

**PRAGUE CENTRE OF
MATHEMATICAL GEOPHYSICS,
METEOROLOGY, AND THEIR
APPLICATIONS
(MAGMA)**

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SECTION 1 MANAGEMENT AND RESOURCE USAGE SUMMARY

1.1. Objectives of the reporting period

The general goal of MAGMA Center is to increase international recognition of Geophysics and Meteorology at the Charles University in Prague and finalizing their inclusion into the European research. The field of interest covers dynamic phenomena of the solid Earth and atmosphere. The Center should promote an unifying mathematical viewpoint, and develop a multi-disciplinary approach, with application to European environmental problems.

In the second year of its existence, the main objectives were similar to the first year, i.e. to better visualize in Europe the geophysical and meteorological studies at the Charles university, to attract as much visitors as possible, and to increase interest in co-operative efforts across borders of the disciplines, and across state borders as well. To this goal, a variety of activities was planned, including conferences, working stays in Prague (PhD, postdocs, senior researchers) and web page continuous maintenance.

1.2. Progress made

In brief, six activities of MAGMA in 2004 can be briefly summarized as follows:

1. One international conference (workshop + mini-symposium) organized within WP7, and another mini-symposium jointly organized by WP1-3.
2. Mobility to MAGMA Center from outside, counting more than 22 man-months in long visits and more than 5 man-months in short stays.
3. Participation in 4 EC projects (SOLICE, SPICE, 3HAZ and ENSEMBLES), entrance into 2 more projects commencing in 2005 (IMAGES and QUANTIFY), and submission of 1 new project (ISSEP).
4. Annual seminar and training course in Prague with representatives of major oil companies.
5. 50 internal seminars to interact with research and practice in the Czech Republic.
6. Constantly upgraded web page, including free availability of seismic data gathered within MAGMA.

Selected activities of 2004 are listed below as *examples*, just to demonstrate specific style of MAGMA work:

- Dr. Jan Matas, researcher from ENS in Lyon, who deals with behavior of Earth mantle materials under realistic pressure-temperature conditions, gave at MAGMA an excellent series of seven lectures on thermodynamics and mineral physics (WP1). The course may contribute to broadening of the department research scope.
- During two-month stay of Balint Sule, a PhD student from Budapest, who worked in Prague on the problem of mantle plumes (WP1), MAGMA group helped him to overcome certain professional isolation after death of his former supervisor Prof. Laszlo Cserepes, an internationally recognized geodynamics expert.
- WP2 included visits of Francois Couturier and Dr. Caroline Dumoulin from the University in Nantes, who dealt with thermal convection in planetary mantles, but needed viscoelasticity to explain relationship between gravity and topography. This is a nice example of the interdisciplinary research, representing one of the MAGMA priorities. The group in Nantes has recently submitted an EC proposal for RTN in planetary physics, including our group.
- Dr. Kevin Fleming from GeoForschungsZentrum Potsdam presented a series of three lectures on glacial rebound and sea-level changes around Greenland since the last glacial maximum (WP3). He overviewed this topic in a transparent way such that even the undergraduate students of geophysics were able to follow this course.
- A book is under preparation in co-authorship of Lars Sjoeborg (Sweden), Petr Vanicek (Canada) and Zdenek Martinec (the WP3 leader).
- Cooperation with oil companies in WP4 resulted, besides other, in preparation of a new EC project IMAGES, coordinated by Leo Eisner at the Schlumberger Cambridge Research. The project has

significant ecological importance because it is focused on microearthquakes induced by oil drilling and corresponding hydrofracturing.

- MAGMA seismic stations in Greece (WP5) were integrated into an international framework within a new EC project 3HAZ-CORINTH. Moreover, using know-how obtained in WP5 studies in Greece, upgrade of the instrumentation at our home station Praha was made, on the occasion of celebrating its 80-years anniversary (purchase of the Praha instrument was, of course, financed from other sources than MAGMA).
- Visit of Christoforos Benetatos, PhD student from the University of Thessaloniki, was devoted to earthquakes in Greece, but much broader geodynamic consequences were discussed (WP6), e.g. the relations between earthquakes, lithospheric subduction of the African plate below Aegean Sea, and deep Earth's structure. This was a good occasion to put our seismology and geodynamics sub-groups closer to each other.
- A joint paper with Patras University about the 1999 damaging Athens earthquake was published in the proceedings of 13th World Conference on Earthquake Engineering, Vancouver, Canada, and another joint paper about the 2003 Lefkada earthquake is in press in Bull. Seism. Soc. Am. (with acknowledgement to MAGMA).
- In September 2004 the project of 6FP ENSEMBLES (ENSEMBLE-based Predictions of Climate Changes and their Impacts) started, dealing with regional climate changes and their impacts on Europe, connected to WP7. In the beginning of 2004, preparation of another 6FP project started. It is QUANTIFY project about impact of emission from transportation on climate change, commencing in 2005 (WP7 and WP8).
- Training in the regional climate modeling was provided to Dr. Klemen Bergant within MAGMA activity WP7.
- In connection with WP8, we took part in the COST 715 action called "Meteorology applied to urban air-pollution problems". The WP8 work has been closely connected with needs of the Czech Ministry of Environment. The ministry has appreciated the role of MAGMA and allowed us to participate in their R&D programmes targeted to the problem of photooxidation pollution, and its modeling.

The Gantt chart attached to this section illustrates the main 2004 activity of the individual work packages as a function of time, namely visits of the individual work packages in man-days. Financial data are included in another table, see the Cost Statement attached to this report.

1.3. Milestones and deliverables

In this section we present deliverables arranged according the individual work packages. For a detailed description (e.g. topics of their research), see Section 3.

WP1 Thermal convection

D1.1 European meeting: reported in 2003

D1.2 Short-term stays in 2004: A. van den Berg (2 visits), J. van Hunen (2 visits)

D1.3 Long-term stays in 2004: J. Matas (series of lectures), A. van den Berg, B. Sule, C. Dumoulin, F. Couturier

D1.4 Twinning agreement with ENS Lyon: signed in 2004 within Erasmus programme (combined with WP2)

D1.5 A combined Czech-French PhD study: reported in 2003

WP2 Viscoelastic response

D2.1 Mini-symposium in 2004: Thermodynamics and Mineral Physics (jointly with WP1, WP3)

D2.2 Short-term stays in 2004: combined with WP3 (D. Wolf)

D2.3 Long-term stays in 2004: combined with WP1 (C. Dumoulin, F. Couturier) and with WP3 (K. Fleming, V. Klemann, J. Hagedoorn)

D2.4 Submission of a new EC project in 2004: new EC project proposal (ISSEP)

D2.5 Twinning agreement with Urbino: reported in 2003

D2.6 Prague-Lyon networking: done, see WP1

D2.7 Benchmark for modeling viscoelastic relaxation: reported in 2003

WP3 Temporal changes of the gravitational field

D3.1 Mini-symposium, see WP2

D3.2 Short-term stays in 2004: D. Wolf, L. Sjoeborg, G. Balasis

D3.3 Long-term stays in 2004: V. Klemann, J. Hagedoorn, K. Fleming

D3.4 Cooperation agreement with GFZ Potsdam: reported in 2003

D3.5 Participation in related projects: GRACE continued in 2004 (Z. Martinec)

WP4 Seismic waves: Theory

D4.1a Annual seminar with major oil companies in 2004: done (4 visitors)

D4.1d Annual training course in 2004: done (4 visitors)

D4.2 Short-term stays in 2004: R. Patzig, M. Berraki, K. Helbig

D4.3 Long-term stays in 2004: G. Dal Moro, L. Eisner, T. J. Moser, S. Buske

WP5 Seismic waves: Observations

D5.1 Twinning agreement with Patras: reported in 2003

D5.2 Visits from Prague to Patras in 2004: done; 2 visits (J. Jansky, V. Plicka, J. Zahradnik)

D5.3 Database on Internet: done, see <http://seis30.karlov.mff.cuni.cz>, and continually upgraded

D5.4 Dissemination of data: done and continually upgraded. Data are freely available on request.

D5.5 Inclusion of two seismic stations into an EC project: done; in framework of 3HAZ-CORINTH

WP6 Earthquakes

D6.1 Mini-symposium: as reported in 2003, it was moved to 2005 to be merged with a bigger event

D6.2 Short-term stays in 2004: S. Miller

D6.3 Long-term stays in 2004: Ch. Benetatos, O. Sebe

D6.4 Cooperation with related EC projects: 3HAZ-CORINTH, SPICE

D6.5a Cooperation agreement with IPG, Paris: reported in 2003

D6.5b Submission of new EC projects: done in 2003

WP7 Climate system

D7.1 Workshop on Regional Climate Modelling and Mini-Symposium on Climate Change in Europe

D7.2 Short-period stay in 2004: none

D7.3 Long-term stays in 2004: K. Bergant, J. Hampson

D7.4 Dissemination of research results on Internet: web pages of the workshop (D7.1), including full presentations of all participants, linked to MAGMA pages

WP8 Air quality

D8.1 No workshop in 2004, because the international conference was organized already in 2003 (sooner than planned in MAGMA proposal), see report 2003

D8.2 Long-term stays in 2004: R. Cesari (but financed from other sources)

D8.3 Dissemination of research results and database on Internet: National research reports (in Czech) for Ministry of Environment: <http://www.recetox.muni.cz/index.php?id=41> and http://www.chmi.cz/uoco/prj/vav_740_4_03/index.html

WP9 Research and technical management

D9.1 Internal seminars in 2004: 50 seminars, see the list in attachment

D9.2 Meeting of the Advisory Board: internal members almost once per week; with the external members occasionally, for example at international conferences

D9.3 Coordination of mobility to Prague in 2004: 11 short visits and 16 long-term stays in Prague, all together counting almost 28 man-months for WP1-WP9. Mobility out of Prague in 2004: 2 short visits within WP5.

D9.4 Web page of MAGMA Center: already very extensive and interesting; continually upgraded; see <http://geo.mff.cuni.cz/magma>; emphasis on related links, e.g. abstracts, presentations, training materials, etc.

1.4. Deviations from the work plan

There were no deviations from the plan in 2004.

1.5. Communication activities

This part is described in detail in Section 3, according to the individual work packages. Here is an abbreviated summary.

Conferences: Workshop and Mini-Symposium, see WP7; mini-symposium, see WP2.

Short-term stays: There were 30 short-stay visitors with the total stay length of 159 days. From this number, 15 visitors belonged to the above mentioned workshop. For names of the visitors, terms of their stay and related research topics see Section 3; for short abstracts, see the MAGMA web page.

Long-term stays: There were 16 long stays of the total duration of 22 months. For names of the visitors, terms of their stay and related research topics see Section 3; for short abstracts, see the MAGMA web page.

Seminars: Complete list of 50 internal seminars organized by MAGMA, helping besides other to interact with research and practice in the Czech Republic, is in the attachment. All seminars were attended by the staff and the students, as well.

Co-operation with other EC projects: 3HAZ (WP5 and WP6), SPICE (WP4, WP6), SOLICE (WP7), ENSEMBLES (WP7).

Participation in submission of new 6th framework EC projects: ISSEP (WP2), IMAGES (WP4), QUANTIFY (WP7).

Co-operation with non-EC international projects: GRACE (WP3).

Industry, environment, society: Annual seminar and training course of WP4 for major oil companies (Shell, Petrobras, ExxonMobil, ChevronTexaco), June 2004, Prague. Cooperation and new EC project with a famous private company Schlumberger Cambridge Research. Contacts (a small meeting, discussion, attendance of a seminar etc.) with several representatives of industry, environmental protection, municipality, etc. in Czech Republic: Czech Ministry of Environment, Institute of Rock Structure and Mechanics, Czech Acad. Sci. Prague, Institute of Geonics, Czech Acad. Sci. Ostrava, Mining Institute at Technical University of Ostrava, Czech Hydrometeorological Institute, Prague.

Education outreach: 9 MSc and 3 PhD students successfully defended their theses in 2004.

Attendance of international conferences: MAGMA staff members and their students attended several conferences, worldwide (financed from other sources than MAGMA). Besides research aspects, these trips served also to advertise MAGMA and attract our visitors. Let us mention the most important ones: EGS (Nice, France), AGU (San Francisco, USA), ESC (Potsdam, Germany) and WCEE (Vancouver, Canada).

1.6. Difficulties

No major difficulties were encountered. The 2nd year was even "smoother" than the 1st one.

MAGMA 2004 Gantt chart of the main activities

Visitors	Months												Person days
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
WP1: Couturier François						■	■						30
WP1: Dumoulin Caroline						■	■						31
WP1: Matas Jan			■	■									32
WP1: Süle Bálint			■	■	■	■							61
WP1: van den Berg Arie			■	■					■		■		49
WP1: van Hunen Jeroen									■		■		14
WP3: Balasis Georgios											■		3
WP3: Fleming Kevin								■	■	■			42
WP3: Hagedoorn Jan										■	■	■	80
WP3: Klemann Volker			■	■									49
WP3: Sjöberg Lars									■				5
WP3: Wolf Detlef						■							4
WP4: Berraki Madjid											■		4
WP4: Buske Stefan										■	■		32
WP4: Dal Moro Giancarlo			■	■									40
WP4: Eisner Leo			■	■									36
WP4: Helbig Klaus											■	■	5
WP4: Moser Tijmen Jan								■	■	■			61
WP4: Patzig Robert				■									7
WP4: 4 persons (Prague)						■							12
WP5: Jansky Jaromir, Zahradnik Jiri					■								11
WP5: Jansky Jar., Plicka Vlad., Zahradnik Jiri										■			16
WP6: Benetatos Christoforos				■	■								33
WP6: Miller Stephen										■			15
WP6: Sebe Olivier											■	■	33
WP7: Bergant Klemen											■	■	39+
WP7: Hampson John											■	■	38+
WP7: 15 persons (Prague)											■	■	74
WP9: seminars (Prague)		■	■	■	■	■			■	■	■	■	-
Persondays:													
long visits	0	0	122	82	62	46	33	33	60	60	68	104	670
short visits	0	0	0	7	0	4	0	0	20	19	21	2	73
workshops	0	0	0	0	0	12	0	0	0	0	28	46	86
visits to Greece	0	0	0	0	11	0	0	0	0	16	0	0	27
total	0	0	122	89	73	62	33	33	80	95	117	152	856

Assignment Key
■ = long visit
■ = short visit
■ = workshop, seminar
■ = visit to Greece

SECTION 2 EXECUTIVE PUBLISHABLE SUMMARY

Contract No:	EVG3-CT-2002-80006	Reporting period:	Jan 1 – Dec 31, 2004
Title:	PRAGUE CENTRE OF MATHEMATICAL GEOPHYSICS, METEOROLOGY, AND THEIR APPLICATIONS (MAGMA)		
<p>Objectives</p> <p>The MAGMA Center aims at increasing international recognition of Geophysics and Meteorology at the Charles University in Prague. The Center should contribute to coordination of research and education in dynamic phenomena of the solid Earth and atmosphere by adopting unifying mathematical viewpoint. The Center should apply a multi-disciplinary approach and application to European environmental problems, such as climate change, pollution transport, earthquake hazard, as well as the energy problems, such as the oil exploration.</p> <p>Achievements</p> <p>The main instrument of the MAGMA Center is inviting PhD students, post-doctoral researchers and senior researchers to Prague, organizing scientific meetings, and participating in EC projects (including submission of the new ones). Research behind the above mentioned mobility is focused on the following tasks: Thermal convection, Viscoelastic response of the Earth, Temporal changes of the gravitational field, Seismic waves, Earthquakes, Climate system, Air quality. Dissemination of results is effectuated through scientific journals, conference contributions, seminars and web. Main results of the second year of the MAGMA Center comprise the following activities:</p> <ul style="list-style-type: none"> • International conference in Prague, providing a broad discussion forum on collaboration in climate change studies and modeling in Central Europe, 37 participants. Mini-symposium on thermodynamics and mineral physics, 15 participants. • There were 46 visitors to the MAGMA Center, who spent almost 28 man-moths, all together, at the Charles University during 2004. Lectures were given by our guests, training was provided by us to some of the visitors, and research has resulted in joint publications. • There were tight links with four running EC projects (SOLICE, SPICE, 3HAZ-CORINTH, ENSEMBLES). Two new EC projects start in 2005 (IMAGES and QUANTIFY). Participation in submission of one new EC project ISSEP. • Constantly upgraded web page (including abstracts of lectures) enabled a rapid dissemination of all information related to MAGMA activities and achievements. Valuable seismic data, gathered by the MAGMA seismic stations in Greece, have been freely available from the web page, too. <p>Socio-economic relevance and policy implications</p> <p>Similarly to 2003, the knowledge transfer to industry was realized through an (annual) seminar and training course, organized in Prague for representatives of major oil companies. Moreover, there were contacts with research institutes, state organizations and municipality concerning environmental tasks such as drilling and hydrofracturing, coal mining, nuclear waste. 50 internal seminars proved to be an efficient way of research and societal interaction between the Center and the other research institutes in the Czech Republic. The seminars also improved awareness of potential employers about our students, and vice versa. 9 MSc and 3 PhD students successfully defended their theses in 2004. MAGMA activity received publicity through radio and TV interviews, an exhibition and the web. Role of MAGMA has been strongly appreciated on several occasions by the University officials, including the Dean and the Vice-Deans.</p>			

Conclusions

The second year of the MAGMA Center was very fruitful, and has increased the number of man-months (compared to 2003) quite considerably. Similarly to 2003, more attention has been paid to a closer co-operation between formerly separated groups and tasks. Awareness of societal needs increases, hence interest of researchers and students in environmental applications is growing. Last but not least, MAGMA improves recognition of the Charles University as an useful partner abroad, and we better recognize possibilities and importance of the European research networking. With 20 % and 34 % of the overall 3-year budget spent in 2003 and 2004, respectively, successful completion of the last 3rd year 2005 can be expected.

Keywords

Earth interior and dynamics. Thermal convection. Post-glacial uplift. Seismic waves. Earthquakes. Climate system. Air quality. Oil exploration. Data and software. Workshops. PhD and Post-Doc mobility.

Publications

Counting both published and submitted papers, research output by the MAGMA staff in 2004 comprises 61 papers (see the Research Overview 2004, and Publications 2004, linked with the MAGMA web page and attached to this report, too). However, as MAGMA is not a research project, but an Accompanying Measure focused on mobility, the only publications strictly related to MAGMA (and thus also including acknowledgement) are those arising from a visitor's stay and work at the Charles University, either completely, or partially. Obviously the percentage of such a production will always be just a small fraction of the whole MAGMA staff production.

Papers with acknowledgement to MAGMA

- Zahradník, J., 2004. How many seismographs do we need to record ground motion at a station?, *Studia Geoph. et Geod.*, 48, 483-492.
- Zahradník, J., Serpetsidaki, A., Sokos, E, and Tselentis, G-A., 2005. Iterative deconvolution of regional waveforms and a double-event interpretation of the 2003 Lefkada earthquake, Greece, *Bull. Seism. Soc. Am.*, 95, in press. [appears in No. 1 (February), 2005]
- Zahradník, J., Plešinger, A., Long-period pulses in broadband records of near earthquakes, *Bull. Seism. Soc. Am.*, submitted.

Other publications and outreach material

- Research Overview 2004 and publications of the MAGMA staff: <http://geo.mff.cuni.cz>.
- 9 MSc and 3 PhD theses.
- Seismic data freely available at <http://seis30.karlov.mff.cuni.cz>.
- Abstracts from visitors' lectures and seminars at <http://geo.mff.cuni.cz/magma>.

SECTION 3

DETAILED REPORT ORGANIZED BY WORK PACKAGES

Important remarks:

Each work-package report has the same content: objectives, achievements, and plan. Each WP plan lists the names of visitors agreed by the day of writing this report. Where the socio-economic relevance has a specific form, it is also discussed in the corresponding work package. However, a lot of aspects of the socio-economic relevance goes across the work packages, and those are detailed in the WP9 (management) report.

WP1 Thermal convection (O. Cadek)

The main scientific objective of WP1 is multidisciplinary study of the Earth mantle convection, including complex mineralogical, rheological and geochemical information, and the corresponding networking of European researchers.

In contrast to the first year, when the WP1 activities were mainly often intended to make the partners familiar with each other, including numerous short-term visits and organization of a European workshop, the second year saw more activities focussed on specific research projects.

The first visitors to our department in 2004 were Dr. Arie van den Berg (Utrecht University), one of the pioneers of mantle convection studies with non-Newtonian rheology, and Dr. Jan Matas, a mineral physicist from ENS in Lyon who deals with behavior of mantle materials under realistic P-T conditions. Dr. Matas gave at MAGMA an excellent series of seven lectures on thermodynamics and mineral physics which were highly appreciated by students and researchers, as well. His interactions with Dr. van den Berg and the Prague convection modelers allowed to open new possible ways for studying some problems of mantle dynamics and inspired new research projects.

Further exchange of students and lecturers between ENS Lyon and the Prague department is now planned in the framework of the Erasmus programme. Dr. Matas also discussed with some University officials the possibility of bilateral research programme between the Charles University and ENS in Lyon.

The long-term stay of Dr. van den Berg in March-April, as well as his shorter stays in September and November, were mainly devoted to developing numerical models of subducting slabs. The cooperation between the Prague geodynamicists and the convection modelers in Utrecht has a long tradition which includes exchanges of researchers and students and several common research papers. Since the treaty on research cooperation between the faculty in Prague and Utrecht has expired, the both sides now look for new ways to formalize this fruitful cooperation.

The visit of Dr. van den Berg was followed in April and May by a two-month stay of Balint Sule, a PhD student from Budapest, who worked in Prague on the problem of mantle plumes and predictions of their surface manifestations. We believe that contacts with Prague geodynamicists and modelers helped him to overcome certain professional isolation after the death of his former Hungarian supervisor Prof. Laszlo Cserepes, an excellent and internationally recognized geodynamics expert.

The spring activities of WP1 were closed by fruitful stay of Dr. Caroline Dumoulin and Francois Couturier from the University in Nantes. This new and potentially important international link was established during the international workshop organized in the MAGMA framework in 2003.

The last activities of WP1 were two short and highly working visits of Dr. Jeroen van Hunen from ETH in Zurich which were devoted to finishing a research paper prepared with a member of the Prague geodynamics group.

Activities planned for 2005

Short-term stays:

- Dr. Jeroen van Hunen, ETH Zurich; topic: 2D modeling of subducted lithospheric slabs and 3D modeling of small-scale convection in asthenosphere
- Dr. Susanne Buitter, Geological Survey of Norway, Trondheim; topic: models of lithospheric deformations
- Dr. Neil Ribe, IPG Paris; topic: models of bending in fluid dynamics

Long-term stays:

- Dr. Arie van den Berg, Utrecht University; topic: models of subducting lithosphere with complex rheology; expected month of arrival: March
- Prof. Harro Schmeling, Frankfurt University; topic: mantle convection, geoid and anisotropy; expected month of arrival: March
- Joost van Summeren, Utrecht University; topic: models of subducting lithosphere with complex rheology; expected month of arrival: April

WP2 Viscoelastic response (O. Cadek)

The main scientific objective of WP2 is viscoelastic modeling in complex 3D models of the Earth, and the corresponding networking of European researchers.

The fact that no visitors have been added on the visitor's list of WP2 in 2004 does not mean that there were no activities related to the research of viscoelasticity. There is a close link between workpackages 1 (convection), 2 (viscoelasticity) and 3 (gravity) and some of the researchers and students who visited Prague in the framework of WP1 and WP3 spent a part of their time dealing with problems of viscoelastic deformation and postglacial rebound.

A typical example of such combination of the activity of several work packages was a mini-symposium "Thermodynamics and Mineral Physics", organized around the lecture series given by Dr. Jan Matas (see WP1), on March 29-31. The other two main personalities of this mini-symposium were the long-term MAGMA visitors, Dr. Volker Klemann (WP3) and Dr. Arie van den Berg (WP1). The mini-symposium was attended by about 15 participants from the Czech Republic, including students of geophysics, the MAGMA staff members and our colleagues from the Geophys. Inst., Czech Acad. Sci., Prague.

F. Couturier and Dr. C. Dumouline from the University in Nantes were others related to WP2, but included in the visitor's list of WP1. They were dealing with thermal convection in planetary mantles but needed viscoelasticity to explain relationship between gravity and topography on some planetary bodies (Mars). This is a nice example of the interdisciplinary research, representing one of the MAGMA priorities. The group in Nantes has recently submitted a proposal of the Marie Curie Host Fellowships for Early Stage Researcher Training project, in which our department has been included, too. It is ISSEP project, "Internal and Surface Studies of Earth-like Planets", coordinated by Professor Christophe Sotin (University of Nantes).

A lot of attention was paid to viscoelasticity in the research of the gravitational field in WP3: The topic of viscoelastic response of the Earth to glacial loading is a common nominator of the research done or presented in Prague by Dr. Kevin Fleming, Dr. Volker Klemann, Jan Hagedoorn and Dr. Detlef Wolf (for more details, see reports on WP1 and WP3).

Activities planned for 2005

Short-term stays:

- Dr. Caroline Dumouline, University of Nantes; topic: viscoelastic deformation of planetary lithospheres

- Dr. Gael Choblet, University of Nantes; topic: dynamic topography, mantle convection and viscoelastic lithosphere

Long-term stays:

- Dr. Gabriele Marquart, University of Frankfurt; topic: deformation of the Earth and temporal variations of the Earth gravitational field; expected month of arrival: February

WP3 Temporal changes of the gravitational field (Z. Martinec)

The main objectives of WP3 include theory and interpretation methods for satellite gradiometric observations, studies of post-glacial viscoelastic relaxation, and the corresponding networking of European researchers.

Several visitors of the MAGMA contributed to the successful performance of WP3. Here is an abbreviated report. For details, the reader is referred to the MAGMA web page.

Dr. Volker Klemann from GeoForschungsZentrum Potsdam visited us for 7 weeks starting the 1st of March, 2004. He was invited to implement the non-linear, stress-dependent constitutive equation of viscoelastic material into glacial-isostatic adjustment (GIA) modeling. He was motivated by the studies of the effect of non-linear, temperature-dependent rheology on mantle-convection flow, which have been carried out at our department for a couple of years. As a basic tool, he used the numerical code developed at our department which implements the spectral, finite-element method for GIA modeling. At the present time, he is finishing this study with the aim at publishing it in the *Geophysical Journal International*.

Jan Hagedoorn, a Ph.D. student from GeoForschungsZentrum Potsdam, visited us for 3 months, starting from the 4th of October, 2004. His stay was oriented into two issues. First, he continued his Ph.D. work on GIA studies. Particularly, he finished the evaluation of the effect of GIA on tide-gauge time series reflecting sea-level changes on 165 sites over the world. He found a good agreement between modeled long-time trends of the sea-level variations and the observed values. Second, he continued the predictions of GIA-induced deformation and changes and their effect on GPS measurements. For this purpose, he used the numerical software on modeling GIA coupled with sea-level equation and rotational deformation installed on one of our most powerful computers one year ago. He made his software available to us for future scientific purposes at our department.

Dr. Kevin Fleming from GeoForschungsZentrum Potsdam visited us for 7 weeks starting August 29, 2004. We invited him to present a series of three lectures on glacial rebound and sea-level changes around Greenland since the last glacial maximum. He overviewed this topic in a transparent way such that the undergraduate students of geophysics were able to follow this course of lectures. His second activity was devoted to test a linear relationship between the gravity field of Venus and its topography. Since the degree-correlation function has been used for similar purposes at our department several times, Dr. Fleming set up a numerical code for computing the degree-correlation function between two fields represented as a series of spherical harmonics. Since his stay expired before he had finished this study, there is a plan to invite him to work on this subject in 2005 once more.

There were 2 short-time visitors, Prof. Detlef Wolf and Dr. Georgios Balasis from GeoForschungs-Zentrum Potsdam. They reported about their latest scientific results at our seminars. Finally, the short-time visit of Prof. Lars Sjoeborg from Technical University in Stockholm was devoted to discussions on some parts of the book under preparation in co-authorship Lars Sjoeborg, Petr Vanicek from New Brunswick University in Fredericton (Canada) and Zdenek Martinec (WP3 leader).

Activities planned for 2005

Short-term stays:

- Dr. Kevin Fleming, GeoForschungZentrum Potsdam; expected month of arrival: March

- Rico Hengst, GeoForschungZentrum Potsdam
- Ingo Sasgen, GeoForschungZentrum Potsdam

Long-term stays:

- Nicola Tosi, Universita degli Studi di Milano, Italy; expected month of arrival: October

WP4 Seismic waves: Theory (L. Klimes)

The main objective of WP4 is development of new theoretical methods for seismic wave propagation in complex 3D heterogeneous and anisotropic media, the corresponding networking of European researchers, and transfer of the knowledge towards oil industry.

A two-day seminar with representatives of major oil companies (4 participants), designed to disseminate theoretical results, and discuss mutual cooperation was held on June 14-15, 2004. For details of the programme, see web page of the Consortium of Seismic Waves in Complex 3D media (SW3D) at <http://sw3d.mff.cuni.cz>. Immediately following the above meeting, a one-day training course was held on June 16, 2004. The training course (4 participants) was devoted to the latest software developed at MAGMA Center during the last year, and to the discussion of the underlying numerical algorithms.

In 2004, WP4 profited from many short- and long-term visits. Here is an abbreviated summary of the performed work. For details, see MAGMA web page, where abstracts of the presentations are given, too.

Together with Dr. Giancarlo Dal Moro (Italy, 6 weeks), we coded and numerically studied the simultaneous 2-D inversion of the travel times of reflected waves and the phase-velocity dispersion curves of surface waves. We focused also onto the corresponding resolution of the P- and S-wave velocity heterogeneities, and the density heterogeneities as well.

Together with Dr. Leo Eisner (United Kingdom, 6 weeks), we coded the inversion of arrival times of microearthquakes simultaneously for the velocity model and hypocentres. We then numerically tested applicability and resolution of the inversion. We also started studies to determine the vertical P-wave and S-wave medium correlation functions from sonic well logs. Importantly, this cooperation resulted in preparation of the EU project IMAGES, coordinated by Leo Eisner at the Schlumberger Cambridge Research. The project has significant ecological importance because it is focused on microearthquakes induced by oil drilling and corresponding hydrofracturing. The project has been accepted, it will start on March 1, 2005, and its duration will be 4 years.

Dr. Robert Patzig (Germany, 1 week) visited the department as a MAGMA guest. Being interested in longer joint work, we agreed on his 6-month stay at our department within the other closely related project SPICE, the EC Marie Curie RTN. Madjid Berraki (France, 4 days) visited us to explore possible cooperation, but so far has not yet decided about his participation in our theoretical research.

Prof. Bjorn Ursin (Norway, no financial support from MAGMA) discussed with us various topics related to true-amplitude prestack depth migrations.

With Dr. Tijmen Jan Moser (The Netherlands, 2 months), we studied a possibility to use symplectic Runge-Kutta algorithms for ray tracing. Unfortunately, the implicit Runge-Kutta methods are numerically inefficient for ray tracing, and we finally found that the explicit Runge-Kutta methods cannot be symplectic. The question remains whether explicit predictor-corrector methods can be symplectic. We also discussed two-point ray tracing and dynamic ray tracing in anisotropic media. A joint paper of T. J. Moser and V. Cervený, leading personality of our department, is now under preparation.

Dr. Stefan Buske (Germany, 1 month) worked with us on the Fresnel volumes in anisotropic media. We also discussed the resolution of prestack depth migrations and possibilities of application of the

polarization vectors. Application of the medium correlation functions to the migrations was also discussed.

Prof. Klaus Helbig (Germany, 5 days) discussed various topics related to wave propagation in anisotropic media, and explained his new ideas in two lectures. The mutual cooperation should continue during his one-month visit in 2005.

Activities planned for 2005

Seminar and training course with major oil companies in Prague:

- analogous to that of 2003 and 2004

Long-term stays:

- Tijmen Jan Moser (The Netherlands, 1 month), topic: to continue his cooperation with Vlastislav Cervený.
- Dirk Roessler (Germany, 1 month), topic: to work on the inversion for the moment tensors of seismic sources.
- Klaus Helbig (Germany, 1 month), topic: to cooperate on the problems of wave propagation in anisotropic media.

WP5 Seismic waves: Observations (J. Zahradnik)

The main objective of WP5 is development of the Charles University seismic stations in Greece, collecting and processing data essential for research in WP6, and their integration into the European framework.

The seismic network of the Charles University, developed in cooperation with the Patras University, presently comprises four sites, each one equipped with a weak-motion broad-band velocigraph CMG 3-T and a strong-motion accelerograph CMG 5-T. Two visits from Prague to Greece in 2004 were devoted to check the stations, download data, make small corrections and on-site calibration, and discuss methodical issues with the staff in Patras. The selected data are available from <http://seis30.karlov.mff.cuni.cz>, updated every 4 months. The stations Sergoula and Mamousia are situated on the northern and southern coast of the Corinth Gulf, respectively, both in its western part. They are operated as stand-alone stations. The other two sites have satellite data transmission to Patras. It is Loutraki station, at the eastern edge of the Corinth Gulf, and Pylos station, close to Kalamata city, on the south-west of the Peloponnesos. During writing of this report, Pylos was temporarily out of operation due to technical problems, and its instruments had to be sent for repair to England.

One of our visits to Greece (in November 2004) was also connected with the kick-off meeting of the new EC project 3HAZ-Corinth, coordinated by P. Bernard, IPG Paris. An oral presentation was made at the meeting by the MAGMA coordinator. In this way, we have reached one of major long-term goals, *viz.* the international link of the stations, because the Sergoula and Mamousia stations now represent an integral component of the 3HAZ project. Data for selected events, studied within 3HAZ, were already sent to H. Lyon-Caen, ENS, Paris.

Main research use of the data in 2004 was to clarify how the weak and strong motion instruments efficiently complement each other. It resulted in a journal paper (Zahradnik, 2004). Nature of strange long period pulses on CMG 3-T broadband records due to nearby earthquakes was also investigated. They were detected first in the Sergoula station. After profound studies, the pulses have been identified as normal response to a bit abnormal ground motion input, *viz.* a sudden (step-like) horizontal acceleration, most likely connected with a local tilt provoked by the vibratory seismic motion in the immediate vicinity of the seismic instrument. A journal paper has been written (Zahradnik and Plesinger, submitted). As a byproduct of our cooperation with Greek colleagues within MAGMA, it was found that similar effects (although less obvious) exist on, and significantly obscure, the Le-3D/20s broadband records of the main seismic network of Greece, operated by the Institute of Geodynamics

of the National Observatory of Athens. A simple way how to detect the long-period disturbances, and how to "clean" the records prior their use in seismic source studies has been suggested by our group in Prague.

Short visit of MAGMA Center in Prague by E. Sokos, planned for 2004, was postponed to early 2005 due to overload connected with the above mentioned paper submission.

MAGMA web page devoted to the stations and data has been updated during 2004 twice. For details, see <http://seis30.karlov.mff.cuni.cz>. Three presentations made in connection with the WP5 activity were presented on the 29th General Assembly of the European Seismological Commission in Potsdam, Germany (September 2004). Two of them have been also posted on that web page, too. A seismic group in Slovenia, around Dr. M. Zivcic, an external member of the MAGMA Advisory Board has been interested in these problems, besides others.

Closely connected to WP5 has been upgrade of the seismic instrumentation at our home station Praha (international acronym PRA). This station, celebrating its 80-years anniversary, has been renovated and newly equipped by the same instrument CMG 3-T with which we have got experience during the MAGMA activity in Greece.

It is a pity that another EC project related to WP5, AEGEAN-QUAKE, was not selected for funding. We were invited to participate in that project by our colleagues from France (H. Lyon-Caen and Mary Ford) and Greece (A. Kiratzi). This planned Marie Curie Research Training Network was important because of its inter-disciplinary relations between earthquakes, lithospheric plates and mantle convection, in a single target region of the Aegean, which is exactly fitting with our MAGMA objectives. It is to consider re-submission of the project.

One of our visits to Greece (in November 2004) was also connected with the kick-off meeting of the new EC project 3HAZ-Corinth, coordinated by P. Bernard. An oral presentation was made there by the MAGMA coordinator. In this way, we are reaching one of major long-term goals, viz the international link of the stations, because the Sergoula and Mamousia stations now represent an integral component of the 3HAZ project.

Activities planned for 2005

Short-term stays:

- Three regular visits to the Seismological Laboratory in Patras, depending on the status of our joint research work and on the technical status of the instruments, approximately scheduled for April, August and November (J. Jansky, V. Plicka, J. Zahradnik).
- Short visit (2 weeks) of MAGMA Center in Prague by E. Sokos of the Seismological Laboratory in Patras, now at National Observatory of Athens, most likely in February.

Web page:

- The database on web will be continually upgraded. The same web page will include also the latest publications and conference presentations.

Public relations:

- Lots of energy will be invested into public presentation of our earthquake research, including WP5, in connection with the latest disaster in south-east Asia. It will include several lectures, popularization articles, radio interview, etc.

WP6 Earthquakes (J. Zahradnik)

The main research objective of WP6 is to synthesize different approaches of earthquake modeling (the so-called integrated modeling), and to promote multidisciplinary studies of the earthquake strong-ground motions in the European framework.

The moment tensor inversion for multiple point sources, successfully applied to the significant M6.3 earthquake at Lefkada, Greece, 2003, was accepted for publication (Zahradnik et al., in press). It was a true team work which significantly strengthened cooperation between the participating groups in Prague, Patras and Athens. The presentation of this activity at the 29th General Assembly of the European Seismological Commission in Potsdam, Germany (September 2004) attracted significant attention and discussion. All material related to this study has been posted on our web page <http://seis30.karlov.mff.cuni.cz>.

Visit of Christoforos Benetatos, PhD student from the University in Thessaloniki, was devoted to several tasks of joint interest related to earthquakes in Greece. He made two presentations comprising not only seismic source studies, but also broader geodynamic consequences, *viz.* the relations between earthquake occurrence and focal mechanism on one side, and the subduction of the African plate below Aegean Sea on the other. Deep Earth structure of that region was also extensively discussed. A smaller part of our discussions was about the so-called earthquakes swarms (the Psachna region in central Greece); swarms represent a research area tightly linked with our active territory in West Bohemia–Vogtland. Most extensive part of this visit was reserved to the above mentioned moment tensor inversion for multiple point sources, being further developed by J. Zahradnik. Ch. Benetatos learnt the Fortran ISOLA code in detail, and jointly with J. Z. they try to apply it to the M6.5 earthquake at Skyros Island, Greece, 2001. V. Plicka of Prague team participated in the same study by his empirical Green's function method. Results have preliminary character, and would require more work before publishing.

Dr. Antonio Emolo, researcher of the University in Naples, whose second visit to MAGMA was planned for 2004, postponed his visit to 2005. However, two PhD students of the MAGMA team in Prague, F. Gallovic and J. Burjanek, made a short visit to A. Emolo and gave their presentations in Naples. Their trip was financed from the RTN SPICE as a secondment, related to their long-term stay in Bratislava. This is a nice example how the cooperation in Europe can profit from mutual combination of various project schemes.

One-month visit of Dr. Olivier Sebe from J. Fourier University in Grenoble was realized at the end of 2004. It was devoted to new techniques for retrieving source-time functions and site effect characterization by the so-called blind deconvolution technique, so far less known in seismology than in other branches of physics, or in signal processing. O. Sebe gave two excellent seminars and spent some time not only developing user-friendly version of his software, but also applying the method to our seismic data from Greece (data of WP5). It is likely that a fruitful long-lasting cooperation may arise from this first contact. Besides other, O. Sebe represents our important link with famous personalities in Grenoble, namely Dr. P. Y. Bard (who suggested Sebe's trip to Prague as his former supervisor), and Prof. M. Bouchon.

The MAGMA staff in Prague continued cooperation with Dr. Ivo Oprsal, our former PhD student, specialized in the finite-difference methods, who is now at long-term postdoc stay at ETH, Zurich. Computer codes developed in previous period in Prague for studies of the strong ground motions, and site effects, were applied to investigate seismic hazard of Basel, using numerical simulations ("seismic scenarios") of a possible future repetition of a $M > 6$ earthquake, known to occur there in 1356. We also worked on possibilities how to raise funds for Oprsal's return to Prague after finishing his 4th year in Zurich. I. Oprsal has been the leading author of our joint paper devoted to 3D seismic response of a site in Athens, heavily damaged during the 1999 earthquake, the paper which has resulted from the cooperation between MAGMA staff in Prague and the Patras University group. The paper was published in the proceedings of 13th World Conference on Earthquake Engineering, Vancouver, Canada.

Dr. Arrigo Caserta, researcher at INGV Rome, who visited MAGMA in 2003, and has cooperated with us in the field of earthquake site effects and numerical modeling of seismic waves, has started his external PhD studies at Charles University, Prague.

Numerical modeling of the strong-ground motions, developed at MAGMA Center in previous years, saw its continuation. New EC project 3HAZ-CORINTH, coordinated by Dr. P. Bernard, mentioned already in WP5, includes this WP6 topic, too. It is important that we can again in this project cooperate with Dr. C. Berge and Dr. D. Baumont of the Institute of Nuclear Safety and Protection, Fontenay-aux-Roses, France. Importantly, Dr. C. Berge is an external member of the MAGMA Advisory Board.

Visit of Dr. M. Cocco, director of the Department of Seismology and Tectonophysics at INGV Rome, planned for 2004, was not realized due to his work overload. Visit of Dr. M. Mai, researcher at ETH Zurich, was not realized. But, instead, our students J. Burjanek and F. Galovic visited him in Switzerland.

Activities planned for 2005

Mini-symposium:

- As reported in 2003, the mini-symposium planned for 2004 was moved to 2005, to be merged into a bigger event, co-organized by MAGMA WP4 and WP6 (together with the Geophysical Institute, Czech Academy of Sciences). This will be an international conference on Seismic Waves in Laterally Inhomogeneous Media (June 2005, Castle of Hrubá Skála, Czech Republic). Attendance of this important event by several young participants will be supported from MAGMA resources.

Short-term stays:

- A short stay of Dr. M. Wyss, director of WAPMER center in Zurich, is scheduled for late February.
- A short stay of Dr. A. Caserta, INGV Rome, April-June.

Long-term stays:

- A 1-month post-doctoral stay of A. Serpetsidaki, University of Patras, devoted to strong-ground motion modeling and other studies of earthquakes in Greece has been fixed for the period February 1-28.
- A 1-month post-doctoral stay of Z. Roumelioti, University of Thessaloniki, devoted to seismic sources, observation and methods, has been agreed for March.
- A 1-month post-doctoral stay of S. Richwalski, GFZ Potsdam, devoted to numerical modeling of seismic ground motion by the finite-difference method, has been planned for September.

WP7 Climate system (T. Halenka)

The main research objective of WP7 is development of mathematical models for modeling the climate system, with emphasis on the Czech Republic and Europe.

The long-term stay of Dr. John Hampson was organized to continue the collaboration after 5th framework project SOLICE, finished in the beginning of 2004. The possibilities of improving performance of the middle atmosphere model MSDOL were analyzed in polar regions. This visit brought the MAGMA Center another aspect of climate change connected with the middle atmosphere, where the sensitivity of chemistry to atmospheric cooling in connection with Green House Gases (GHG) increase is significant. A seminar about stratosphere and middle atmosphere modeling was made, see the attached list of seminars. J. Hampson also attended the workshop organized in framework of WP7, see below.

The stay of Dr. Klemen Bergant was organized in framework of the activities in regional climate modeling which are now a part of 6th framework project ENSEMBLES. In this visit, the MAGMA Center provided training in the regional climate modeling. The visitor learnt the basic principles of RCM RegCM3 and tested several configurations of the model for different purposes. He has been performing validation study of long period run of RegCM3 driven by NCEP Reanalysis from 1961 till 2000, completed in the framework of a local project. K. Bergant also attended the workshop organized in framework of WP7, see below.

Probably the most important event of WP7 was the MAGMA Workshop on Regional Climate Modelling and Mini-Symposium on Climate Change in Europe, Prague, Nov 29-Dec 3, 2004. There were 37 participants, 37 contributions, and broad discussion forum on collaboration in climate change studies and modeling in Central Europe. Preliminary discussions were devoted also to a joint effort to prepare a proposal for a next 6FP call.

In September 2004 the project of 6FP ENSEMBLES (ENSEMBLE-based Predictions of Climate Changes and their Impacts) started dealing with regional climate changes and their impacts on Europe using multi-model ensembles prediction and regional climate simulation with high resolution, which is connected to the part of MAGMA Center activities and DMEP is involved in this project (PI – Halenka).

In the beginning of 2004, preparation of another 6FP project started. It is QUANTIFY project (now in stage of finalizing of the contract, assumed to start in March 2005), dealing with quantifying impact of emission from transportation on climate change. It is connected both with WP7 and WP8. DMEP is involved in this project as well (PI – T. Halenka).

Four other seminars connected with the WP7 activity are listed in the attachment. They represented MAGMA contribution to the Annual meeting of Czech Meteorological Society.

Activities planned for 2005

Workshop:

- Workshop on Climate Change and Climate Prediction (Joint Workshop of Working Group on Seasonal to Inter-annual Prediction and Working Group on Climate Change in 20th Century of CLIVAR Program), June 2005

Short-term stays:

- F. Mesinger, April 2005
- A. Berger, June 2005
- J. Bates, October 2005

Long-term stays:

- K. Bergant and J. Hampson, as a continuation of the cooperation started in 2004
- One-month stay of J. Pal, May 2005
- Another 1.5-month stay under negotiation for autumn 2005

WP8 Air quality (J. Brechler)

The main research objective of WP8 is numerical atmospheric modeling with emphasis on local air pollution in the Czech Republic and Europe.

In 2004, a new method has been developed to implement biogenic emissions (BVOC) to model SMOG (previously developed at our department). Implementation of BVOC enables us to obtain more realistic results regarding the spatial distribution and temporal evolution of concentration of the photooxidation smog. The next steps to be done include verifications and comparison of the modeling results with measurements, hopefully followed by publication.

Another important achievement has been development of a method applicable for mapping emission sources responsible for tropospheric ozone creation (at a given location). Also this method has to be further tested and validated prior publication.

In the framework of international collaboration, our department also took part in the COST 715 action called "Meteorology applied to urban air-pollution problems", that finished in 2004.

In the home country, the work performed in WP8 has been tightly connected with needs of the Czech Ministry of Environment. The ministry has appreciated the role of the MAGMA Center in this direction, thus allowing us to participate in their R&D programmes targeted to the problem of photooxidation pollution, and its modelling.

One 3-month visit to the MAGMA Center (Dr. Rita Cesari, CNR-ISAC, Lecce) was realized from June to August (financed in the framework of the NATO Senior Fellowship Programme), and it was agreed that the same scientist will be hosted by our department, as a regular MAGMA visitor for two months or more, in 2005.

Dissemination of research results and database on Internet: National research reports (in Czech) for Ministry of Environment: <http://www.recetox.muni.cz/index.php?id=41> and http://www.chmi.cz/uoco/prj/vav_740_4_03/index.html.

Activities planned for 2005

Workshop:

- The main WP8 action of the MAGMA Center, scheduled for the second half of 2005, is the workshop on the air pollution problems on mesoscale and microscale (urban scale). The planned attendance is up to about 20 participants. The main emphasis will be given to effects of the complex orography and urban geometry on airflow and other meteorological variables.

Long-term stays:

- One 2-month visit of Dr. Rita Cesari, summer 2005

WP9 Research and technical management (C. Matyska, L. Hanyk)

The main objective of WP9 is to manage synchronization among work packages, and to co-ordinate communication of the MAGMA Center with research and industrial partners in the Czech Republic and Europe.

Second year of MAGMA Center management was characterized by very stable relations within the Faculty of Mathematics and Physics, where the Center like this has been highly appreciated, in particular by the Dean and Vice-Deans. The Financial Department has provided a considerable help and continuous monitoring and checking of the account.

The web page of the MAGMA Center has grown considerably in 2004. It has been continually updated after each event. In order to keep the main MAGMA page easily readable, specialized web pages were linked with it, so the whole system is now as follows:

- the MAGMA home page, <http://geo.mff.cuni.cz/magma>
- home page of the Department of Geophysics, i.e. the main site to post the research summaries going across the individual work packages, training materials, etc., <http://geo.mff.cuni.cz>
- home page of the Consortium of Seismic Waves in Complex 3D media, including mainly the WP4 activities, publications, software, etc., <http://sw3d.mff.cuni.cz>
- home page of the seismic stations of the Charles University in Greece, WP5 and WP6, its database, publications, software, etc., <http://ses30.karlov.mff.cuni.cz>
- home page of the Department of Meteorology and Environmental Protection, <http://kmop.mff.cuni.cz>

To keep high information value of the web page, for each visit, not only basic facts are posted, such as names, dates of stay, research topic, etc., but also a link is made to more detailed materials related to the visit and/or the visitor himself. It includes, for example, abstracts submitted to a conference as a result of the stay at the MAGMA Center, a related teaching material, a link to the visitor's own research web pages, etc.

Probably the most important management activity was a nearly everyday contact of the WP leaders (internal members of the Advisory Board) with each other, during which all activities (both forthcoming and past) were thoroughly discussed. Lot of time was spent on thinking how to optimize impact of the visits on our students. As a result, several long term visits in 2004 have included intensive lecture series, given by leading specialists during their stay in Prague. At the same time, some of our students were jointly working with the visitors. And, last but not least, the students made a trip to home institutions of some visitors. All the details are listed in the reports from the individual work packages. Key role in this activity, similarly to 2003, was played in 2004 by the MAGMA Center seminars. The goal was not only to have lectures of our visitors, but also (during their visit) to make them familiar with research made by our staff and our students. Another goal was to co-operate among work packages. The seminars have been also major occasion for the contacts between the MAGMA Center and the related research institutes in Prague, mainly the Geophysical Institute, and the Institute of Rock Structure and Mechanics (both belonging to the Czech Academy of Sciences). See the complete list of seminars in attachment.

Great management efforts were devoted to linking the individual WP tasks with each other. As a result, not only members of the geodynamics group were attending the seismology seminars more often than in the past, and vice versa, but we were also trying hard to transfer new mathematical methods from one sub-group to the other. This trend is not easily apparent in the report, but can be traced in the seminar list and publication output (Research overview 2004), attached to this report. At least two typical examples to be given here: (i) Among the visitors related to WP1 and WP2 it was mainly F. Couturier and Dr. C. Dumoulin from the University in Nantes, who dealt with thermal convection in planetary mantles but needed viscoelasticity to explain relationship between gravity and topography on some planetary bodies (Mars). This is a nice example of the interdisciplinary research, representing one of the MAGMA priorities. (ii) During long-term stay of Ch. Benetatos, PhD student from the University in Thessaloniki, not only the earthquakes source parameters were discussed, but also broader geodynamic relations, such as subduction of the African plate below Aegean Sea and/or deep structure of the region.

Everyday interaction among the internal members of the Advisory Board was already discussed above. Organization of meeting with the external members of the Advisory Board is doubtful due to their work overload. At least, MAGMA periodic reports are being sent to them. As regards the external advice, great and immediate help has been always provided to us by Dr. Tobias-Berthold Fuchs, the European Commission-DG Research officer.

Links with several EC projects were mentioned in the detailed reports of the work packages. This activity has further grown, compared to 2003. Here, let us admit, that MAGMA plays a significant role also in the preparation of national projects. In particular, a new 6-year framework research plan, including MAGMA, was submitted in 2004 by our Faculty for approval at the Ministry of Education, Youth and Sports under the title "Research of the Earth and Universe by advanced physical methods". This huge project is coordinated by Professor Jan Bednar, head of the Department of Meteorology and Environmental Protection, a member of the MAGMA staff.

Last but not least, outreach to education should be mentioned. During the year 2003, the PhD, MSc and BSc thesis, supervised at MAGMA Center, were successfully defended as follows:

PhD Theses

- J. Miksovsky: On some meteorological applications of nonlinear time series analysis methods (supervisor: A. Raidl)
- K. Potuzniková: Modelling of atmospheric boundary layer processes and their interactions with fog and low-level clouds development (supervisor: J. Bednar)
- R. Mladek: Study of indirect influence of orographic obstacles in numerical weather prediction models (supervisor: T. Halenka)

MSc Theses

- M. Behounkova: Seismic tomographic inversion of synthetic data (supervisor: H. Cizkova)

- P. Burian: Processing of weather doppler data in a digital radar receiver (supervisor: P. Novak)
- Z. Chladova: The observed changes of selected climate characteristics (supervisor: J. Kalvova)
- P. Huszar: Use of MM5 for the purpose of simulation of atmospheric processes on smaller scales (supervisor: T. Halenka)
- L. Inovecky: Postglacial relaxation of the Earth's models in a cylindrical geometry (supervisor: C. Matyska)
- M. Pauer: The gravity field of Venus and its relationship to the dynamic processes in the mantle (supervisor: O. Cadek)
- T. Pergler: Postseismic relaxation of the Earth's models with maxwellian rheology (supervisor: C. Matyska)
- H. Sedenkova: The estimate of spreading of ground concentration from the line source in the urban build-up area and in the open landscape (supervisor: Z. Kanour)
- P. Zacharov: Diagnostic and prognostic convection precursors (supervisor: J Bednar)

An important management issue is also the internal computer network. Using MAGMA funds, the existing computer infrastructure was further upgraded with two main objectives: to guarantee excellent working conditions for our guests, and to help students to get closer to research by allowing them to work together with us, right on the premises of the MAGMA offices.

Contacts with industry were maintained by the meeting with representatives of major oil companies, see the WP4 report. (One of the participants of the meeting, P. M. Bakker, Shell, The Netherlands, is an external member of the MAGMA Advisory Board). The cooperation resulted in preparation of the EC project IMAGES, coordinated by Dr. Leo Eisner at the Schlumberger Cambridge Research. The project has been accepted, it will start on March 1, 2005, and its duration will be 4 years. The project has significant ecological importance because it is focused on microearthquakes induced by oil drilling and corresponding hydrofracturing.

Environmental aspects were studied mainly in WP7 and WP8 in connection to climatic models and to the air pollution. The work performed in WP8 has been tightly connected with needs of the Czech Ministry of Environment. The ministry has appreciated the role of the MAGMA Center in this direction, thus allowing us to participate in their R&D programmes targeted to the problem of photooxidation pollution, and its modelling.

As regards the project outreach into our home country, Dr. O. Novotny, member of MAGMA staff, co-authored a lecture at the mining-oriented conference, organized by the Institute of Geonics, Czech Acad. Sci. of the Czech Republic, Ostrava. His lecture on the utilization of quarry blasts for seismic purposes (structural studies) was published in Transactions of the Technical University of Ostrava. Other contacts with mining industry were kept also through V. Rudajev, former head of the Institute of Rock Structure and Mechanics (an external member of our Advisory Board). There were also frequent personal contacts between J. Bednar (head of the Department of Meteorology and Environmental Protection) and I. Obrusnik (director of the Czech Hydrometeorological Institute, and external member of the MAGMA Advisory Board), oriented towards continuous improvement of the curricula, including the PhD curriculum at the Charles University. This is because the Czech Hydrometeorological Institute is the most important employer of our meteorology students, and, because the institute is representing WMO in the Czech Republic, the cooperation like that is important for MAGMA from viewpoint of international co-operation, too.

Public relations of MAGMA had a variety of forms. Prof. Vlastislav Cervený was honored by Society of Exploration Geophysicists with the Maurice Ewing Medal in recognition of his lifetime internationally recognized work in the ray theory of wave propagation. Dr. Jiri Zahradnik was elected Vice-President of the European Seismological Commission at its 29th general assembly in Potsdam (September 2004). Dr. J. Kalvova, climatologist, member of the MAGMA staff, helped us to overcome academic borders of our work. She had two radio and TV interviews concentrated on climate change and its impact on living conditions and society. Significant public activity of MAGMA followed also the earthquake and tsunami disaster in south-east Asia in the end of 2004. When finishing this report the interest of media still continues, so details will be included in the 2005 report.

Activities planned for 2005

The same management activities as in 2004 (co-ordination among the work packages, mainly through seminars, co-ordination of meetings and visits, co-ordination of educational, industrial and societal outreach, web pages).

LIST OF ATTACHMENTS

- A** **Research Overview 2004**
- B** **Publications in 2004**
- C** **Seminars in 2004**

Attachment A RESEARCH OVERVIEW 2004

Professor Vlastislav Cervený was honored by Society of Exploration Geophysicists with the Maurice Ewing Medal in recognition of his lifetime internationally recognized work in the ray theory of wave propagation.

The MAGMA center, i.e. the Prague Center of Mathematical Geophysics, Meteorology, and their Applications, supported by the European Commission, has completed in 2004 its second successful year of existence. The geophysical group profited from short visits as well as from more than 1 month lasting stays of 13 senior researchers, 7 post-doctoral researchers and 13 PhD students (23 person-months altogether). For more details, see <http://geo.mff.cuni.cz/magma>. In a close relation with MAGMA, we entered into three new 6th-framework European projects: SPICE, 3HAZ-CORINTH and IMAGES. SPICE (2004-2007) is the pan-European Marie Curie Research Training Network involving 14 universities and specialized in theory of seismic wave propagation. 3HAZ-CORINTH (2004-2006) is a targeted research project oriented to three main natural hazards in the Gulf of Corinth, Greece, viz earthquakes, landslides and tsunamis. IMAGES (2005-2008) aims at transfer of knowledge between seismologists and applied geophysicists (Schlumberger Cambridge Research), studying microearthquakes induced by oil drilling. Intensive cooperation with several major oil companies, lasting since 1993, has been strengthened, too.

Similarly to the previous years, research at the Department of Geophysics was carried out in three directions: Geodynamics, Theory of seismic waves, and Earthquake and structural studies.

Geodynamics

(reported by Ctirad Matyska)

Viscoelastic post-glacial response of the Earth

For a spherically symmetric viscoelastic Earth model, the movement of the rotation vector due to surface and internal mass redistribution during the Pleistocene glaciation cycle has conventionally been computed in the Laplace-transform domain (Martinec and Hagedoorn, submitted). The new method offers the possibility to model the rotational response of the Earth induced by surface glacial loading by numerical time integration of the linearized Liouville equation. The theory extends the conventional approach based on the second-degree load Love numbers to general 3-D viscoelastic earth models. The time-domain solution of both the glacial isostatic adjustment and the induced rotational response of the Earth is easy to combine with a time-domain solution of sea-level equation with a time-varying shoreline geometry. An axisymmetric viscoelastic model was employed to explain Fennoscandian relaxation data (Martinec and Wolf, in press).

Moreover, we have studied the possibility of short time-scale energy transfer from the ice sheet loading and unloading processes to the Earth's interior via viscous dissipation associated with the transient viscoelastic flow in the mantle (Hanyk et al., submitted). We have focussed on the magnitude of glacially-induced deformations and the corresponding shear heating for an ice sheet of the spatial extent of Laurentide region in Maxwellian viscoelastic compressible models with a Newtonian viscosity. We have found that shear heating from the transient viscoelastic flow can represent a non-negligible mantle energy source with cryogenic origins.

We also investigated global geoid change resulting from fluctuations in the spatial and temporal configuration of several regions of major present-day glaciation (Fleming et al., 2004). The areas of primary interest are Greenland, Antarctica, Patagonia, Alaska and Iceland. The contribution to geoid displacement due to the ongoing isostatic adjustment of the Earth to past ice-load changes was examined, in particular those following the Last Glacial Maximum, but also more recent events, e.g. the late Holocene and Little Ice Age. For present-day predictions, we employ recently published descriptions of changes in these glaciated areas that are a product of a variety of data types. Based on an optimistic accuracy estimate of the new satellite mission GRACE, the geoid displacement in these areas is detectable up to degree and order 48, however, this is still dependent upon the final accuracy achieved.

Earth's mantle convection, lithospheric subduction

Studies on generation of slab-like downwellings in the global layered mantle convection models and influence of the zone of weakness on the dip angle of subducting lithosphere, submitted in 2003, were finally published (Cizkova and Matyska, 2004; Kukacka and Matyska, 2004). Combined effects of kinematic and free-slip boundary conditions, age of the plate and trench migration rate on the stresses within the slabs in 2-D Cartesian numerical models of lithospheric subduction have been modeled in a broad parameter space and publication of results is under preparation. Convection models with a hypothetical interface at a 1000 km depth have been also used as synthetic models in 2-D and 3-D synthetic tomographic inversions (Behounkova et al., submitted). The resolving

power of tomography in different parts of the mantle has been described in detail. We have found that the role of projection (discretization) error, usually omitted in standard resolution studies, may be substantial.

Dynamic consequences of the recently discovered post-perovskite phase in the deep mantle were studied in (Matyska and Yuen, in press; Matyska and Yuen, submitted). They have investigated the impact arising from the interaction of temperature-dependent and depth-dependent viscosity with radiative thermal conductivity on the dynamics of both the ascending and descending flows in the presence of both the phase change at 670 km depth and post-perovskite transition at 2650 km depth. The importance of radiative thermal conductivity in maintaining the coherent structures of large upwellings in the lower mantle was demonstrated. These results also revealed that a greater degree of asymmetry is produced in the vertical flow structures of the mantle by the phase transitions. Therefore, mass and heat-transfer between the upper- and lower mantle will deviate substantially from the traditional whole-mantle convection model.

In order to overcome a lack of data that could constrain mantle flow models, a new insight into dynamics of the asthenosphere is now expected from comparing the plate-driven flow models with the data on seismic and electrical anisotropy in the sublithospheric mantle. The research, combining different types of mantle flow modeling with both electromagnetic and seismic data, has been recently started by O. Cadek. It is focussed on the Australian plate, which is relatively fast and for which a unique set of seismic and electromagnetic observations is available.

Viscosity of the Earth

Effects of lateral viscosity variations in the lower mantle on the long-wavelength geoid and surface topography have been studied (Cadek and Fleitout, submitted). Information on gravitational and topographic signal was also used to investigate the internal structure of Venus (Pauer, 2004). The main result is that the viscosity in the Venusian mantle must increase with depth by several orders of magnitude. This conclusion differs from previous studies by other authors who mostly argued for only a weak increase of viscosity with depth.

Conductivity of the Earth

Forward modeling of electromagnetic induction was implemented in the time domain for satellite data (Martinec and McCreddie, 2004; McCreddie and Martinec, 2004). The input of the model consists of the X-component of the magnetic induction vector recorded by the CHAMP and/or Oersted vector magnetometer along individual night-time, mid-latitude satellite tracks during intense geomagnetic storms. The output is the Z-component of the magnetic induction vector at the satellite altitudes, which is used as misfit function in the inverse formulation. Conductivity in the mantle under the Pacific region is sought by the local 2-D inverse modeling of electromagnetic induction. The results of the inverse modeling suggest an increased mantle conductivity in the southern Pacific. Similar approach can be used below other areas to construct a preliminary 3-D conductivity model of the upper mantle. Fully 3-D responses of conductivity model are also verified (Velimsky and Martinec, in press).

Theory of seismic waves

(reported by L. Klimes)

Most of work reported in this section belongs to the consortium "Seismic Waves in Complex 3-D Structures" (coordinated by Prof. V. Cervený). This is a framework of our long-lasting cooperation with the research departments of major oil companies, worldwide.

Recent developments in seismic ray method

Important developments in seismic ray method achieved during the last 20 years have been described in an extensive review paper by Cervený, Klimes & Psencik (submitted). The topics include ray histories, two-point ray tracing, controlled initial-value ray tracing, wavefront tracing, interpolation within ray cells, paraxial ray methods, third-order and higher-order spatial derivatives of travel time, second-order and higher-order perturbation derivatives of travel time, optimization of model updates during linearized inversion of travel times, coupling ray theory for S waves, quasi-isotropic approximations of the coupling ray theory, Gaussian beams, Gaussian packets, optimization of the shape of Gaussian beams or packets, asymptotic summation of Gaussian beams and packets, linear canonical transforms, coherent state transforms, Maslov methods, decomposition of a general wave field into Gaussian packets or beams, sensitivity of waves to heterogeneities, Gaussian packet migrations, higher-order ray-theory approximations, direct computation of first-arrival travel times, ray method with complex eikonal, hybrid methods, ray chaos, Lyapunov exponents and rotation numbers, models suitable for ray tracing, application of Sobolev scalar products to smoothing models.

Seismic waves in viscoelastic anisotropic media

Considerable attention has been devoted to harmonic plane waves in viscoelastic anisotropic media (Cerveny 2004a; Cerveny & Psencik, 2004a, 2004b, submitted-a, submitted-b), and to the corresponding reflection/transmission coefficients (Cerveny, 2004b).

Anisotropic ray theory

The caustic identification algorithm for isotropic media has been generalized to anisotropic media, and the rules for the phase shift of the anisotropic-ray-theory wave field due to caustics have been derived (Klimes, submitted).

Coupling ray theory

The equations for the second-order perturbations of travel time have been applied to the estimation of the errors due to the common-ray approximations of the coupling ray theory (Klimes & Bulant, 2004). The errors due to the common-ray approximations of the coupling ray theory and the errors due to other quasi-isotropic approximations of the coupling ray theory have been demonstrated on numerical examples (Bulant & Klimes, 2004b; Klimes & Bulant, 2004). Isotropic ray theory, anisotropic ray theory and various kinds of the coupling ray theory for weakly anisotropic models have been studied and compared with the exact solution derived for the "simplified twisted crystal" and "oblique twisted crystal" models (Bulant & Klimes, 2004b; Bulant, Klimes, Psencik & Vavrycuk, 2004; Klimes, 2004a). Equations for the numerical common S-wave ray tracing and for the corresponding dynamic ray tracing in a smooth elastic anisotropic medium have been proposed, coded, numerically tested, and applied to the calculation of coupling-ray-theory seismograms (Bulant & Klimes, 2004a).

Velocity macro models and numerical ray tracing

The equations derived for the estimation of the average Lyapunov exponents, describing the ray chaos due to heterogeneities in the velocity model, have been applied to the construction of velocity models suitable for ray tracing and other high-frequency asymptotic methods. The designed algorithm of constructing velocity models has been compared with the smoothing methods of other authors and tested on various 2-D and 3-D synthetic structures (Bulant, 2004). Capabilities of the ray tracing software have further been extended (Bucha & Bulant, 2004; Bulant & Klimes, 2004a). Numerical ray tracing has been tested on various 3-D synthetic structures, including the smoothed SEG/EAGE Salt Model (Bucha, 2004a, 2004b, 2004c; Bucha & Bulant, 2004).

Gaussian beams and packets

Equations for the propagation of Gaussian packets in smooth isotropic media have been derived in the form suitable for numerical applications (Klimes, 2004b). Klimes (2004c) and Klimes & Zacek (2004) demonstrated that the summation of Gaussian beams and packets is considerably comprehensive and flexible, and may be formulated in many ways. The form of the summation depends primarily on the specification of the wave field. Asymptotic summation of Gaussian beams or packets also includes the Maslov method and its various generalizations, based on canonical transforms or coherent state transforms, as special cases. Decomposition of a general wave field into Gaussian packets also includes the system of Gaussian packets scattered from Gabor functions forming medium perturbations.

Gaussian-packet prestack depth migration

The decomposition of the time sections into optimized Gaussian packets is of key importance in the Gaussian packet migration. The equations for the decomposition have been derived and the decomposition was numerically tested (Zacek, 2004a). Gaussian-packet prestack depth migration of the decomposed time sections has been proposed and first numerical tests have been started (Zacek, 2004b, 2004c).

Earthquake and structural studies

(reported by J. Zahradnik)

Seismic stations of the Charles University in Greece

The present network, developed in cooperation with the Patras University, comprises four sites, each one equipped with a weak-motion broad-band velocigraph CMG 3-T and a strong-motion accelerograph CMG 5-T. The selected data are available from <http://seis30.karlov.mff.cuni.cz>, updated every 4 months. The stations Sergoula

and Mamousia are situated on the northern and southern coast of the Corinth Gulf, respectively, both in its western part. They are operated as stand-alone stations, and (since 2004) belong to the new EC project 3HAZ-Corinth, coordinated by P. Bernard. The other two sites have satellite data transmission to Patras. It is Loutraki station, at the eastern edge of the Corinth Gulf, and Pylos station, close to Kalamata city, on the south-west of the Peloponnesos.

Main use of the data in 2004 was to clarify how the weak and strong motion instruments efficiently complement each other (Zahradnik, 2004). Nature of strange long period pulses on CMG 3-T broadband records due to nearby earthquakes. was also investigated. The pulses have been identified as normal response to a bit abnormal ground motion input, viz a sudden (step-like) horizontal acceleration, most likely connected with a local tilt provoked by the vibratory seismic motion in the immediate vicinity of the seismic instrument (Zahradnik and Plesinger, submitted). The paper also shows that similar effects (although less obvious) may significantly obscure the Le-3D/20s broadband records of the Greek national network. A simple way how to detect the long-period disturbances, and how to "clean" the records prior their use in seismic source studies has been suggested.

The 3-D hybrid earthquake modeling

The 3-D modeling based on a hybrid combination of the source, path and site effects, methodically developed since 2002, has been applied in practice. The source and path effects are modeled by the composite-source model and the discrete wavenumber method (method PEXT of J. Zahradnik), while the local sedimentary basin are modeled by the 3-D finite-difference method (I. Oprsal). The hybrid modeling proved to be an efficient tool up to frequency of engineering interest. As such, it enabled explanation of the damaging ground motions at the Ano Liosia site during the 1999 Athens earthquake as a combined effect of the source directivity and lateral heterogeneity of the site. Results were presented in Japan, Germany and Canada, and published (Oprsal et al., 2004).

The same method was successfully applied to predict earthquake effects of a hypothetical future strong earthquake in Basel, Switzerland (Oprsal et al., submitted).

Strong-ground motion simulation

Several versions of the strong-motion simulation technique have been tested and further developed.

The composite method, based on fractal distribution of subevent sizes, with Green function interpolation, has been upgraded by J. Burjanek.

The kinematic method based on representation theorem, the $k^{**(-2)}$ stochastic slip distribution with k -dependent rise time, optionally including also asperities, was published (Gallovic and Brokesova, 2004a). A parametric study and application to the 1999 Athens earthquake was also completed (Gallovic and Brokesova, 2004b). J. Gallovic concentrated not only on his attempts how to make the source directivity modeling realistic enough, e.g. by combining the composite and kinematic models, but also how to employ the finite-extent source numerical ground motion simulation into probabilistic hazard assessment schemes.

A quite new research line was followed by J. Burjanek, who developed his codes for calculating dynamic stress field on the fault whose slip is described by a kinematic source model. It is important for understanding rheology of the faulting process, e.g. for testing applicability of the broadly used slip weakening rheological model.

Location and seismic source parameters

Grid search and a recently developed innovation of the seismic location method, the so-called station-difference method, were applied to the Egion M4.3 earthquake of 2001, Corinth Gulf (Jansky et al., 2004). Focal mechanism of the same earthquake was retrieved by inverting amplitude spectra at three local stations (Zahradnik et al., 2004).

A 1-D gradient model for the Egion region was retrieved by J. Jansky and V. Plicka from the Corinth Rift Laboratory (French-Greek) data using the Neighbourhood Algorithm.

A new inversion code to simultaneously locate earthquakes and to retrieve a 1-D crustal model was developed by O. Novotny, based on gradient methods. First attempts were made to apply the method in the Corinth Gulf.

Master-event relocation of weak earthquakes in Western Bohemia was published by (Jansky and Malek, 2004).

The moment tensor inversion for multiple point sources, based on full waveform data at regional distances (code ISOLA) was further developed by J. Zahradnik. The code was successfully applied to the M6.3 earthquake at Lefkada, Greece, 2003. The model consists of two fault segments, well explaining two aftershock clusters: one at the Lefkada Island, and the other one at the Cefalonia Island, nearly 40 km apart and 14 seconds later. The earthquake proved to be a complex rupture process, not only as regards its space-time development, but also as regards the focal mechanism. The paper came through revision and was accepted for publication (Zahradnik et al., in press). Ch. Benetatos from the University in Thessaloniki worked with us in Prague for one month as a guest within the EC project MAGMA, and ISOLA code was also applied to the M6.5 earthquake at Skyros Island, Greece, 2001.

Structural studies

We participated in a new phase of the structural studies of the Earth's crust in our country by the method of Deep Seismic Sounding method (DSS). We concentrated on the interpretation of the DSS data from seismo-active region of West Bohemia. The available experience and possibilities have been reviewed by Malek et al. (2004b). New methods of smoothing travel time curves, based on polynomial and rational approximations were developed (Novotny et al., 2004a). Data interpretation for three individual geological blocks in Western Bohemia was separately performed, and 1-D velocity models of the upper crust were derived (Malek et al., 2004a). Fast velocity increase in the uppermost 1 km was found, not detected in the previous DSS studies. Analogic structural studies based on body waves have been developed for the Moravia-Silesia region, too.

A theoretical approach based on dispersive surface waves was applied to measurements from the eastern and northeastern Moravia (Novotny et al., 2004b).

Attachment B PUBLICATIONS IN 2004

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V. Bucha (2004c)

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Attachment C SEMINARS IN 2004

Geodynamics Seminar

- Feb 25: L. Hanyk (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Visualization system Amira
- Mar 3: A. Raidl (Department of Meteorology and Envir. Protection, Fac. of Math. and Phys., Charles Univ.)
Deterministic chaos
- Mar 8, 10, 15, 17, 22, 24, 29: J. Matas (Ecole Normale Supérieure, Lyon)
Thermodynamics and minerals physics
- Mar 31: V. Klemann (GeoForschungsZentrum Potsdam)
Viscoelastic layering of the lithosphere and implications for its effective thickness in response to Pleistocene ice loads
- Apr 7: A. van den Berg (Utrecht University)
The impact of temperature and pressure dependent thermal conductivity on mantle convection and secular cooling of the Earth
- Apr 14: A. Spicak (Geophysical Institute of Czech Academy of Sciences)
Geodynamic development of the Ohárecký rift
- Apr 21: L. Vecsey, J. Plomerova, V. Babuska, U. Achauer (Geophysical Institute of Czech Academy of Sci.)
BOHEMA W.G., seismic anisotropy and tomography of the upper mantle of the western Czech massiv - preliminary results of the passive experiment BOHEMA 2001-2003
- May 3: Z. Martinec (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Geomagnetic induction modelling based on CHAMP magnetic vector data
- May 12: B. Sule (Eötvös University, Budapest)
The effect of temperature dependent viscosity on the structure and on the surface manifestation of mantle plumes in three dimensional models
- Jun 11: D. Wolf (GeoForschungsZentrum Potsdam)
Sea level, glacial isostasy and gravity change
- Sep 8: J. van Hunen (ETH Zürich)
Three-dimensional small scale convection below the oceanic lithosphere
- Sep 15: K. Fleming (GeoForschungsZentrum Potsdam)
Glacial rebound and sea level change around Greenland since the last glacial maximum
- Sep 22: K. Fleming (GeoForschungsZentrum Potsdam)
The influence of the viscosity stratification below Iceland on glacial-isostatic adjustment
- Sep 29: K. Fleming (GeoForschungsZentrum Potsdam)
Present-day sea-level and geoid change around Greenland
- Oct 27: S. Buske (Freie Universität Berlin)
Reflection-Image-Spectroscopy of a subduction zone
- Nov 3: J. Hagedoorn (GeoForschungsZentrum Potsdam)
Reduction of the influence of pleistocene ice-sheet evolution on a global tide-gauge data set
- Nov 10: M. Batka (Department of Meteorology and Envir. Protection, Fac. of Math. and Phys., Charles Univ.)
Numerical solution of the equations of atmospheric dynamics
- Nov 24: G. Balasis (GeoForschungsZentrum Potsdam)
Study electromagnetic induction in the Earth: from magnetotellurics to satellite measurements
- Dec 1: L. Kostal (Physiological Institute of Czech Academy of Sciences)
Similarity of continuous probability distributions and its application for information coding in neurons
- Dec 8: M. Behouňková (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Three-dimensional synthetic tomographic inversion
- Dec 15: O. Souček (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Thermomechanical model of a polythermal glacier

Talks at the Annual meeting of Czech Meteorological Society, Radostovice, Oct 12-14

- Z. Chladova, J. Kalvová (Department of Meteor. and Env. Prot., Fac. of Math. and Phys., Charles University)
On the changes of selected climate characteristics in the Czech Republic in period of 1961-2000
- T. Halenka (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
History and development of climate modeling.
- T. Halenka (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
Regional climate models in CR, first results
- P. Pisoft (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
Wavelet analysis in climatology: Theory and application

Seismology Seminar

- Feb 20: I. Oprsal (Department of Geophysics, Faculty of Math. and Phys., Charles University & ETH Zurich)
3D hybrid earthquake modeling
- Feb 27: K. Zacek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Wavefield decomposition into optimized Gaussian beams
- Mar 5: F. Gallovic and J. Brokesova (Department of Geophysics, Fac. of Math. and Phys., Charles University)
"King Kong" - hybrid combination of the kinematic and composite source model
- Mar 12: M. Novotny (Geophysical Institute of Czech Academy of Sciences)
Tomographic velocity models on seismic refraction profiles CELEBRATION 9 a 10: Recursive approach
- Mar 26: T. Pergler (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Coulomb stress calculation using finite elements combined with spectral decomposition
- Apr 2: G. Dal Moro (University of Trieste)
Near-surface geophysics: seismic and ground penetrating radar data for site characterization
- Apr 16: L. Eisner (Schlumberger Cambridge Research)
Hydraulic fracturing, multiplet detection and graph theory
- Apr 23: J. Veverka (Institute of Rock Structure and Mechanics, Czech Academy of Science)
Space-time analysis of acoustic emission during laboratory experiments on rocks
- May 14: Ch. Benetatos (University of Thessaloniki)
Recent earthquakes in Greece
- May 19: Ch. Benetatos (University of Thessaloniki)
The active subduction zone of Southern Aegean Sea
- May 26: J. Burjanek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
Dynamic stress corresponding to kinematic models of the seismic source
- Sep 29 (in Geoph. Inst. of Czech Acad. of Sci.): T. J. Moser (Fugro-Jason, Rotterdam)
1. Migration velocity analysis using multifocusing/CRS attributes based on paraxial raytracing
2. New approach to point-to-curve raytracing
- Oct 15: J. Zahradník (Department of Geophysics, Faculty of Math. and Phys., Charles University), A. Plesinger (Geophysical Institute of Czech Academy of Sciences)
Long-period pulses in broadband records of nearby earthquakes
- Oct 22: R. Patzig (University of Hamburg)
Local earthquake tomography in the Antofagasta (Chile) Region
- Nov 12: Pavel Kalenda (Institute of Rock Structure and Mechanics, Czech Academy of Science)
Can the Earth tides affect earthquake triggering?
- Nov 19, 26: O. Sebe (Université Joseph Fourier, Grenoble)
Spectral estimations, blind deconvolutions and applications in seismology
- Dec 1 (in Geoph. Inst. of Czech Acad. of Sci.): K. Helbig (Hannover)
Anomalous polarization in anisotropic media