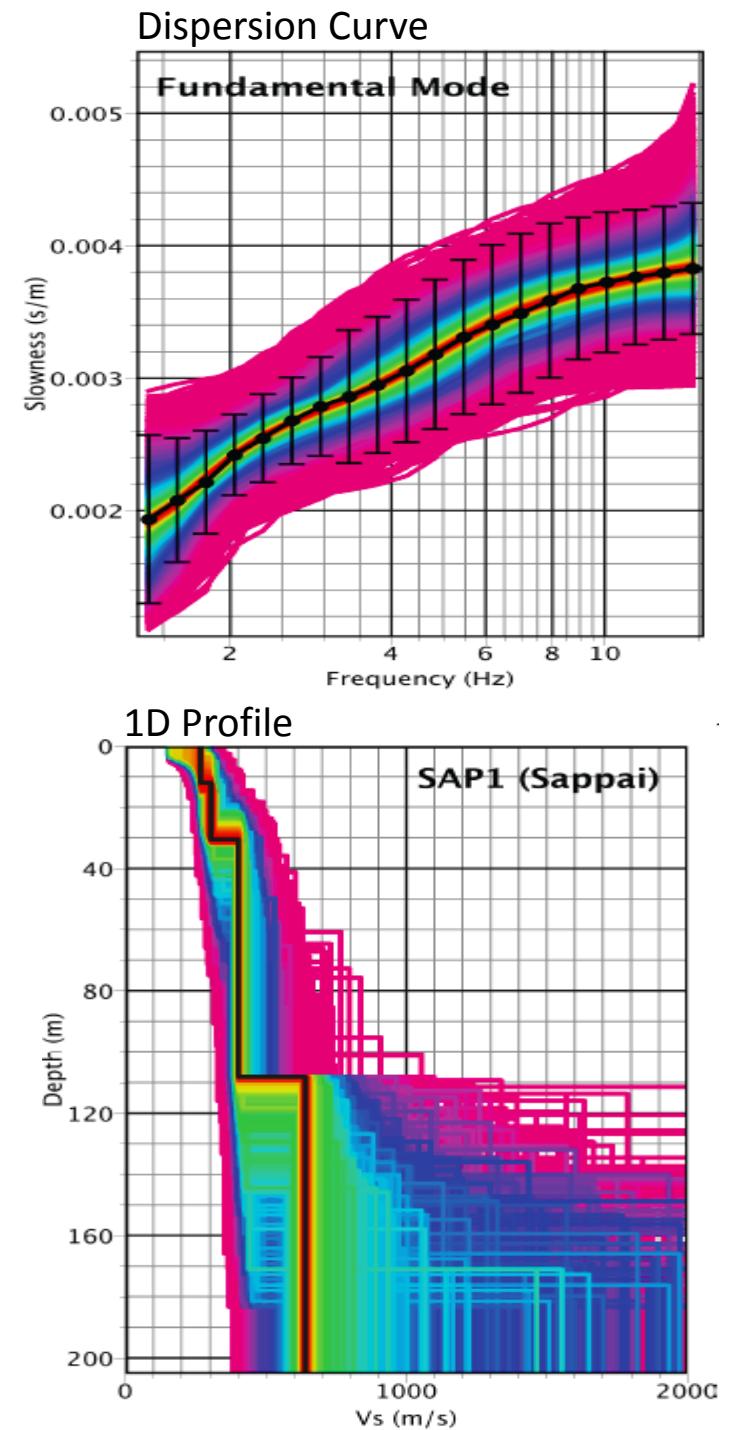
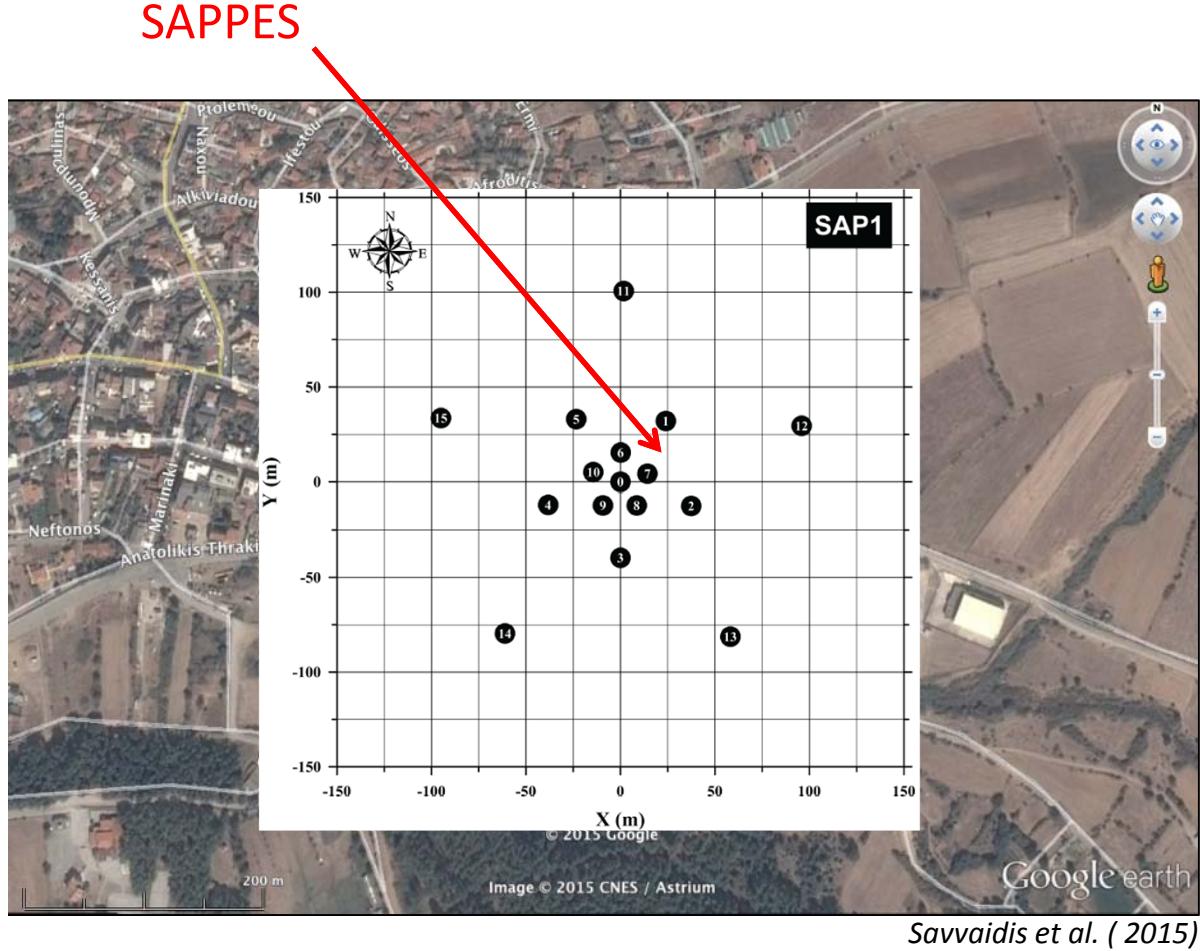




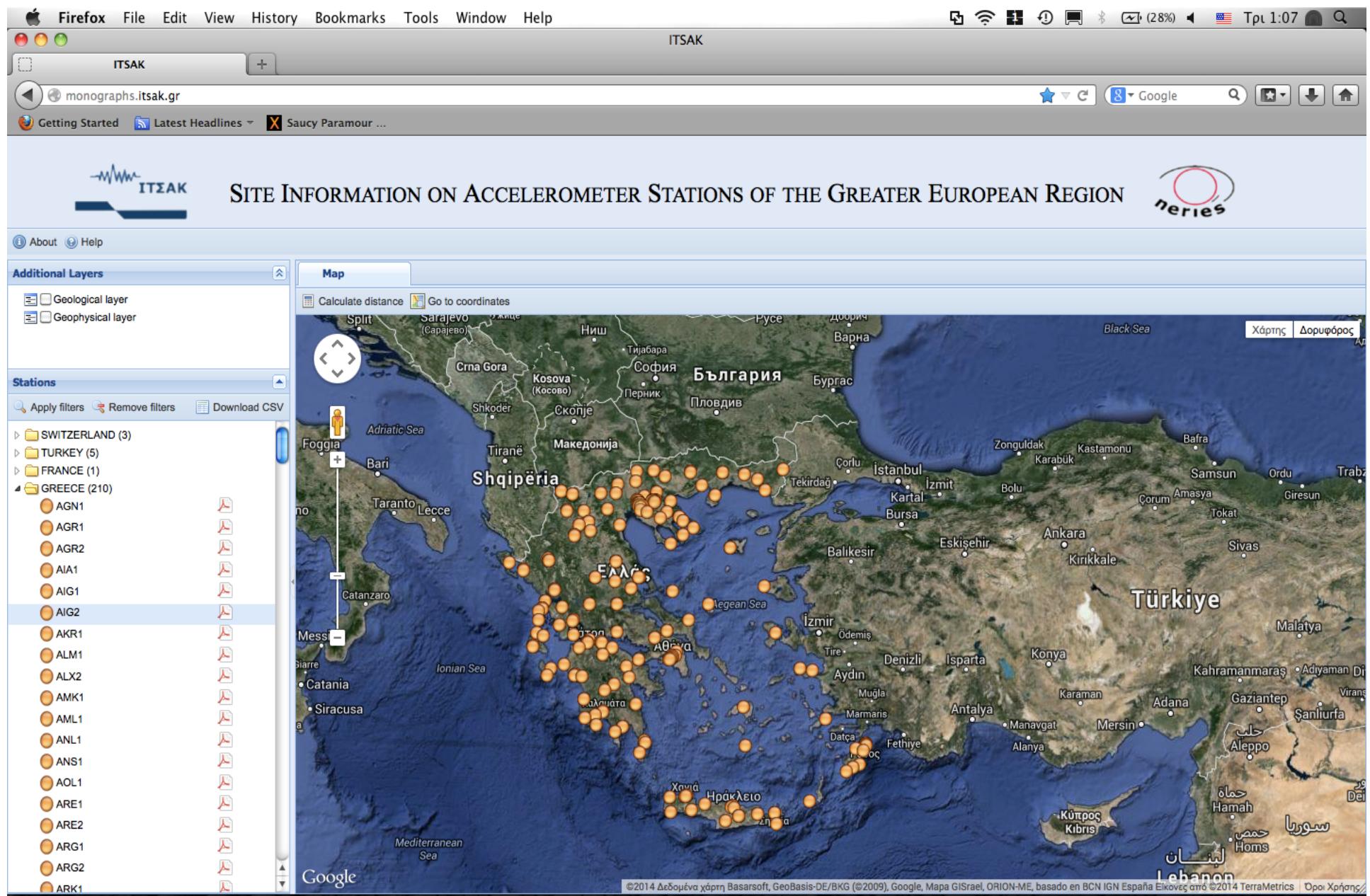
Savvaidis et al. (2015)

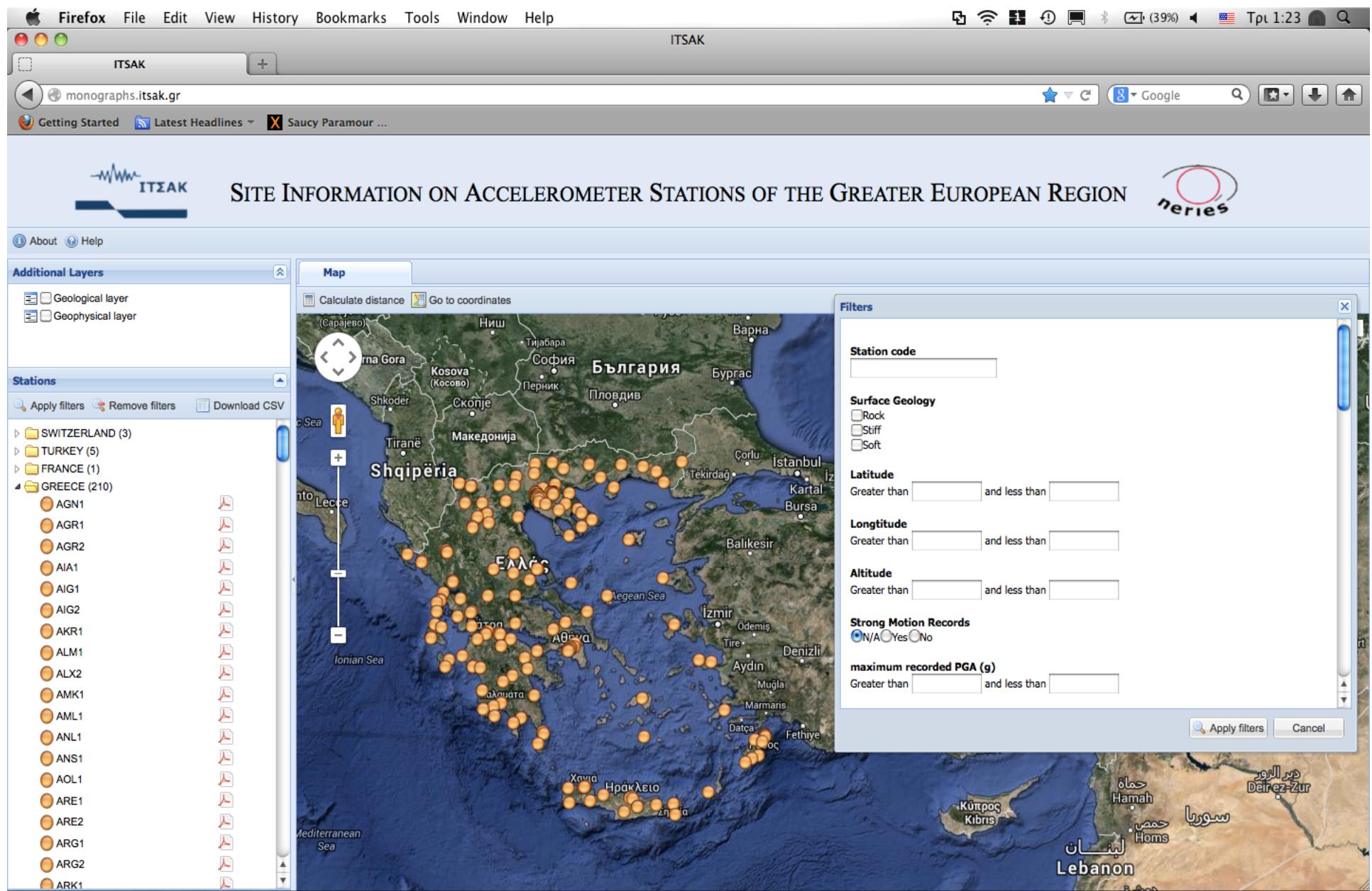
Istanbul, 12-13 Nov. 2015





Use & Application





ACCELEROMETER NETWORK – ITSAK

web page: monographs.itsak.gr

The screenshot shows a map of Italy with numerous orange dots representing accelerometer stations. A specific station, TST0, is highlighted with a callout box containing the following information:

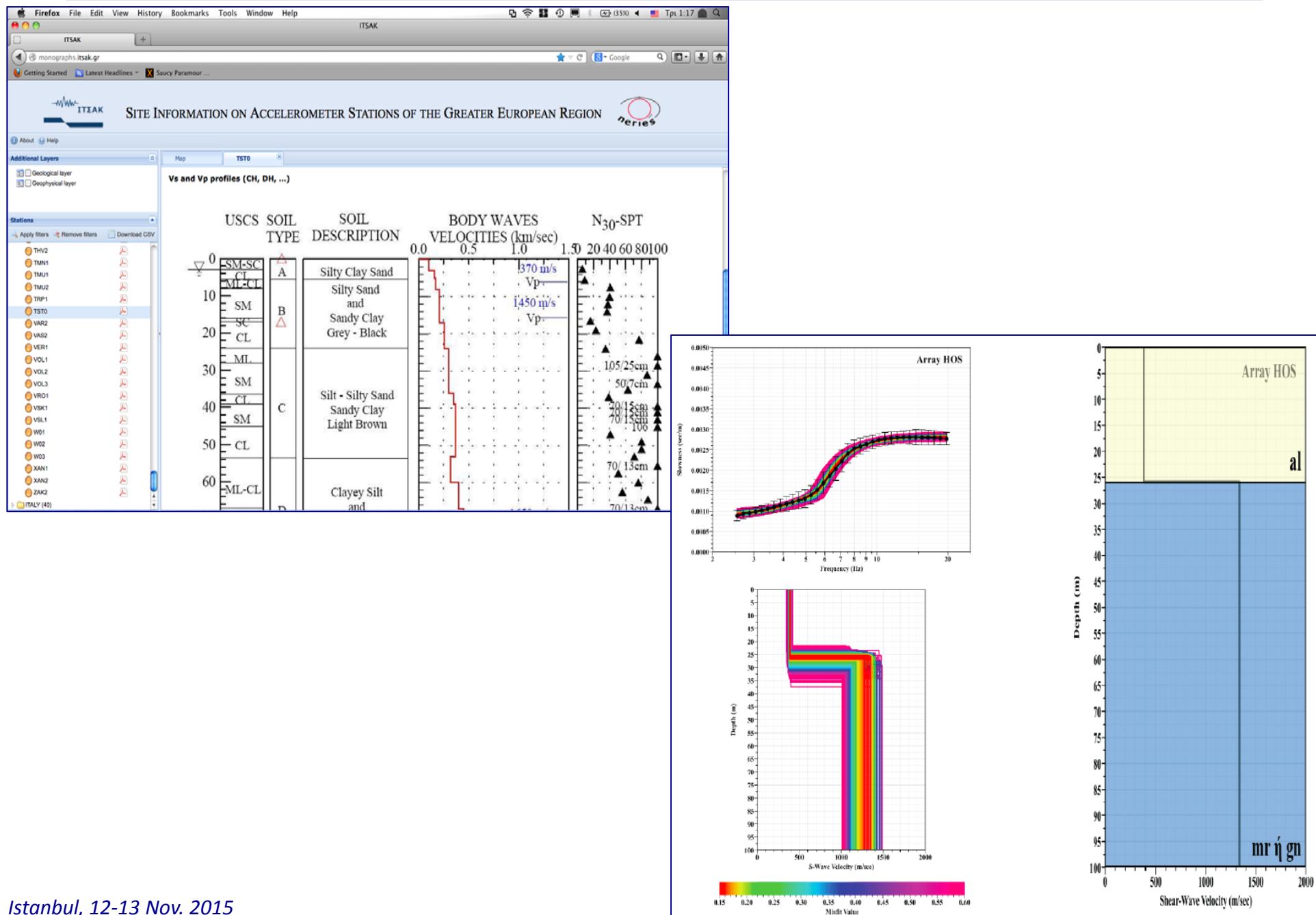
- EURESETEST (Streos-Profiles)
- General Site Information
- Geological Data
- Site Description - Housing
- Earthquake Recording
- Microbiological Data
- Geological Data
- Geotechnical Investigation
- Geotechnical Laboratory Analysis
- Geophysical Data
- Nearby Recordings
- Site Recordings
- Site Transfer Function
- Dispersion Curve Information
- Contact

The screenshot shows a geological map of the area around station TST0. The map includes labels such as GRA, E01, and Mura di Fouzana. A red circle highlights the station location. To the right of the map, there is a legend and descriptions of geological features:

- Lacustrine sediments: sandy clay, silt and fine-grained sand, rich in silica.
- Deposits in river and torrent beds: sandy clay, sand and gravel.
- Valley deposits: sandy clay.
- PLIOCENE
- Lower terrace system: gravel and sand under a clays' cover (P_{ter}l). The top of the system is located 5-6 m higher than the rivers' level.
- Middle terrace system: sand (P_{ter}m) or gravel (P_{ter}c). The top of the system is located 40-13 m higher than the rivers' level. Probably it represents older lacustrine sediments.
- Upper terrace system: grits and pebbles with loam or sandy clay.

ACCELEROMETER NETWORK – ITSAK

web page: monographs.itsak.gr



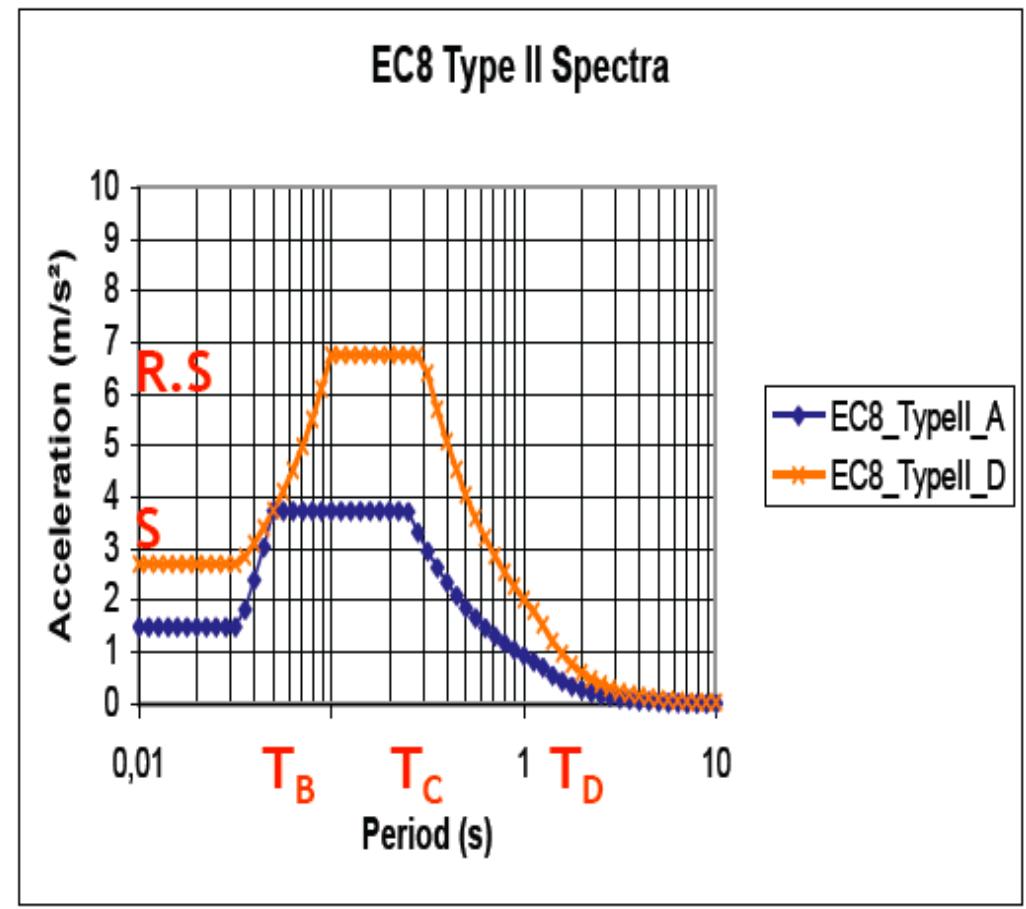
EC8 DESIGN SPECTRA

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

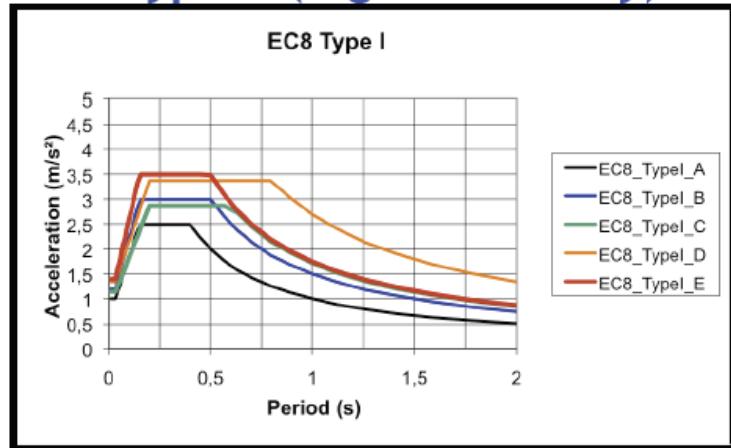
- Depends on site classes
- Today : V_{S30}
- A : $V_{S30} > 800 \text{ m/s}$
- B : $V_{S30} \in [360, 800 \text{ m/s}]$
- C : $V_{S30} \in [180, 360 \text{ m/s}]$
- D : $V_{S30} \in [100, 180 \text{ m/s}]$
- E : soft & thin layer ($h < 20 \text{ m}$) over hard bedrock



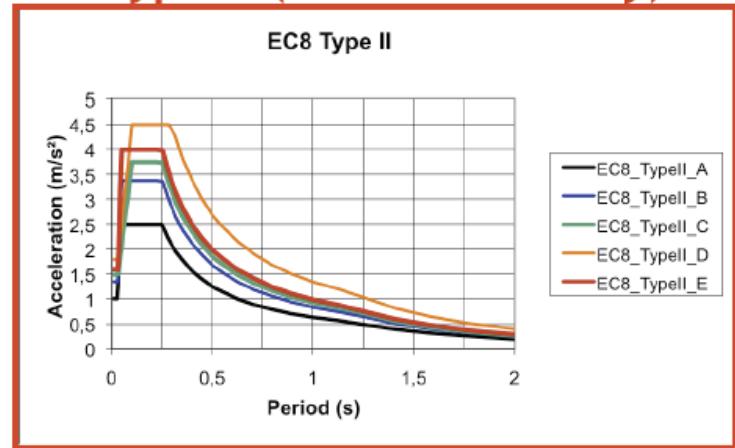
EC8 DESIGN SPECTRA

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

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