Project funded by the EUROPEAN UNION

A Scientific Network
for Earthquake, Landslide & Flood Hazard Prevention

SciNetNatHazPrev - PROJECT WORKSHOP
MARCH 13-14, 2014, ISTANBUL, TURKEY

SEISMIC HAZARD
GREEK CASE STUDY

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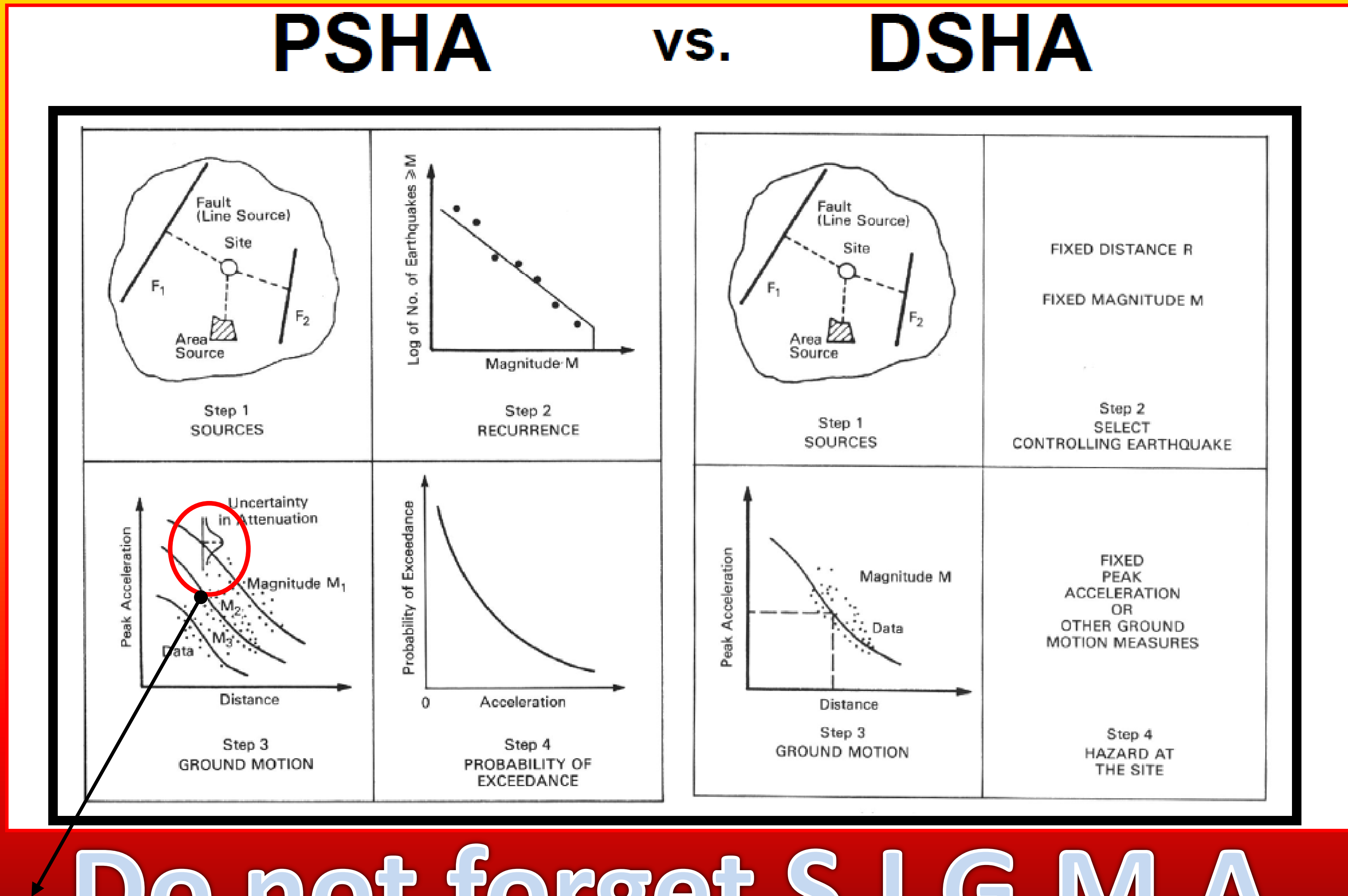
BASIC ELEMENTS OF SEISMIC HAZARD



Do not forget S.I.G.M.A.

Scatter In Ground Motion Attenuation

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Black Sea CROSS BORDER COOPERATION

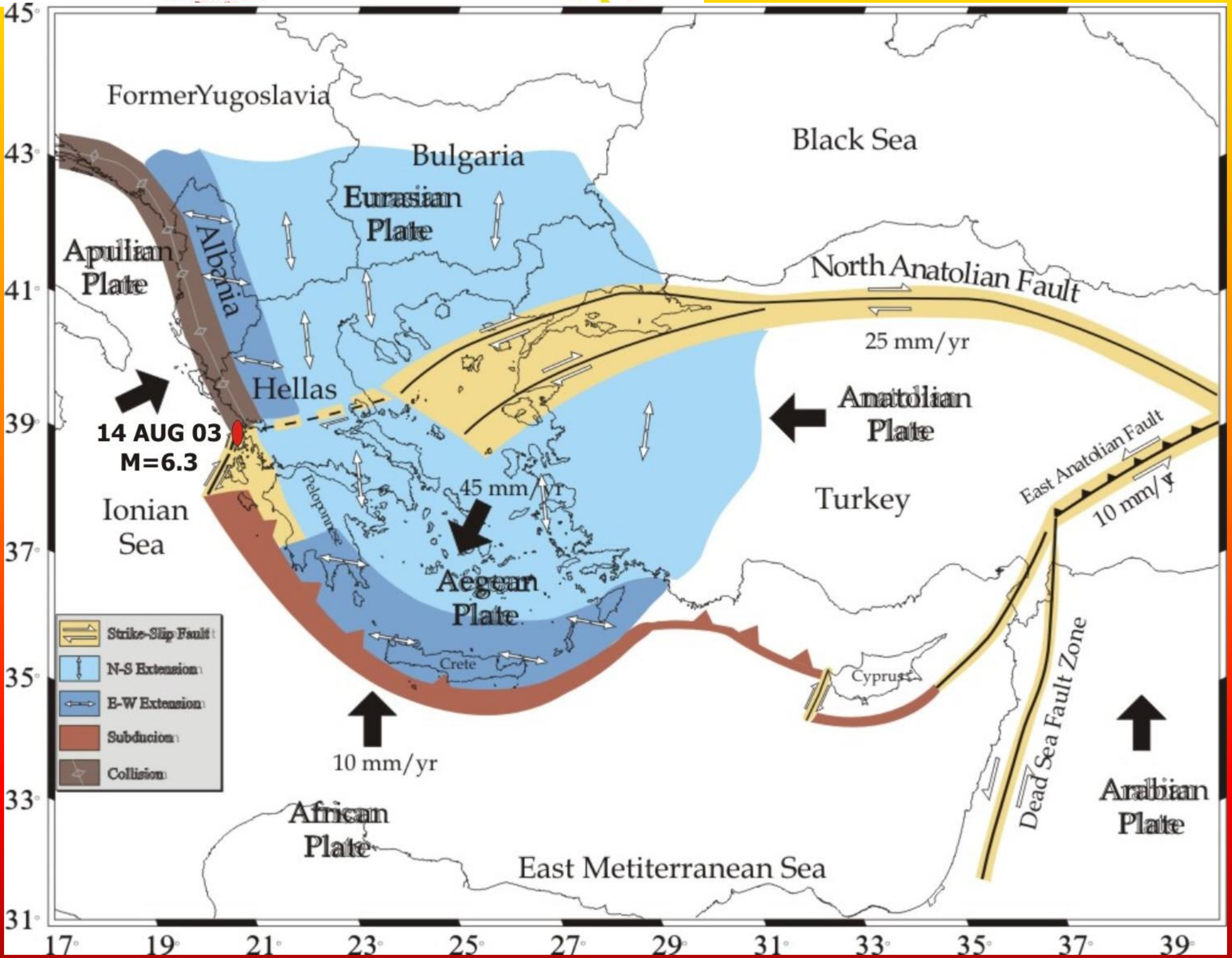
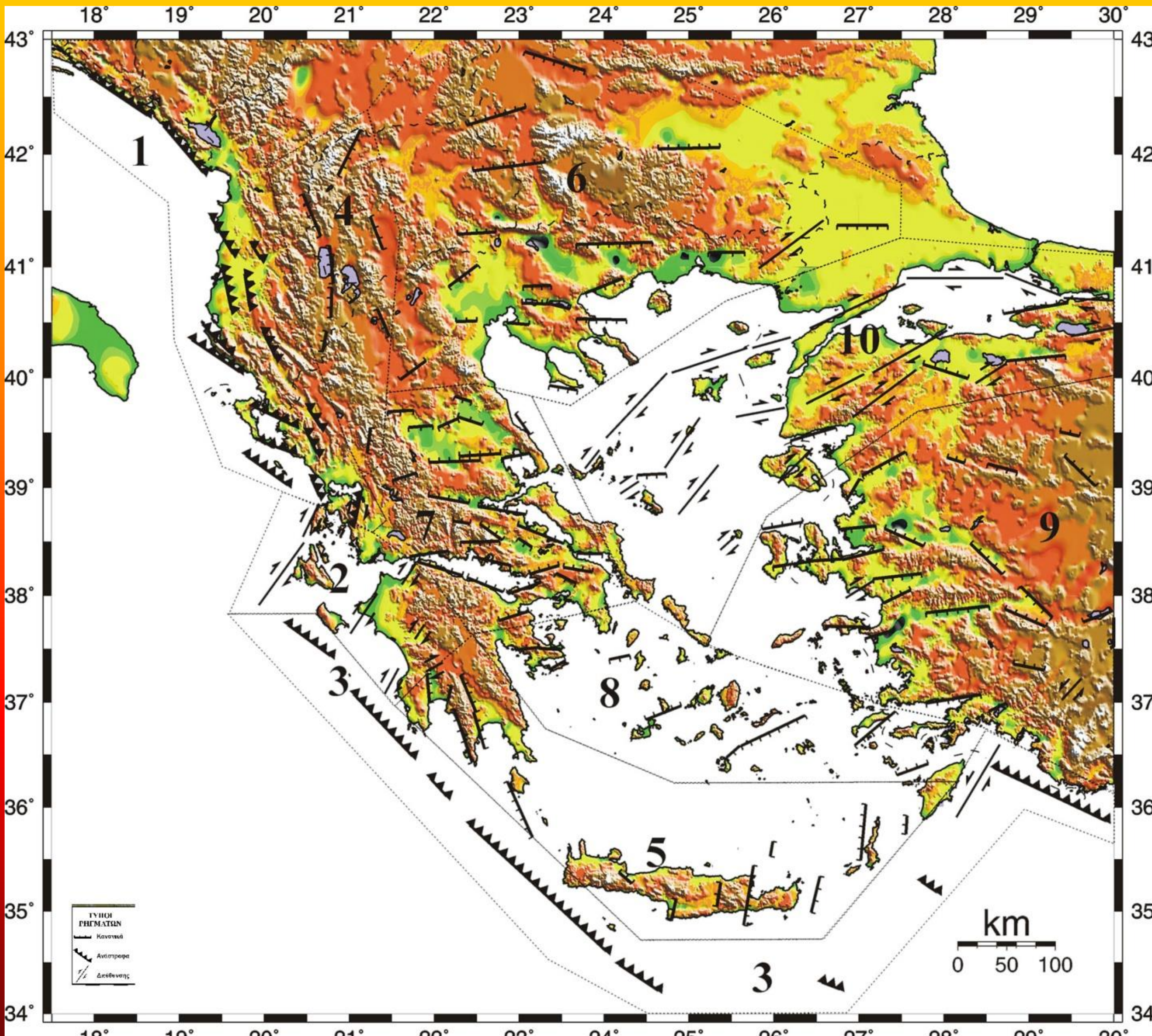
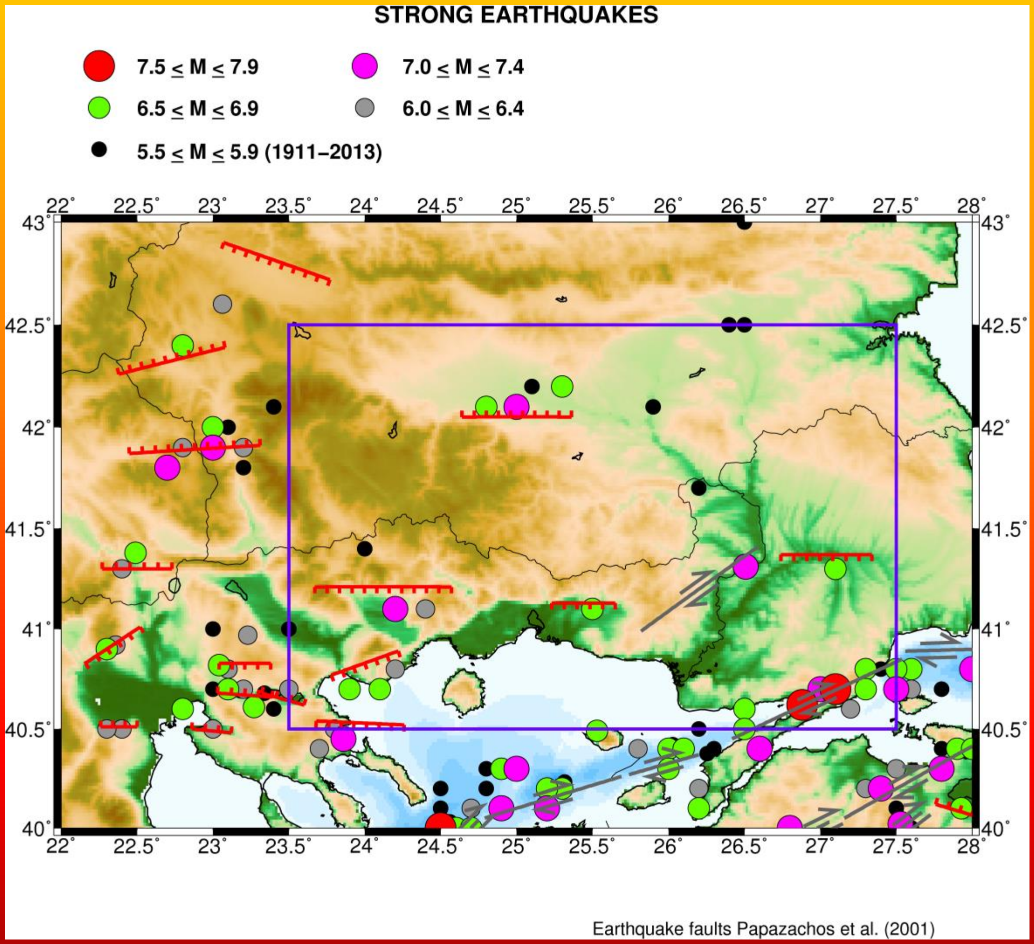


Plate Motions



Faults of strong earthquakes in the Aegean area since 550BC

(Papazachos et al., 2001)



STRONG HISTORICAL EARTHQUAKES

Papazachos and Papazachou (1997, 2003)

LOW SEISMICITY REGION
HOWEVER STRONG (M≥7.0) OCCURRED SINCE ANTIQUITY

TWO models of seismic sources

PAPAIOANNOU & PAPAZACHOS (:BSSA 2000)

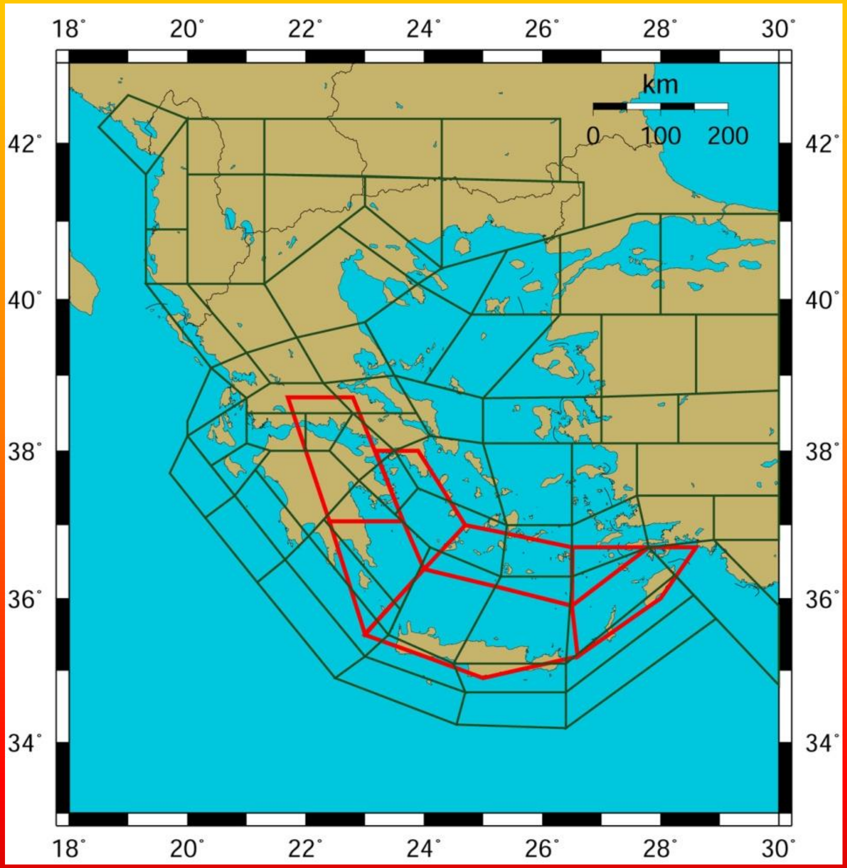
AREA TYPE SOURCES OF SHALLOW EQs. ONLY

PAPAIOANNOU (2006)

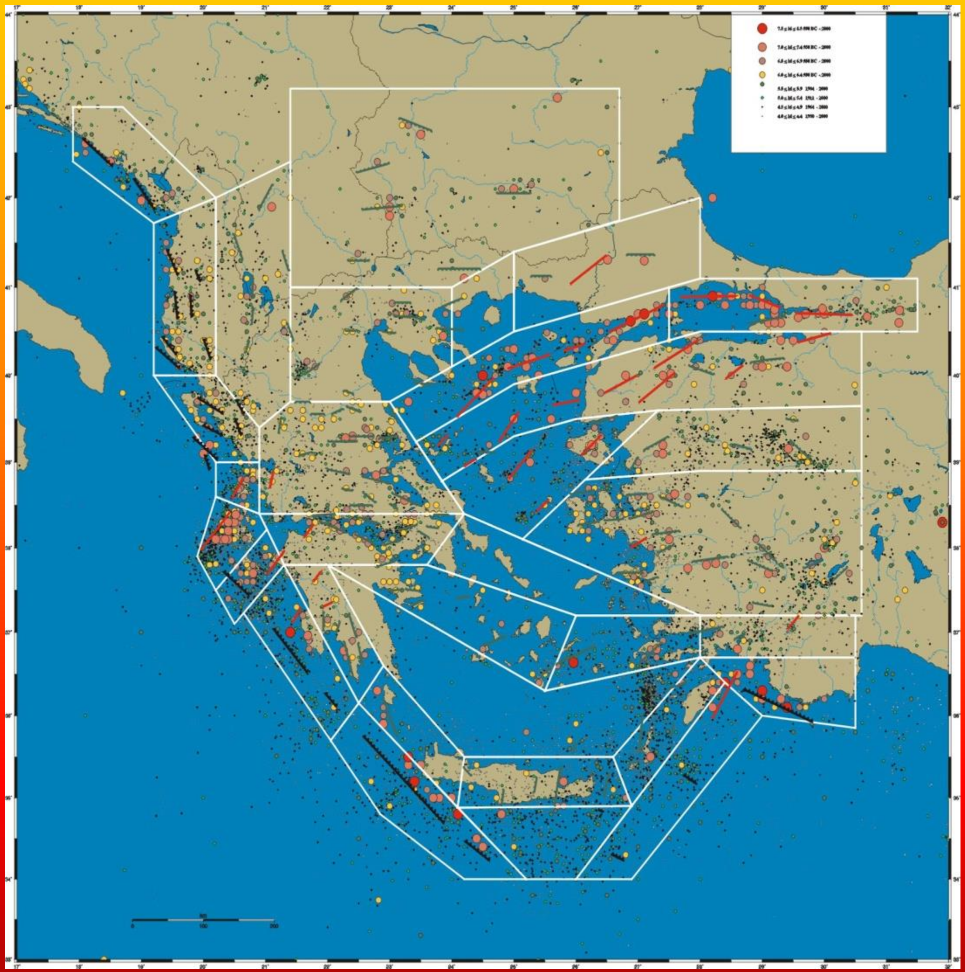
USED FOR THE REVISION OF THE S.H. MAP OF GREECE

CONSISTS OF FAULTS (FOR THE M≥6.0 EQS) &

AREA TYPE SOURCES OF EQS. WITH 4.0 ≤ M ≤ 5.9

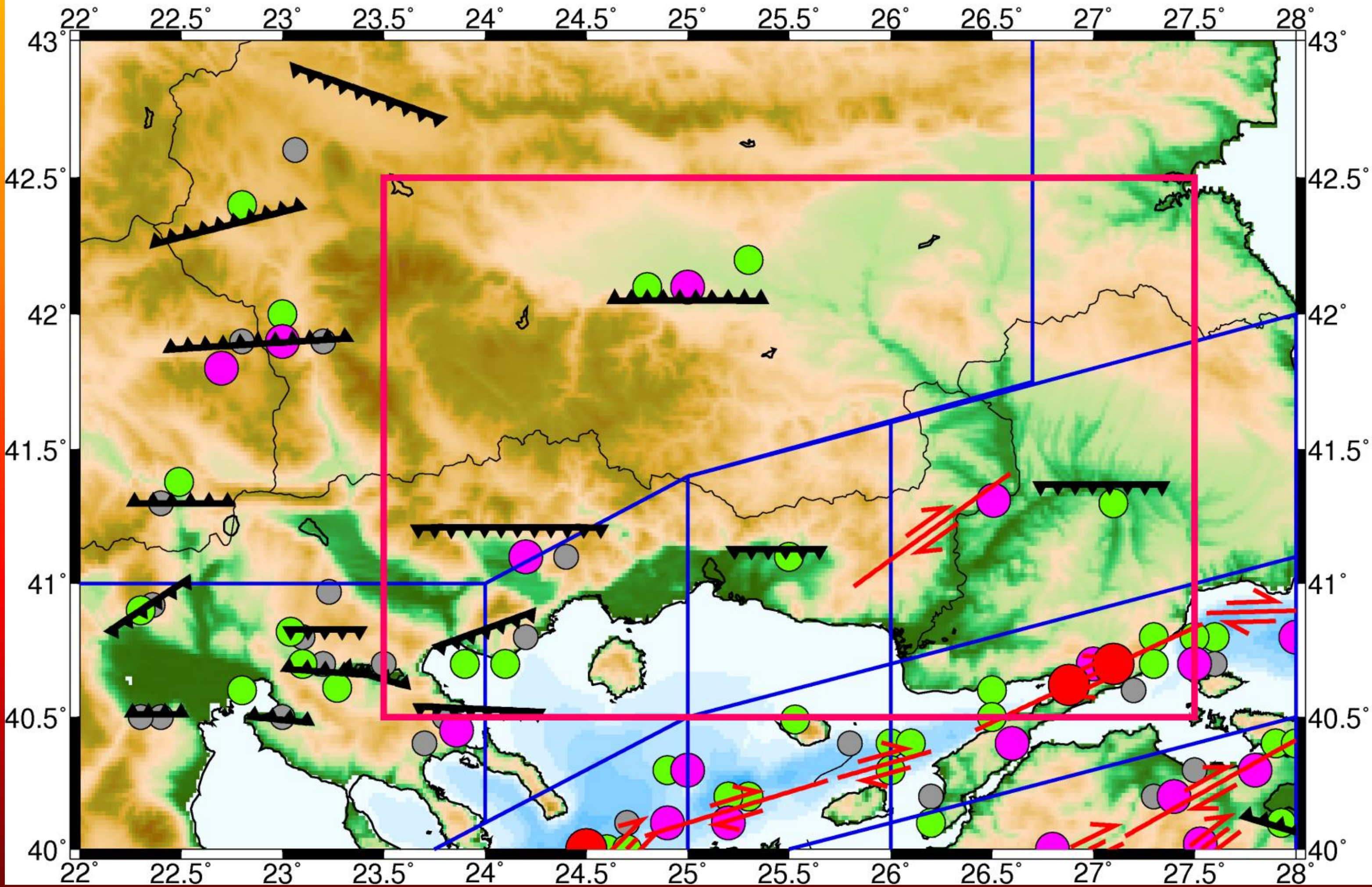


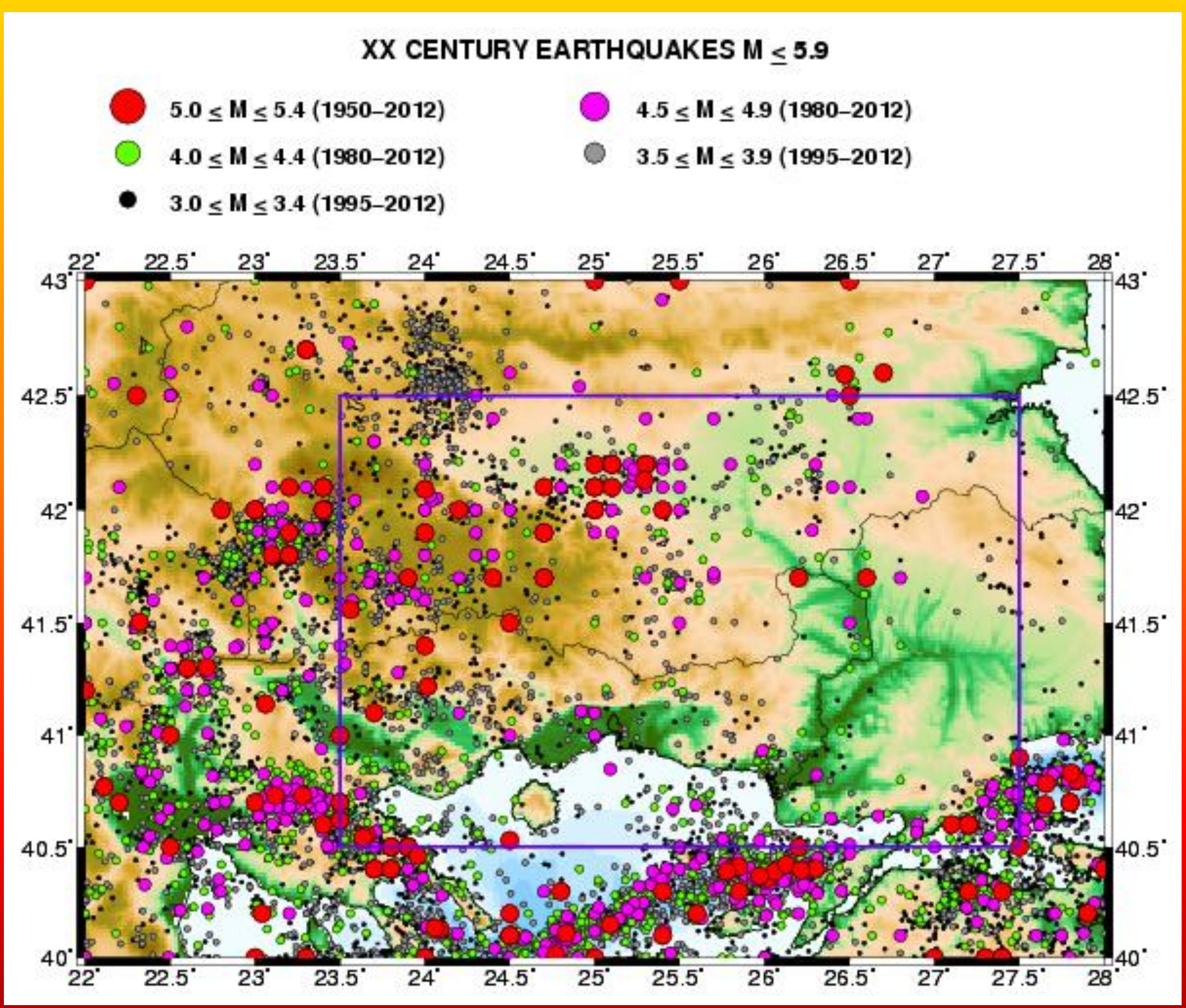
PAPAIOANNOU & PAPAZACHOS (:BSSA 2000)



PAPAIOANNOU (ECEES 2006)

Hybrid Model of Area Sources & Faults

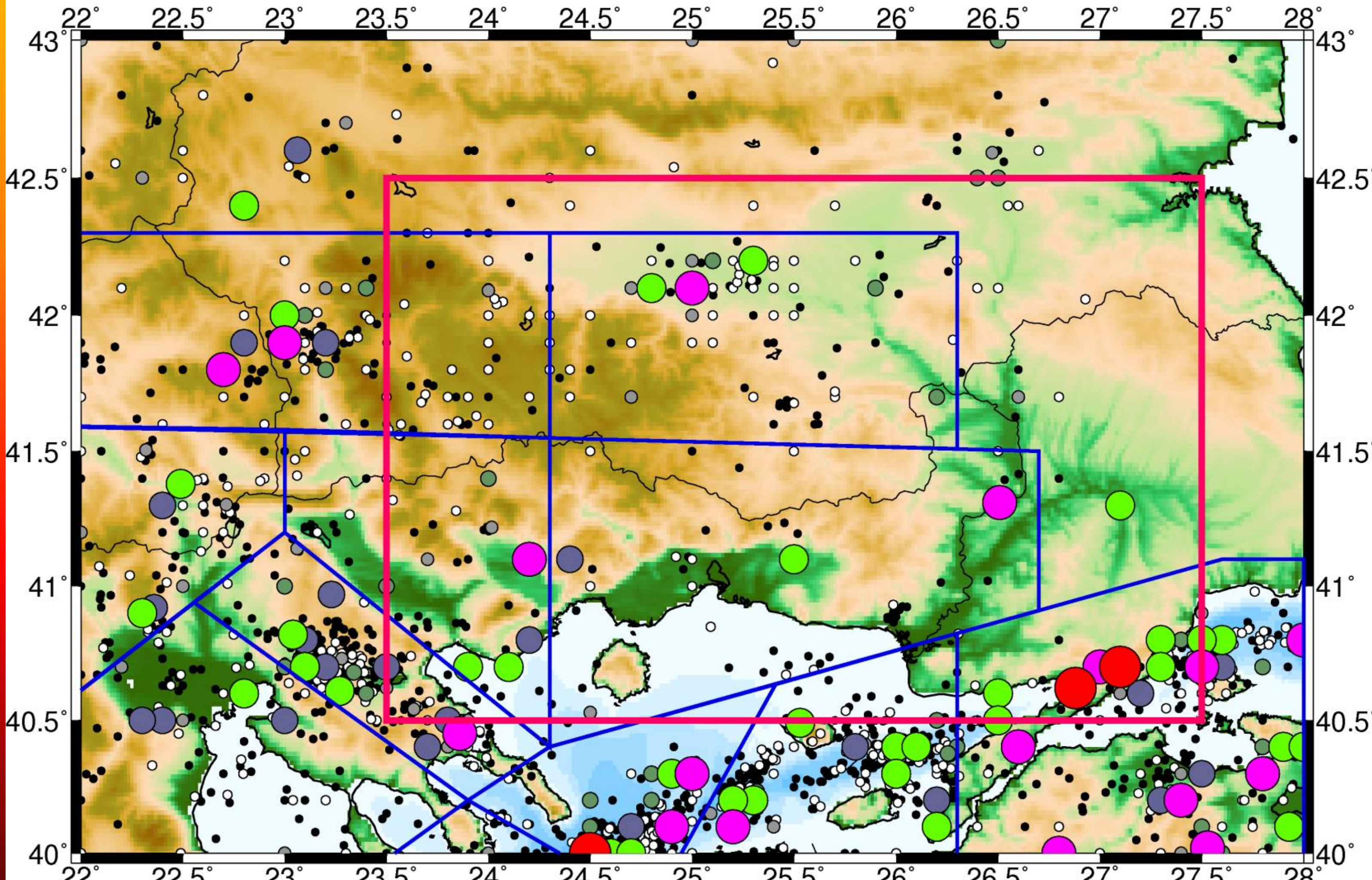




LOW SEISMICITY REGION

WITH ACTIVITY OF SMALL –MEDIUM SIZE EVENTS

Model of Area Sources (BSSA 2000)

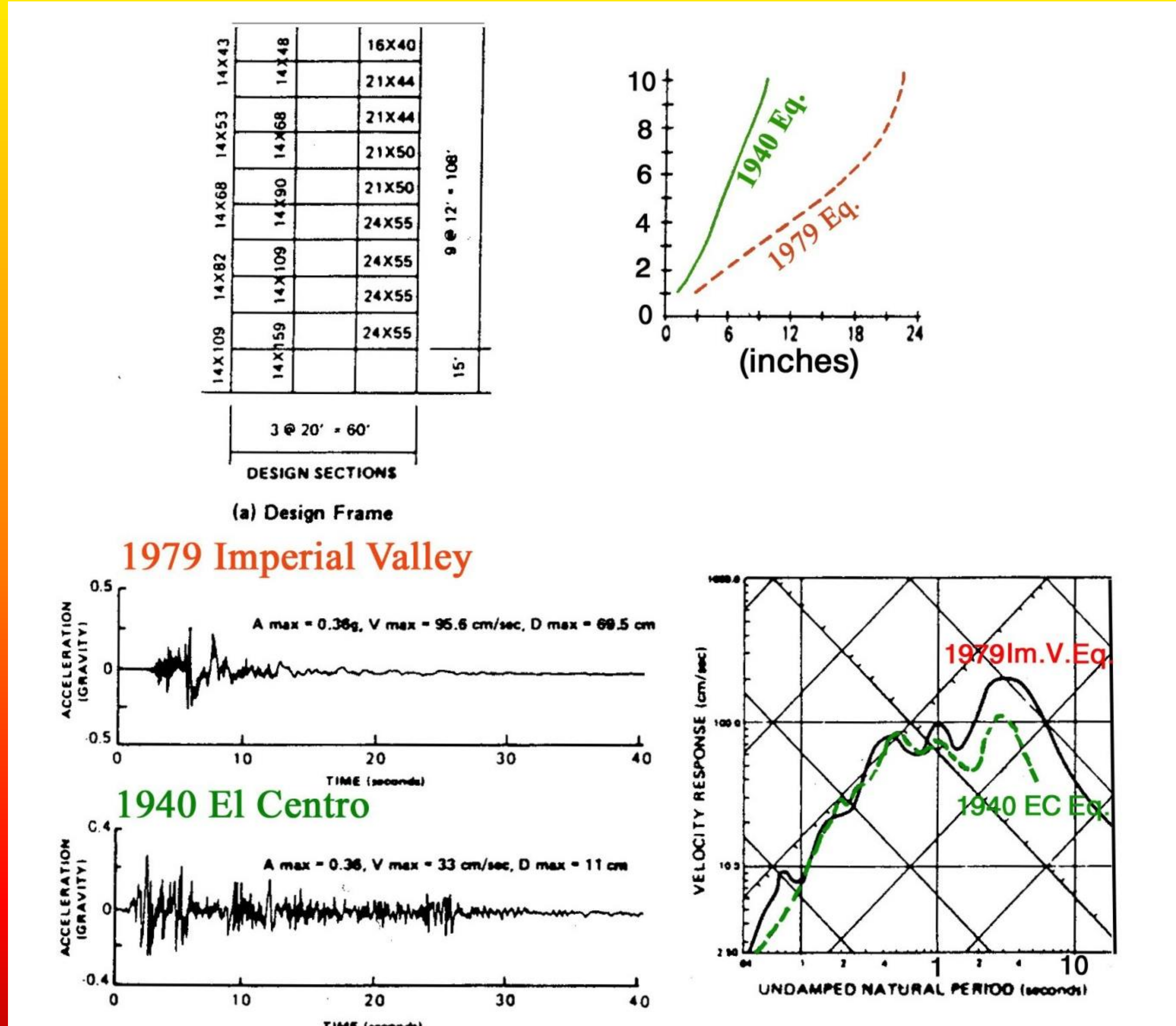


MACROSEISMIC INTENSITIES

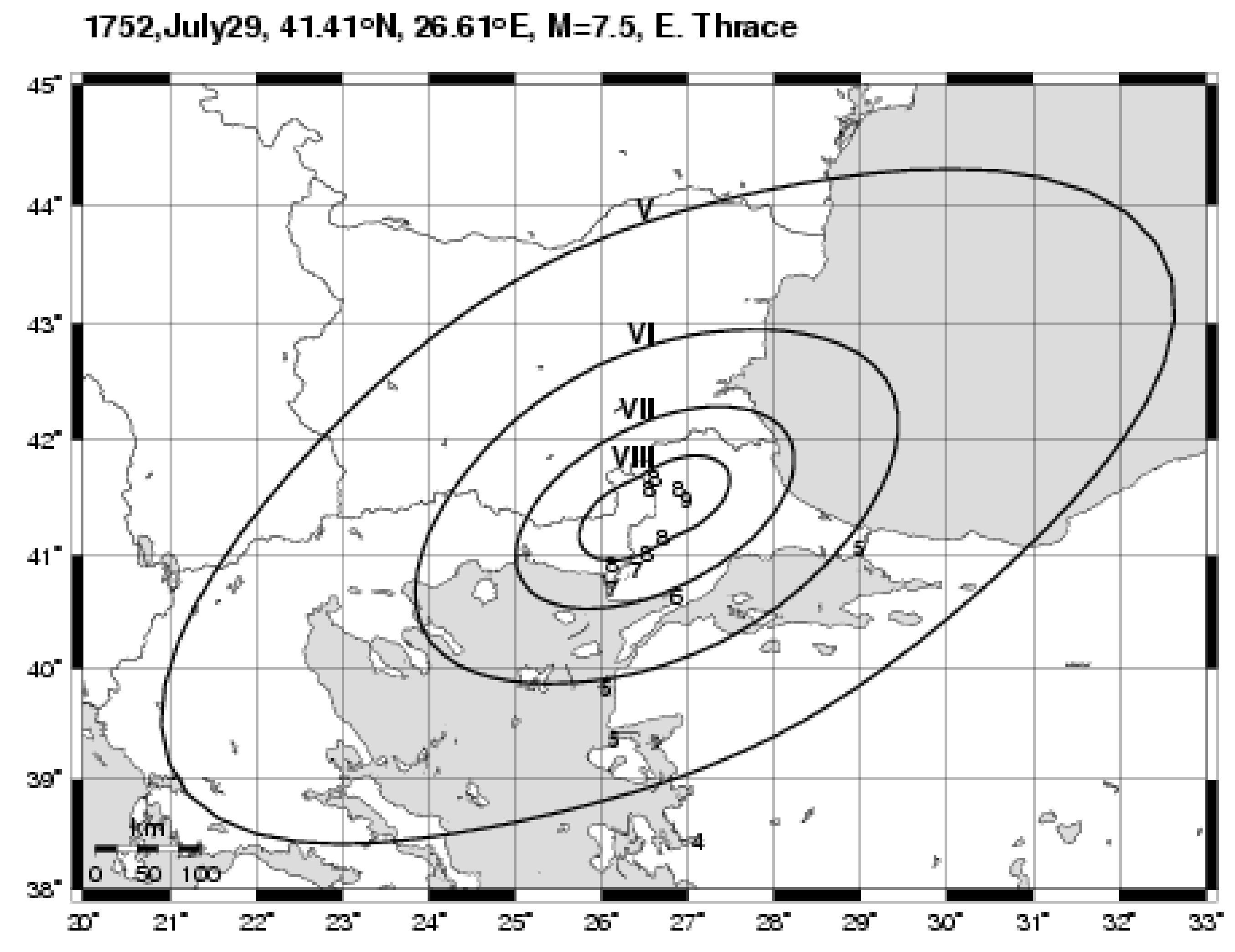
WHY ???

- Attenuation for Probabilistic Seismic Hazard
- **Macroseismic field**
- **Validation the results of Hazard analysis**
- **Hazard assessment in terms of statistical treatment of macroseismic intensities**.

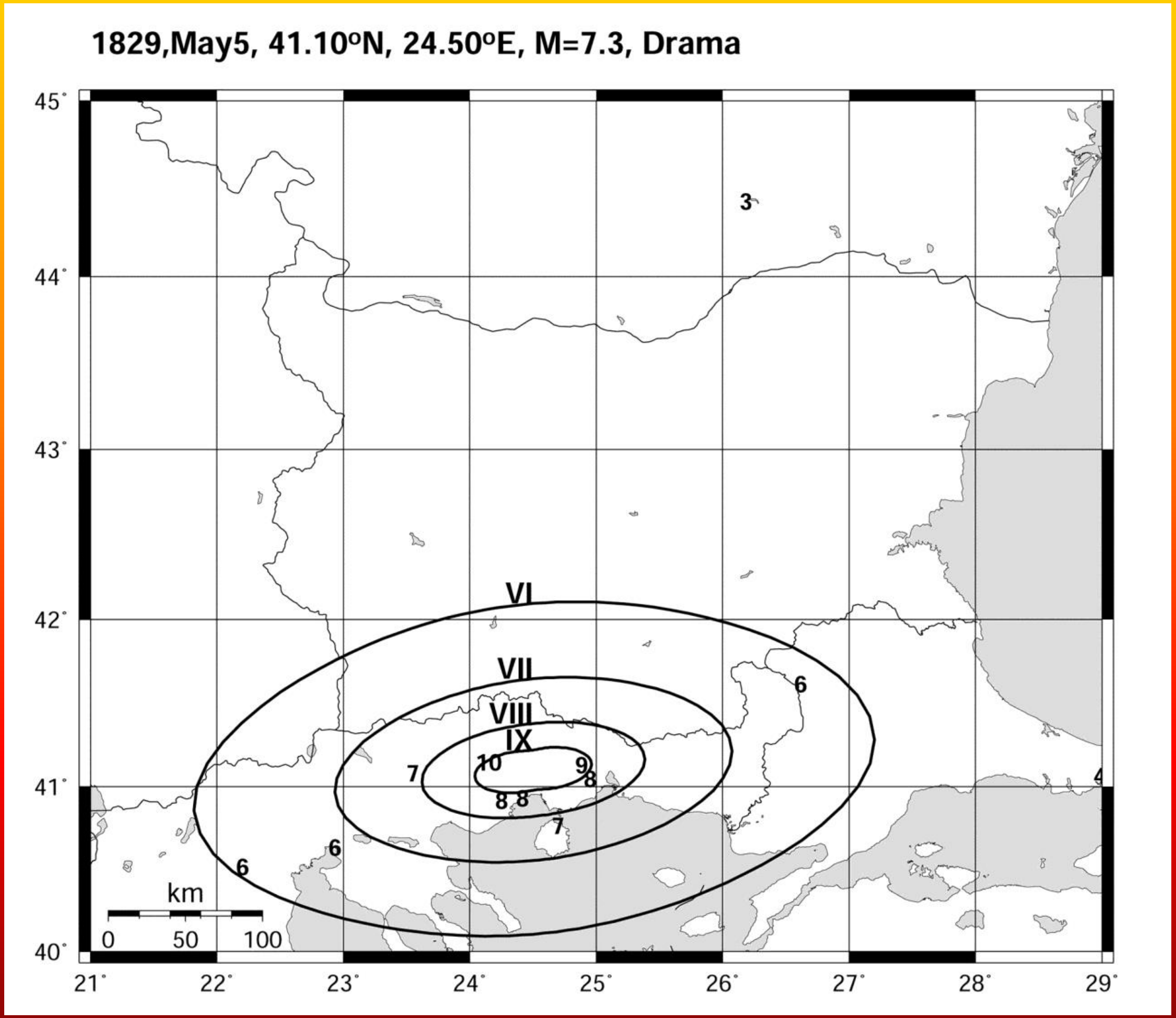
The macroseismic intensities
reflect the total result
of the ground motion



Notice the **different response** of the structure due to different accelerograms with the **same (0.36g) PGA**.

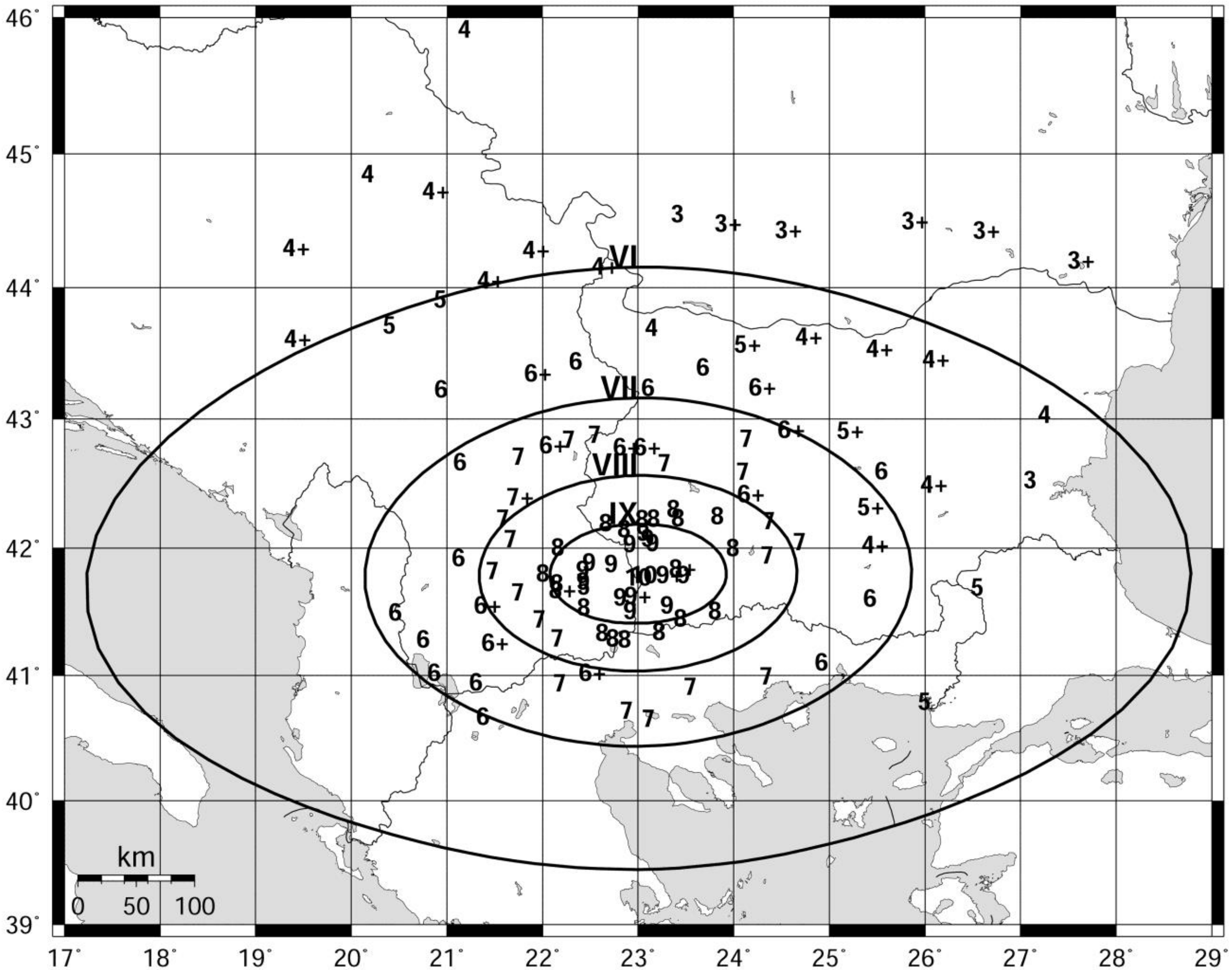


Papazachos et al., 1997.



Papazachos et al., 1997.

1904,Apr.4, 41.80°N, 23.00°E, M=7.7, Bulgaria



Papazachos et al., 1997.

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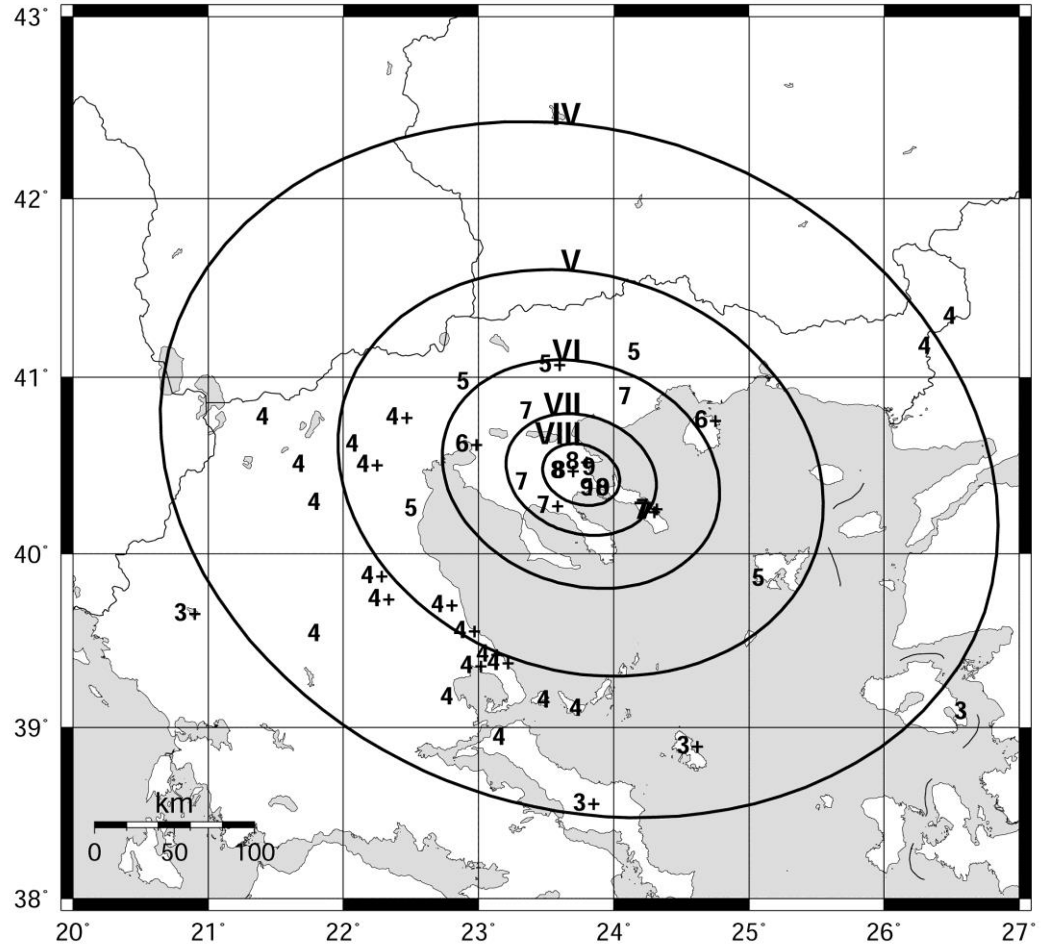
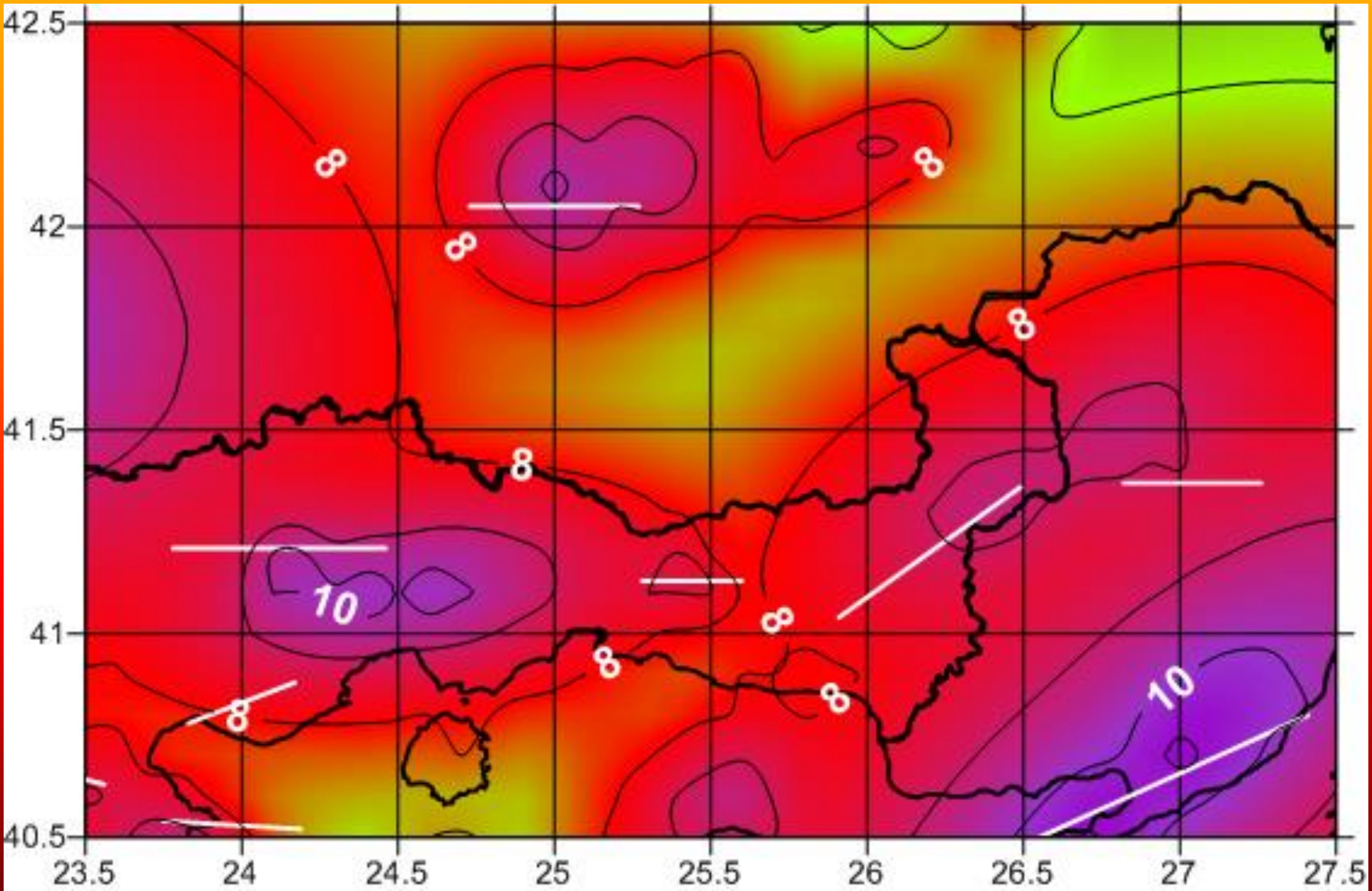
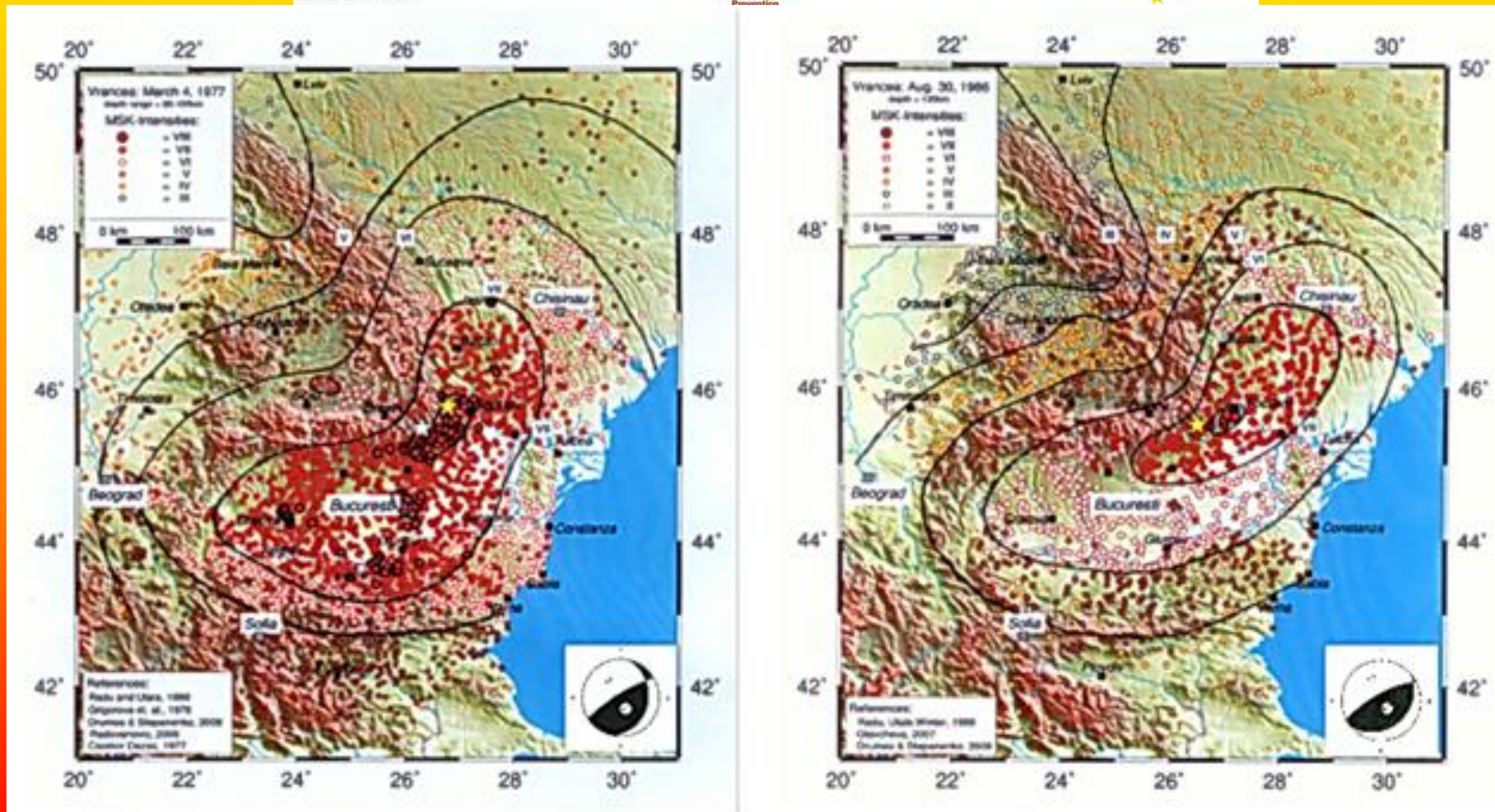
1932,Sep.26, 40.45ºN, 23.76ºE, M=7.0, Hierissos



Papazachos et al., 1997.

MAP OF MAXIMUM OBSERVED INTENSITIES





Unified macroseismic maps in MSK scale of the Vrancea events of 1977 (Mw=7.5, H=83km) and 1986 (Mw=7.2, H=132km).

(Radu et al., 1987: Bonjer 2013 mod.).

In spite of their large magnitude these events do not cause significant damage in Bulgaria and Greece

METHODOLOGIES APPLIED FOR SEISMIC HAZARD ASSESSMENT

1. PROBABILISTIC METHODS BASED ON THE CORNELL'S (1968) AND ITS MODIFICATION BY MCGUIRE (1976) USING AREA- AND LINE- TYPE SOURCES
2. PROBABILISTIC METHOD BASED ON THE STATISTICAL TREATMENT OF OBSERVED INTENSITIES.

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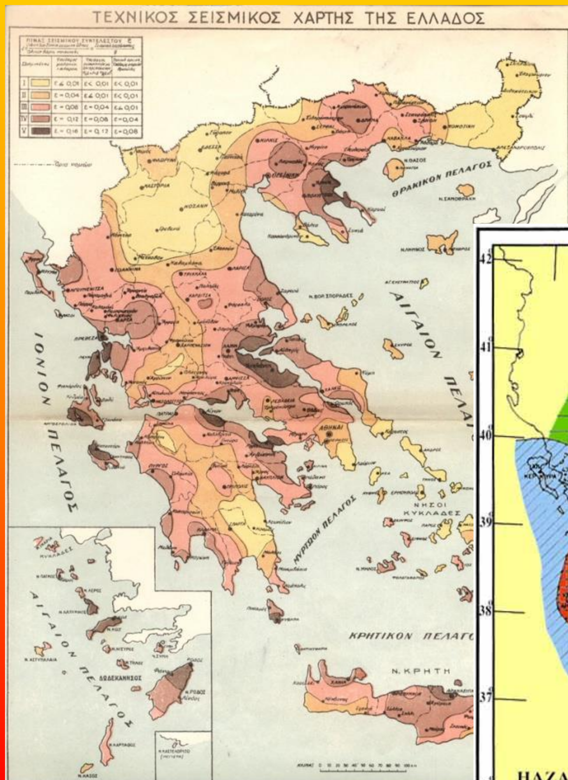
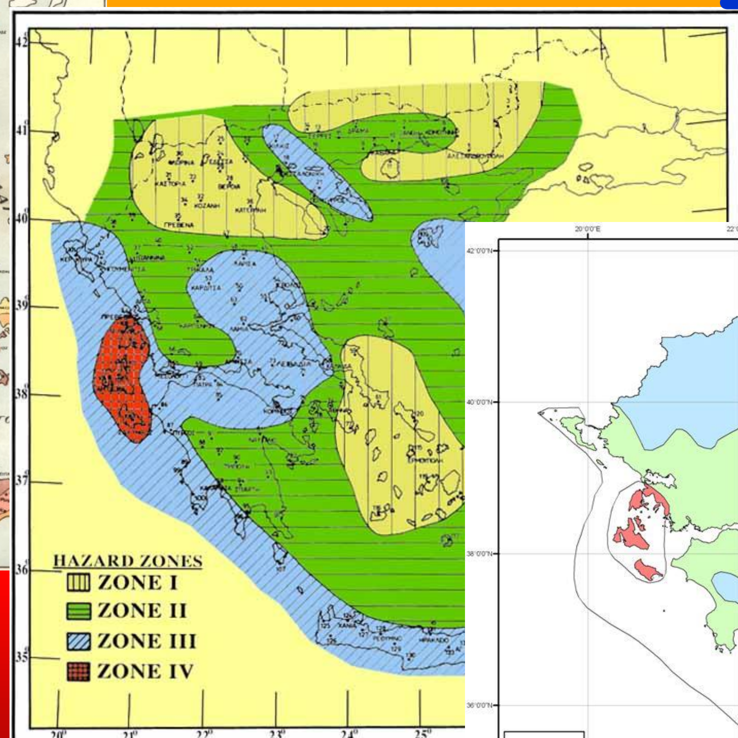
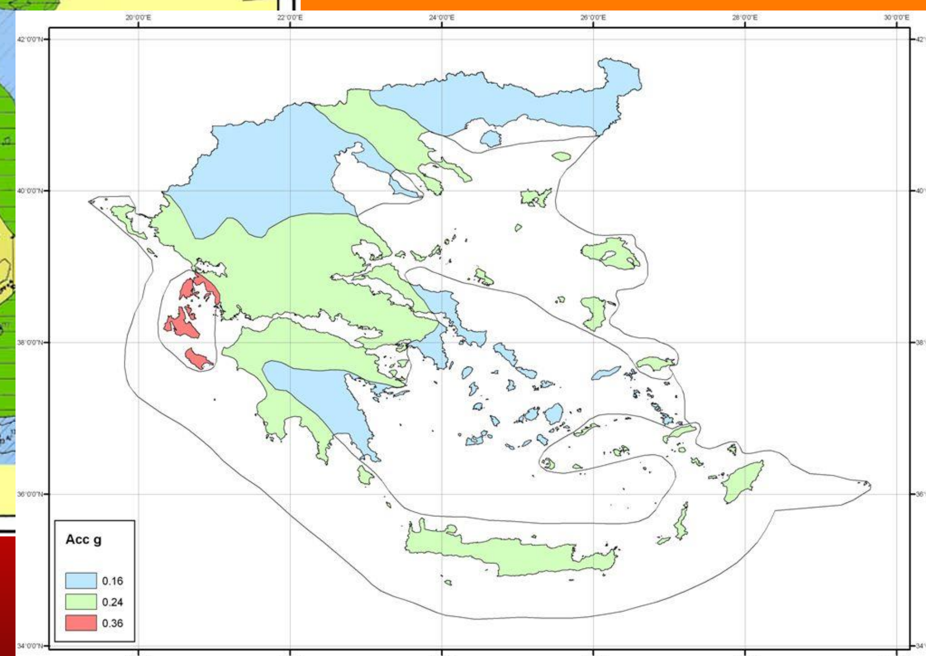
1956
Roussopoulos



1989
(Effective since 1995)

4 Seismological Centers

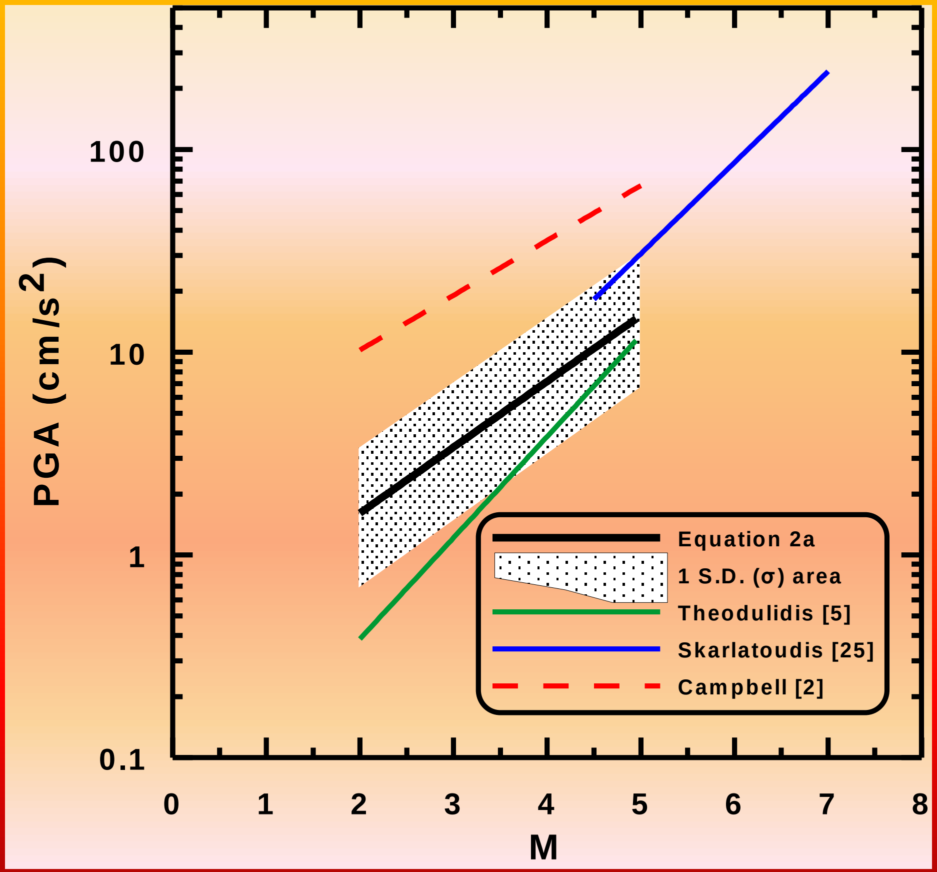


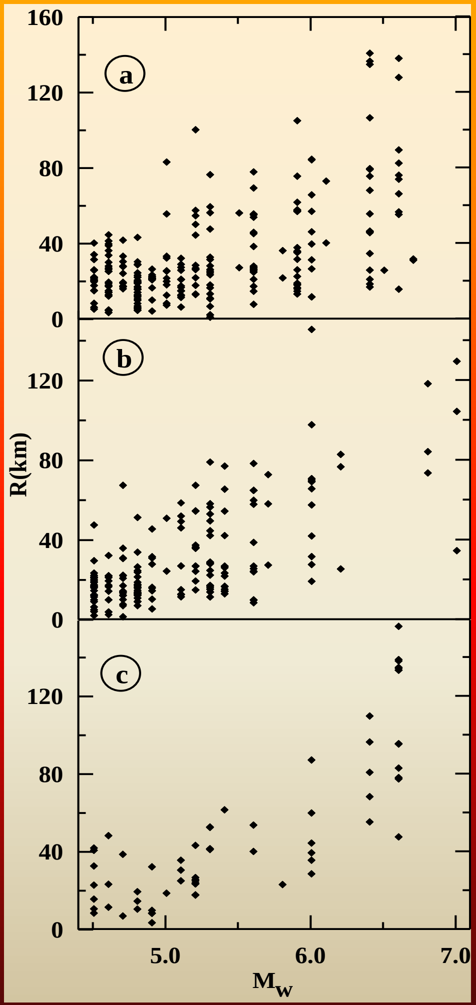


2001: All (5) the seismological institutions

EMPIRICAL PREDICTIVE RELATIONS FOR PGA SMALL VS MODERATE-STRONG MAGNITUDES

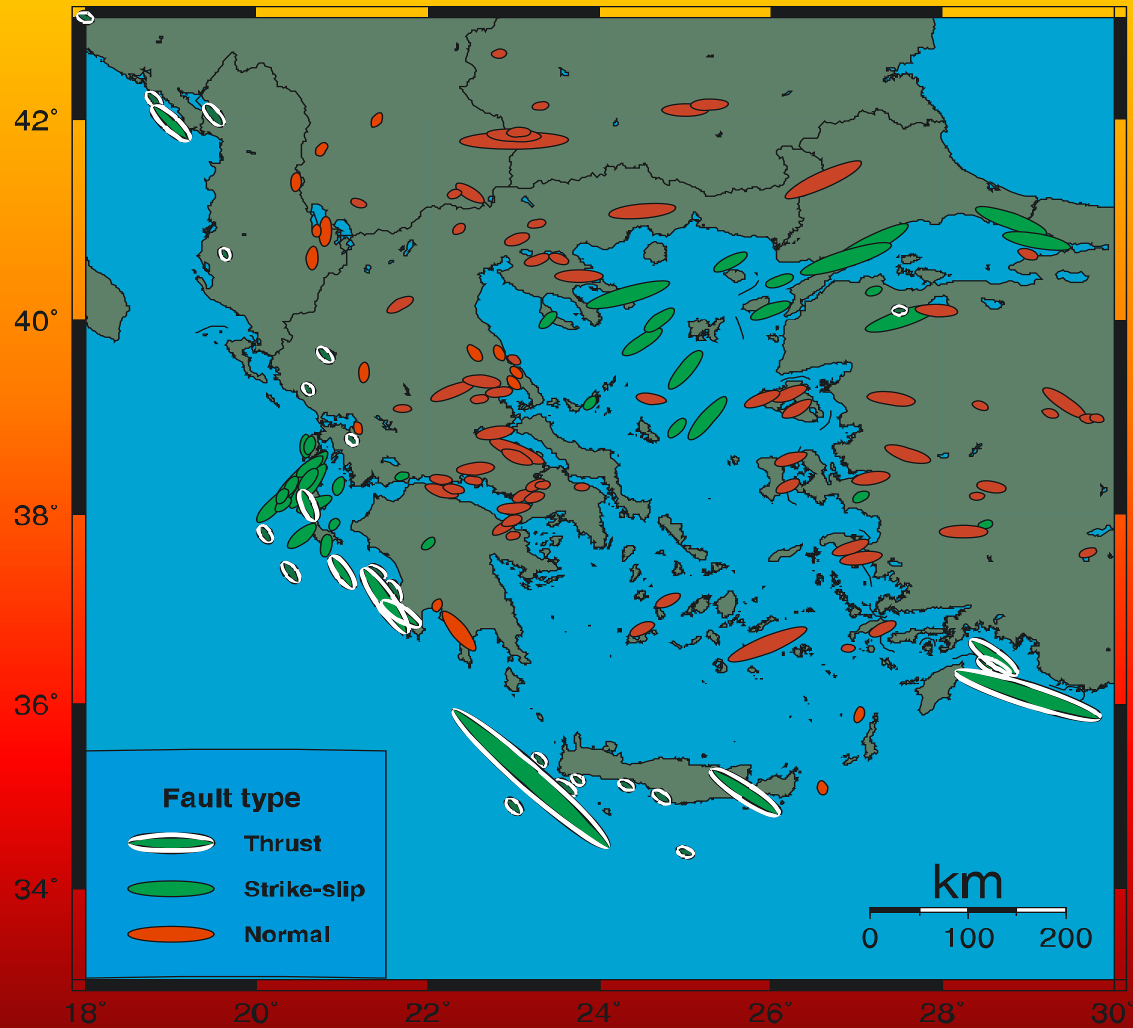
SKARLATOUDIS ET AL. 2004, 2005





Notice the difference for smaller predicted PGA values (black line) compared to the corresponding ones from large magnitude earthquakes (blue line).

RUPTURE ZONES OF KNOWN EQS. 550 B.C. - 1997



Papazachos et al., 1999

METHODOLOGIES APPLIED FOR SEISMIC HAZARD ASSESSMENT

MCGUIRE (1976) & FRISK88M

BOTH WERE MODIFIED FOR THE ATTENUATION OF SMALL MAGNITUDE EARTHQUAKES AND CONSIDERATION OF VARIOUS PREDICTIVE RELATIONS HOLDING FOR DIFFERENT TECTONIC ENVIRONMENTS.

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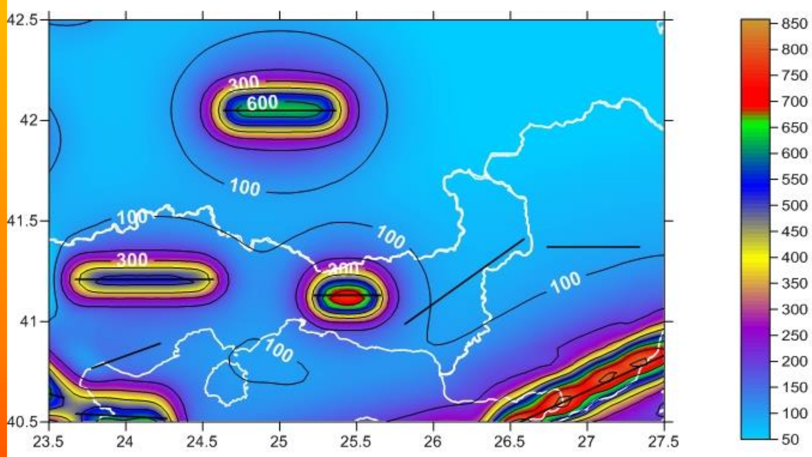
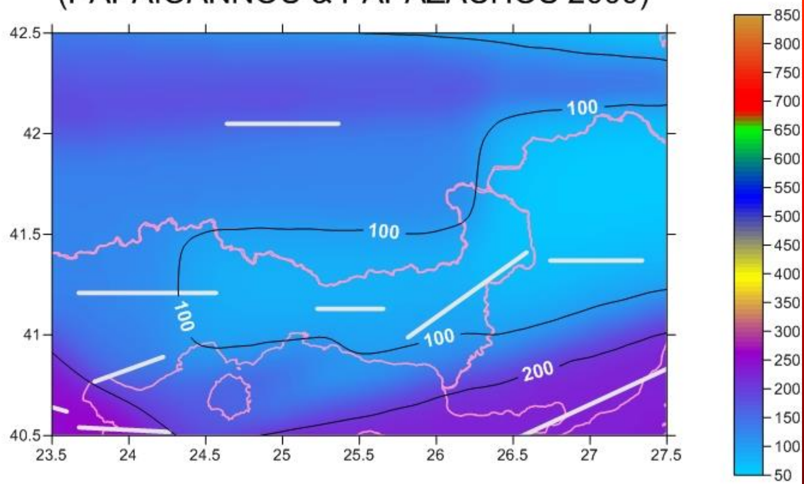
HYBRID MODEL OF AREA AND FAULT -TYPE SOURCES

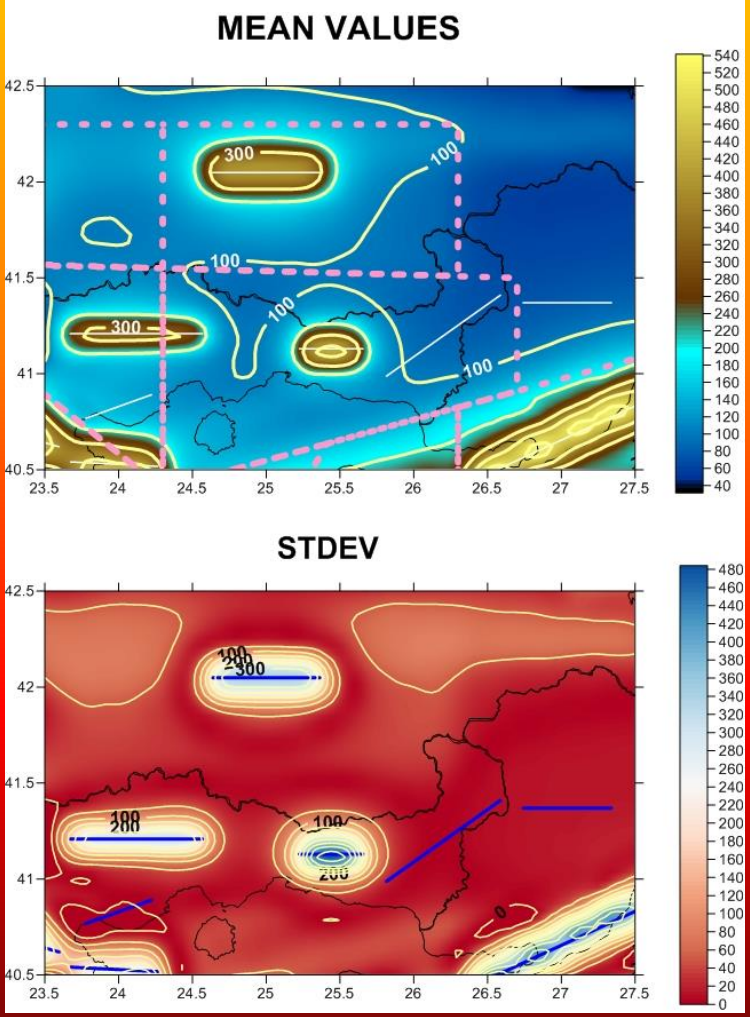


MODEL OF AREA TYPE SOURCES
(PAPAIOANNOU & PAPAZACHOS 2000)



RESULTS FOR T_M =476 yrs

TM = 476 years


MEAN VALUES
STDEV
23.5
24
24.5
25
25.5
26
26.5
27
27.5
40.5
41
41.5
42
42.5
100
300

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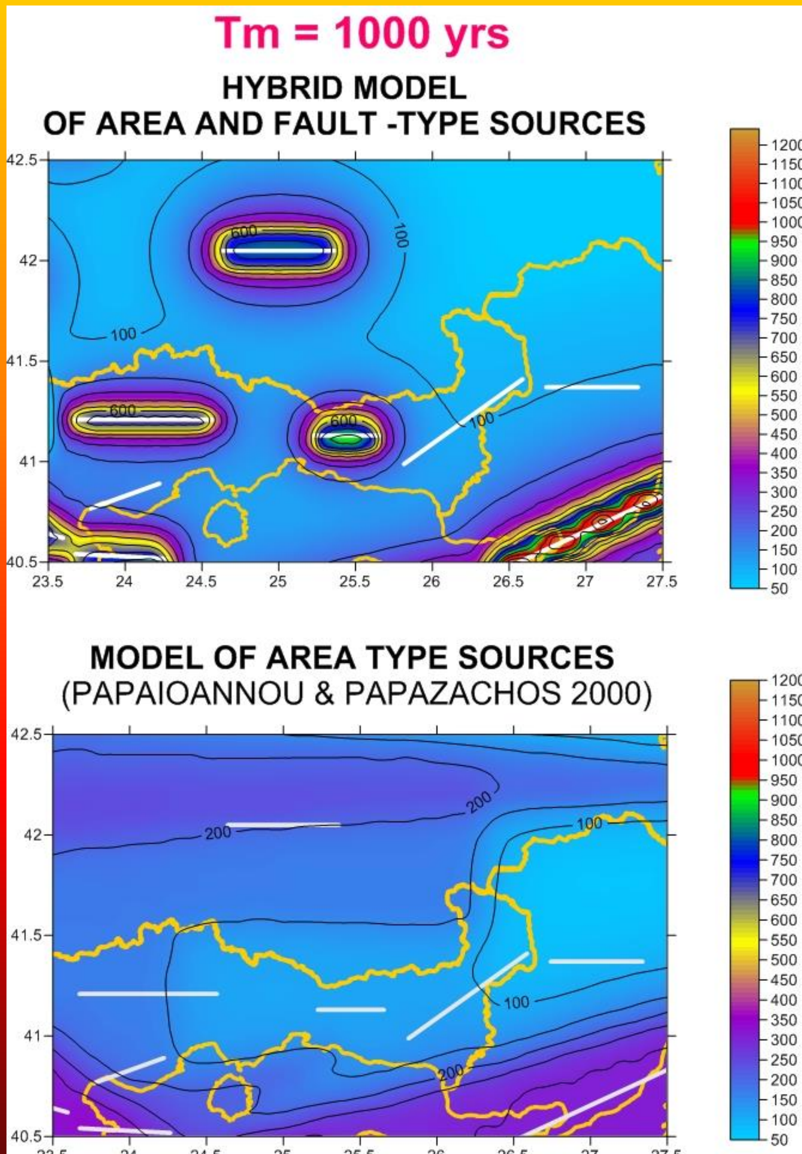
Black Sea CROSS BORDER COOPERATION



RESULTS FOR T_M = 952 yrs

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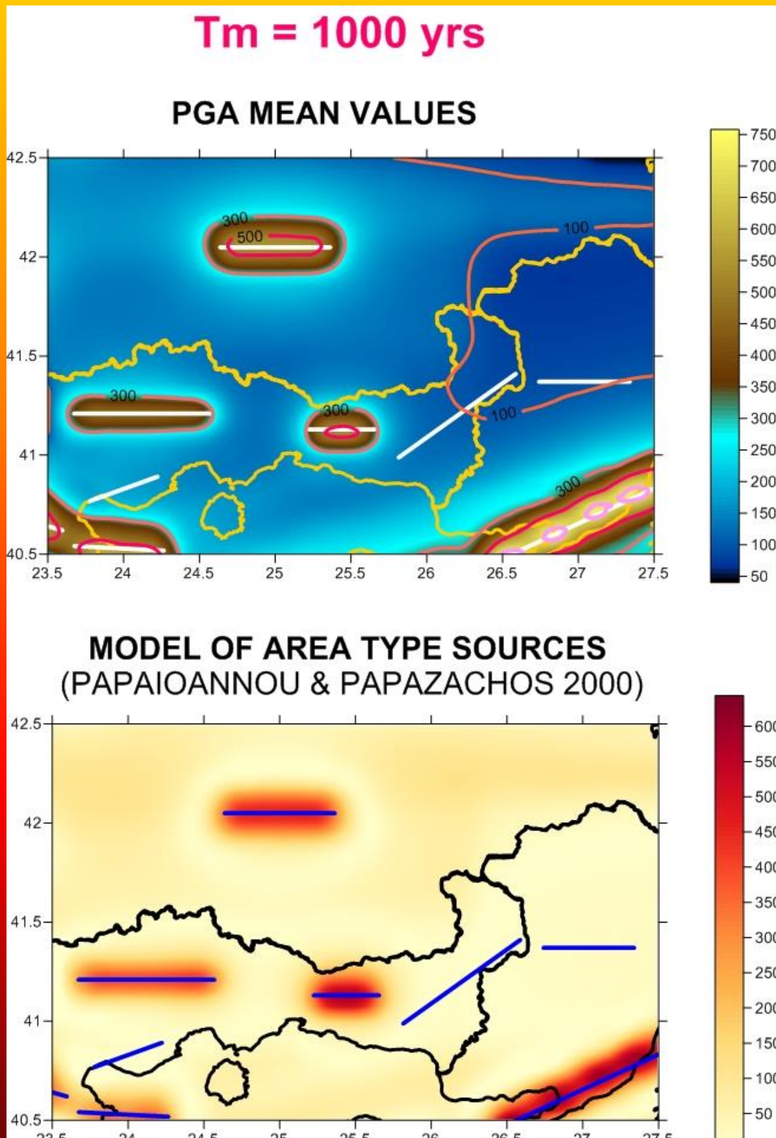
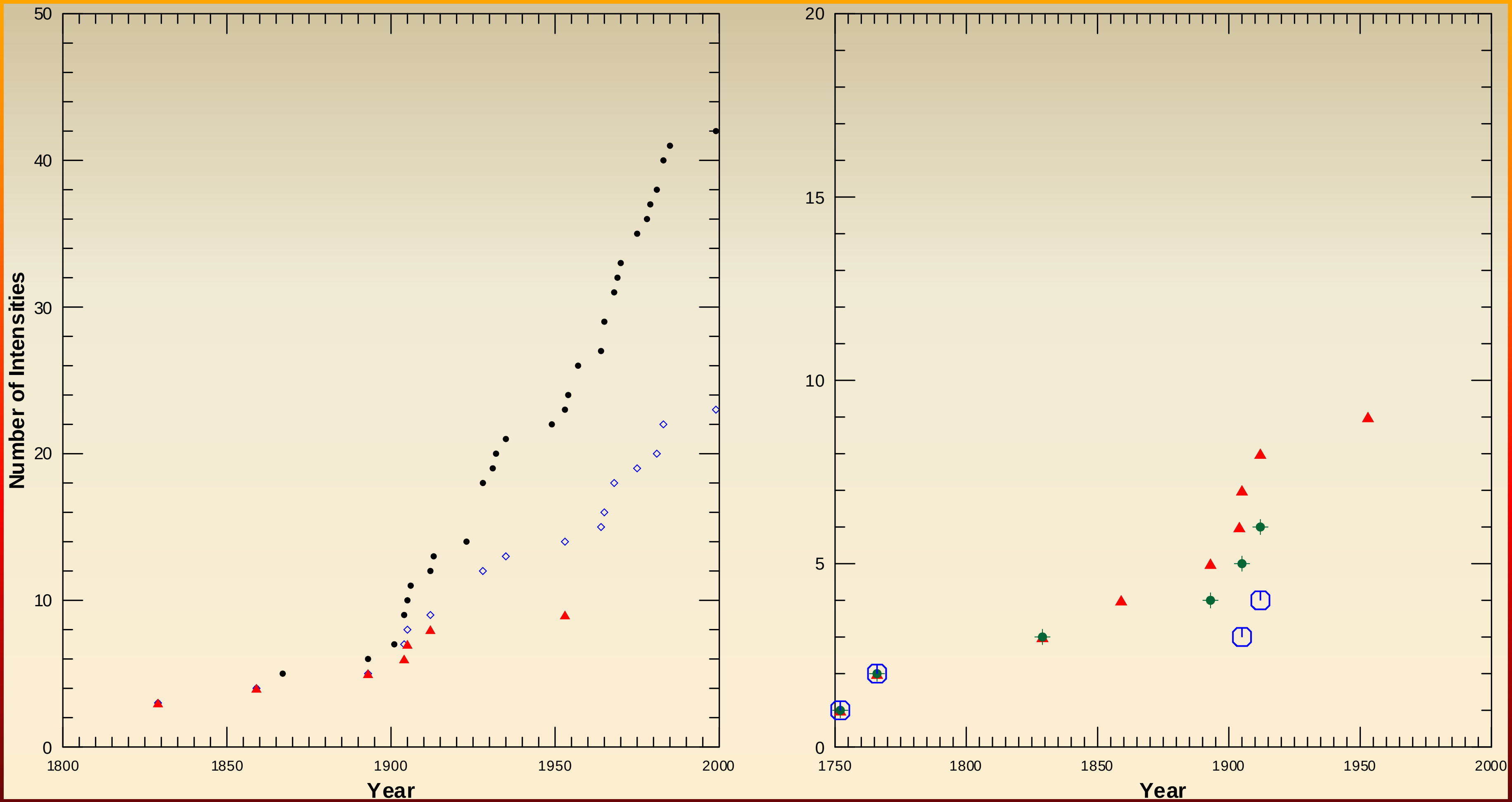
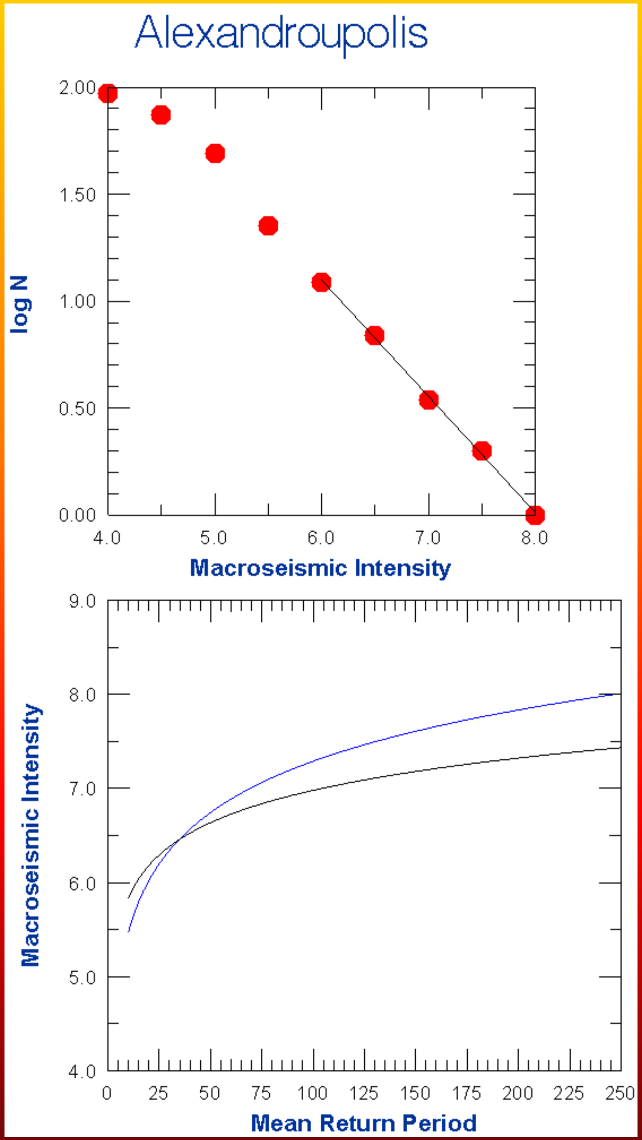


ALEXANDROUPOLIS INTENSITY RATE





INTENSITY DISTRIBUTION

COMPARISON OF THE RESULTS

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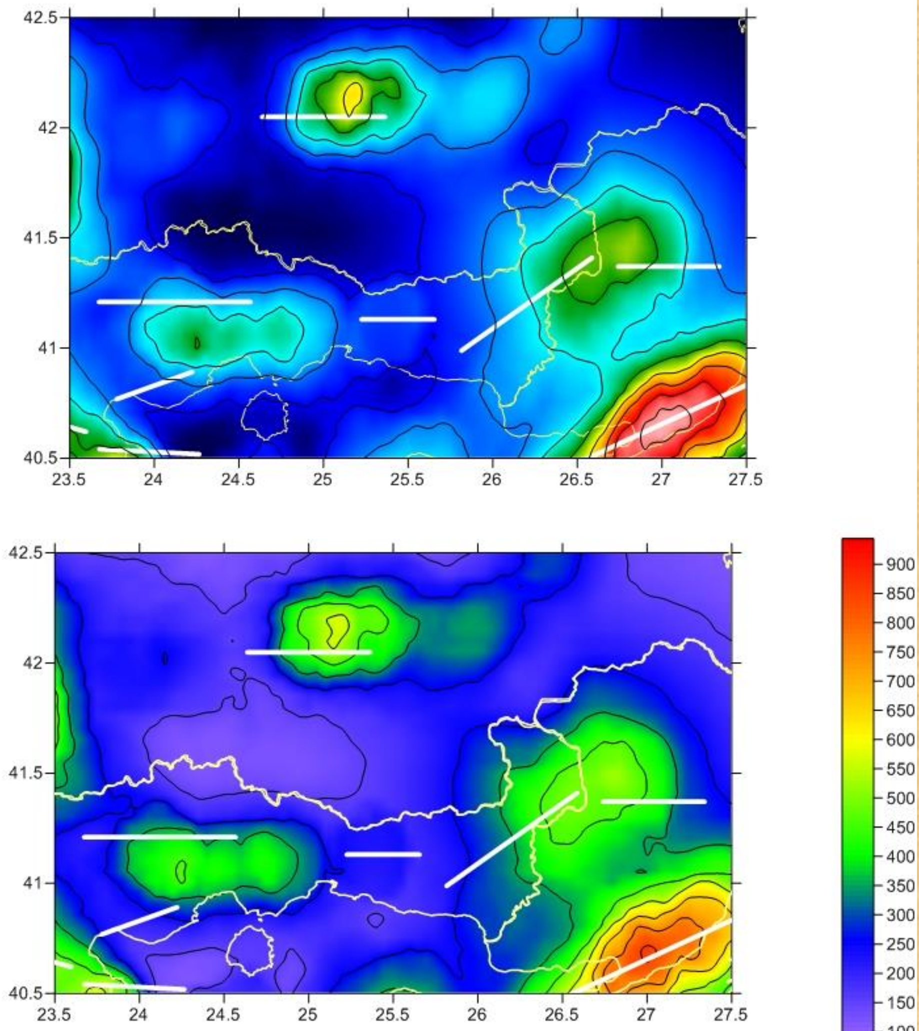
MAXIMUM ACCELERATION VALUES



Maps depicting the maximum PGA values for ROCK sites on the basis of the geographical distribution of maximum intensities converted to PGA & PGA+1σ using scaling relations.

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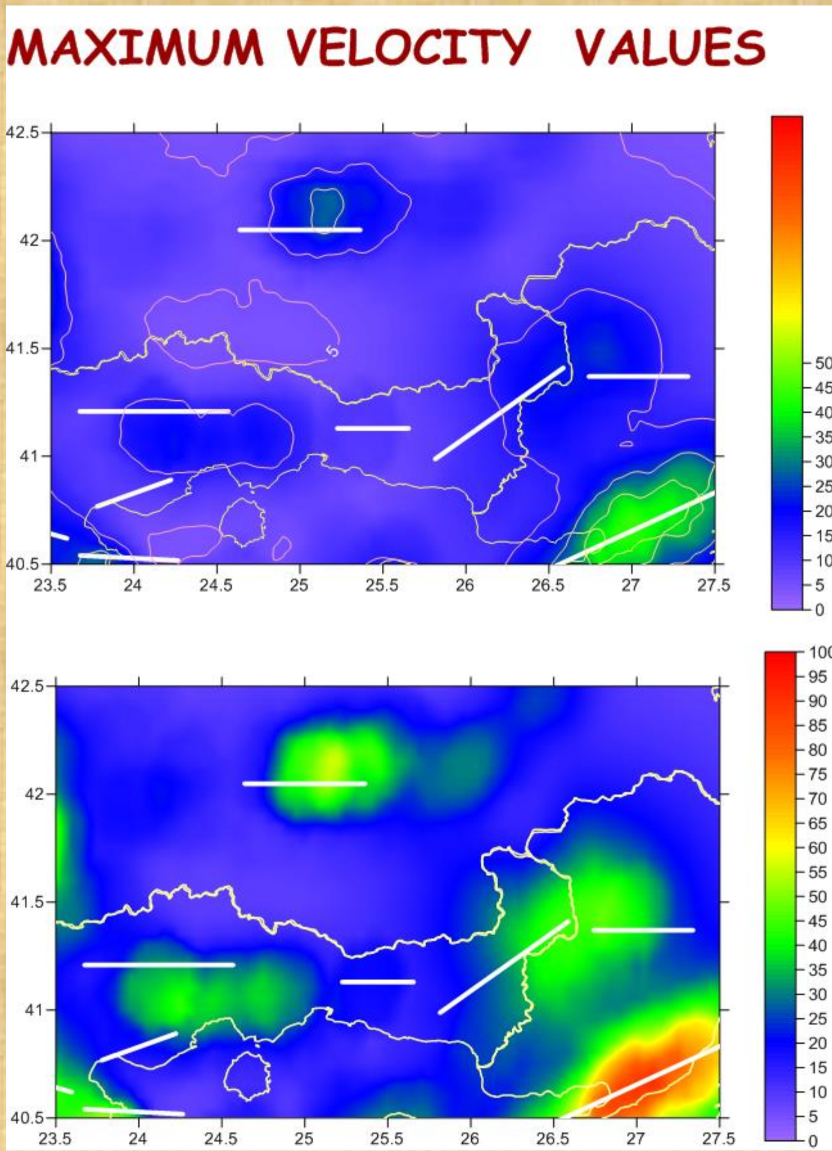

Maps depicting the maximum PGV values for ROCK sites on the basis of the geographical distribution of maximum intensities converted to PGV & PGV+1σ using scaling relations.

Εμπειρικές Σχέσεις

$$\log PGA = 0.86 + 0.45M_w - 1.27\log\left(R^2 + h^2\right)^{1/2} + 0.10F + 0.06S \quad \pm 0.232$$

$$\log PGV = -1.47 + 0.52M_w - 0.93\log\left(R^2 + h^2\right)^{1/2} + 0.07F + 0.11S \quad \pm 0.244$$

$$\log PGD = -4.08 + 0.88M_w - 1.27\log\left(R^2 + h^2\right)^{1/2} - 0.02F + 0.25S \quad \pm 0.341$$

Skarlatoudis et al. 2004