Project funded by the EUROPEAN UNION

SciNet NatHaz Prevention

Black Sea CROSS BORDER COOPERATION

A Scientific Network for Earthquake, Landslide & Flood Hazard Prevention

SciNetNatHazPrev - PROJECT WORKSHOP

MARCH 13-14, 2014, ISTANBUL, TURKEY

VENUE: MAÇKA SOCIAL CENTER, ISTANBUL TECHNICAL UNIVERSITY FOUNDATION

Seismic Hazard Assessment Methodologies :

Partner's Presentation

Greek P2: *Selected Seismic Hazard Assessment Methodologies Applied to Specific National Case Studies*

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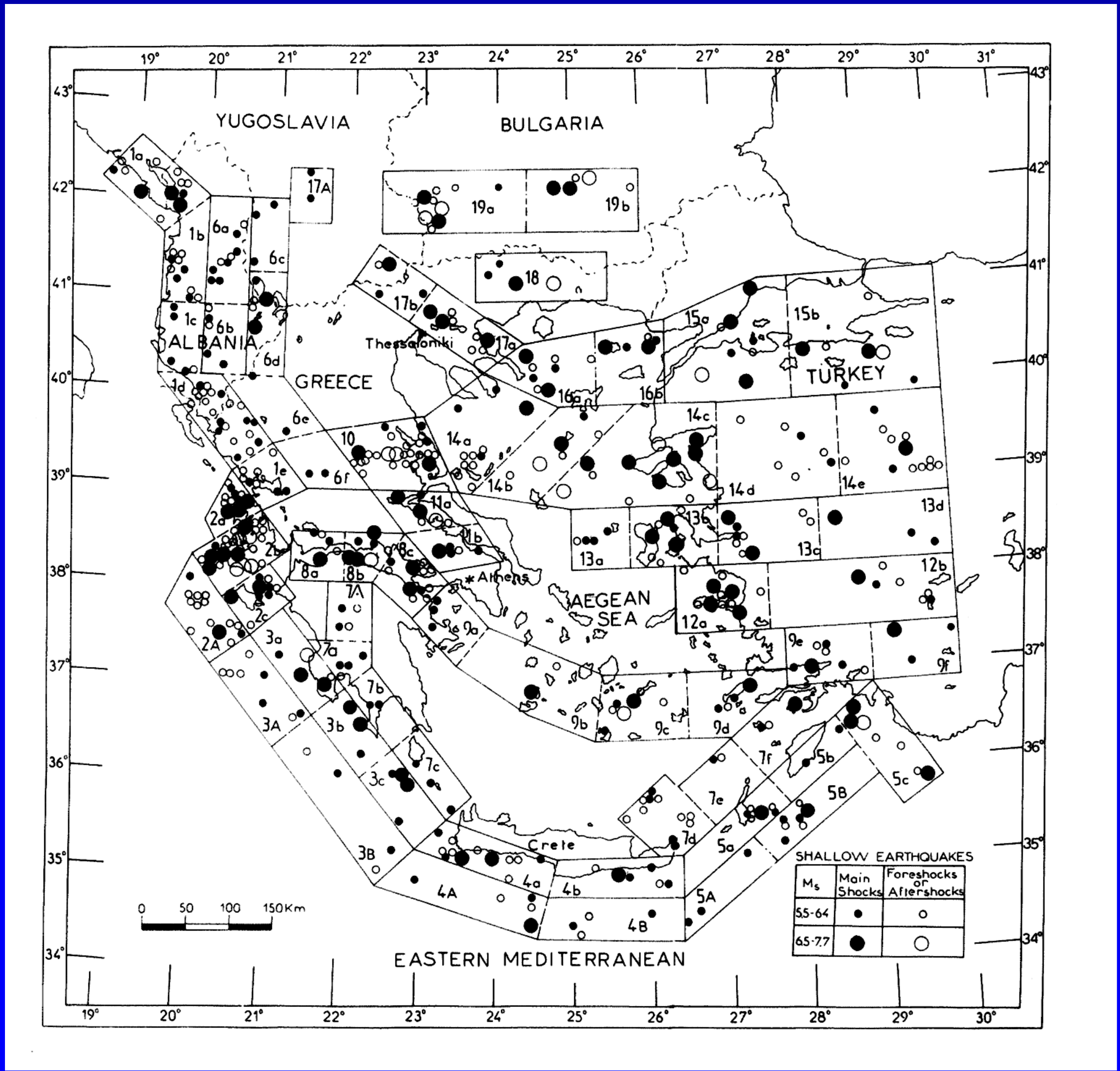
Dr. Geophysicist-Seismologist

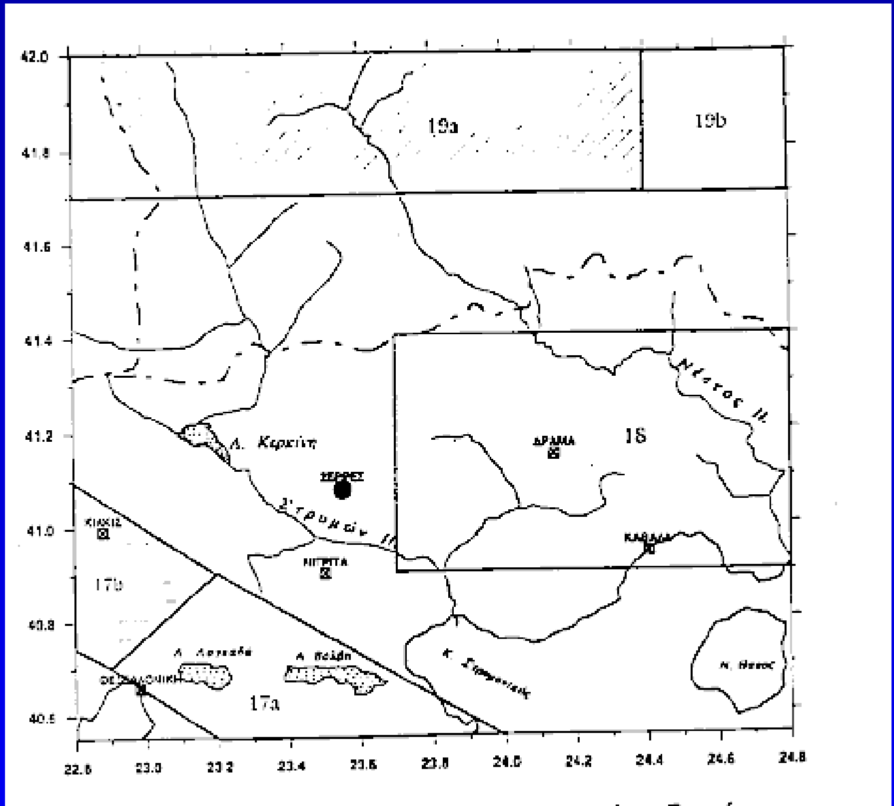
Seismic Hazard Assessment

- *Seismic Sources*
- *Ground motion parameters*
- *Deterministic Seismic Hazard Analysis*
- *Probabilistic Seismic Hazard Analysis*
- *Results of Seismic Hazard Analysis*

Seismic Source in Greece

(Papazachos etal. 1993)

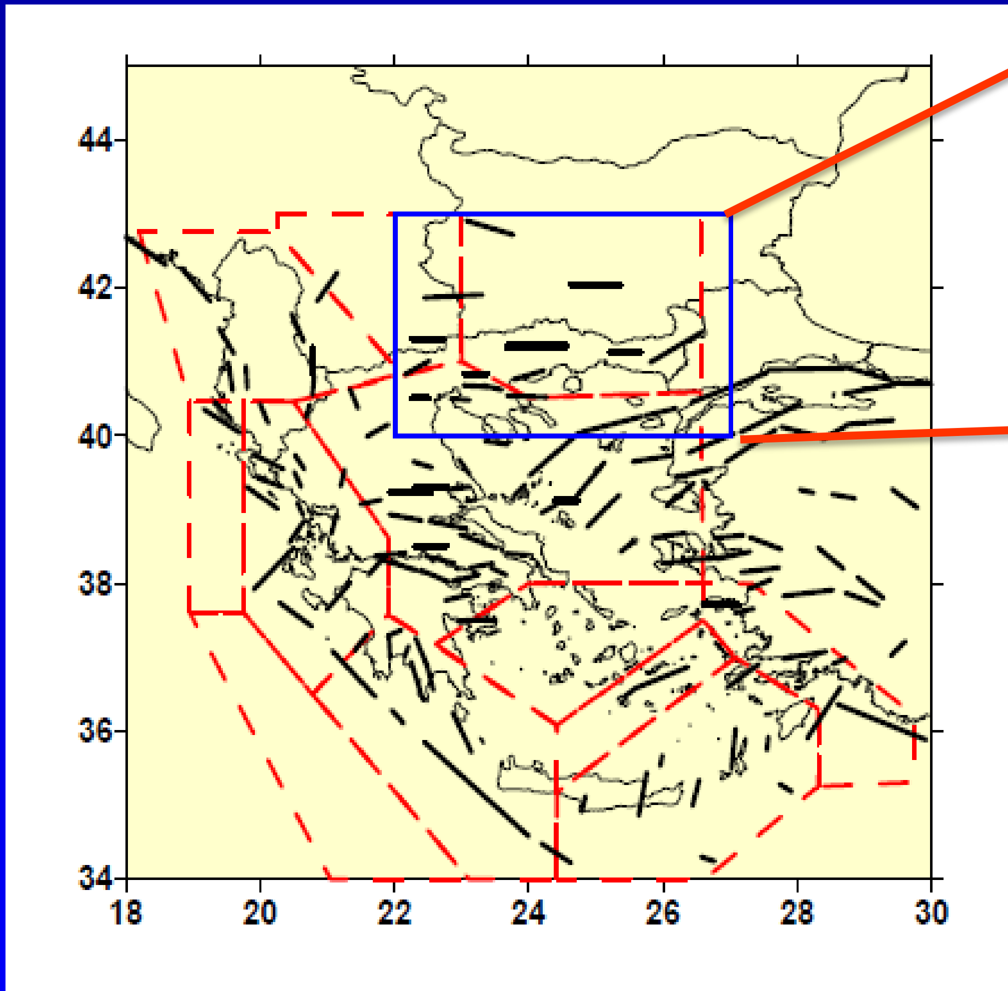


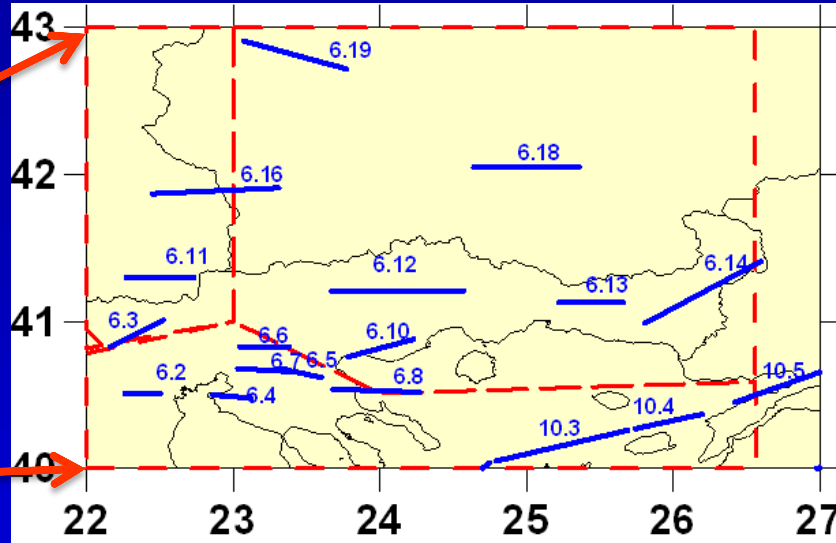


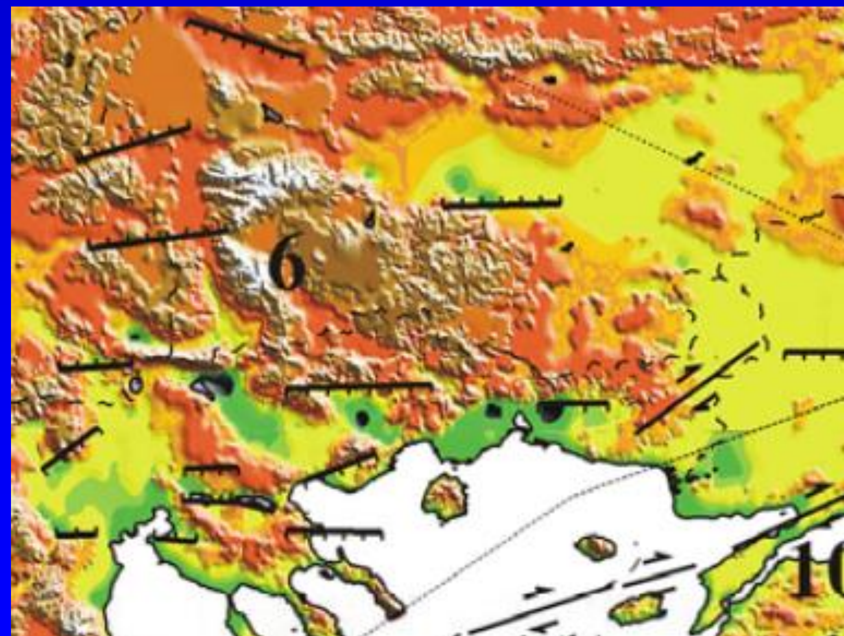
Σχ. 5. Χάρτης σεισμικών πηγών στην ευρύτερη περιοχή των Σερρών.

Seismic Source in Greece

(Papazachos etal. 2006)

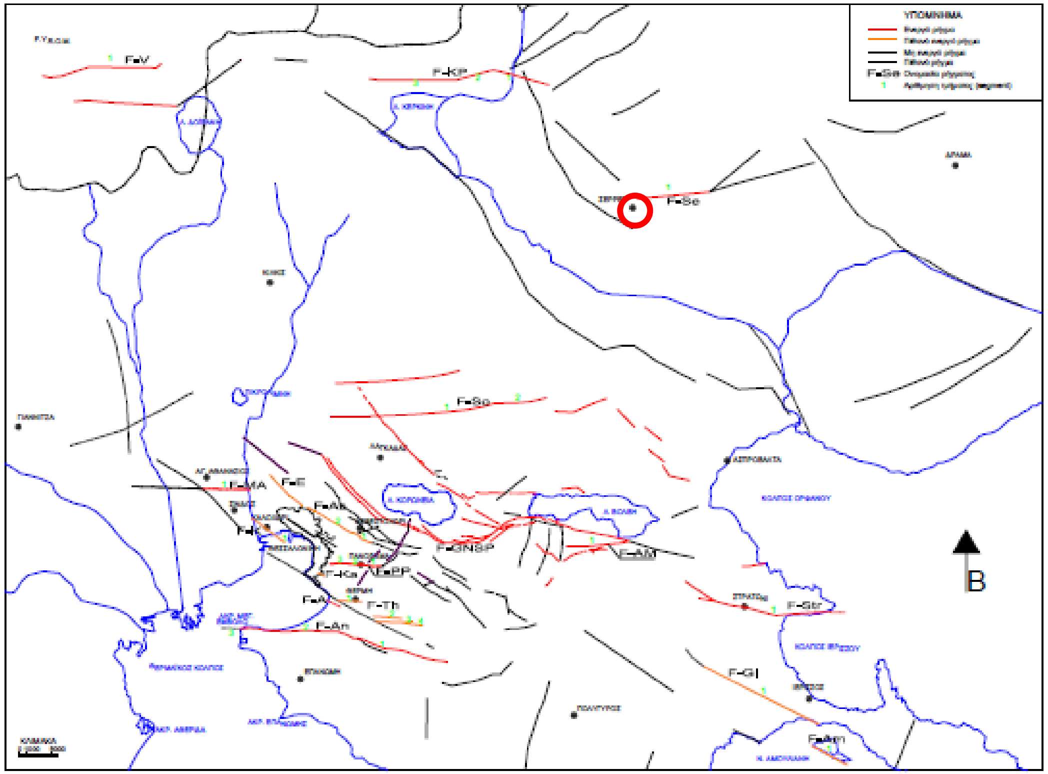




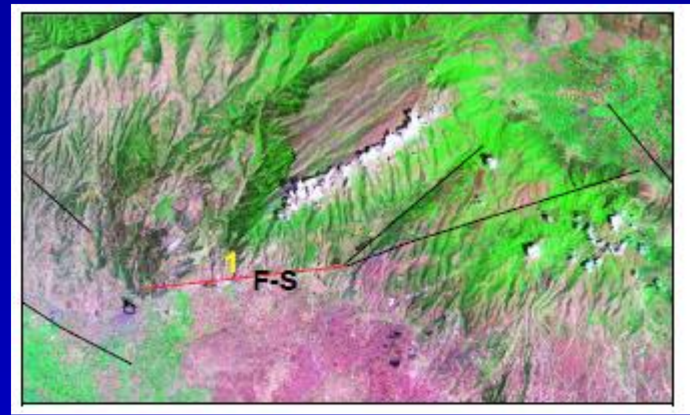


Seismic Faults (Papazachos etal., 2001)
Seismci Sources (Papazachos and Papaioannou, 2000)

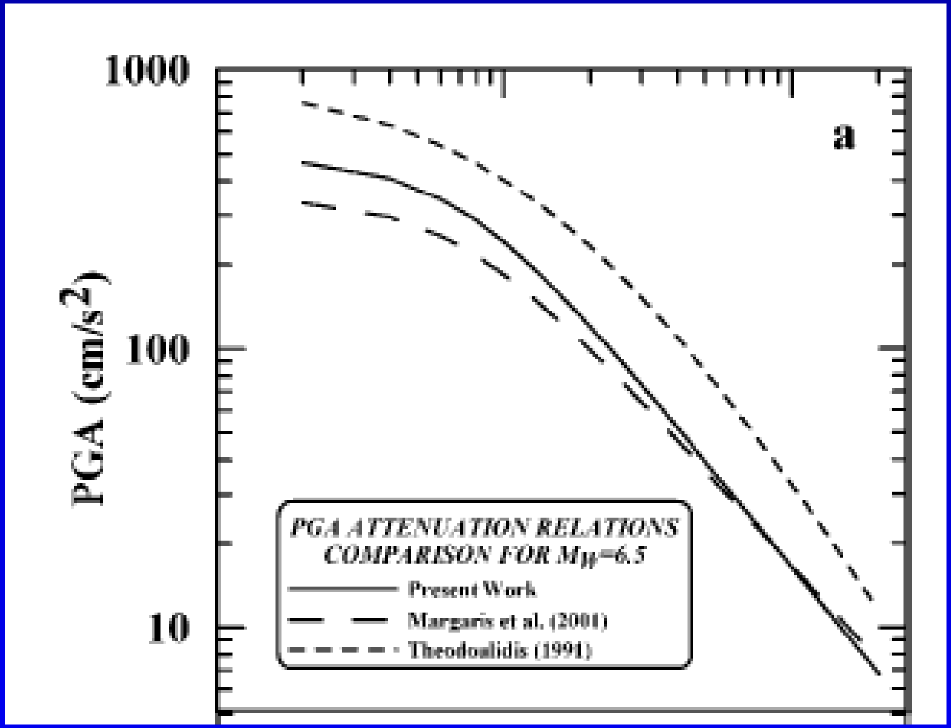
Active Faults in Area Studied
(Pavlidis et al., 2005)

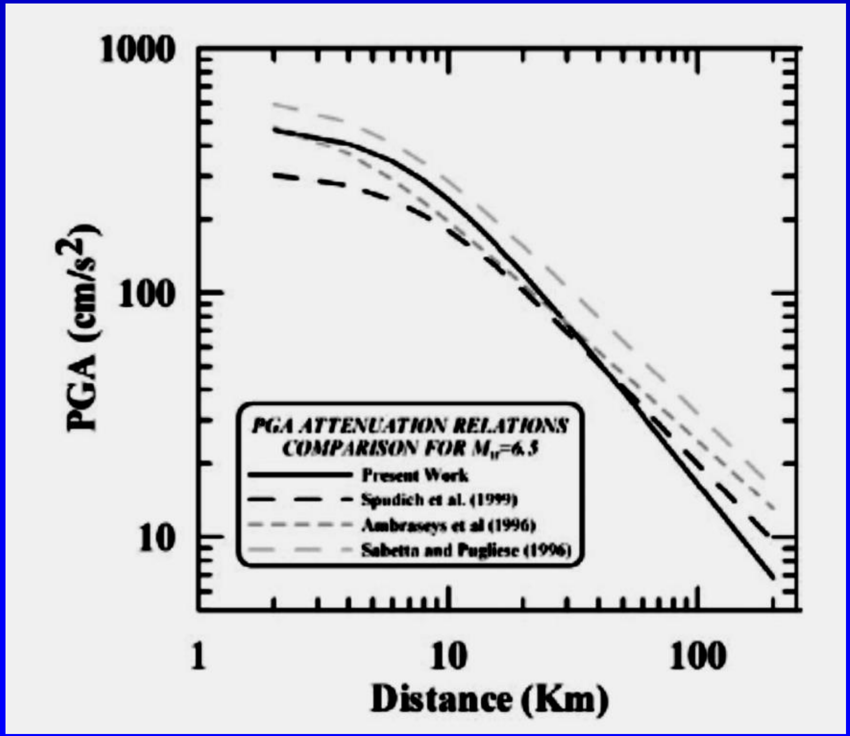


Χάρτης 1: Ενεργά ρήγματα της ευρύτερης περιοχής της Θεσσαλονίκης (F-Str Στρατωνίου, F-Gl Γοματίου–Ιερισσού, F-KP Κερκίνης–Πετριτσίου, F-Th Θέρμης, F-An Ανθεμούντα, F-PP Πυλαίας–Πανοράματος, F-As Ασβεστοχωρίου, F-E Ευκαρπίας, F-A Αεροδρομίου, F-MA N. Μεσημβρίας–Αγχίαλου, F-K Καλοχωρίου, F-So Σοχού, F-AM N. Απολλωνίας–N. Μαδύτου, F-Se Σερρών, F-Am Αμουλιανής, F-V Βαλάντοβο, F-GNSP Γερακαρούς–Νικομιδηνού–Στίβου-Περιστερώνα F-Ka Καλαμαριάς).



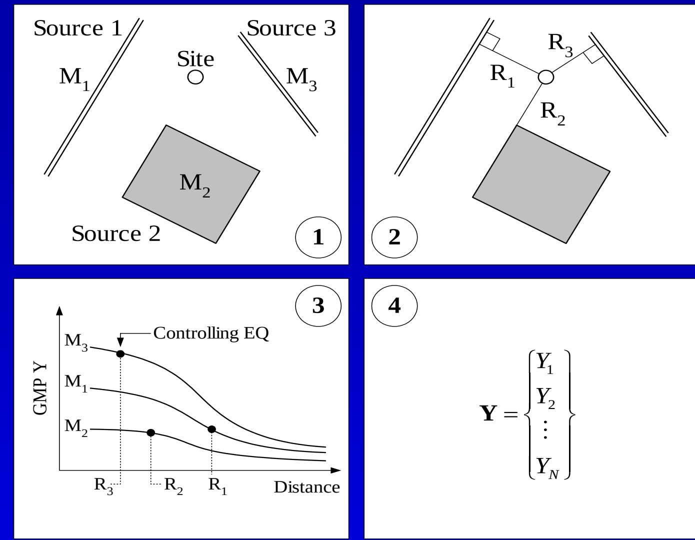
GMPE's: Ground Motion Prediction Equations in Greece (Skarlatoudis etal., 2003; BSSA)





Seismic Hazard Assessment

Seismic Hazard Analysis: Estimation of ground-shaking hazards at a particular site



Two basic approaches

Deterministic (DSHA):

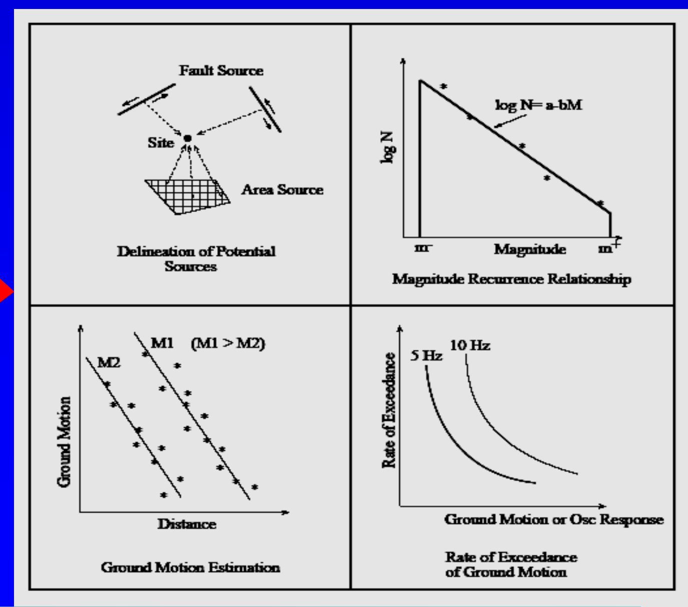
Assumes a single "scenario"

- Select a single magnitude, *M*
- Select a single distance, *R*
- Assume effects due to *M*, *R*

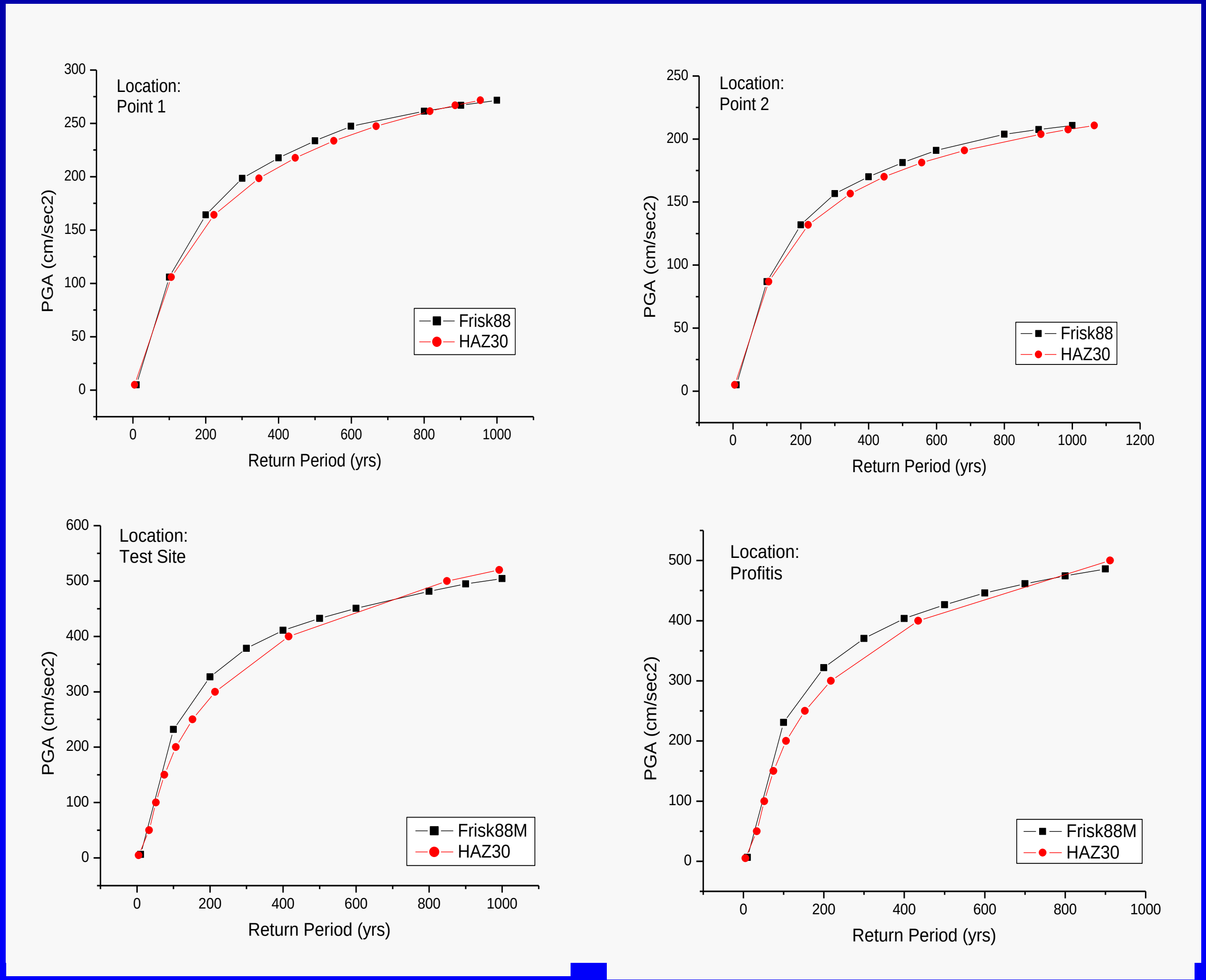
Probabilistic (PSHA):

Assumes many scenarios

- Consider all magnitudes
- Consider all distances
- Consider all effects

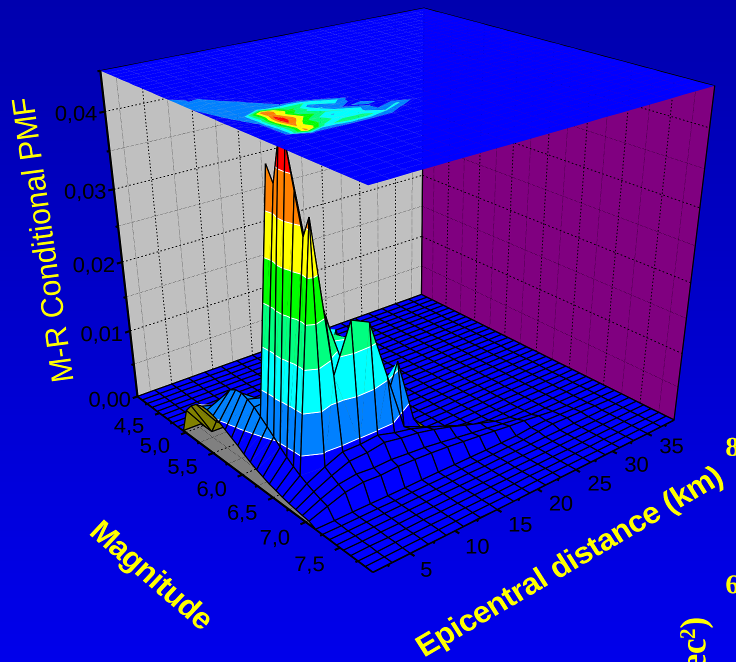


Comparison of 2 Different PSHA Codes
FRISK (McGuire 1998) & HAZ (Abrahamson 2000)

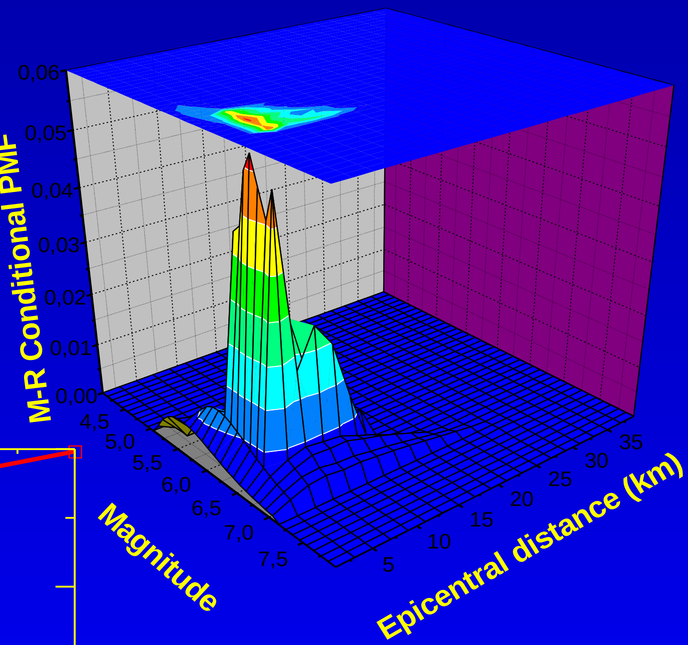


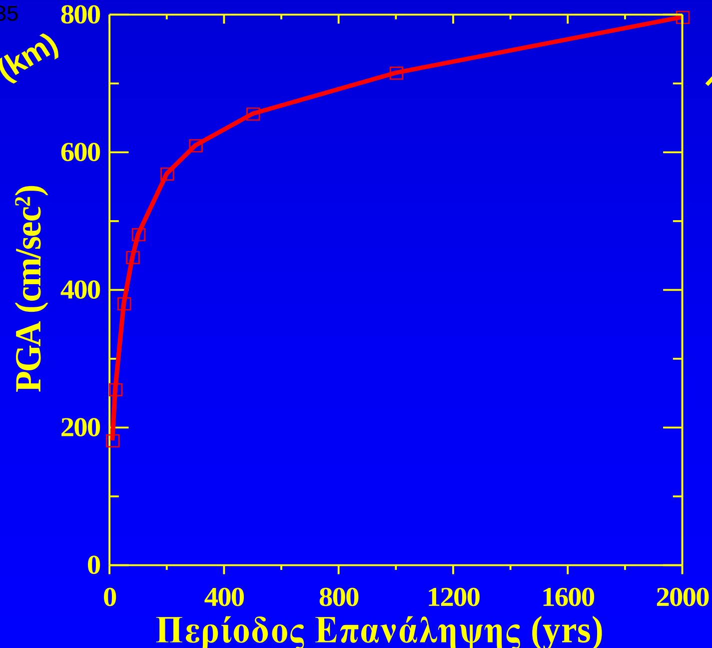
PSHA & Dis-Aggregation (Margaris & Koutrakis 2004)

Πόλη Λευκάδας, PGA=333 cm/sec²(~52 yrs RP)
M-R max at 6.35-5.0



Πόλη Λευκάδας PGA=410 cm/sec²(~87 yrs RP)
M-R max at 6.35-5.0



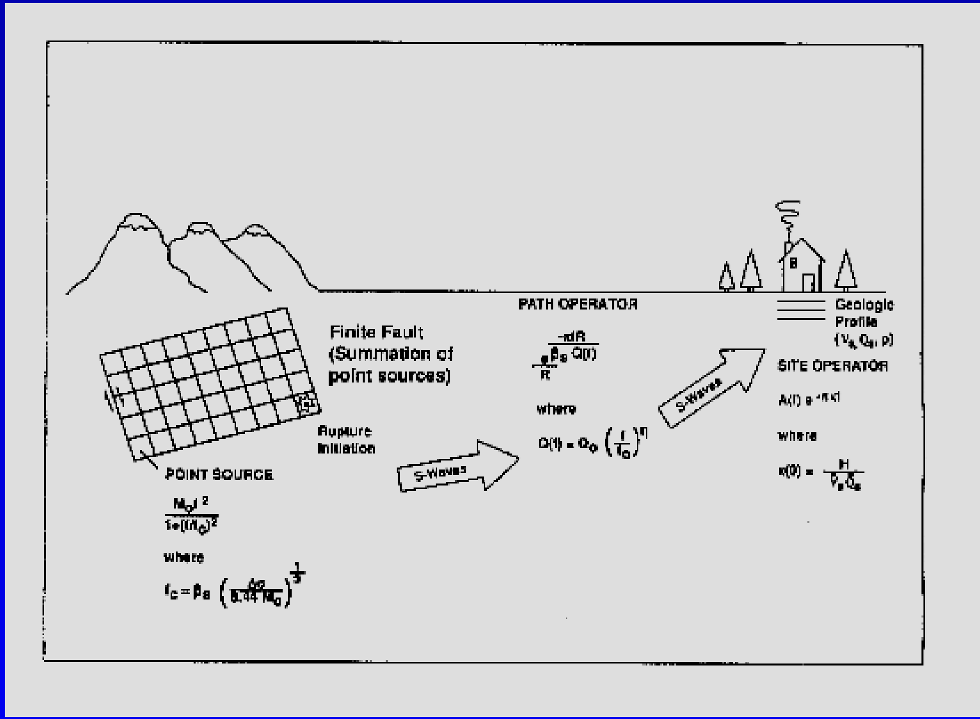


Strong Motion Stochastic Siumulation (PSM-FSM)

Methodology

1. Point Source Model (PSM)

(Hanks, 1979; McGuire & Hanks, 1981; Boore, 1983;Joyner,1984; Boore,1997; Margaris & Boore, 1998; Margaris 2002, Atkinson and Boore 2000, 2006, Boore etal., 2009, among others).



Description

Ground Motion Spectrum: $R(f) = C\ S(f)\ A(f)\ D(f)\ I(f)$

1. $C = (R_{\theta\varphi}\ F\ V)/\ (4\pi\rho_0\ \beta_0^3\ R)$ Scaling Factor

2. $S(f) = M_0\ /[1 + (f/f_0)^2]$ Source Spectrum Factor

3. $A(f) = (\rho_0\beta_0\ /\ \rho_r\beta_r\ )$ Amplification factor

4. $D(f) = [(-\pi\ f\ R)/(Q(f)\ \beta_0)]\ P(f)$ Diminution factor

   $P(f) = \exp(-\pi\kappa_0 f)$ (Anderson and Hough, 1984)

5. $I(f) = (2\ \pi\ f\ )^n$ n=1,2 Παράγοντας Απόκρισης Οργάνου

Strong Motion Stochastic Siumulation (PSM-FSM: continued)

2. Finite fault Model (FSM)

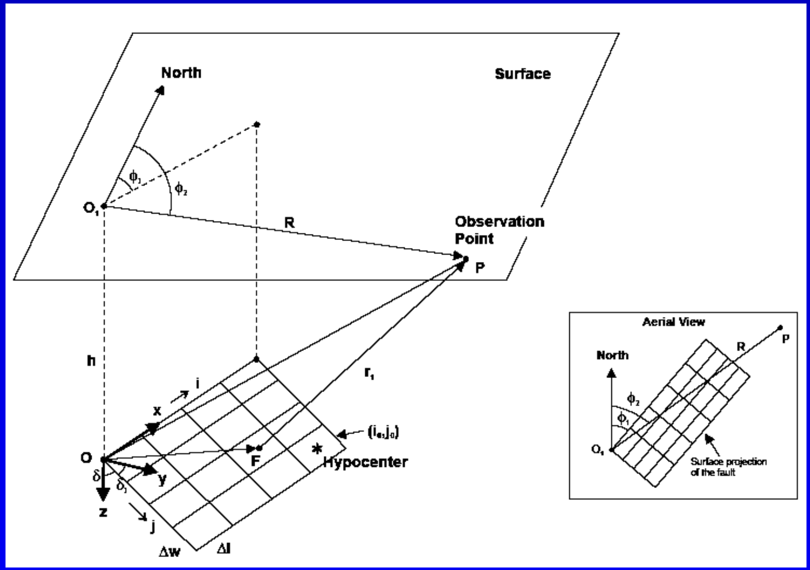
(Beresnev and Atkinson, 1997; 1998a; 1998b; 1999; Atkinson and Silva, 1997; 2000, Margaris 2001; Boore 2009).

Description

$f_0 = (y\ z\ /\ \pi)\ \beta_0\ /\ \Delta l$ Corner Frequency

$m_0 = \Delta\sigma\ \Delta l^3$ Seismic Momment

$\log \Delta l = -2.0 + 0.4\ M$ Relation Fault length vs M



Basic Equations

$f_0 = 4.9\ 10^6\ \beta_0\ (\Delta\sigma/M_0)^{1/3}$

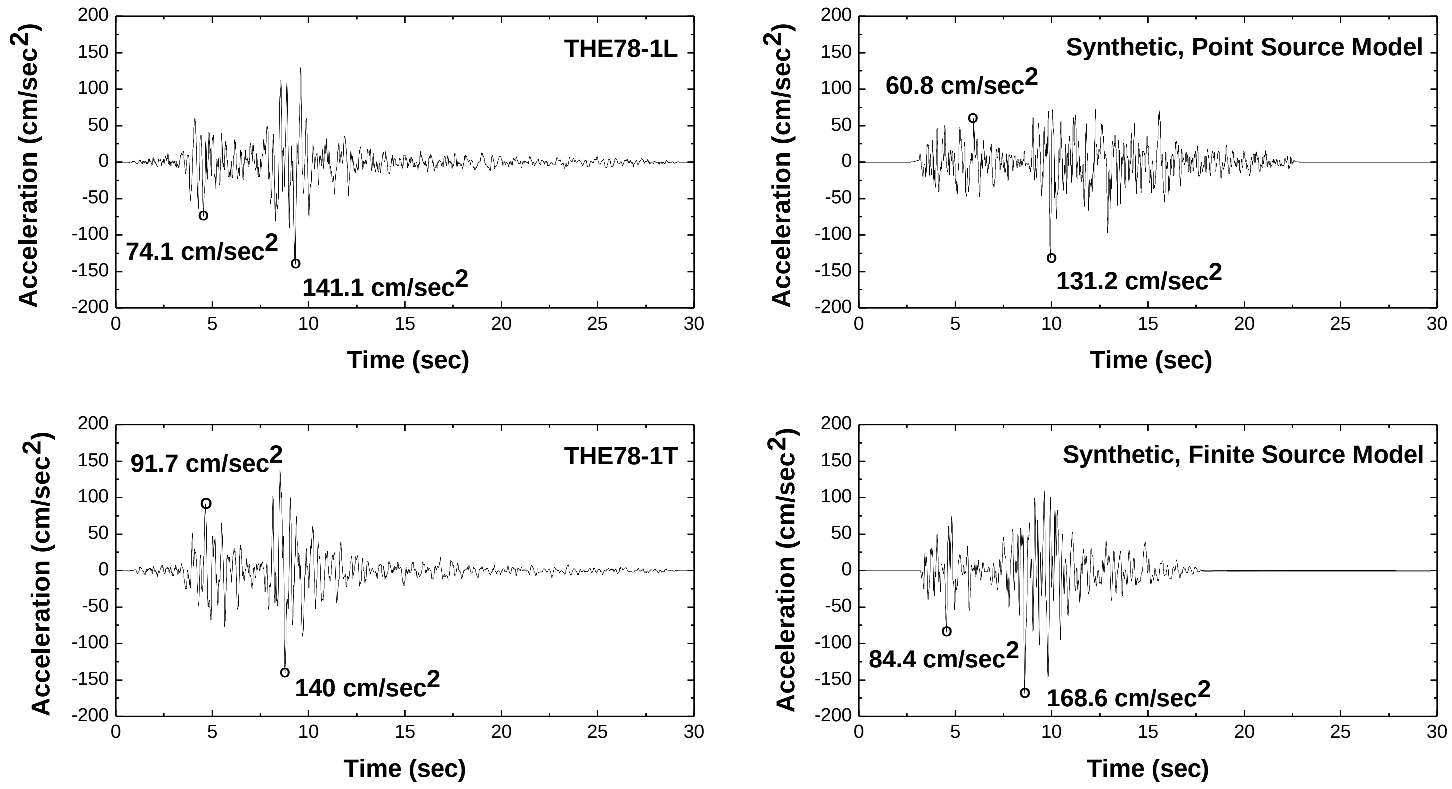
Corner Frequency (Brune, 1970)

(Margaris & Hatzidimitriou 2002)

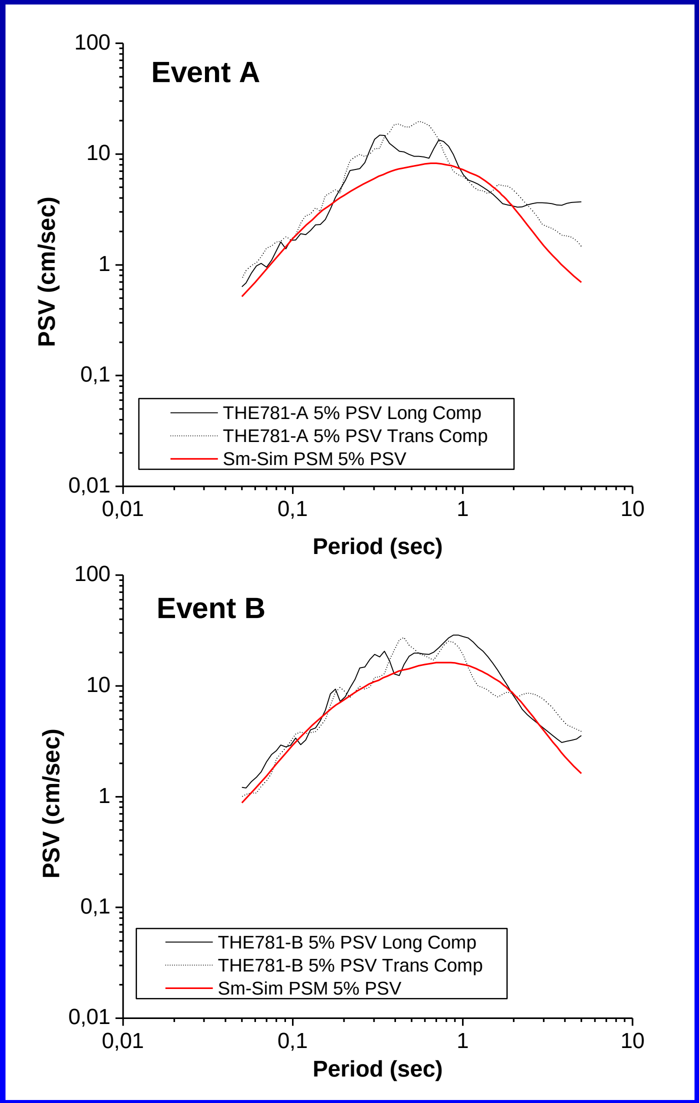
$T_w = T_s + T_d\ (R)$

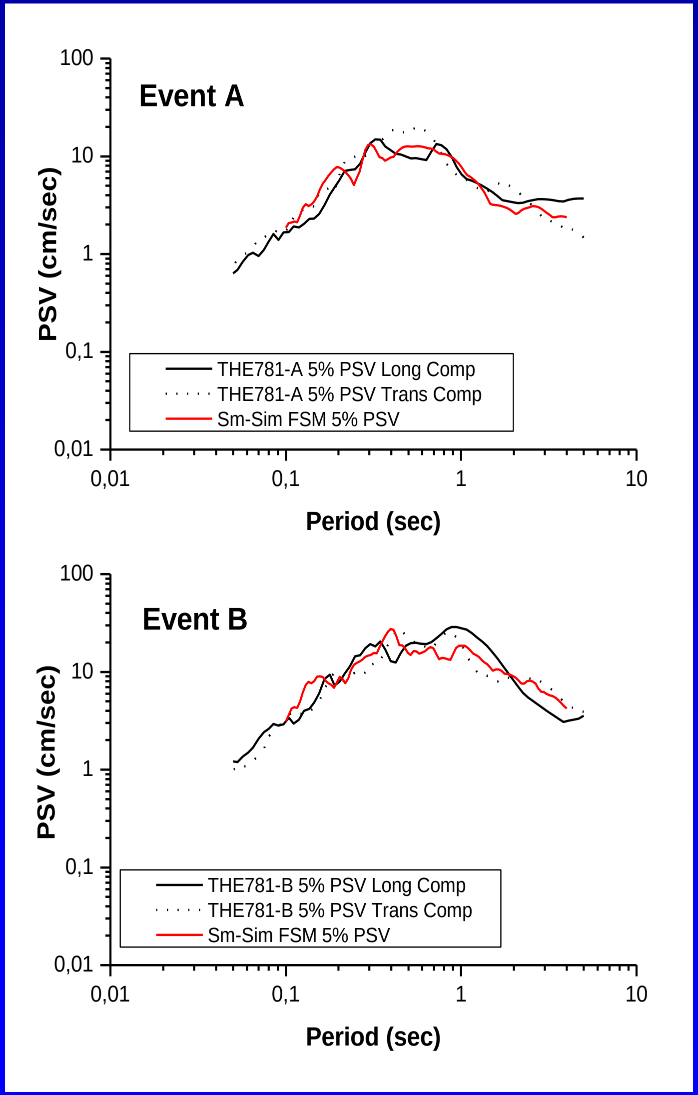
Duration (Hanks & McGuire, 1981; Herrmann, 1985; Atkinson, 1993)

Stochastic Simulation Verification with Observed Strong Motion Data THE78-1 (Margaris & Boore, 1998; BSSA)

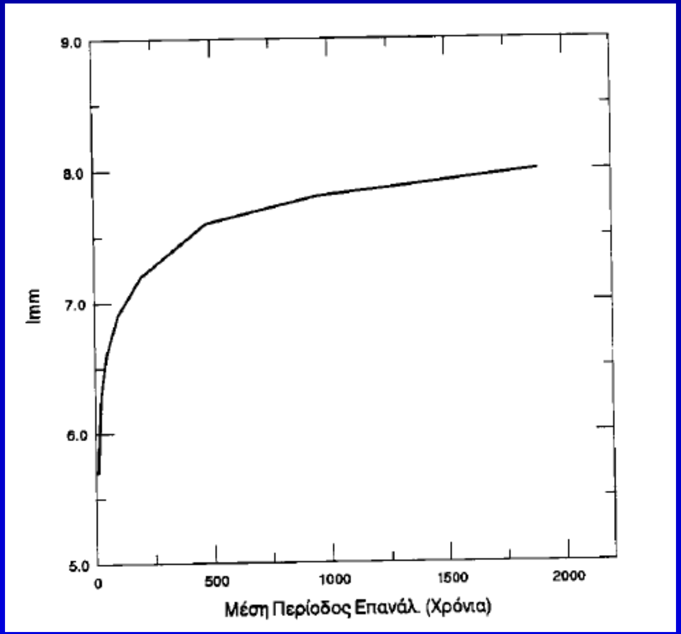


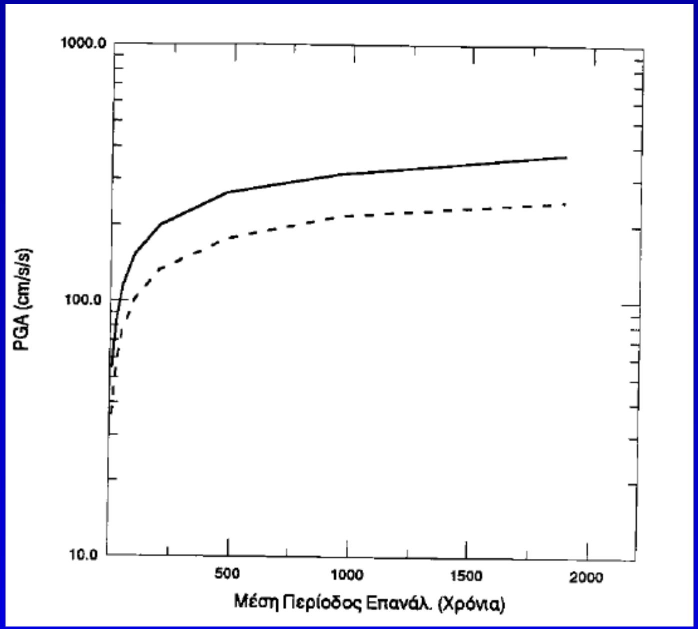
Stochastic Simulation Verification with Observed Strong Motion Data THE78-1 (Margaris & Boore, 1998; BSSA)





PSHA in Serres City Greece (Papazachos etal., 1996)

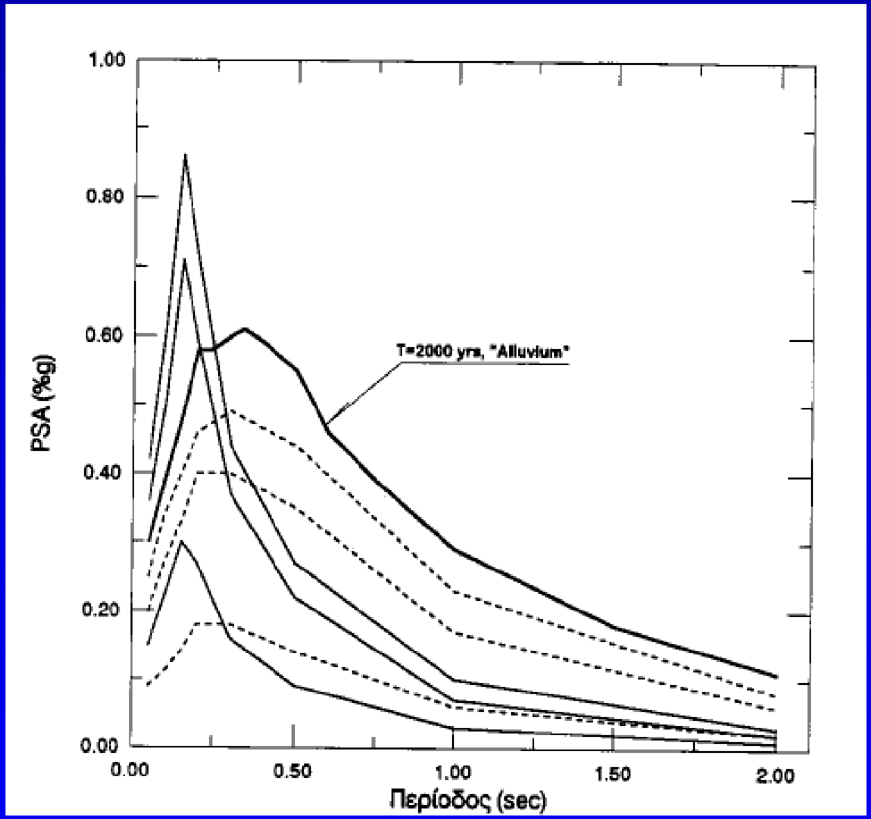


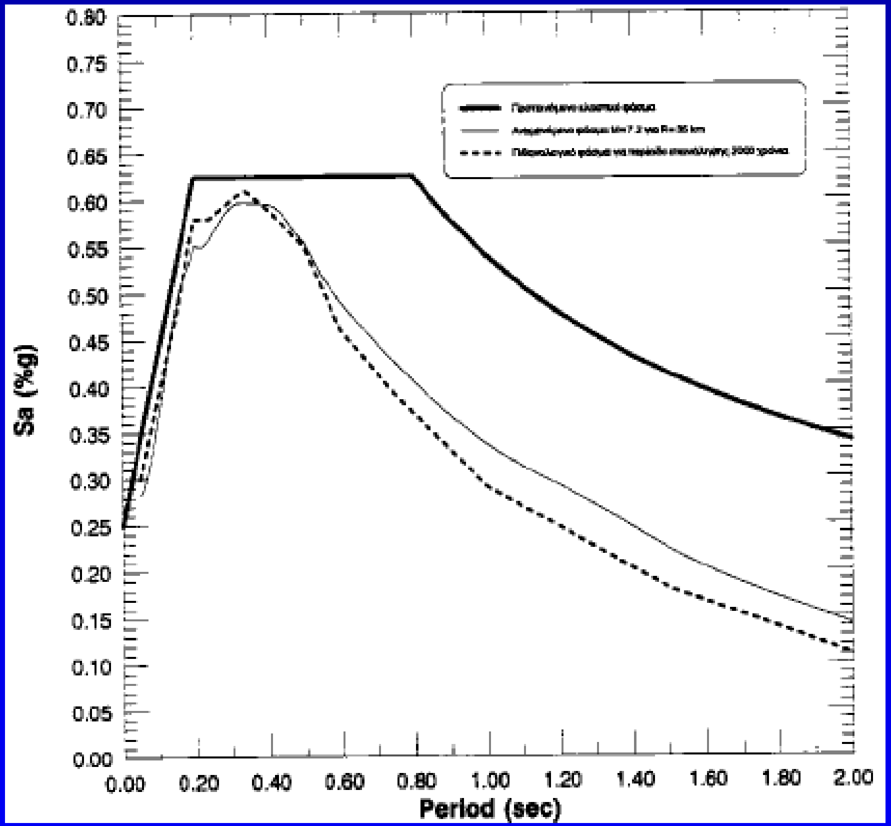


Eqk. Scenarios for PSHA in Serres City

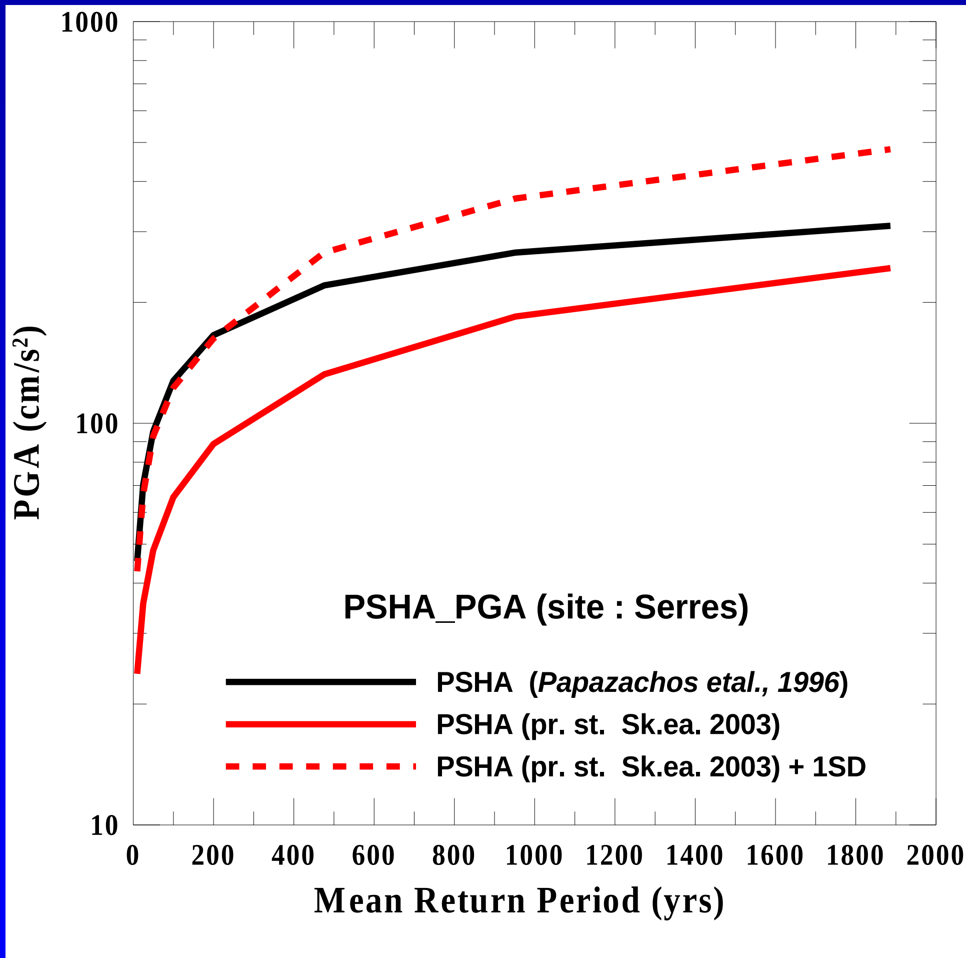
Ret.Per :	Tr (yrs)	476	980
AMP:	PGA (cm/s^2)	175.0	215.0
M*		6.2	7.0
D*		13.0	33.0

PSHA in Serres City Greece & Design Response Spectra (Papazachos etal., 1996)





PSHA and Disaggregation Analysis in Serres City (Margaris, 2013)

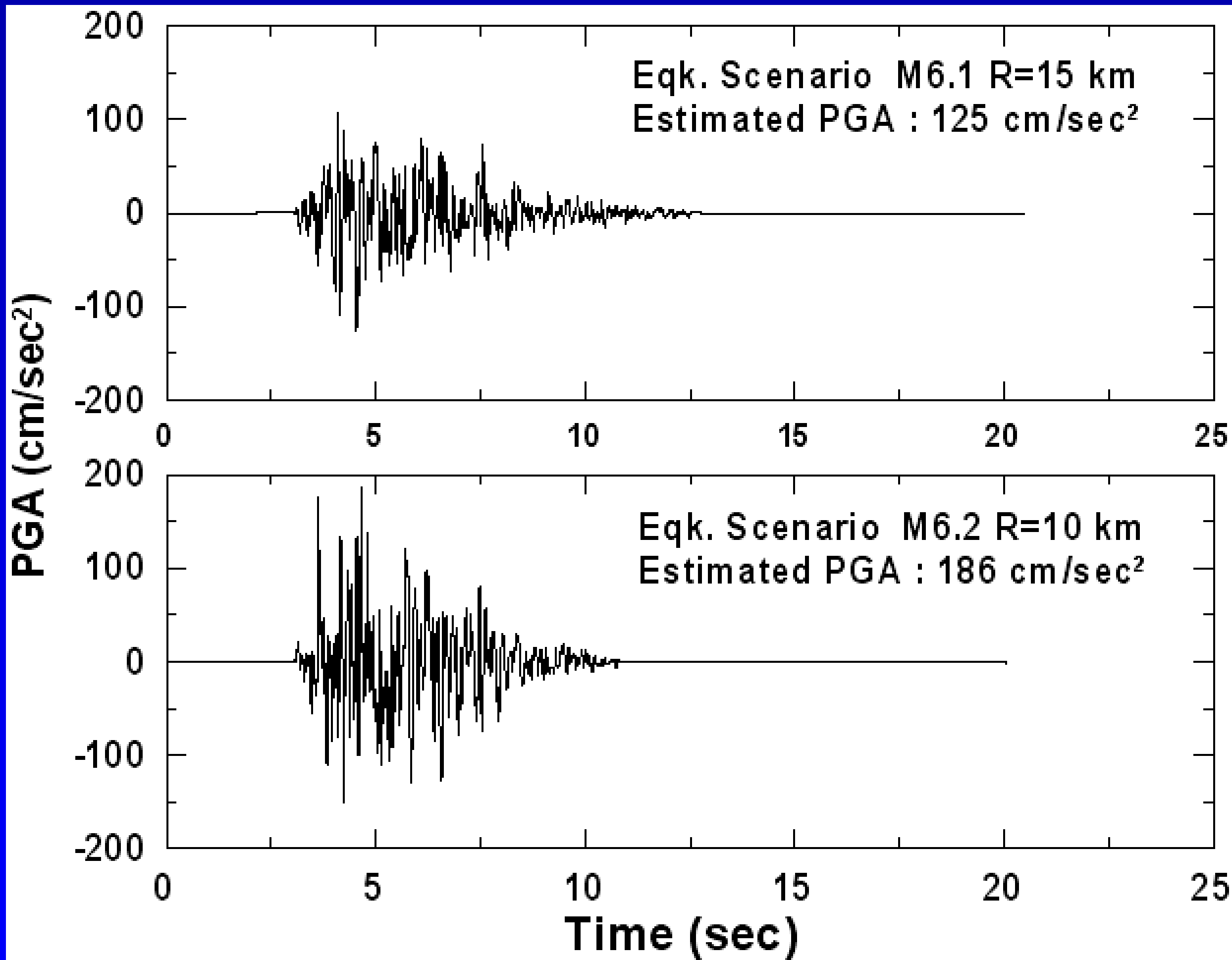


Hazard (pdf) disaggregated in M,D and EPS

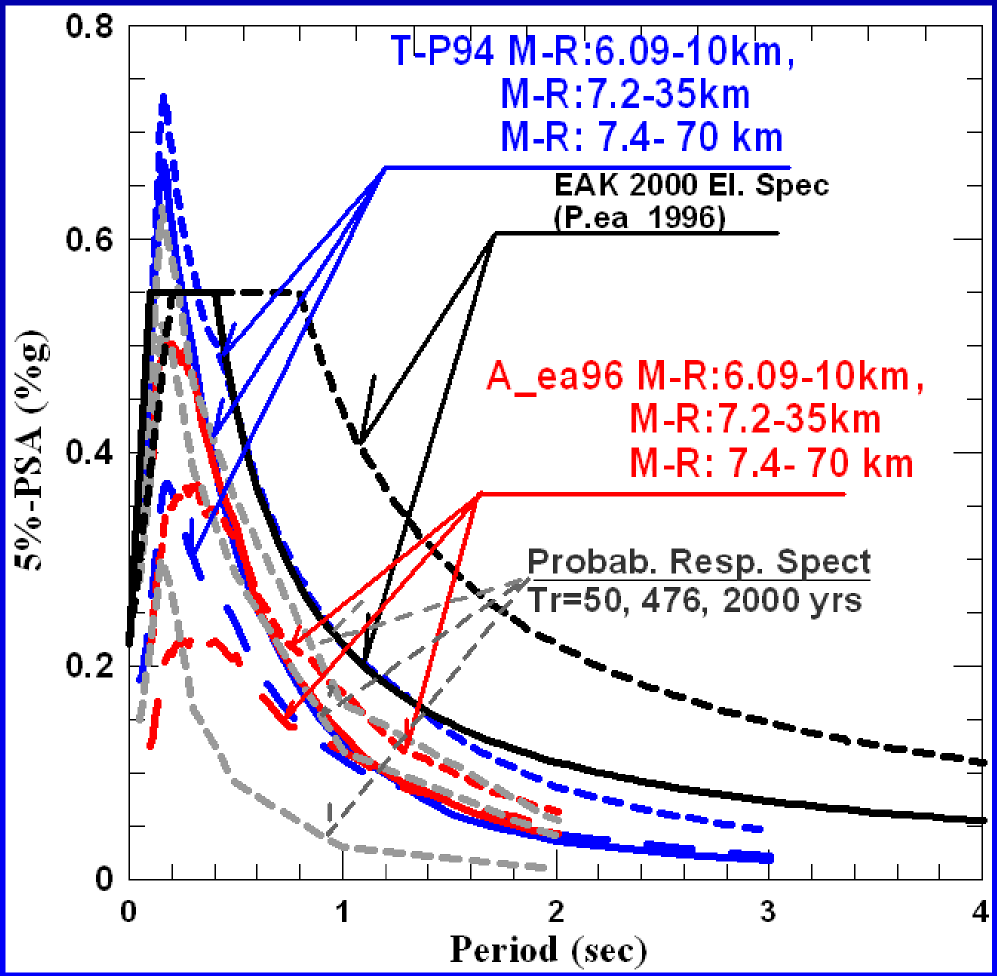
Ret.Per :	Tr (yrs)	476	980
AMP:	PGA (cm/s^2)	130.0	190.0

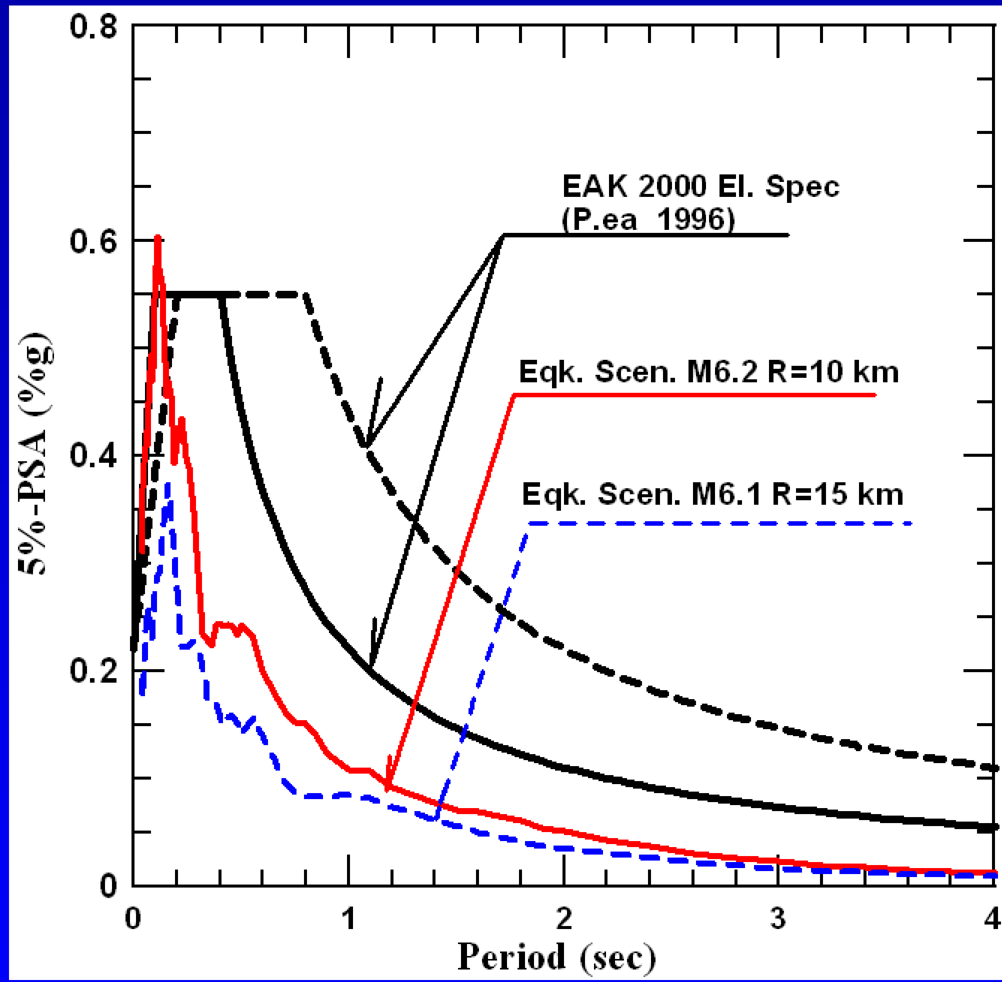
M*	6.1	6.2
D* (km)	15.0	10.0
Eps*	0.438	0.563
Mode	0.507E-02	0.723E-02

Simulated Time Histories in Serres City based on PSHA & Disaggregation results (Margaris, 2013)



Response Spectral Comparison vs Design Spectra
(Papazachos etal., 1997: Margaris, 2013)





Issues should be discussed

1. **Determination of seismic hazard parameters to be assessed (e.g. Imm, Pga, Psa etc.).**

2. **Seismicity and seismic zonation of the areas examined (Greece, Turkey etc.).**

3. **Ground motion predictive equations (GMPE) adopted for seismic hazard assessment.**

4. **Return periods (or probabilities of exceedence) for Probabilistic Seismic Hazard Assessment (PSHA).**

5. **Analytical Description of the seismic hazard input data.**

6. **Description of the adopted and applied methodological approaches for seismic hazard analysis deterministically or probabilistically**