CHARLES UNIVERSITY, PRAGUE

Faculty of Mathematics and Physics

Department of Geophysics

(http://geo.mff.cuni.cz)

SEISMOLOGY x **GLOBAL GEODYNAMICS**

Mantle convection
Viscoelastic relaxation of the Earth
Dynamical geoid modelling
Temporal changes of the gravity field

Theory of seismic wave propagation
Brokesová, Bulant, Červený, Klimeš

Structural seismic studies
Janský, Novotný

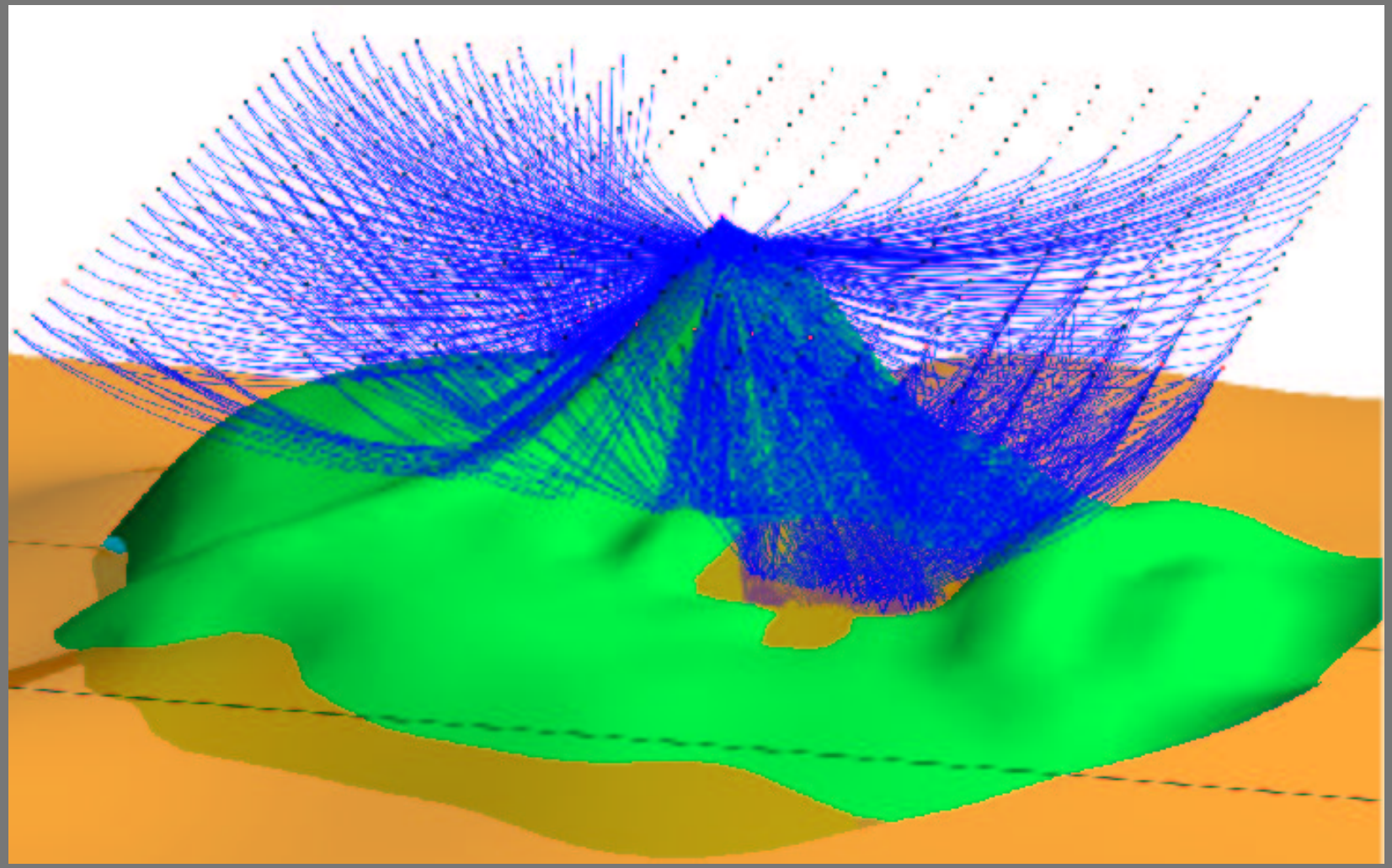
High-frequency asymptotic methods
Brokesová, Bulant, Červený, Klimeš, Žáček

Finite-difference modelling of seismic waves
Opršal, Zahradník

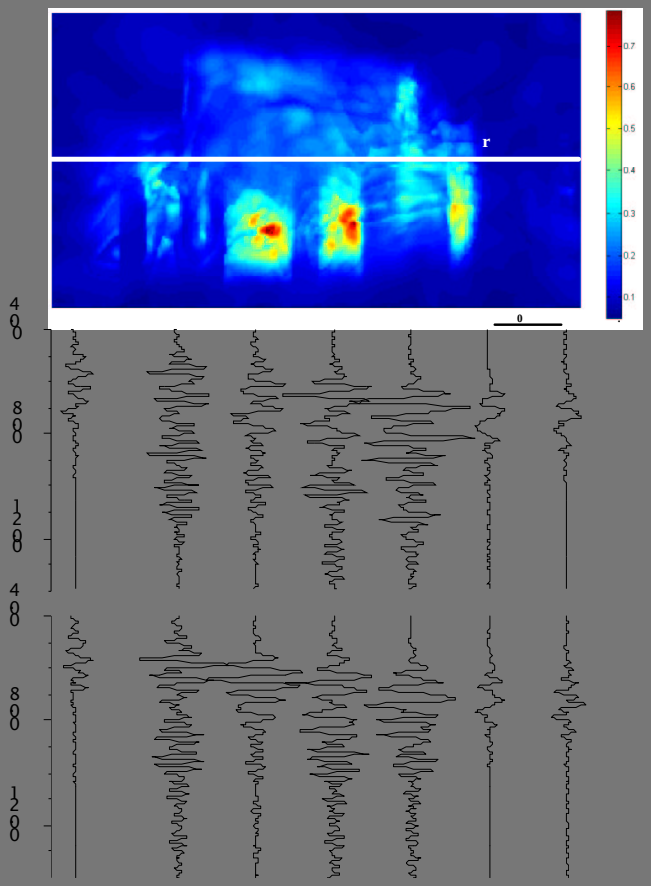
Finite-extent source simulations
Brokešová, Burjánek, Gallovič, Plicka, Zahradník

Observations and modelling of earthquakes
Janský, Plicka, Zahradník

Rays in 3D complex models

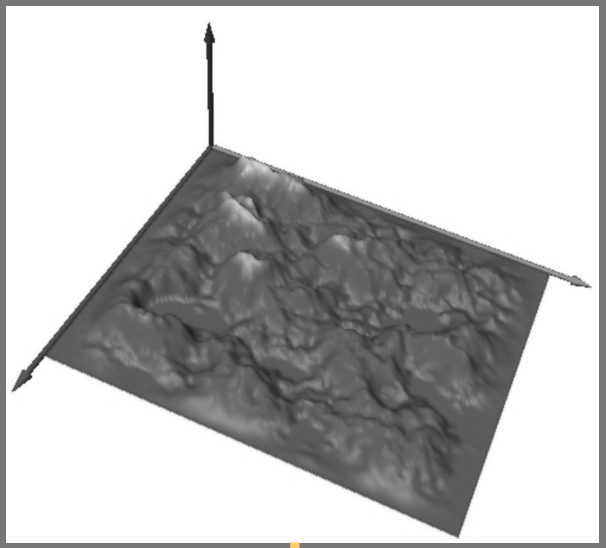


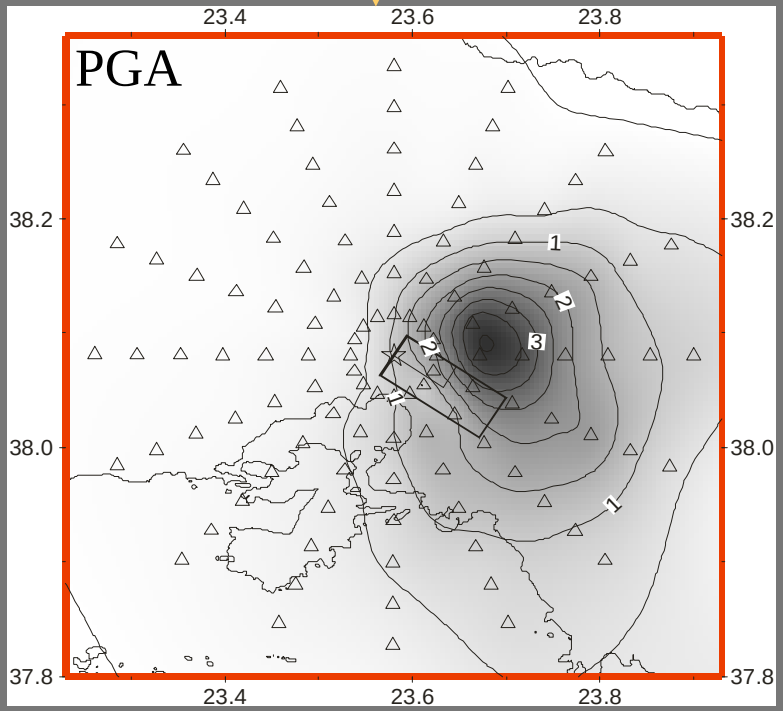
Basin excited by a finite-extent fault, 3D FD simulation



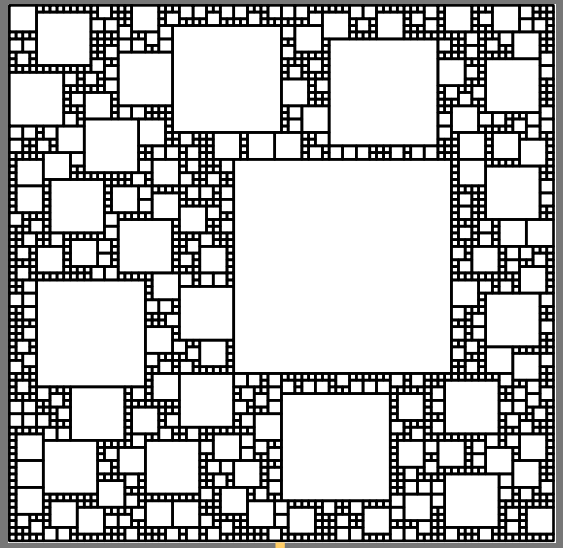
Surface-motion animation (Ivo Opršal)

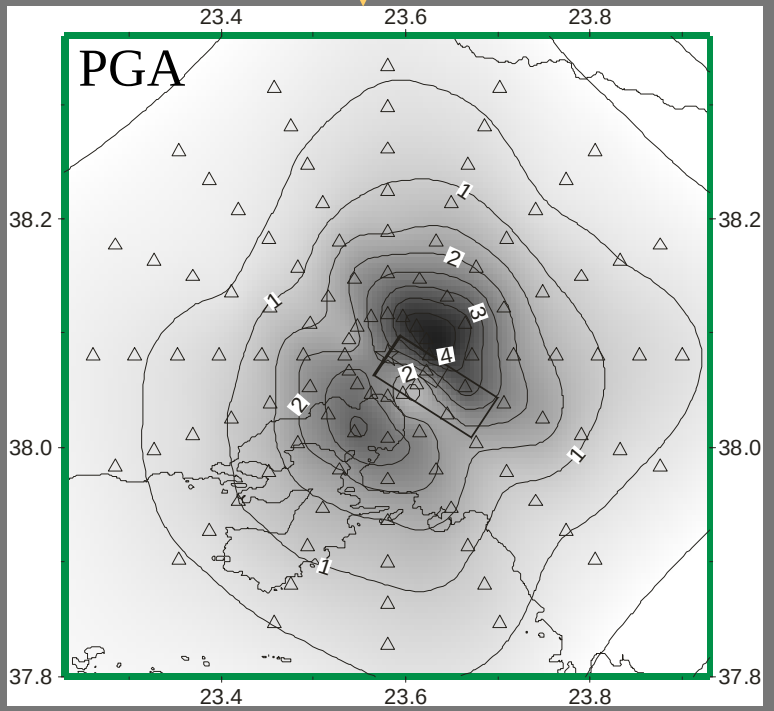
k^{-2} kinematic approach





Composite approach



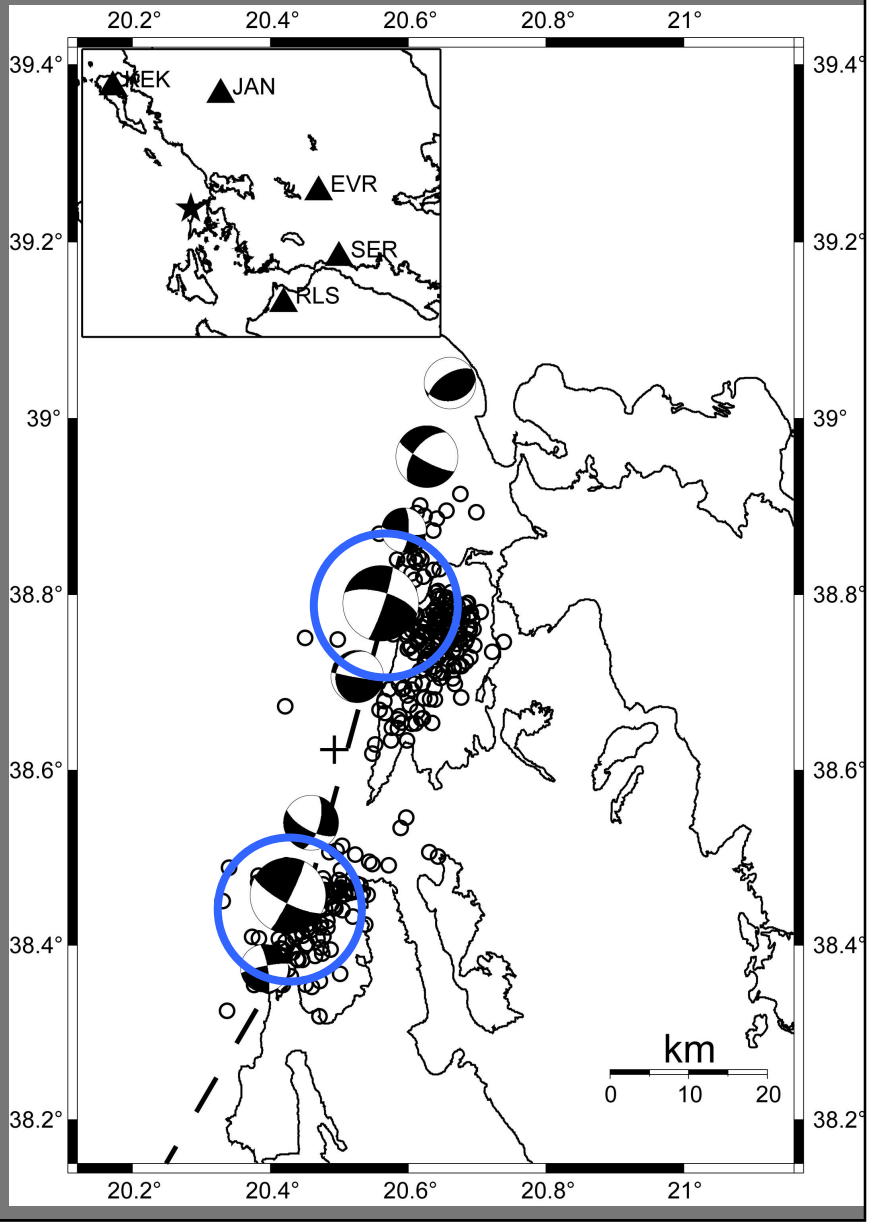


Modelling of earthquakes

- Colfiorito sequence (1997), Italy
- M5.8 aftershock of the Izmit earthquake (1999), Turkey
- Athens earthquake (1999), Greece
- Tottori earthquake (2000), Japan
- Aegion earthquake (2001), Greece
- Skyros earthquake (2001), Greece
- Kagoshima earthquake (2001), Japan
- Lefkada earthquake (2003), Greece

2003 Lefkada earthquake: double-event interpretation

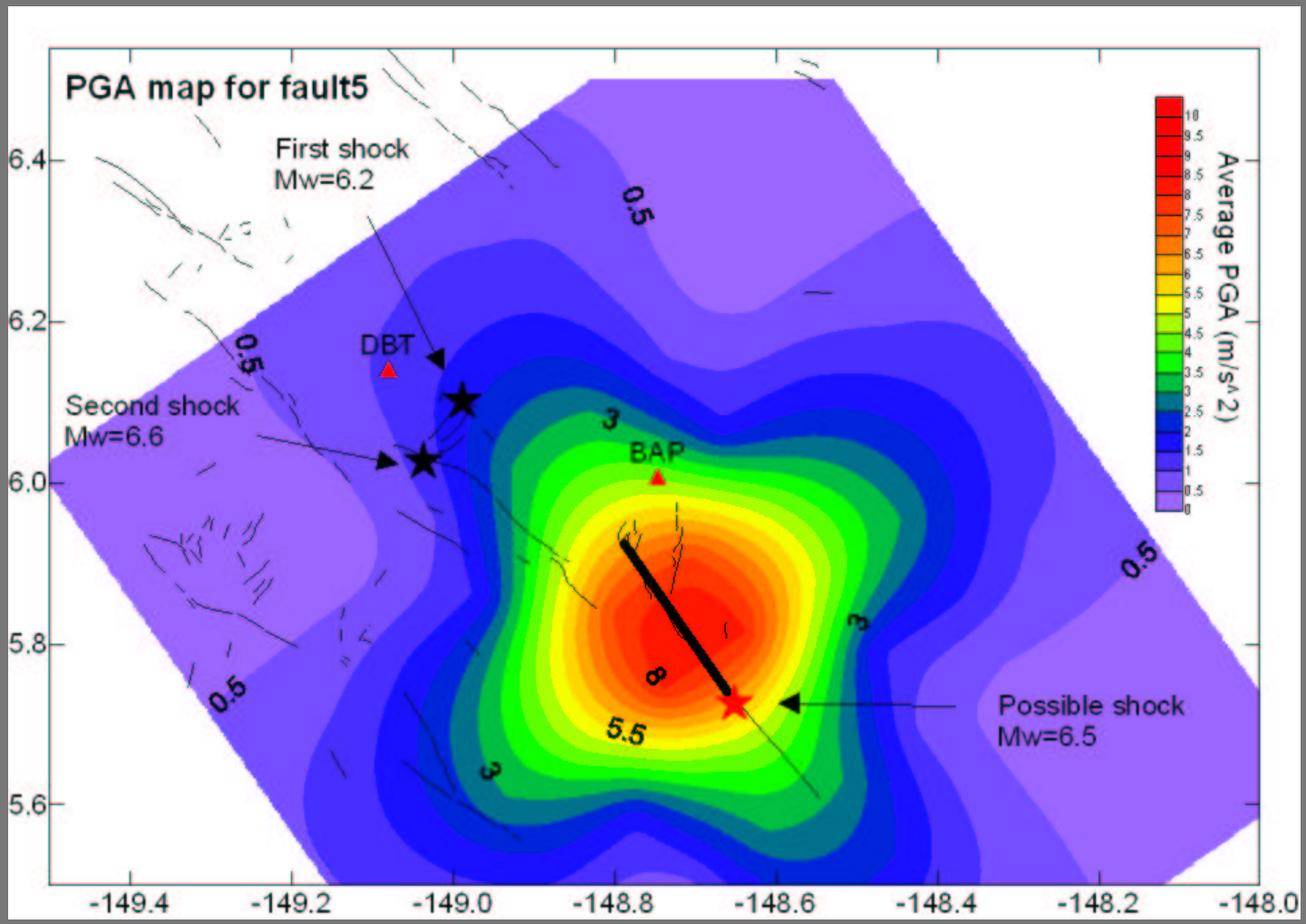
- 1) Lefkada
- 2) Cephalonia, ~ 14 sec. later



IMPORTANT RECENT PROJECTS

- **1997-1999**: "Constructing Major Earthquakes: Microearthquake Ruptures and Green's Functions in the Western Gulf of Corinth Greece" (EC IncoCopernicus, COME, co-ordinated by G-A. Tselentis, Patras, Greece).
- **1997-1999**: "Towards an Integrated Strong Motion Modelling: Comparison of Source Path and Site Effects on the Example of EUROSEISTEST Data"(EC IncoCopernicus, ISMOD, co-ordinated by P.-Y. Bard, Grenoble, France).
- **2000-2001**: "Understanding Earthquakes in Western Greece" (NATO Collaborative Linkage grant, co-ordinated by G-A. Tselentis, Patras, Greece).
- **2000-2002**: "3D modeling of seismic waves" (GAUK, co-ordinator I. Opršal).
- **2003**: "3D strong ground motion modeling for realistic seismic source model" (GAUK, co-ordinator I. Opršal)
- **2000-2003**: "Towards Practical, Real-time Estimation of Spatial Aftershocks Probabilities: a Feasibility Study in Earthquake Hazard" (EC 5th framework EESD, PRESAP, co-ordinated by J. McCloskey, Univ. of Ulster)
- **2003-2005**: "Prague Centre of Mathematical Gephysics, Meteorology, and Their Applications" (MAGMA, co-ordinated by J. Zahradník)

PRESAP - Prague group task: Prediction of strong motion for aftershocks indicated by Coulomb stress in real-time



Blind experiment (2003) - example by Burjánek

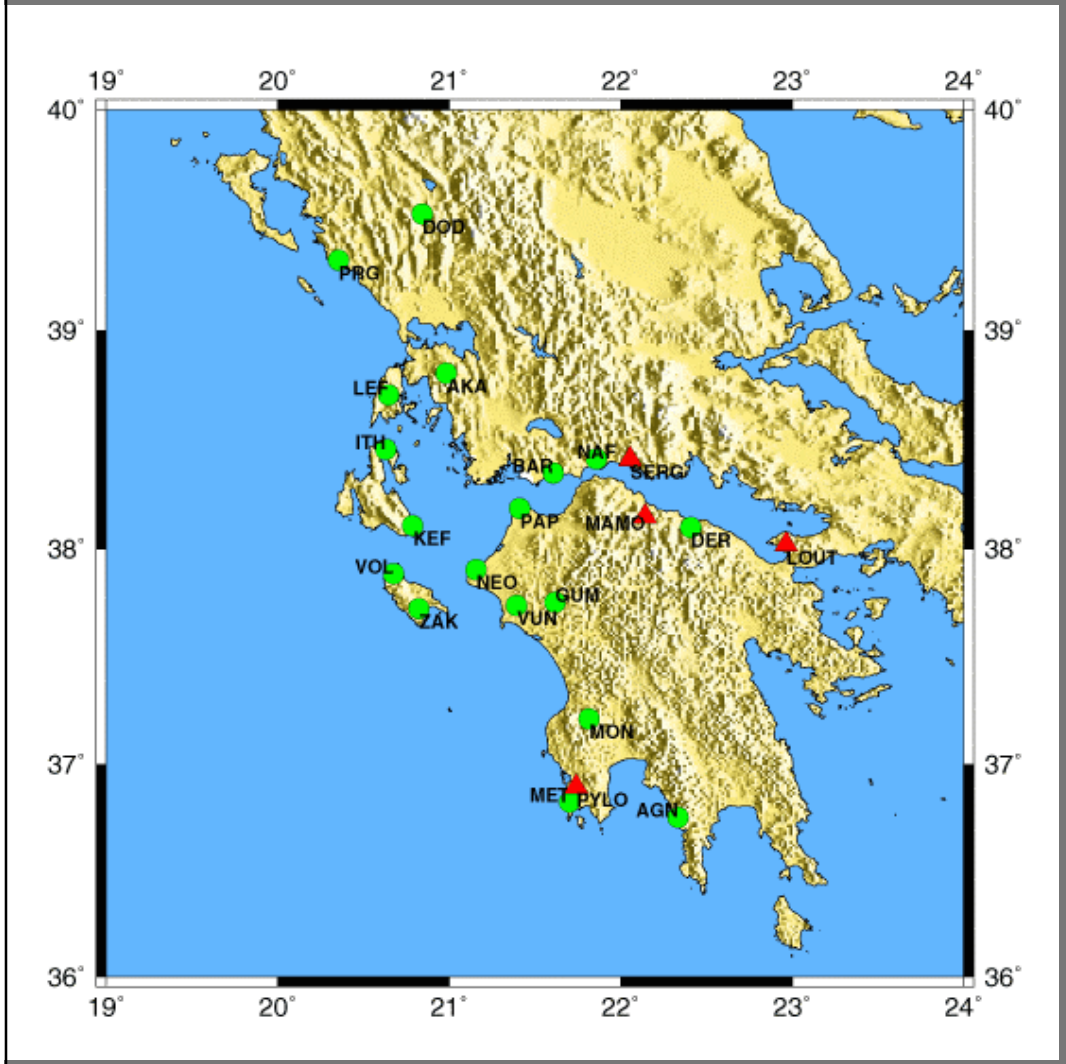
Seismic Waves in Complex 3-D Structures (SW3D)

Project co-ordinator: Vlastislav Červený

MAJOR PARTICIPATING COMPANIES:

- **Shell**
- **Chevron**
- **Japan National Oil Corporation**
- **Elf Exploration UK**
- **Amerada Hess Corporation**
- **Aramco**
- **Western Geophysical**
- **Landmark Graphics Corporation**
- **Petrobras**
- **BHP Billiton Petroleum**
- **Paradigm Geophysical**

Charles University stations in Greece



- **green dots: PATNET stations**
- **red dots: Charles University stations**
  - **Guralp CMG-3T(broad-band)**
  - **Guralp CMG-5T(strong-motion)**

Current PhD. Theses

- J. Burjánek: Inversion for parameters of finite source in 3D structures, supervisor J. Zahradník
- F. Gallovič: Kinematic modelling of strong ground motions, supervisor J. Brokešová
- O. Šrámek: Formation de noyaux planetaires, supervisors O. Čadek & Yanick Ricard, ENS Lyon
- K. Žáček: Prestack seismic migration using Gaussian packets, supervisor L. Klimeš

Themes for prospective SPICE visitors in Prague

Main topics:

- modelling of seismic wave propagation (by asymptotic methods, 3D finite differences, matrix methods) and their hybrid combinations
- finite extent source simulations (dynamic, kinematic) and inversions
- interpretation of seismic measurements (refractions, surface-wave dispersion)
- static coseismic response of viscoelastic Earth

Detailed list of 29 topics is available on http://geo.mff.cuni.cz/spice/

Equipment

Network servers

12 servers with Linux: Intel/AMD 500MHz–2.4GHz
RAM 256 MB – 1 GB (total 4.0 GB)
hard disks 20 – 40 GB (total 300GB)

5 servers with HP-UX: Apollo 9000 Series
RAM 128 – 256 MB (total 1.0 GB)
hard disks 4 – 20 GB (total 60 GB)

4 servers with Solaris: Sun Ultra SPARC, Netra and Blade 100
RAM 128 – 256 MB (total 0.6 GB)
hard disks 10 – 60 GB (total 100 GB)

3 servers with MS Windows NT, 2000: CPU Intel 160 MHz – 1.6 GHz
RAM 64 – 256 MB (total 0.6 GB)
hard disks 3 – 40 GB (total 70 GB)

Personal workstations

40 PCs with Linux and/or MS Windows: Intel/AMD 500 MHz – 2.4 GHz
RAM 256 – 1024 MB (total 10.0 GB)
hard disks 4 – 60 GB (total 350 GB)

Network connection (Fast-Internet connection of all computers)

1 Gbit optical connection installed on the floor
100 Mbit TP / 10 Mbit BNC connection installed in each room

Equipment

Selected software

compilers: Fortran 77/90/95, C/C++

development: Mathematica, NAG, IMSL, Numerical Recipes, LAPACK, TeX

graphics: Amira, IDL, GMT, Grapher/Surfer, GrADS, NCAR Graphics, etc.

expert SW: VISTA, GOCAD, SCREAM (Guralp), SPSS, Statistica

Peripheral devices

2 network color laser printers (HP, Apple)

3 network b/w laser printers (HP)

11 personal b/w laser printers (HP, Xerox)

8 personal color inkjet printers (HP, Epson)

1 shared A0 color printer (HP)

5 scanners, 1 tablet, 1 streamer, 3 magneto-optical drives

10 CD recorders, 1 DVD recorder, 40 CD/DVD drives, 25 ZIP drivers

10 UPS

Other equipment

2 data projectors, 3 copy machines, 2 diaprojectors, 5 overhead projectors

Preliminary announcement of an international conference:

Co-organized by the Geophysical Inst., Academy of Sciences, and the Charles University, Prague

(Psencik and V. Cerveny)

„Seismic Waves in Laterally Inhomogeneous Media IV"

June 2005, Hruba Skala Castle, Czech Republic.