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

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FINAL REPORT

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for reporting period: January 1 – December 31, 2005

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SECTION 1
MANAGEMENT AND RESOURCE USAGE SUMMARY

1.1. Objectives of the reporting period

The general goal of MAGMA Center was to increase international recognition of Geophysics and Meteorology at the Charles University in Prague and to finalize their inclusion into the European research. The field of interest covered dynamic phenomena of the solid Earth and atmosphere. The Center promoted the unifying mathematical viewpoint and development of a multi-disciplinary approach with application to European environmental problems.

In the third, last year of its existence, the main objectives were similar to the first and second 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, numerous actions were adopted, including several workshops, many working stays of PhD students, postdocs and senior researchers in Prague and continuous maintenance of the MAGMA web page.

1.2. Progress made

In brief, the main activities of MAGMA Center in 2005 can be briefly summarized as follows:

1. Four international workshops organized by work packages WP4, WP7 and WP8.
2. Intensive lecture course with international attendance organized by WP9.
3. Annual meeting with representatives of major oil companies (Chell, BP, Chevron, Petrobras).
4. Hosting 87 short- and long-term visitors, counting more than 38 person-months.
5. Participation in current EC projects SPICE, 3HAZ, IMAGES, ENSEMBLES and QUANTIFY.
6. Participation in two other international projects.
7. Participation in submission of new EC projects REAP (rejected), GEOHAB, C2C and CECILIA (coordinated at the Charles University by the WP7 leader, now already accepted).
8. More than 50 internal seminars to interact with research and practice in the Czech Republic.
9. Constantly upgraded web pages, including free availability of seismic data gathered within MAGMA.

A few selected activities of 2005 are briefly characterized below as examples, just to demonstrate the specific style of MAGMA work:

- Christophe Sotin (University of Nantes) gave an excellent public lecture on EC space activities. We also discussed the possibilities of including the research programme of the Prague department into the European planetology network. Specific planetology projects related to the internal structure and dynamic evolution of Venus and Mars were solved during intermediate- and long-term stays of Kevin Fleming (GFZ Potsdam), Gael Choblet and Caroline Dumoulin (both from University of Nantes).
- Ingo Sasgen, from GeoForschungsZentrum Potsdam, was invited for a short-time visit to report about the GRACE satellite mission gravity field solutions released recently by GFZ in Potsdam and CSR in Austin (Texas, USA).
- Christopher Chapman (Schlumberger Cambridge Research, United Kingdom) discussed with Vlastislav Cerveny and other researchers in Prague specific problems of wave propagation in anisotropic media: dynamic ray tracing in Cartesian versus ray-centered coordinates, surface-to-surface paraxial matrices in anisotropic inhomogeneous media, specification of models composed of varying anisotropic media of higher symmetry, first-order ray tracing in inhomogeneous weakly anisotropic media etc.
- Seismic stations jointly operated in the framework of the MAGMA Center by the Charles University Prague and the University of Patras, Greece, contributed to investigation of important earthquakes. Zafeiria Roumelioti, researcher from the University of Thessaloniki, stayed 6 weeks in Prague and

worked with us on the source process of the Skyros earthquake of 2001, and the Lefkada earthquake of 2003. A joint journal paper is under preparation.

- New codes for strong-motion synthesis have been developed by PhD students of our department. To validate the techniques before their potential application after a strong event, the MAGMA efforts were combined with participation in an international benchmark. It is a strong-motion "blind" prediction experiment at the Turkey-Flat test site, California, devoted to the M6 Parkfield earthquake of Sep 28, 2004.
- Antonio Emolo from the University Federico II Naples spent 1 month in Prague working with us on the the 1980 Irpinia M6.9 earthquake and preparing joint presentations for AGU, San Francisco 2005 and IASPEI, Santiago de Chile 2005. Correspondingly, the Prague group was invited to participate in the 2005-2007 project on "Shaking scenarios and damage testification in priority and/or strategic areas of interest", launched by the Italian Civil Defence Department.
- Visit of Klemen Bergant (Nova Gorica Polytechnic, Slovenia) has been organized in framework of the activities in regional climate modeling which are now a part of 6FP Project ENSEMBLES. MAGMA Center provided training on regional climate modeling.
- Workshop on "Climate Change Impacts in Central and Eastern Europe" took place in Prague, Oct 10-11, 2005. The 21 participants had 7 presentations and many working discussions. A lot of effort was invested into preparation of the proposal of the EC project CECILIA (Central and Eastern Europe Climate Change Impact and Vulnerability Assessment). This project, involving 16 partners from 11 countries, was submitted for last (4^{th}) 6FP call.
- A lecture course "The Week on Weak Formulations of Partial Differential Equations" took place in Prague, Nov 28 – Dec 2, 2005, with 13 participants from 5 countries (Italy, the Netherlands, Greece, Germany, Czech Republic). The course made students acquainted with fundamental ideas of weak formulations of PDEs, which can be used in applications of numerical methods (spectral methods, finite element methods) to various geophysical problems.

The Gantt chart attached to this section illustrates the main 2005 activity of the individual work packages as a function of time, namely visits of the individual work packages in person-days. Financial data are included in the Cost Statement attached to this report.

1.3. Milestones and deliverables

Here we present deliverables arranged according to 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 2005: D. Breuer, N. Croiset, M. Jacobs, J. Matas, A. Muntendam-Bos, H. Schmeling, Ch. Sotin, A. van den Berg, J. van Hunen.
D1.3 Long-term stays in 2005: H. Schmeling, A. van den Berg, J. van Summeren.
D1.4 Twinning agreement with ENS Lyon: reported in 2004.
D1.5 A combined Czech-French PhD study: reported in 2003.

WP2 Viscoelastic response

D2.1 Mini-symposium: reported in 2004.
D2.2 Short-term stays in 2005: G. Choblet, C. Dumoulin, L. Fleitout (2 visits), G. Marquart.
D2.3 Long-term stays in 2005: K. Fleming, G. Marquart.
D2.4 Submission of a new EC project in 2005: GEOHAB, C2C
D2.5 Twinning agreement with Urbino: reported in 2003.
D2.6 Prague-Lyon networking: reported in 2004.
D2.7 Benchmark for modeling viscoelastic relaxation: reported in 2003.

WP3 Temporal changes of the gravitational field

D3.1 Mini-symposium: reported in 2004.
D3.2 Short-term stays in 2005: K. Fleming (2 visits), R. Hengst, I. Sasgen.
D3.3 Long-term stays in 2005: N. Tosi.

D3.4 Cooperation agreement with GFZ Potsadam: reported in 2003.
D3.5 Participation in related projects: GRACE and a new Czech-Greek project in geomagnetism.

WP4 Seismic waves: Theory
D4.1 Annual seminar with major oil companies in 2005: done.
D4.2 Short-term stays in 2005: Ch. Chapman, T. J. Moser (2 visits).
D4.3 Long-term stays in 2005: K. Helbig, D. Roessler.
D4.4 (moved from WP6) Workshop on "Seismic Waves in Laterally Inhomogeneous Media VI".
D4.5 (above the plan) Participation in EC project IMAGES.

WP5 Seismic waves: Observations
D5.1 Twinning agreement with Patras: reported in 2003.
D5.2a Visits from Prague to Patras in 2005: J. Jansky (2 visits), V. Plicka, J. Zahradnik (2 visits).
D5.2b Visits from Patras to Prague in 2005: E. Sokos (2 visits).
D5.3 Database on Internet: http://seis30.karlov.mff.cuni.cz, continually updated.
D5.4 Dissemination of data: continually upgdated. Data are freely available on request.
D5.5 Inclusion of two seismic stations into an EC project: done; in framework of 3HAZ-CORINTH.
D5.6 (above plan): Visits from Prague to France, Germany and Italy in 2005: O. Cadek (3 visits).

WP6 Earthquakes
D6.1 Mini-symposium: moved to WP4, see D4.4.
D6.2 Short-tem stays in 2005: O. Kulhanek, H. Lyon-Caen.
D6.3 Long-term stays in 2005: A. Caserta, A. Emolo, S. Richwalski, Z. Roumelioti, A. Serpetsidaki.
D6.4a Cooperation with related EC projects: 3HAZ-CORINTH, SPICE.
D6.4b (above plan): Participation in a seismic-hazard project of Italian Civil Defense Department.
D6.5a Cooperation agreement with IPG, Paris: reported in 2003.
D6.5b Submission of new EC projects in 2005: participation in REAP (rejected).

WP7 Climate system
D7.1a Workshop on "Global Change in 20th Century and Seasonal and Interannual Climate Prediction".
D7.1b Workshop on "Climate Change Impacts in Central and Eastern Europe".
D7.2 Short-term stay in 2005: funds used in D7.1b.
D7.3 Long-term stays in 2005: K. Bergant (2 visits), X. Bi, T. Csaba, J. Hampson.
D7.4 Dissemination of research results on Internet: web pages of the above mentioned workshops.
D7.5 (above plan): Cooperation with related EC projects: ENSEMBLES, QUANTIFY.
D7.6 (above plan): Coordination of a new EC project proposal in 2005: CECILIA (now accepted).

WP8 Air quality
D8.1: Workshop on "Transformation of Emissions from Source to Large Scale for Evaluation of Their Effects on Climate".
D8.2 Long-term stays in 2005: R. Cesari.
D8.3 Dissemination of research results and database on Internet: web page of the above mentioned workshop.

WP9 Research and technical management
D9.1 Internal seminars: more than 50 seminars in 2005, see the list in attachment.
D9.2 Meeting of the Advisory Board: internal members continually; external members occasionally.
D9.3a Coordination of mobility to Prague: 25 short-term visits, 51 workshop participations and 19 long-term stays in Prague in 2005, altogether counting more than 38 person-months.
D9.3b Coordination of mobility out of Prague (planned for WP5 only): 8 short visits of the total length of 43 days in 2005.
D9.4 Web page of MAGMA Center: continually upgraded in 2005; see http://geo.mff.cuni.cz/magma; emphasis on related links, e.g. abstracts, presentations, training materials etc.
D9.5 (above plan): Lecture course "The Week on Weak Formulations of Partial Differential Equations" with international attendance.
D9.6 (above plan): Financial audit.

1.4. Deviations from the work plan

There were no failures in the activities planned for 2005. On the contrary, a few actions were added above the plan as indicated above.

1.5. Communication activities

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

Workshops:
- Workshop on "Seismic Waves in Laterally Inhomogeneous Media VI", Castle of Hruba Skala, June 20-25, 2005. (Co-organized with Geophysical Institute, Czech Academy of Sciences.)
- Workshop on "Global Change in 20th Century and Seasonal and Interannual Climate Prediction", Prague, July 4-6, 2005.
- Workshop on "Transformation of Traffic Emissions from Source to Large Scale for Evaluation of Their Effects on Climate", joint with the Workshop of the EC 6FP Integrated Project QUANTIFY ("Quantifying the Climate Impact of Global and European Transport Systems"), Prague, September 26–28, 2005.
- Workshop on "Climate Change Impacts in Central and Eastern Europe", Prague, October 10-11, 2005.

Intensive lecture course:
- "The Week on Weak Formulations of Partial Differential Equations" (lecturer: C. Matyska). 13 PhD students and postdocs from Germany, Italy, Greece, the Netherlands and the Czech Republic.

Participation in current EC projects:
- 2004-2006: 3HAZ-CORINTH ("Earthquakes, Tsunamis and Landslides in the Corinth Rift, Greece"), coordinated by P. Bernard, IPGP Paris.
- 2004-2007: SPICE ("Seismic Wave Propagation and Imaging in Complex Media: a European Network"), coordinated by H. Igel, LMU Munich.
- 2005-2009: IMAGES ("Induced Microseismics Applications from Global Earthquake Studies"), coordinated by L. Eisner, Schlumberger Cambridge Research, United Kingdom.
- 2004-2009: ENSEMBLES ("Ensemble-based Predictions of Climate Changes and their Impacts"), coordinated by D. Griggs, Met Office, Exeter, United Kingdom.
- 2005-2010: QUANTIFY („Quantifying the Climate Impact of Global and European Transport Systems"), coordinated by R. Sausen, DLR, German.

Participation in other international projects:
- 2005-2007: Czech Republic-Helenic Republic joint project on "A Study of Electrical Conductivity in the Earth's Crust and Mantle using Satellite-Borne Geomagnetic Data", coordinated by E. Konstantinos, University of Athens.
- 2005-2007: "Shaking Scenarios and Damage Testification in Priority and/or Strategic Areas of Interest", Italian Civil Defense Department, coordinated by F. Pacor, INGV, Milan.

Submitted project proposals:
- Coordination of the project proposal CECILIA ("Central and Eastern Europe Climate Change Impact and Vulnerability Assessment"), EC 6FP, 16 partners from 11 countries. Coordinated by T. Halenka, Charles University Prague. Accepted, now in the negotiation stage.
- Participation in the project proposal GEOHAB ("Geological Evolution and Habitability of Earth-like Planets"), EC 6FP, 14 partners from 10 countries. Coordinated by D. Breuer, DLR Berlin.
- Participation in the project proposal C2C ("Crust to core: the fate of subducted material"), EC 6FP, 11 partners from 10 countries. Coordinated by G. Steinle-Neumann, University of Bayreuth.

Short-term stays: There were 84 short-term visits with the total stay length of 452 days. For names of the visitors and terms of their stay see the following Gantt chart; for the related research topics see Section 3; for short abstracts see http://geo.mff.cuni.cz/magma/magma-v-05.htm.

Long-term stays: There were 19 long stays of the total duration of 25 months. For names of the visitors and terms of their stay see the following Gantt chart; for the related research topics see Section 3; for short abstracts see http://geo.mff.cuni.cz/magma/magma-v-05.htm.

Seminars: Complete list of more than 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, students and guests from other institutions. Some of them resembled rather a small "minisymposium", because, occasionally, the seminars were attended by several guests who visited the MAGMA Center simultaneously.

Industry, environment, society: Annual meeting of WP4 with representatives of major oil companies. Participation in the Transfer-of-Knowledge EC project IMAGES to cooperate with a well known 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 Academy of Sciences Prague, Institute of Geonics, Czech Academy of Sciences Ostrava, Mining Institute at Technical University of Ostrava, Czech Hydrometeorological Institute, Prague.

Education outreach: 2 (geophysics) + 6 (meteorology) MSc, and 2 (geophysics) PhD students successfully defended their theses in 2005.

Attendance of international conferences: MAGMA staff members and their students attended several conferences, worldwide (financed from other sources than MAGMA): e.g. EGU (Vienna), AGU (San Francisco).

1.6. Difficulties

No difficulties were encountered. The 3rd year of the project was the most busy and exciting one.

1.7. Gantt chart of the main activities

Months / Visitors	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Person days
WP1: Breuer Doris													3
WP1: Croiset Nolwenn													3
WP1: Jacobs Michel													7
WP1: Matas Jan													24
WP1: Muntendam-Bos Annemarie													3
WP1: Schmeling Harro													31+6
WP1: Sotin Christophe													5
WP1: van den Berg Arie													31+8
WP1: van Hunen Jeroen													4
WP1: van Summeren Joost													34
WP2: Choblet Gael													15
WP2: Dumoulin Caroline													15
WP2: Fleitout Luce													9+8
WP2: Fleming Kevin													34
WP2: Marquart Gabriele													89+6

WP3: Fleming Kevin													4+3
WP3: Hengst Rico													7
WP3: Sasgen Ingo													8
WP3: Tosi Nicola													83
WP4: Chapman Christopher													15
WP4: Helbig Klaus													42
WP4: Moser Tijmen Jan													10+19
WP4: Roessler Dirk													34
WP4: 4 persons (S. Waves, Hruba Skala)													24
WP4: 4 persons (SW3D, Prague)													12
WP5: Cadek Ondrej													2+2+7
WP5: Jansky Jaromir													8+9
WP5: Plicka Vladimir													5
WP5: Sokos Efthymios													11+12
WP5: Zahradnik Jiri													5+5
WP6: Caserta Arrigo													30
WP6: Emolo Antonio													23
WP6: Kulhanek Ota													10
WP6: Lyon-Caen Helene													4
WP6: Richwalski Sandra													30
WP6: Roumelioti Zafeiria													39
WP6: Serpetsidaki Anna													28
WP7: Bergant Klemen													29+34
WP7: Bi Xunqiang													35
WP7: Csaba Torma													30
WP7: Hampson John													55
WP7: 9 persons (Global Change, Prague)													38
WP7: 13 persons (CECILIA, Prague)													37
WP8: Cesari Rita													30
WP8: 11 persons (QUANTIFY, Prague)													29
WP9: 10 persons (WWF PDF, Prague)													50
WP9: seminars (Prague)													-
Persondays:													
long visits	60	82	148	102	1	0	0	0	6	64	142	136	741
short visits	0	11	14	24	27	33	0	19	0	26	23	42	219
workshops	0	0	0	0	0	36	38	0	29	37	30	20	190
visits abroad	0	0	0	2	2	13	0	0	7	19	0	0	43
total	**60**	**93**	**162**	**128**	**30**	**82**	**38**	**19**	**42**	**146**	**195**	**198**	**1193**

Assignment Key

= long visit
= short visit
= workshop, seminar, lecture course
= visit abroad

See also http://geo.mff.cuni.cz/magma/magma-gantt-05.htm.

SECTION 2
EXECUTIVE PUBLISHABLE SUMMARY

Contract No:	EVG3-CT-2002-80006	**Reporting period:**	Jan 1 – Dec 31, 2005
Title:	**PRAGUE CENTRE OF MATHEMATICAL GEOPHYSICS, METEOROLOGY, AND THEIR APPLICATIONS (MAGMA)**		

Objectives
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.

Achievements
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 MAGMA Center in 2005 comprise the following activities:

- Four international workshops organized by WP4, WP7 and WP8, and an intensive lecture course with international attendance organized by WP9.
- Participation in current EC projects SPICE, 3HAZ, IMAGES, ENSEMBLES, QUANTIFY, and participation in submission of new EC projects: REAP (rejected), GEOHAB, C2C, CECILIA (coordinated at the Charles University, now already accepted).
- The 87 visitors spent more than 38 person-moths at the Charles University during 2005. Lectures were given by the guests, training was provided by us to some of them, and joint research has been carried out.
- Constantly upgraded web page (including abstracts of lectures) enabled 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.

Socio-economic relevance and policy implications
The knowledge transfer has been achieved by participation in the EC ToK project IMAGES, 2005-2009. The regular (annual) meeting was organized for representatives of major oil companies. Moreover, there were other contacts with research institutes, state organizations and municipality concerning environmental tasks such as coal mining, underground gas storage, nuclear waste disposal etc. More than 50 internal seminars in 2005 proved to be an efficient way of research and societal interaction between the MAGMA Center and the other research institutes in the Czech Republic. In 2005, 2 (geophysics) + 6 (meteorology) MSc, and 2 (geophysics) PhD students successfully defended their theses. Participants of the MAGMA Center wrote three popularization articles and were active in several public lectures, TV interviews and spots, mainly those related to the disastrous Sumatra earthquake of December 26, 2004, to the global climatic change, and to the air quality issues.

Conclusions

The last, third year of the MAGMA Center was the most busy and exciting one. The number of visitors was very large, guests of several work packages usually stayed in Prague simultaneously. We profited from new ideas brought by the visitors, from everyday joint work with them, but also from broad contacts they helped us to establish. Status reached in 2005, with several EC projects solved by MAGMA staff, and several others under submission proves that the geophysical and meteorological research at the Charles University has been well fixed in the pan-European collaboration.

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 postdoc mobility.

Publications

Counting both published and submitted publications, research output by the MAGMA staff in 2005 comprises 94 items (see the Research Overview 2005 and Publications 2005 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 the visitor stays and their work at the Charles University, either completely or partially. Obviously the percentage of such a production (listed below) cannot be more but just a small fraction of the whole MAGMA staff production.

Papers with acknowledgement to MAGMA

- Bergant K., M. Belda and T. Halenka, 2005. Systematic errors in simulation of European climate (1961-2000) with RegCM3 driven by NCEP/NCAR Reanalysis, *Int. Journal of Climate* (submitted).
- Burjánek J., F. Gallovič and J. Zahradník, 2005. Seismological predictions: reality and dreams (in Czech), *Čs. čas. fyz.,* 55, 127-134.
- Červený V., T. J. Moser, 2005. Simplified construction of 4x4 ray propagator matrices in ray-centered coordinates, In: *Seismic waves in complex 3-D structures, Report 15*, Charles University, Prague, 173-187.
- Červený V., T. J. Moser, 2006. Ray propagator matrices in 3-D anisotropic inhomogeneous layered media, *Geophys. J. Int.* (submitted).
- Čížková H., 2005. Numerical simulation of lithospheric subduction process (in Czech), *Čs. čas. fyz.,* 55, 135-140.
- Moser T. J., V. Červený, 2005. Paraxial ray methods for anisotropic inhomogeneous media, *Geophysical Prospecting* (submitted).
- Pauer M., K. Fleming K., O. Čadek, O., Modeling the dynamic component of the geoid and topography of Venus, *J. Geophys. Res.* (submitted).
- Rössler D., I. Pšenčík, F. Krüger and G. Rümpker, 2005, Retrieval of source parameters for local earthquakes in anisotropic media. In: *Seismic Waves in Complex 3-D Structures, Report 15*, Charles University, Prague, 333-344.
- Zahradník J., J. Burjánek and F. Gallovič, 2005. Physical research of earthquakes (in Czech), *Čs. čas. fyz.*, 55, 120-126.
- Zahradník J., A. Plešinger, 2005. Long-period pulses in broadband records of near earthquakes, *Bull. Seism. Soc. Am.*, 95, 1928-1939.
- Zahradník J., A. Serpetsidaki, E. Sokos and G-A. Tselentis, 2005. Iterative deconvolution of regional waveforms and a double-event interpretation of the 2003 Lefkada earthquake, *Greece Bull. Seism. Soc. Am.*, 95, 159-172.

Other publications and outreach material

- Research Overview 2005 and publications of the MAGMA staff at http://geo.mff.cuni.cz and http://kmop.mff.cuni.cz.
- Seismic data freely available at http://seis30.karlov.mff.cuni.cz.
- Abstracts from visitors' lectures and seminars at http://geo.mff.cuni.cz/magma, link "Visitors".
- Lecture notes at http://geo.mff.cuni.cz/magma, link "Lecture notes".
- 8 MSc and 2 PhD theses at http://geo.mff.cuni.cz/magma, link "List of theses".

SECTION 3
DETAILED REPORT ORGANIZED BY WORK PACKAGES

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.

The activities in 2005 have comprised multidisciplinary investigation of thermal convection in mantles of terrestrial planets and the corresponding networking of European researchers. For two submitted EC project proposals, see WP2.

The traditionally good co-operation with researchers from ENS in Paris, ENS Lyon and the University of Utrecht was further intensified. In case of Lyon and Utrecht, it got even a solid formal base (exchange of students between Prague and Lyon in the framework of Erasmus programme, two research projects submitted together with the geodynamics group in Utrecht). The new research links with DLR in Berlin and the planetology department of the University of Nantes, established during the visits of German and French researchers in Prague in the last years, opened the room for including the Prague department in European planetology projects. The co-operation with GFZ in Potsdam and the Frankfurt University deepened interdisciplinary aspects of the mantle dynamics studies in WP1 by links to seismology (anisotropy as an integral record of mantle flow), gravimetry (temporal variations of the gravity field as indication of active processes in the crust and mantle) and geomagnetism (relationship between electrical conductivity and viscosity structures).

The last year has seen ten visitors coming in the WP1 framework. Some of the visits were short and mainly devoted to preparing projects (A. Muntendam-Bos, Utrecht) or to planning long-term stays of the visitors in Prague in future (N. Croisset, ENS Lyon). The short stays of D. Breuer (DLR Berlin) and Ch. Sotin (University of Nantes) were related to planetary research.

Ch. Sotin gave an excellent public lecture on EC space activities and we discussed the possibilities of including the research programme of the Prague department into the European planetology network. Specific planetology projects related to the internal structure and dynamic evolution of Venus and Mars were solved during intermediate- and long-term stays of K. Fleming (GFZ), G. Choblet and C. Dumoulin (both from Nantes) – see description of WP2 activities.

The long-term stay of H. Schmeling (Frankfurt) was related to application of seismic anisotropy data to constraining the mantle flow models. This new interdisciplinary subject is theoretically difficult and computationally demanding, but highly challenging because it may potentially provide a constraint on the mantle flow pattern in the past.

Other interdisciplinary aspect of the mantle dynamics research was intensely discussed during the stays of two mineral physicists, M. Jacobs (Utrecht) and J. Matas (Lyon), who presented their views of the role of compressibility in the evolution of planetary mantles.

The long-term stays A. van den Berg and J. van Summeren (both from Utrecht) were focused on numerical modeling of subduction. This was also the main goal of the visit of J. van Hunen (ETH Zurich). Besides, he discussed the possibility to involve seismic anisotropy computation in his complex 3-D model of small-scale convection in the asthenosphere.

WP2 Viscoelastic response (O. Cadek)

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

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

The activities in this work package in 2005 were closely linked to the research and organisation works carried out in the frameworks of WP1 and WP3. Some of our visitors contributed, in fact, to all three research programmes: WP1-3. This was the case of G. Choblet and C. Dumoulin (University of Nantes) whose stays were focused on studying viscous and viscoelastic responses of terrestrial bodies to topographic and internal loading and the forward and inverse modeling of related gravitational signals.

Thanks to the contacts established in the MAGMA framework in the previous two years, the researchers of the Prague geodynamics group were involved into two proposals of the Marie-Curie Research Training Network (GEOHAB "Geological Evolution and Habitability of Earth-like Planets" and C2C "Crust to core: the fate of subducted material").

K. Fleming (GFZ Potsdam) visited Prague three times, dividing his effort among analyses of the temporal changes of the Earth's gravitational field (see WP3) and investigation of the role of elasticity in evolution of topographic features on the Earth and Venus. A similar interdisciplinarity characterised also the highly productive stays of G. Marquart (Frankfurt). "Practical" problems related to viscoelastic modeling were solved during two stays of L. Fleitout (ENS Paris). The goal of these visits was to compare different numerical tools used in postglacial rebound modeling. After two years of effort, this benchmark was finally finished and its results are now prepared for publishing.

One of the most successful activities of the MAGMA project in 2005, tightly related to WP1 and WP2, was the international Week on Weak Formulations of Partial Differential Equations organised by C. Matyska, a member of the Prague geodynamics group. This school, devoted to theoretical aspects of the partial differential equations governing various processes of geophysics and meteorology attracted to Prague 13 PhD students and postdocs from Germany, Italy, Greece and the Netherlands, and it was also well attended by students from the Czech Republic.

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

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

Four visitors of the MAGMA Center contributed to the successful performance of WP3 in 2005.

Nicola Tosi, a PhD student from GeoForschungsZentrum Potsdam, visited us for 12 weeks, starting October 1, 2005. His stay was oriented towards two issues. First, he continued his PhD work on present-time mantle convection with a laterally-varying viscosity distribution. His discussions with J. Velimsky resulted in significant improvements in the numerical coding of the problem. He managed to model the effect of an elastic lithosphere on mantle flow in 2-D spherical geometry. His results demonstrate a possible mechanism for the creation of continental shelves near large lithospheric cratons. Second, Nicola took part in the course "Weak formulations of partial differential equations", taught for invited PhD students by C. Matyska (WP9). He appreciated the high theoretical level of the course, which helped him to understand details of the formulation of present-time mantle convection, originally developed at our department.

Ingo Sasgen, a PhD student from GeoForschungsZentrum Potsdam, was invited for a short-time visit to report about the GRACE gravity field solutions released recently by GFZ in Potsdam and CSR in Austin (Texas, USA). His seminar talk showed how to obtain information about postglacial rebound and present-day ice-mass changes over Antarctica from GRACE gravity models, and how to compare this information with modeling of these effects.

Rico Hengst, a PhD student from GeoForschungsZentrum Potsdam, was also invited for a short-term visit to report on his latest results in modeling the effect of the continental water budget on polar motion. The continental hydrology, the atmospheric mass motion and oceanic circulations are the three main effects contributing to the short-time variations of the Earth's rotation.

The first short-term visit of Kevin Fleming from GeoForschungsZentrum Potsdam was devoted to finalizing a manuscript on the interpretation of the topography and gravity field of Venus. His second short-term visit during 2005 was also devoted to discussions about his proposal for a EU project dealing with improved earth models for glacial-isostatic modeling.

Z. Martinec, coordinator of WP3, actively participated in data processing and interpretations of the GRACE satellite gravity data during his long-term stay in Germany. The 2-and-half-year satellite mission GRACE provides monthly solutions of the gravitational field that has started to be used for monitoring annual and secular time changes of the gravitational field. The project has already attracted a large scientific interest. Beside the impact on continental water budget and oceanographic circulation, the GRACE gravity models provide a valuable constraint on the viscosity models of the Earth, but also on the present-day ice-mass changes over glaciated areas. The latter represents an important outreach of the WP3 research into the environmental research. Z. Martinec has been also heavily engaged in developing a mathematical theory necessary for the correct interpretation of the GRACE data.

The WP3 group of the MAGMA Center was also successful in application for a Czech Republic-Hellenic Republic bilateral joint project on "A study of electrical conductivity in the Earth's crust and mantle using satellite-borne geomagnetic data" (2005-2007), coordinated by E. Konstantinos form the University of Athens (at Charles University by Z. Martinec). Electromagnetic induction studies using Oersted and CHAMP satellites magnetic data will ultimately provide important new constraints on the electrical conductivity of Earth's mantle. In contrast to the spatially sparse geomagnetic observatory data, which provide the basis for most of our present knowledge about deep Earth conductivity, data collected from these satellites provide a full coverage of the Earth every day. An important issue in the emergent field of electromagnetic induction studies with magnetic satellite data is the assumed morphology of the external source fields. As a step toward this goal we will analyze night side observatory data to better understand spatial complexity in the magnetospheric sources. Improved models of night side magnetospheric spatial structure will allow us to improve estimates of satellite induction transfer functions, and thence conductivity of the Earth. Furthermore, we will focus on the inverse modeling for determining 3-D electrical conductivity distributions of the Earth's mantle using both satellite and observatory data.

WP4 Seismic waves: Theory (L. Klimes)

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

The already traditional meeting of WP4 members and researchers of major oil companies was organized in June in cooperation of MAGMA with the Consortium of Seismic Waves in Complex 3-D Media (coordinated by Prof. V. Cerveny). The meeting was attended by Peter Bakker (Shell, The Netherlands), Petr Jilek (BP Exploration & Production Inc., USA), Anca Rosca (Chevron, USA) and Alcides Aggio Sobrinho (Petrobras, Brasil).

An international workshop on "Seismic waves in laterally inhomogeneous media VI" took place at the Castle of Hruba Skala on June 20-25, 2005. It was organized in the framework of the MAGMA Center in cooperation with the Geophysical Institute of the Academy of Sciences of the Czech Republic. The 61 participants from 14 countries presented 58 oral and poster contributions. Proceedings from the workshop will be published in two special issues of the international journal Studia Geophysica et Geodaetica. Four participants were financially supported by MAGMA, viz Kolja Gross (Freie Universität,

Berlin), Reneta Raykova (Geophysical Institute, Sofia), Dirk Roessler (University of Potsdam) and Sens-Schoenfelder (University of Leipzig).

Chris Chapman (Schlumberger Cambridge Research, United Kingdom; 2 weeks) discussed with Vlastislav Cerveny and other researchers in Prague specific problems of wave propagation in anisotropic media: dynamic ray tracing in Cartesian versus ray-centered coordinates, surface-to-surface paraxial matrices in anisotropic inhomogeneous media, specification of models composed of varying anisotropic media of higher symmetry, first-order ray tracing in inhomogeneous weakly anisotropic media etc.

Klaus Helbig (Hannover, 6 weeks) studied various representations of stiffness tensor (fourth-rank tensor, Kelvin 6x6 tensor, Voigt 6x6 matrix) and decomposition of the stiffness tensor into eigenstiffnesses and eigenstrains.

Tijmen Jan Moser (Horizon Energy Partners, Gravenhage, The Netherlands; 6 weeks) continued his common research with Vlastislav Cerveny of the paraxial propagator matrices in anisotropic inhomogeneous media. They studied surface-to-surface paraxial matrices for anisotropic inhomogeneous layered media (Moser & Cerveny, submitted 2005). They also paid a special attention to transformations from 4x4 propagator matrices in ray-centered coordinates to 6x6 propagator matrices in Cartesian coordinates (Cerveny & Moser, 2005).

Dirk Roessler (University of Potsdam, Germany; 1 month) worked on the retrieval of the seismic source mechanism for sources situated in laterally varying anisotropic structures. Anisotropy may significantly affect the retrieval of moment tensors. It may produce apparent volumetric components or hide real tensile characteristics of the source. Tests were performed with synthetic data, as well as with data from the West Bohemia earthquake swarm region.

The WP4 group of the MAGMA Center, in cooperation with Geophysical Institute of Czech Academy of Sciences, was successful in application for EC grant to transfer their basic research closer towards end-users within project IMAGES (2005-2009). This is a Marie Curie ToK project, focused on "Induced microseismics applications from global earthquake studies", coordinated by L. Eisner, Schlumberger Cambridge Research, United Kingdom (at Charles University by L. Klimes). This ToK-Industry-Academia Partnership Scheme project proposes a two-way transfer of knowledge between petroleum industry and global earthquake seismology. The project will benefit petroleum industry by developing tools and techniques for seismic monitoring of gas and oil reservoirs (hydraulic fracture monitoring and passive seismic) to control rock fracturing, optimize the reservoir production, prolong life of existing reservoirs, and mitigate hazard associated with the occurrence of induced microearthquakes. The seismic monitoring will substantially help to solve geomechanical problems in petroleum industry, such as imaging deformations associated with primary production, secondary recovery or waste injection operations.

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.

Four seismic stations were jointly operated in the framework of the MAGMA Center by the Charles University Prague and the Patras University. Two stations Sergoula (SER) and Mamousia (MAM), situated on the northern and southern coast of the Corinth Gulf, were operated as stand-alone stations. Each one is equipped with a weak-motion broad-band velocigraph CMG 3-T and a strong-motion accelerograph CMG 5-T. The other two equally equipped stations Pylos (PYL) and Loutraki (LTR) were operated as a part of the satellite network of the Patras University (SATNET). The latter got an international registration and technical negotiations were started how to provide the data through the ORFEUS Center on-line. Data from all stations have already been available of-line through Internet from our web page at http://seis30.karlov.mff.cuni.cz, including a useful "search" feature.

Free access and easy availability of our data to seismological community worldwide has been major objective of this work package. Two regular technical visits to the stations were realized in June and October, both combined with scientific discussions and research planning with our colleagues in Greece.

Stations contributed to an interesting instrumental problem. Indeed, strange long period disturbances occasionally present on the CMG 3-T broadband records of small nearby earthquakes were explained and the results were published. The explanation is that the disturbances are normal instrumental response to a specific ground motion input, viz a sudden (step-like) horizontal acceleration, most likely connected with a tilt of unknown origin, most likely a relative strong tilt of a very local origin provoked by high-frequency earthquake ground motions.

New code ISOLA for seismic source studies, being developed since 2003, was considerably upgraded in 2005 to enable routine application and free distribution. Development and free distribution of new scientific software has been one of major objectives of the MAGMA Center. The ISOLA code serves for multiple point-source moment-tensor inversion based on full waveform data at regional and/or local distances. The algorithm is iterative deconvolution of several subevents, similar to well known teleseismic method of Kikuchi and Kanamori, but Green's functions are calculated by discrete wavenumber method of Bouchon. The moment tensor of subevents is found by the least-square minimization of misfit between observed and synthetic waveforms, while position and time of subevents is found by maximization of correlation through grid search. The Fortran part of the code, including simple documentation and a test example (author J. Zahradnik), has been released for free public use in July 2005.

The MAGMA Center supported a broad Czech-Greek collaboration related to the ISOLA code. In parallel with development of the Fortran part, a user-friendly graphic interface in Matlab has been developed by E. Sokos at the University of Patras, and its release is expected in the beginning of 2006. Submission of a joint journal paper to describe the new software is under preparation. E. Sokos visited us in Prague twice in 2005 (in February and May). Both visits were devoted to the joint work on the code, but also to planning future development of the joint seismic observations and studies of significant earthquakes in Eastern Mediterranean. Discussions included also possible cooperation on structural and geodynamic research, thus opening room for a closer cooperation within the MAGMA groups in WP1-2 on one side and WP5-6 on the other side. The latter issue has been deeply investigated in 2005 by O. Cadek, the WP1 and WP2 leader, during his short visits to France, Germany and Italy.

Partly thanks to the MAGMA activities, the WP5 members have been invited to participate in the 2004-2006 EC project 3HAZ-CORINTH. This is a STREP project focused on "Earthquakes, tsunamis and landslides in the Corinth rift, Greece", coordinated by P. Bernard, IPGP Paris (at Charles University by J. Zahradnik). The project will contribute to better measure, model, and predict the processes leading to earthquakes, landslides, submarine slides, and tsunamis, and their effect in terms of hazard. The target area is well known for its exceptional activity with respect to these hazards. Our main contribution to this project comes from the above mentioned seismic stations SER and MAM, their data gathering and interpretation, as well as from developing the corresponding new software. As an example, let us mention application of the ISOLA code to five selected weak earthquakes which occurred exactly in the target area of the Corinth Gulf in recent years. The paper will be submitted in 2006.

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.

Structural studies connected with the Corinth Gulf events were also carried out in 2005 by the WP6 MAGMA members (J. Jansky, O. Novotny, V. Plicka). This work was reported at EGU Vienna 2005 and

a paper was submitted to the journal Studia Geophysica et Geodaetica. As a partial result, new 1-D models of the upper crust in the Egion region, Greece, were inferred from arrival times of simultaneously relocated 133 events of the 2001 earthquake sequence. The main result is that the newly retrieved models have faster velocities than those in the recently published tomographic models. These studies would not have been possible without data of the French CRL network (Corinth Rift Laboratory), tightly related to the above mentioned project 3HAZ. Helene Lyon-Caen from ENS, Paris visited us in Prague to discuss these topics in detail and to plan a future collaboration.

New codes for strong-motion synthesis suitable for selected sites as well as for areas (shake maps) have been developed by J. Zahradnik and PhD students of our department (J. Burjanek, F. Gallovic). To validate the techniques before their potential application after a strong event, the MAGMA efforts were combined with participation in an international benchmark. Its is a strong-motion "blind" prediction experiment at the Turkey-Flat test site, California, devoted to the site-, path- and source effects. The experiment focuses on the Parkfield, M6 earthquake of Sep. 28, 2004. We concentrated on the finite-extent source. Comparison with true ground motions (existing, but kept secret till the end of this experiment) will be possible in 2006.

The EC project SPICE provided a forum for validating our codes developed for retrieving slip on earthquake faults, e.g. the ISOLA code (see WP5). To this goal we participated in a "blind" inversion experiment organized within SPICE by P. M. Mai of ETH, Zurich. Two independent solutions were submitted by our group (J. Zahradnik and J. Burjanek).

Within WP6, new methods to simulate strong ground motions for past and future earthquakes have been developed in 2005. It is mainly: (i) integration method based on representation theorem and stochastic slip distribution, including asperities, and (ii) composite-source method with equal or non-equal (fractal) subevent sizes. The techniques were combined and modified to produce realistic directivity. Empirical attenuation relations were used to validate the methods and determine some free parameters, e.g. the maximum slip velocity. Ground-motion simulations were employed in the probabilistic seismic hazard assessment, and applied to the 1980 Irpinia M6.9 earthquake.

The latter topic enabled the WP6 participants in Prague to strengthen their intensive collaboration with Italian colleagues. Antonio Emolo from the University Federico II Naples spent a month in Prague working with us on the Irpinia earthquake and preparing joint presentations for AGU, San Francisco 2005 and IASPEI, Santiago de Chile 2005. Finally we were invited to participate in the 2005-2007 project on "Shaking scenarios and damage testification in priority and/or strategic areas of interest" launched by the Italian Civil Defence Department, coordinated by F. Pacor, INGV, Milan, sub-coordinated at the University Federico II Naples by A. Emolo (at Charles University by J. Brokesova). The aim of the project is to provide shaking and damage scenarios in some areas of prior and/or strategic interest in the Italian territory.

Most of the WP6 MAGMA activity has been closely related also to our participation in the 2004-2007 EC project SPICE. It is a Marie Curie RTN focused on "Seismic wave propagation and imaging in complex media", coordinated by H. Igel, LMU Munich (at Charles University by J. Brokesova). The project aims at integrating 14 European institutions specialized in physical, mathematical, geological, and computational aspects of the seismic wave propagation, including our department.

Ota Kulhanek, former head of the Seismological Institute of the Uppsala University, contributed to WP6 by his efficient short visit in which he thought us about practical aspects of the seismicity (b-values) research, with possible applications in the long-term earthquake prediction. Excellent examples of his methods from recent damaging events in Sumatra and Pakistan were discussed in detail.

Anna Serpetsidaki of the University of Patras spent her long-term stay in Praha by learning our strong motion simulation methods. It is her wish to return to her PhD topic and to apply some of our methods to a detailed re-analysis of the damaging 1999 Athens earthquake.

Zafeiria Roumelioti, researcher from the University of Thessaloniki, realized her long-term stay at the MAGMA Center in March-April, 2005. She worked with us on the investigation of the source process of two significant earthquakes in Greece, the Skyros earthquake of 2001, and the Lefkada earthquake of 2003. Joint paper will be submitted in 2006.

WP6 has contributed also to strengtening cooperation with GeoforschungsZentrum Potsdam and Instituto Nazionale di Geofisica, Rome. Sandra Richwalski (GFZ Potsdam) and Arrigo Caserta (INGV, Roma) synchronized their long-term stays in Prague to November-December 2005, and we worked together with them on numerical modeling of local site effects upon earthquake strong ground motions. They learn codes recently developed in Prague, mainly the hybrid code of I. Oprsal, to efficiently combine the source-, path and site effects. The visitors applied the codes to their data for sites in Italy and Turkey.

We participated in submission of the Marie Curie RTN proposal REAP ("Real Time Estimation of Aftershock Probabilities and Hazard"), but the REAP proposal was rejected. The efforts will continue in 2006.

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.

Continuation of the previous long-term stay of John Hampson (CNRC, Paris) has been organized to strengthen the collaboration after the completion of the 5FP Project SOLICE. The improvement of performance of the middle atmosphere model MSDOL was tested in polar regions. This visit brought the center another aspect of climate change related with processes in middle atmosphere, where the sensitivity of chemistry to atmospheric cooling in connection with GHG increase is significant. A seminar on the stratosphere and middle atmosphere modeling took place on November 1, 2005.

Visit of Klemen Bergant (Nova Gorica Polytechnic, Slovenia) has been organized in framework of the activities in regional climate modeling which are now a part of 6FP Project ENSEMBLES. During this visit the MAGMA Center provided training on regional climate modeling. Visitor learnt the basic principles of RCM RegCM3 and tested several configuration of the model for different purposes. He performed validation study of long period run of RegCM3 driven by NCEP Reanalysis from 1961 till 2000, completed before in framework of a local project. He returned for another long term visit in November to finish preparation of a paper prepared for submission to the Int. Journal of Climate ("Systematic errors in simulation of European climate (1961-2000) with RegCM3 driven by NCEP/NCAR Reanalysis" by K. Bergant, M. Belda, and T. Halenka). Due to the advantages of RegCM3 simulation results the model is a useful tool for regional projections of future climate change simulations.

A one-month visit of Csaba Torma (Budapest University), November-December 2005, has been also organized in framework of the activities in regional climate modeling which are now a part of 6FP Project ENSEMBLES. In this visit the MAGMA Center provided the training on regional climate modeling. Visitor learnt the basic principles of RCM RegCM3 and tested several configuration of the model for Hungarian region.

Visit of Bi Xunqiang (ICTP, Trieste) (one month, November-December 2005) has been organized to intensify cooperation with The Abdus Salam ICTP, Trieste, Italy. In this visit, the MAGMA Center got involved in deep experience of the ICTP team with regional climate modeling and especially with RegCM provided by the visitor.

Practical workshops continued in connection to the previous main workshop on RCM held in Prague in 2004, mainly concerning the application of different driving fields for RCM studies (ERA40) and validation of the model against CRU database.

Workshop on "Global Change in 20th Century and Seasonal and Interannual Climate Prediction", Prague, July 4-6, 2005, organized in the framework of MAGMA Center, was attended by 24 participants. The 25 contributions contributed to the collaboration in the global climate change issues, climate variability in last century and the climate modeling and prediction.

Workshop on "Transformation of Emissions from Source to Large Scale for Evaluation of Their Effects on Climate", Prague, September 26-28, 2005, was organized by the MAGMA Center jointly with WP8. The 22 participants attended 3 panel discussions on impact of emissions from transportation of different modes on climate change.

Workshop on "Climate Change Impacts in Central and Eastern Europe", Prague, October 10-11, 2005. The 21 participants had 7 presentations and many working discussions. A lot of effort was invested into preparation of the proposal of project CECILIA, now already accepted, see below. Intensive work on networking European researchers included three major tasks:
(i) Continuation of the participation on 6FP Integrated Project ENSEMBLES (ENSEMBLE-based Predictions of Climate Changes and their Impacts) dealing with regional climate changes and their impacts on Europe using multi-model ensembles prediction and regional climate simulation with high resolution. Department of Meteorology and Environment Protection (DMEP) is involved in this project (PI – Halenka).
(ii) In March 2005, 6FP Integrated Project QUANTIFY launched dealing with quantifying the impact of emission from transportation on climate change. It is related both with the WP7 and WP8 of the MAGMA Center. DMEP is involved in this project as well (PI – Halenka, member of Steering Committee of the Project, Co-leader of activity AC2).
(iii) Based on cooperation and connections started under MAGMA Center, proposal CECILIA (Central and Eastern Europe Climate Change Impact and Vulnerability Assessment, 16 partners from 11 countries) was finished in October 2005 and submitted for the last (4th) 6FP call. The project is coordinated by the WP7 leader (T. Halenka) at the Charles University Prague. Accepted, now in the negotiation stage.

The WP7 leader was elected Vice-President and Treasurer of the European Meteorological Society, in 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.

On September 26–28, 2005 a QUANTIFY workshop (Quantifying the Climate Impact of Global and European Transport Systems) took place in Praha, organized in collaboration with WP7 Climate system. In the framework of this EU FP6 Integrated Project the impact of traffic emissions on climatic system has been studied.

In the end of 2005, Rita Cesari (ISAC - CNR Lecce, Italy) visited the Department of Meteorology and Environment Protection. The main goal of her long-term MAGMA stay was the problem of biogenic emission and future joint investigations in this field. A journal paper is under preparation.

Work and results obtained in the framework of WP8 have a very tight connection to the needs of the Czech Ministry of Environment. For example, we participated in R&D national programmes dealing mainly with the problem of photooxidation pollution and its modeling. A new project on the related topic has been accepted also by the Grant Agency of the Czech Republic.

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.

Third, last 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 Economic Department provided considerable help and continuous monitoring and checking of the account.

Web page of the MAGMA Center has grown considerably in 2005. 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 quite transparent:

- the MAGMA home page, http://geo.mff.cuni.cz/magma,
- home page of the Department of Geophysics, 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 3-D 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 increase 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, whenever possible. 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. A lot of time was spent on optimizing impact of the visits on our students. Some of our students were jointly working with the visitors. All the details are listed in the reports from the individual work packages. The key role in this activity, similarly to the previous two years, was played in 2005 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 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 "visible" in the report, but can be traced in the seminar list and publication output (Research overview 2005), attached to this report. At least two typical examples can be given here: (i) Ch. Sotin (University of Nantes), guest of WP1, gave an excellent public lecture on EC space activities and we discussed the possibilities of including the research programme of the Prague department into the European planetology network. At the same time, specific planetology problems related to the internal structure and dynamic evolution of Venus and Mars were solved during intermediate- and long-term stays of K. Fleming (GFZ), G. Choblet and C. Dumoulin (both from Nantes) – see description of WP2 activities. (ii) Lecture of Helene Lyon Caen (ENS, Paris) on active Corinth Rift in Greece widely combined the seismic, geologic, geodetic observations and stimulated our modelers in WP1, 2, 5 and 6. These are nice examples of the interdisciplinary research, representing one of the MAGMA priorities.

Links with several EC projects were mentioned in the detailed reports of the work packages. Compared to 2003 and 2004, this activity has further grown. Here, let us admit, that MAGMA played a significant role also in the preparation of national projects. In particular, preparation of a new 7-year

framework research plan under participation of the Departments of Geophysics, Meteorology, Theoretical Physics, Astronomy and Electronics has been substantially enriched by the experience and ideas of the MAGMA project. The project will be submitted in early 2006 by our Faculty for approval at the Ministry of Education, Youth and Sports under the title "Interdisciplinary studies of the mass and energy transport in physical and astrophysical media". It will be of vital importance for at least partial continuation of the modern work style started in the framework of MAGMA at our departments.

Last but not least, outreach to education should be mentioned. During the year 2005, 2 (geophysics) and 6 (meteorology) MSc and 2 (geophysics) PhD theses, supervised at MAGMA Center, were successfully defended as follows:

PhD Theses
- T. Fischer: West-Bohemian Earthquake Swarms and Their Dynamics (supervisor: V. Vavrycuk)
- K. Zacek: Gaussian Packet Prestack Depth Migration (supervisor: L. Klimes)

MSc Theses
- J. Chrastecky: Using of semi-Lagrangian methods in numerical forecast models; in Czech (supervisor: M. Batka)
- A. Demeterova: Statistical downscaling of GCMs outputs - a linear approach; in Czech (supervisor: J. Kalvova)
- R. Kelnerova: Evaluation of concentration distributions for a point source in the surface layer in urban environment; in Czech (supervisor: Z. Janour – external)
- J. Micza: Chaos and fractals in meteorology; in Czech (supervisor: A. Raidl)
- K. Rezba: Point-source inversion of teleseismic records (in Czech; supervisor: J. Zahradnik)
- O. Soucek: Termomechanical model of the polythermal ice-sheet (supervisor: Z. Martinec)
- O. Vlcek: Determination of seasonal and monthly precipitation characteristics using free-atmosphere variables and their use in construction of daily precipitation series; in Czech (supervisor: R. Huth – external)
- K. Zemankova: A comparison of modeled ozone ground concentrations with measurement; in Czech (supervisor: J. Brechler)

An important management issue has been 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. Environmental aspects were studied mainly in WP7 and WP8 in connection to climatic models and to the air pollution. The work performed on air quality in WP8 has been tightly connected with needs of the Czech Ministry of Environment. The Ministry has appreciated the role of MAGMA Center in this direction, thus allowing us to participate in their R&D programmes targeted to the problem of photooxidation pollution, and its modeling. Newly, an interesting topic related to climate change has been detected and studied (perhaps surprisingly) even within WP2 and WP3, where the gravity measurements provided by the recent satellite mission GRACE can be used to obtain information about postglacial rebound and present-day ice-mass changes over Antarctica.

As regards the project outreach into our home country, we entered in tight contacts with theoretical geodesists at the Research Institute of Geodesy, Topography and Cartography in the framework of the Research Center "Recent Dynamics of the Earth". J. Velimsky and O. Soucek (a postdoc and a PhD student, respectively, at the Department of Geophysics) are working on the problem of employment GPS data from permanent stations to evaluation of viscoelastic response of the Earth to glacial loads. Their main contribution will consist in creation of new numerical methods in solving this problem. We also broadened our contacts with the staff of the group of computer vision at the Faculty of Electrical Engineering of the Czech Technical University and with the private company Neovision, who helped us substantially with prospection of a borehole planned for installing a new seismometer in the framework of the Center activities. Note that the group of computer vision at the CTU is a part of the

EC Center of Excellence MIRACLE. In 2005, application for two other Centers were also submitted by the members of the MAGMA staff, linking our University research with the more practical needs of the Institute of Rock Structure and Mechanics and the Geophysical Institute, both belonging to the Academy of Sciences, the Czech Republic. Unfortunately, the latter Centers have not been selected for funding. 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), oriented towards continuous improvement of the curricula, including the PhD curriculum in meteorology at the Charles University.

Public relations of MAGMA had a variety of forms. Several public lectures were given in 2005 as response to the earthquake and tsunami disaster in South-East Asia at the end of 2004. Radio and Czech TV channels made several interviews and spots with the participation of the MAGMA staff members. Three popularization articles were published by our staff in the Czechoslovak Journal of Physics. Modern achievements of geophysics and meteorology were also presented at the Day of Open Door and the Day with Physics intended to attract young people to our Faculty. Maybe partly thanks to all these efforts, 14 new students (7 of geophysics and 7 of meteorology) declared in 2005 their wish to make their Bc theses with us.

The WP7 leader (T. Halenka) was elected Vice-President and Treasurer of the European Meteorological Society in 2005. Importantly, as regards the education outreach, T. Halenka has been also the Chair of the EMS Educational Committee since 2003.

To be sure with correctness of all financial operations during the whole three-year period, the WP9 leader asked the Economic Department of the Faculty to perform a financial audit of the MAGMA project. The auditor licenced for EC projects detected no mistakes in the accounting documents.

SECTION 4
TECHNOLOGICAL IMPLEMENTATION PLAN

Not required for this type of actions.

SECTION 5
EXECUTIVE PUBLISHABLE SUMMARY related to the overall project duration

Contract No:	EVG3-CT-2002-80006	**Project duration:**	Jan 1, 2003 – Dec 31, 2005
Title:	**PRAGUE CENTRE OF MATHEMATICAL GEOPHYSICS, METEOROLOGY, AND THEIR APPLICATIONS (MAGMA)**		

Objectives

The MAGMA Center aimed at increasing international recognition of Geophysics and Meteorology at the Charles University in Prague. The Center had to contribute to coordination of research and education in dynamic phenomena of the solid Earth and atmosphere by adopting the unifying mathematical viewpoint. The Center had to 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.

Achievements

The main instrument of the MAGMA Center was inviting PhD students, post-doctoral researchers and senior researchers to Prague, organizing scientific meetings, and participating in EC projects (including submission of new ones). Research behind the above mentioned mobility was 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 was effectuated through scientific journals, conference contributions, seminars and web.

Main deliverables

- 7 international conferences and workshops organized or co-organized by the MAGMA Center in 2003-2005: 4th International Converence on Urban Air Quality, Mar 2003 (5 supported participants), 8th European Workshop on Numerical Modeling of Mantle Convection and Lithospheric Dynamics, Sep 2003 (37 s. p.), Workshop on Regional Climate Modelling, Nov-Dec 2005 (15 s. p.), Workshop on Seismic Waves in Laterally Inhomogeneous Media VI, Jun 2005 (4 s. p.), Workshop on Global Change in 20th Century and Seasonal and Interannual Climate Prediction, Jul 2005 (9 s. p.), Workshop on Transformation of Traffic Emissions From Source to Large Scale for Evaluation of Their Effects on Climate, Sep. 2005 (11 s. p.), Workshop on Climate Change Impacts in Central and Eastern Europe, Oct 2005 (13 s. p.).
- Two intensive lecture courses with international attendance: J. Matas - Thermodynamics and Mineral Physics, Mar 2004 (15 attendees), C. Matyska - The Weak on Weak Formulations of Partial Differential Equations, Nov-Dec 2005 (13 attendees).
- Three annual seminars with major oil companies in 2003-2005 (6 + 4 + 4 representatives).
- The 73 other visitors spent more than 67 person-months at the Charles University in 2003-2005. Lectures were given by the guests, training was provided by us to some of them, and joint research has been carried out.
- Participation in EC projects DGLAB, SAFE, PRESAP, SOLICE, SPICE, 3HAZ, ENSEMBLES, IMAGES, QUANTIFY, and participation in submission of new EC project proposals CECILIA, REAP (rejected), GEOHAB and C2C.
- Constantly upgraded web page enabled rapid dissemination of all information related to MAGMA activities and achievements. Valuable seismic data, gathered by the MAGMA seismic stations in Greece, have been made freely available from the web page, too.

Socio-economic relevance and policy implications

The knowledge transfer has been achieved also by participation in the EC ToK project IMAGES (2005-2009). The air-quality research was synchronized through several national projects with the needs of the Czech Ministry of Environment and priorities of the Grant Agency of the Czech Republic. Every year, a regular meeting was organized for representatives of major oil companies. Moreover, there were other contacts with research institutes, state organizations and municipality concerning environmental tasks such as coal mining, underground gas storage, nuclear waste disposal, the hazardous and explosive material leakage, its effect upon urban population etc. More than 150 internal seminars organized in 2003-2005 proved to be an efficient way of research and societal interaction between the MAGMA 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 PhD, 24 MSc and 3 BSc students successfully defended their theses in 2003-2005. Staff members of the MAGMA Center wrote 3 popularization articles and were active in several public lectures, TV interviews and spots, mainly those related to the disastrous Sumatra earthquake of December 26, 2004, to the global climatic change, and to the air quality issues. Positive role of MAGMA has been strongly appreciated on several occasions by the representatives of the Faculty, including the Dean and Vice-Deans. Two members of the MAGMA staff were elected for the vice-presidents of the European Meteorological Commission and the European Seismological Commission.

Conclusions

The three years of the MAGMA Center considerably affected the two involved departments (geophysics and meteorology) at the Faculty of Mathematics and Physics, Charles University in Prague. It was an extremely busy and exciting period. The number of visitors was very large, guests of several work packages often stayed in Prague simultaneously, thus having also possibility to interact with each other, and contributing to a closer co-operation between formerly separated groups of the MAGMA staff. Spirit of the two involved departments became truly international. We profited from new ideas brought by the visitors, from everyday joint work with them, but also from broad contacts they helped us to establish. To conclude, the present status, with several EC projects being solved in Prague and some others under submission, provides an optimistic outlook, seeing the geophysical and meteorological research at the Charles University well fixed in the European collaboration. Finally, taking into account that all provided funds were properly and timely spent, MAGMA project can be considered successfully completed.

Dissemination of results

Counting both published and submitted publications, research output by the MAGMA staff in 2003-2005 comprises more than 200 items (see the Research Overviews and Lists of Publications 2003-2005, linked with the MAGMA web page). 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 the visitor stays and their work at the Charles University, either completely, or partially. Obviously the percentage of such a production (listed below) cannot be more but just a small fraction of the whole MAGMA staff production.

Papers with acknowledgement to MAGMA

- Bergant K., M. Belda and T. Halenka, 2005. Systematic errors in simulation of European climate (1961-2000) with RegCM3 driven by NCEP/NCAR Reanalysis, *Int. Journal of Climate* (submitted).
- Burjánek J., F. Gallovič and J. Zahradník, 2005. Seismological predictions: reality and dreams (in Czech), *Čs. čas. fyz.,* 55, 127-134.
- Červený V., T. J. Moser, 2005. Simplified construction of 4x4 ray propagator matrices in ray-centered coordinates, In: *Seismic waves in complex 3-D structures, Report 15*, Charles University, Prague, 173-187.
- Červený V., T. J. Moser, 2006. Ray propagator matrices in 3-D anisotropic inhomogeneous layered media, *Geophys. J. Int.* (submitted).
- Čížková H., 2005. Numerical simulation of lithospheric subduction process (in Czech), *Čs. čas. fyz.,* 55, 135-140.
- Moser T. J., V. Červený, 2005. Paraxial ray methods for anisotropic inhomogeneous media, *Geophysical Prospecting* (submitted).
- Pauer M., K. Fleming K., O. Čadek, O., Modeling the dynamic component of the geoid and topography of Venus, *J. Geophys. Res.* (submitted).
- Rössler D., I. Pšenčík, F. Krüger and G. Rümpker, 2005, Retrieval of source parameters for local earthquakes in anisotropic media. In: *Seismic Waves in Complex 3-D Structures, Report 15*, Charles University, Prague, 333-344.
- 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., J. Burjánek and F. Gallovič, 2005. Physical research of earthquakes (in Czech), *Čs. čas. fyz.*, 55, 120-126.
- Zahradník J., A. Plešinger, 2005. Long-period pulses in broadband records of near earthquakes, *Bull. Seism. Soc. Am.*, 95, 1928-1939.
- Zahradník J., A. Serpetsidaki, E. Sokos and G-A. Tselentis, 2005. Iterative deconvolution of regional waveforms and a double-event interpretation of the 2003 Lefkada earthquake, *Greece Bull. Seism. Soc. Am.*, 95, 159-172.

Other publications and outreach material

- Research Overviews 2003–2005 and Lists of Publications of the MAGMA staff at http://geo.mff.cuni.cz and http://kmop.mff.cuni.cz.
- Seismic data freely available at http://seis30.karlov.mff.cuni.cz.
- Abstracts from visitors' lectures and seminars at http://geo.mff.cuni.cz/magma, link "Visitors".
- Lecture notes at http://geo.mff.cuni.cz/magma, link "Lecture notes".
- PhD, MSc and BSc theses at http://geo.mff.cuni.cz/magma, link "List of theses".

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 postdoc mobility.

SECTION 6
DETAILED REPORT – related to the overall project duration

6.1. Background

Geophysics and meteorology have had long tradition in Prague, mainly in their theoretical disciplines. Nevertheless, with political and economical changes in the Czech Republic related to accession to European Union it became clear that the true accommodation into the pan-European research needs a fundamental action and financial support. When the EC call with the intention to support Centres of Excellence was issued, the idea of the MAGMA Center has born.

6.2. Scientific/technological and socio-economic objectives

The general goal of the MAGMA Center was formulated as follows: "to increase international recognition of Geophysics and Meteorology at the Charles University in Prague and finalize their inclusion into the European research". The field of interest was chosen quite large, to cover dynamic phenomena in both the solid Earth and atmosphere. According to the tradition, the Center declared its intention to promote a unifying mathematical viewpoint, and development of a multi-disciplinary approach. Application to European environmental problems was included in the planned objectives.

Since MAGMA was created as an Accompanying Measure, not an R&D project, the main emphasis was concentrated on such research aspects which could contribute to the pan-European networking. Consequently, 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, the following tools were chosen: organization of workshops, hosting European researchers in Prague (PhD students, postdoctoral researchers, senior researchers), participation in EC projects, participation in preparation of new EC (and other) project proposals, educational outreach and communication with potential end-users (oil companies, Ministry of Environment, etc.), including the MAGMA web page continuous update.

6.3. Applied methodology, scientific achievements and main deliverables

6.3a Method and selected achievements

The MAGMA Center was active in four main research fields covering dynamics of solid Earth and atmosphere, viz

- geodynamics,
- seismology,
- dynamic climatology,
- air-quality problems.

They were represented by nine work packages listed below (leaders given in brackets), 8 specialized ones, and the 9th aimed at coordination and outreach.

WP1 Thermal convection (O. Cadek)
WP2 Viscoelastic response of the Earth (O. Cadek)
WP3 Temporal changes of the gravitational field (Z. Martinec)
WP4 Seismic waves: Theory (L. Klimes)
WP5 Seismic waves: Observations (J. Zahradnik)
WP6 Earthquakes (J. Zahradnik)
WP7 Climate system (T. Halenka)
WP8 Air quality (J. Brechler)
WP9 Research and technical management (C. Matyska, L. Hanyk and J. Zahradnik - project leader)

After three years of its existence the MAGMA staff is able to present a persuasive list of achievements. For details, see the Periodic Reports 2003, 2004 and 2005 (http://geo.mff.cuni.cz/magma, link "Documents"). The most important achievements can be briefly characterized as follows.

Multidisciplinary studies were conducted, combining numerical modeling of mantle convection and lithospheric subduction (including complex mineralogical and rheological composition). The most important event towards these goals was the 8th European Workshop on Numerical Modeling of Mantle Convection and Lithospheric Dynamics, Sep 13-18, 2003, Castle of Hruba Skala, Czech Republic. From 96 participants, almost 1/2 of which were PhD students and postdocs, 37 were supported by the MAGMA Center.

Network of European researchers dealing with viscoelastic modeling in complex 3-D media was established. New theory and codes for interpretation of the satellite measurements of the gravitational field were proposed. Multidisciplinary studies were promoted to study viscoelastic relaxation beneath Fennoscandia, including data about temporal changes from satellite gradiometric observations of external gravitational field (mission GRACE), repeated GPS measurements, and the sea-level change observations. The sea-level change, related to the global climate change, has represented an interesting new link between the geodynamic and environmental research.

The traditionally good co-operation with researchers from ENS in Paris, ENS Lyon, the University of Utrecht and GFZ Potsdam was further intensified. The new research links with DLR in Berlin and the planetology department of the University of Nantes, established during the visits of German and French researchers in Prague, opened the room for a significant broading of the research scope in Prague, namely for including the Department of Geophysics into European planetology projects. The jointly submitted EC project proposals include GEOHAB and C2C.

New achievements in the theory of seismic wave propagation developed in Praha (group around professor Vlastislav Cerveny) attracted numerous well known researchers of Europe to join us and work together. Specific problems of wave propagation in complex media included, for example, the isotropic ray theory, the anisotropic ray theory and various kinds of the coupling ray theory. A new algorithm of surface-to-surface paraxial ray tracing in anisotropic inhomogeneous layered media was proposed. Equations were derived to estimate Lyapunov exponents describing the ray chaos due to heterogeneities of the medium and to construct the velocity models suitable for high-frequency asymptotic methods.

The theoretic research was linked with practice through annual meetings with representatives of major oil companies (e.g., Shell, BP, Chevron, Petrobras). To mention just a few achievements, construction of velocity models suitable for ray tracing from field VSP measurements and from sonic velocity logs was tested. Decomposition of the time sections into Gaussian packets was developed, with application potential in seismic migration. The finite-difference seismograms were compared with the ray-theory seismograms for benchmark models.

Finally, for even closer co-operation with end-users, the MAGMA Center entered into the EC Transfer-of-Knowledge Industry-Academia Partnership Scheme. We joined the EC project IMAGES (2005-2009), focused on "Induced microseismics applications from global earthquake studies", coordinated by a leading private company, the Schlumberger Cambridge Research, United Kingdom.

Seismic stations of the Charles University in Greece (operated in co-operation with the University of Patras) were integrated into complex seismological/geodynamic studies of the region, especially in the Gulf of Corinth. A key role was played by our inclusion into EC project 3HAZ-CORINTH, focused on possible hazards in the studied zone, such as earthquakes, landslides and local tsunamis. All data have been freely and continually provided to seismological community through the web off-line, but preparation for on-line transmission progressed in the last year of the project.

New contacts with Greek and French researchers were established to promote integrated (observational/theoretical) studies of significant earthquakes of Greece (Athens 1999, Skyros 2001, Lefkada 2003, Cythera 2005), including usage of data from our own stations.

Participation in EC project PRESAP (coordinated by J. McCloskey, University of Ulster), successfully completed in 2003, enabled us to integrate methods developed in Prague into broader framework. In particular, new codes developed for strong motion synthesis from extended seismic sources were integrated into schemes enabling quick (near real-time) assessment of aftershock probabilities and accompanying hazards. Forward and inverse problems of the seismic sources were also solved in the framework of the EC Marie Curie project SPICE.

One of the most successful action of the MAGMA Center (although not presumed in the long-term project plan) was the Week on Weak Formulations of Partial Differential Equations. This intensive course of lectures was devoted to highly theoretical aspects of the partial differential equations governing various processes of geophysics and meteorology. It attracted to Prague 11 PhD students and postdocs from Germany, Italy, Greece and the Netherlands, and it was also well attended by 2 students from the Czech Republic.

New mathematical models were developed for the climate system, with emphasis on the Czech Republic and Europe. It was tightly connected within the 5FP EC project SOLICE and continued in a number of more recent projects. The middle-atmosphere model MSDOL was considerably improved. Another important studied aspect of the climate change, connected with the middle atmosphere, was the sensitivity of chemistry to atmospheric cooling in connection with Green House Gases (GHG) increase.

The Workshop on Regional Climate Modelling and Mini-Symposium on Climate Change in Europe, Prague, Nov 29-Dec 3, 2004, represented a broad forum to promote collaboration in the climate change studies and modeling in Central Europe. The efforts culminated later in the 6FP project ENSEMBLES (ENSEMBLE-based Predictions of Climate Changes and their Impacts). It deals with regional climate changes and their impacts on Europe using multi-model ensemble prediction and regional climate simulation with high resolution, which is one of the MAGMA priorities. In 2005, another 6FP project has started, the QUANTIFY project, dealing with quantifying impact of emission from transportation on climate change. It is connected to two MAGMA work packages.

One of the largest events of MAGMA was the 4th International Conference on Urban Air Quality - Measurement, Modelling and Management, UAQ4 (Mar 25-27, 2003), co-organized with the Institute of Physics, London, and the University of Hertfordshire, United Kingdom. The conference took place at the Charles University in Prague and the audience was about 140 participants.

In 2003, a photochemical model inter-comparison campaign occurred, called CityDelta, organized by the Joint Research Center, Ispra, Italy. The Czech Republic was represented by the MAGMA WP8 leader.

A new method has been developed to implement biogenic emissions (BVOC) to model smog (previously developed in MAGMA at the Department of Meteorology and Environment Protection). Implementation of BVOC enables us to obtain more realistic results regarding the spatial distribution and temporal evolution of concentration of the photooxidation smog. Another important achievement has been a development of a method applicable for mapping emission sources responsible for tropospheric ozone creation. In the framework of international collaboration, the Department o also took part in the COST 715 action called "Meteorology applied to urban air-pollution problems".

6.3b Main deliverables: Conferences and workshops organized or co-organized by MAGMA Center

For scope, programme and list of participants supported by MAGMA etc., see http://geo.mff.cuni.cz/magma, links “Conferences and workshops” and “List of visitors”.

- 4th International Converence on Urban Air Quality, Mar 25-27, 2003 (5 participants supported by MAGMA)
- 8th European Workshop on Numerical Modeling of Mantle Convection and Lithospheric Dynamics, Sep 13-18, 2003 (37 participants supported by MAGMA)

- Workshop on Regional Climate Modelling, Nov 29-Dec 3, 2005 (15 participants supported by MAGMA)
- Workshop on Seismic Waves in Laterally Inhomogeneous Media VI, Jun 20-25, 2005 (4 participants supported by MAGMA)
- Workshop on Global Change in 20th Century and Seasonal and Interannual Climate Prediction, Jul 4-6, 2005 (9 participants supported by MAGMA)
- Workshop on Transformation of Traffic Emissions From Source to Large Scale for Evaluation of Their Effects on Climate (QUANTIFY), Sep 26-28, 2005 (11 participants supported by MAGMA)
- Workshop on Climate Change Impacts in Central and Eastern Europe (CECILIA), Oct 10-11, 2005 (13 participants supported by MAGMA).

6.3c Main deliverables: Lecture courses

For lecture notes and list of attendees supported by MAGMA, see http://geo.mff.cuni.cz/magma, links "Lecture notes" and "List of visitors".

- J. Matas: Thermodynamics and minerals physics, 7 lectures, Mar 8-29, 2004 (total of 15 attendees, 2 supported by MAGMA)
- C. Matyska: The Week on Weak Formulations of Partial Differential Equations, 8 lectures, Nov 28-Dec 2, 2005 (total of 13 attendees, 10 supported by MAGMA)

6.3d Main deliverables: Visitors of the individual work packages

For titles or abstracts of their talks, see http://geo.mff.cuni.cz/magma, links "List of visitors".

WP1 Thermal Convection

- GALSA Attila, Nov 10-13, 2003, Eötvös University, Budapest, Hungary
- SCHMELING Harro, Mar 27-28, 2003, Institut für Meteorology und Geophysics, Frankfurt am Main, Germany
- SÜLE Bálint, Nov 13-18, 2003, Geodetic and Geophysical Research Institute, Budapest, Hungary
- COUTURIER François, Jun 17-Jul 16, 2004, Université de Nantes, France
- DUMOULIN Caroline, Jun 17-Jul 17, 2004, Université de Nantes, France
- MATAS Jan, Mar 4-Apr 4, 2004, Ecole Normale Supérieure, Lyon, France
- SÜLE Bálint, Apr 19-Jun 18, 2004, Geodetic and Geophysical Research Institute, Budapest, Hungary
- VAN DEN BERG Arie, Mar 12-Apr 13, Sep 2-6, Nov 5-15, 2004, University of Utrecht, The Netherlands
- VAN HUNEN Jeroen, Sep 3-12, Nov 7-10, 2004, Institute of Geophysics, ETH Zurich, Switzerland
- BREUER Doris, Jun 12-14, 2005, Deutsches Zentrum fűr Luft- und Raumfahrt, Berlin, Germany
- CROISET Nolwenn, Dec 3-5, 2005, Ecole Normale Supérieure, Lyon, France
- JACOBS Michel, Apr 16-22, 2005, University of Utrecht, The Netherlands
- MATAS Jan, Apr 14-May 7, 2005, Ecole Normale Supérieure, Lyon, France
- MUNTENDAM-BOS Annemarie, Nov 9-11, 2005, University of Utrecht, The Netherlands
- SCHMELING Harro, Mar 12-Apr 11 and Dec 12-17, 2005, University of Frankfurt, Germany
- SOTIN Christophe, Dec 17-21, 2005, Université de Nantes, France
- VAN DEN BERG Arie, Apr 1-May 1 and Nov 14-21, 2005, University of Utrecht, The Netherlands
- VAN HUNEN Jeroen, Nov 1-4, 2005, Eidgenössische Technische Hochschule, Zürich, Switzerland
- VAN SUMMEREN Joost, Mar 13-Apr 15, 2005, University of Utrecht, The Netherlands

WP2 Viscoelastic Response

- FLEITOUT Luce, Aug 17-Aug 30, 2003, Ecole Normale Supérieure, Paris, France
- KARPYTCHEV Mikhail, May 26-Jun 25, 2003, Université de La Rochelle, La Rochelle, France
- PELFRENE Gilles, Aug 15-Sep 28, 2003, Ecole Normale Supérieure, Paris, France
- CHOBLET Gael, Jun 12-26, 2005, Université de Nantes, France

- DUMOULIN Caroline, Jun 12-26, 2005, Université de Nantes, France
- FLEITOUT Luce, Oct 28-Nov 5 and Dec 15-22, 2005, Ecole Normale Supérieure, Paris, France
- FLEMING Kevin, Nov 28-Dec 31, 2005, GeoForschungsZentrum Potsdam, Germany
- MARQUART Gabriele, Feb 1-Apr 30 and Dec 12-17, 2005, University of Frankfurt, Germany

WP3 Gravitational Field

- HAGEDOORN Jan, Oct 5-Dec 23, 2003, GeoForschungsZentrum, Potsdam, Germany
- McCREADIE Heather, Sep 5-9, 2003, GeoForschungsZentrum, Potsdam, Germany
- BALASIS Georgios, Nov 23-25, 2004, GeoForschungsZentrum, Potsdam, Germany
- FLEMING Kevin, Aug 29-Oct 9, 2004, GeoForschungsZentrum, Potsdam, Germany
- HAGEDOORN Jan, Oct 4-Dec 22, 2004, GeoForschungsZentrum, Potsdam, Germany
- KLEMANN Volker, Mar 1-Apr 18, 2004, GeoForschungsZentrum, Potsdam, Germany
- SJŐBERG Lars, Sep 3-7, 2004, Royal Institute of Technology, Stockholm, Sweden
- WOLF Detlef, Jun 10-Jun 13, 2004, GeoForschungsZentrum, Potsdam, Germany
- FLEMING Kevin, Mar 6-9 and Nov 4-6, 2005, GeoForschungsZentrum, Potsdam, Germany
- HENGST Rico, Nov 22-28, 2005, GeoForschungsZentrum, Potsdam, Germany
- SASGEN Ingo, May 20-27, 2005, GeoForschungsZentrum, Potsdam, Germany
- TOSI Nicola, Oct 1-Dec 22, 2005, GeoForschungsZentrum, Potsdam, Germany

WP4 Seismic Waves: Theory

- IVERSEN Einar, Nov 24-Dec 4, 2003, NORSAR, Kjeller, Norway
- BERRAKI Madjid, Oct 21-24, 2004, ISEN, Lille, France
- BUSKE Stefan Herbert, Oct 10-Nov 10, 2004, Freie Universität Berlin, Germany
- DAL MORO Giancarlo, Mar 8-Apr 16, 2004, University of Trieste, Italy
- EISNER Leo, Mar 13-Apr 17, 2004, Schlumberger Cambridge Research, Cambridge, United Kingdom
- HELBIG Klaus, Nov 28-Dec 2, 2004, Hannover, Germany
- MOSER Tijmen Jan, Aug 2-Oct 1, 2004, Fugro-Jason, Rotterdam, The Netherlands
- PATZIG Robert, Apr 18-Apr 24, 2004, Institut für Geophysics, University Hamburg, Germany
- CHAPMAN Christopher, Oct 15-29, 2005, Schlumberger Cambridge Research, United Kingdom
- HELBIG Klaus, Sep 25-Nov 5, 2005, Hannover, Germany
- MOSER Tijmen Jan, Mar 19-28 and Aug 8-26, 2005, Horizon Energy Partners, Gravenhage, The Netherlands
- RŐSSLER Dirk, Feb 27-Apr 1, 2005, University of Potsdam, Germany

WP5 Seismic Waves: Observations
(small number of visitors here is due to fact that, according the plan, this work package served for visits out of MAGMA, related to the seismic stations in Greece)

- SOKOS Efthymios, Feb 1-11 and May 15-26, 2005, Institute of Geodynamics, National Observatory of Athens, and Seismological Laboratory, University of Patras, Rio, Greece

WP6 Earthquakes

- CASERTA Arrigo, Jun 16-20, 2003, Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy
- EMOLO Antonio, Oct 5-14, 2003, Universita' degli Studi di Napoli "Federico II", Napoli, Italy
- IRIKURA Kojiro, Sep 2-7, 2003, Kyoto University, Kyoto, Japan
- SOKOS Efthymios, Sep 1-Oct 9, 2003, Institute of Geodynamics, National Observatory of Athens, and Seismological Laboratory, University of Patras, Rio, Greece
- BENETATOS Christoforos, Apr 29-May 31, 2004, Aristotle University of Thessaloniki, Greece
- MILLER Stephen, Oct 11-25, 2004, Institute of Geophysics, ETH Zurich, Switzerland
- SEBE Olivier, Nov 18-Dec 20, 2004, Universite Joseph Fourier, Grenoble, France
- CASERTA Arrigo, Nov 12-Dec 11, 2005, Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy
- EMOLO Antonio, Mar 1-23, 2005, Universita' degli Studi di Napoli "Federico II", Napoli, Italy

- KULHANEK Ota, Dec 10-19, 2005, Uppsala University, Sweden
- LYON-CAEN Helene, Dec 11-14, 2005, Ecole Normale Supérieure, Paris, France
- RICHWALSKI Sandra, Nov 13-Dec 12, 2005, GeoForschungsZentrum Potsdam, Germany
- ROUMELIOTI Zafeiria, Mar 8-Apr 15, 2005, Aristotle University of Thessaloniki, Greece
- SERPETSIDAKI Anna, Feb 1-28, 2005, University of Patras, Rio, Greece

WP7 Climate System

- FÜLLEKRUG Martin, Sep 15-18, 2003, Institut für Geophysik, Frankfurt am Main, Germany
- LISARIDIS Iraklis, Nov 2-Dec 23, 2003, Aristotle University of Thessaloniki, Thessaloniki, Greece
- BERGANT Klemen, Nov 23-Jan 29, 2005, Nova Gorica Polytechnic, Slovenia
- HAMPSON John, Nov 24-Feb 24, 2005, Centre national de la recherche scientifique, Paris, France
- BERGANT Klemen, Oct 30-Dec 2, 2005, Nova Gorica Polytechnic, Slovenia
- BI Xunqiang, Nov 13-Dec 17, 2005, International Centre for Theoretical Physics, Trieste, Italy
- CSABA Torma, Nov 14-Dec 13, 2005, Eotvos Lorand University, Budapest, Hungary
- HAMPSON John, Nov 24, 2004-Feb 24, 2005, Centre national de la recherche scientifique, Paris, France

WP8 Air Quality

- CESARI Rita, Nov 29-Dec 28, 2005, CNR - Istituto di Scienze dell'Atmosfera e del Clima - Sezione di Lecce, Italy

6.3e Main deliverables: Participation in EC projects

- 2000-2003: PRESAP ("Towards Practical, Real-time Estimation of Spatial Aftershocks Probabilities: a feasibility study in earthquake hazard"), coordinated by J. McCloskey, University of Ulster,
- 2004-2006: 3HAZ-CORINTH ("Earthquakes, Tsunamis and Landslides in the Corinth Rift, Greece"), coordinated by P. Bernard, IPGP Paris,
- 2004-2007: SPICE ("Seismic Wave Propagation and Imaging in Complex Media: a European Network"), coordinated by H. Igel, LMU Munich,
- 2005-2009: IMAGES ("Induced Microseismics Applications from Global Earthquake Studies"), coordinated by L. Eisner, Schlumberger Cambridge Research, United Kingdom,
- 2004-2009: ENSEMBLES ("Ensemble-based Predictions of Climate Changes and their Impacts"), coordinated by D. Griggs, Met Office, Exeter, United Kingdom,
- 2005-2010: QUANTIFY („Quantifying the Climate Impact of Global and European Transport Systems"), coordinated by R. Sausen, DLR, German.

6.3f Main deliverables: Participation in other international projects

- 2005-2007: Czech Republic-Helenic Republic joint project on "A Study of Electrical Conductivity in the Earth's Crust and Mantle using Satellite-Borne Geomagnetic Data", coordinated by E. Konstantinos, University of Athens,
- 2005-2007: "Shaking Scenarios and Damage Testification in Priority and/or Strategic Areas of Interest", Italian Civil Defense Department, coordinated by F. Pacor, INGV, Milan.

6.3g Main deliverables: Participation in submitted project proposals

- CECILIA ("Central and Eastern Europe Climate Change Impact and Vulnerability Assessment"), EC 6FP, 16 partners from 11 countries, coordinated by T. Halenka, Charles University Prague; accepted, now in the negotiation stage.
- GEOHAB ("Geological Evolution and Habitability of Earth-like Planets"), EC 6FP, 14 partners from 10 countries, coordinated by D. Breuer, DLR Berlin,
- C2C ("Crust to core: the fate of subducted material"), EC 6FP, 11 partners from 10 countries, coordinated by G. Steinle-Neumann, University of Bayreuth.

6.4. Conclusions including socio-economic relevance, strategic aspects and policy implications

The three years of the MAGMA Center considerably affected the two involved departments (Departments of Geophysics and Meteorology and Environment Protection) at the Faculty of Mathematics and Physics, Charles University in Prague. It was an extremely busy and exciting period. The number of visitors was very large, guests of several work packages often stayed in Prague simultaneously, thus having also possibility to interact with each other, and contributing to a closer co-operation between formerly separated groups of the MAGMA staff. Spirit of the two involved departments became truly international. We profited from new ideas brought by the visitors, from everyday joint work with them, but also from broad contacts they helped us to establish.

A positive experience was to learn that visitors like not only charming atmosphere of the historical town, but also modern infrastructure and specific style of work in Prague. Indeed, such features of our group like its highly theoretical approach and almost individual work with very few dedicated students appeared to be something attractive, which should not be modified towards "gray" international standards. On the contrary, features like that should be kept and grown because they complement well with the cooperating parties. What should however be changed at our group, and MAGMA project has already contributed partly to such an evolution, is a quicker accommodation to emerging new interdisciplinary needs. For example, we must be more flexible in mutual coupling our geodynamic and seismic investigations, we should be better aware of possibilities and needs of new data sources (e.g., satellite data, new seismic networks etc.). Also, we should become more flexible in penetrating into consortia solving apparently too distant tasks. In fact, our methods can be often adopted to new problems relatively easily and thus can broaden our scope. A typical positive example is the present trend of our geodynamic group to apply the knowledge gain for Earth in the international programs of the planetary research.

To conclude, the present status, with several EC projects being solved in Prague, and some others under submission, provides an optimistic outlook, seeing the geophysical and meteorological research at the Charles University well fixed in the European collaboration. Finally, taking into account that all provided funds were properly and timely spent, MAGMA project can be considered successfully completed.

6.5. Dissemination and exploitation of the results

6.5a Exploitation in oil industry

Annual meetings with representatives of oil companies (Consortium of Seismic Waves in Complex 3-D Media, SW3D)

- Jun 9-12, 2003,
- Jun 14-16, 2004,
- Jun 27-29, 2005.

For list of participants, http://geo.mff.cuni.cz/magma, links “List of visitors”.

6.5b Exploitation in environmental projects

Project of the Czech Ministry of Environment

- 2003-2005: Research of the air-pollution transport models, Project No. VaV/740/04/03, coordinated by J. Keder, Czech Hydrometeorological Institute; Topic No. 3: Mathematics models of the creation, transport and dispersion of photochemical smog – assessment of practical use, coordinated by J. Brechler, Charles University.

6.5c Dissemination of MAGMA results: Theses defended 2003-2005

PhD Theses

2003
- T. T. Nam: A semi-Lagrangian semi-implicit limiter-area forecast model (supervisor: M. Batka)
- V. Plicka: Modeling of finite-extent seismic sources by empirical Green's functions (supervisor: J. Zahradnik)
- F. Vana: Le schema d'advection semi-Lagrangienne avec attenuation controlee – une formulation alternative de la diffusion horizontale non-lineaire dans un modele numerique de prevision du temps; in French/Czech (supervisor: M. Batka)
- J. Velimsky: Electromagnetic induction and heterogeneous Earth's mantle: time-domain modeling (supervisor: Z. Martinec)

2004
- J. Miksovsky: On some meteorological applications of nonlinear time series analysis methods (supervisor: A. Raidl)
- R. Mladek: Study of indirect influence of orographic obstacles in numerical weather prediction models (supervisor: T. Halenka)
- K. Potuzniková: Modelling of atmospheric boundary layer processes and their interactions woth fog and low-level clouds development (supervisor: J. Bednar)

2005
- T. Fischer: West-Bohemian Earthquake Swarms and Their Dynamics (supervisor: V. Vavrycuk)
- K. Zacek: Gaussian Packet Prestack Depth Migration (supervisor: L. Klimes)

MSc Theses

2003
- M. Belda: Adaptation of photochemical smog model for actual situations; in Czech (supervisor: T. Halenka)
- J. Beran: Modeling of mesosynoptical scale; in Czech (supervisor: J. Brechler)
- P. Kolinsky: Dispersion of seismic surface waves along selected Eurasian paths; in Czech (supervisor: O. Novotny)
- L. Kostal: Free oscillations of maxwellian models of the Earth; in Czech (supervisor: C. Matyska)
- H. Kyznarova: Radar observation of tornadas; in Czech (supervisor: P. Novak)
- R. Lechner: Atmospheric radiative transfer, trace gases and aerosols; in Czech (supervisor: T. Halenka)
- P. Skalak: Global ocean – An important part of the climate system; in Czech (supervisor: J. Kalvova)

2004
- M. Behounkova: Seismic tomographic enversion 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)

2005
- J. Chrastecky: Using of semi-Lagrangian methods in numerical forecast models; in Czech (supervisor: M. Batka)
- A. Demeterova: Statistical downscaling of GCMs outputs - a linear approach; in Czech (supervisor: J. Kalvova)
- R. Kelnerova: Evaluation of concentration distributions for a point source in the surface layer in urban environment; in Czech (supervisor: Z. Janour)
- J. Micza: Chaos and fractals in meteorology; in Czech (supervisor: A. Raidl)
- K. Rezba: Point-source inversion of teleseismic records; in Czech (supervisor: J. Zahradnik)
- O. Soucek: Termomechanical model of the polythermal ice-sheet (supervisor: Z. Martinec)
- O. Vlcek: Determination of seasonal and monthly precipitation characteristics using free-atmosphere variables and their use in construction of daily precipitation series; in Czech (supervisor: R. Huth)
- K. Zemankova: A comparison of modeled ozone ground concentrations with measurement; in Czech (supervisor: J. Brechler)

BSc Theses

2003
- J. Mazanek: Algorithms for radar detection of dangerous meteorological phenomena; in Czech (supervisor: J. Kracmar)
- M. Sova: Vertical profiles of wind velocity in boundary layer; in Czech (supervisor: J. Bednar)
- K. Svehlova: Evapotranspiration in the lower Ohre river basin; in Czech (supervisor: I. Sladek)

6.5d Dissemination of MAGMA results: Seminars

Complete lists of more than 150 talks are also available in http://geo.mff.cuni.cz/magma, link "Documents".

Geodynamics Seminar

2003
- Feb 19: M. Kukačka (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Does water in a lithospheric slab influence its dip angle?
- Feb 26: J. Matas (ENS Lyon, France)
  Thermodynamics of phase interfaces
- Mar 5: L. Vecsey (Geophysical Institute of Czech Academy of Sciences)
  Wavelets and their application
- Mar 12: J. Velímský (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Time-domain modelling of electromagnetic induction
- Mar 19: M. Pauer (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  What do we know about dynamic processes in Venus?
- Mar 26: E. Petrovský (Geophysical Institute of Czech Academy of Sciences)
  Magnetomineralogy and its application to environmental studies
- Mar 27: H. Schmeling (University of Frankfurt)
  Iceland plume modelling
- Apr 2: R. Inovecký (Faculty of Mathematics and Physics, Charles University)
  Weak formulation of equations for viscoelastic response of the Earth
- Apr 16: J. Šafanda (Geophysical Institute of Czech Academy of Sciences)
  Impact of climate changes on underground temperature field
- Apr 23: J. Laštovička (Institute of Physics of Atmosphere, Czech Academy of Sciences)
  Role of human activity and solar effects in long-term changes of asthenosphere and ionosphere
- Apr 30: D. Uličný, L. Špičáková (Geophysical Institute of Czech Academy of Sciences) and M. Rajchl (Faculty of Sciences, Charles University)
  Sediments as indicators of tectonic and surface processes

- May 7: J. Laurin (Geophysical Institute of Czech Academy of Sciences), B.B. Sageman (North-western University, Evanston, US) and D. Waltham (Royal Holloway, University of London, UK)
  Orbitally controlled sea level changes during cretaceous: New arguments from a combination of field data (Colorado Plateau) and numerical models
- Oct 15: M. Pauer (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Gravitational field and topography of Venus
- Oct 22: J. Hagedoorn (GFZ Potsdam)
  Glacial isostatic adjustment and recent sea-level change
- Oct 29: L. Vecsey (Institute of Geophysics, Czech Academy of Science)
  High Rayleigh number thermal convection
- Nov 5: L. Inovecky and T. Pergler (Faculty of Mathematics and Physics, Charles University)
  Weak formulation and finite element approximation of viscoelastic response of the Earth to postglacial and postseismic loading
- Nov 12: A. Galsa and B. Sule (Eotvos University, Budapest)
  Thermal convection modelling in Budapest
- Nov 26: A. Spicak, J. Vanek and V. Hanus (Institute of Geophysics, Czech Academy of Science)
  Deep structure and seismotectonics of convergent lithospheric margins obtained from the analysis of global seismic data
- Dec 3: L. Hanyk (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Dissipation heating in the Earth's mantle induced by glacial forcing
- Dec 10: C. Matyska (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Bullen's parameter in the Earth's mantle
- Dec 17: M. Behounkova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Tomographic inversion of synthetic data

2004

- 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 University)
  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 University)
  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. Behounkova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Three-dimensional synthetic tomographic inversion
- Dec 15: O. Soucek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Thermomechanical model of a polythermal glacier

2005

- Jan 5: T. Pergler (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Three-dimensional finite elements
- Mar 16: C. Matyska (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  PPP
- Mar 16: J. van Summeren (Utrecht University, The Netherlands)
  On the survival of a heterogeneous deep mantle reservoir: constraints from evolutionary numerical mantle convection models
- Mar 23: H. Schmeling (Frankfurt University, Germany)
  The problem of modeling subduction in numerical codes
- Mar 30: M. Pauer (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Is the Martian crust thin or thick?
- Apr 6: G. Marquart (Frankfurt University, Germany)
  A numerical approach to model the accretion of Icelandic crust
- Apr 13: A. van den Berg (Utrecht University, The Netherlands)
  Mars from crust to core: some global physical considerations
- Apr 20: J. Pek (Geophysical Institute, Czech Academy of Sciences)
  Magneto-telluric methods of electric conductivity investigation
- May 4: J. Velimsky (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  EM induction: modeling in the time domain, 1-D a 2.5-D data inversion from satellite CHAMP
- May 25: I. Sasgen (GeoForschungsZentrum Potsdam, Germany)
  Geodetic signatures of glacial changes in Antarctica
- Oct 12: N. Tosi (GeoForschungsZentrum Potsdam, Germany)
  Spherical harmonic-finite element approach to present-day mantle convection
- Oct 26: R. Hengst (GeoForschungsZentrum Potsdam, Germany)
  The continental water storage - variations of the Earth's rotation caused by hydrological effects
- Nov 2: F. Nemec (Department of Electronics and Vacuum Physics, Faculty of Math. and Phys., Charles University)
  Influence of earthquakes on intensity of electromagnetic waves in the upper ionosphere
- Nov 9: J. Velimsky (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  (In)finite elements in modeling viscoelastic response of the Earth

- Nov 16: M. Behounkova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Relationship between temperature anomalies and seismic velocities in the lower mantle
- Nov 23: H. Cizkova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Stress in subducting lithospheric plates - influence of a boundary condition in a numerical model
- Dec 7: G. Kocurek (University of Texas at Austin, USA)
  Sedimentary Geology on Mars: Aeolian Dune Patterns and Signs of Ancient Water Bodies
- Dec 14: O. Cadek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Constraints on mantle flow from geoid, dynamic topography and seismic anisotropy
- Dec 19: Ch. Sotin (University of Nantes, France)
  News from Mars and Titan

Seminars of Czech Meteorological Society

2003
- Mar 4: J. Kalvova (Dept. of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  Climate change and what we can expect from up to date global climate models?
- Oct 21: T. Halenka (Dept. of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  Regional climate modeling in Czech Republic – how to go ahead?

2004
- Z. Chladova, J. Kalvova (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

2005
- Mar 8: J. Zahradnik (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Preliminary findings on the Sumatra earthquake
- Mar 22: P. Pisoft (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  Pseudo-2D wavelet transformation of NCEP/NCAR reanalyses: first results
- Apr 19: J. Miksovsky (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  Chaos and nonlinearity in climatic time series
- May 17: T. Halenka (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  On the influence of solar activity on processes in Earth atmosphere
- Dec 20: A. Farda (Czech Hydrometeorological Institute), T. Halenka (Dept. of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  First experience with regional climate model ALADIN-CLIMATE, project ENSEMBLES

Seismology Seminar

2003
- Feb 21: P. Kolinsky (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Group-velocity dispersion of surface waves from earthquakes in Europe and Asia

- Feb 28: K. Zacek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Depth migration by Gaussian packets
- Mar 7: J. Zahradnik (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Discussion on the uncertainty estimates in seismology inverse problems
- Mar 14: F. Gallovic (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Discussion on synthetic attenuation curves
- Mar 21: J. Burjanek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Composite models of the finite-extent seismic source
- Mar 28: T. Fischer, J. Horalek, Z. Hudova, A. Plesinger (Inst. of Geophysics, Czech Acad. of Sci.)
  West-Bohemia earthquake swarm 2000: Source parameters of stronger events and structure of the fault plane
- Apr 4: V. Plicka (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Empirical Green function method (the EGTD version) and its application in Western Bohemia
- Apr 25: J. Malek (Institute of Rock Structure and Mechanics, Czech Academy of Science)
  Induced seismic events in vicinity of the underground gas storage in Pribram
- May 2: J. Jansky (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Location of the 2001 earthquake sequence close to city of Aegion, Greece
- May 9: K. Rezba (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Point-source inversion of teleseismic earthquake records using SYN4 code, IASPEI software library
- May 16: B. Ruzek (Institute of Geophysics, Czech Academy of Science)
  Seismic profile experiment CELEBRATION 2000, and preliminary application of the VISTA software
- Jun 17 and Jun 18: A. Caserta (Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy)
  Interaction of earthquakes and noise with near-surface geological structures: data analysis and numerical modeling
- Sep 5: K. Irikura (Disaster Prevention Research Institute, University of Kyoto, Japan)
  Recipe of strong motion prediction for future earthquakes
- Oct 3: E. Sokos (National Observatory of Athens and the University of Patras, Greece)
  User-friendly software for the seismic-source inversion; linking Fortran, Matlab and GMT
- Oct 7: A. Emolo (University of Naples, Italy)
  Non-linear seismic-source inversion of high-frequency data
- Oct 10: A. Emolo (University of Naples, Italy)
  Source mechanism of the 1930 Irpinia earthquake, Italy, based on a kinematic model
- Oct 17: J. Zahradnik (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Instrumental problems of CMG-3T and CMG-5T seismographs, the Charles University stations in Greece
- Oct 24: F. Gallovic, J. Burjanek and J. Zahradnik (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Blind experiment on the aftershock prediction (in the framework of EC project PRESAP), and our results in the experiment
- Oct 31: J. Zahradnik (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Inversion of regional seismic data (moment-tensor, multiple point-source model); new code and its application to the 2003 Lefkada earthquake, Greece
- Nov 7: V. Vavrycuk (Institute of Geophysics, Czech Academy of Science)
  Anisotropy of subduction zone in Tonga region from moment tensors of deep earthquakes
- Nov 14: J. Burjanek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Composite-source model; effects of finite-extent subsources and the so-called effective source parameters; application in strong-motion simulation of the 2000 Tottori earthquake, Japan
- Nov 14: J. Malek and M. Broz (Institute of Rock Structure and Mechanics, Czech Acad. of Sci.), J. Jansky and O. Novotny (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Investigation of the upper-crustal structure using quarry blasts
- Nov 28: K. Rezba (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Point-source inversion of teleseismic earthquake records using SYN4 code, IASPEI software library – part

- Dec 12: J. Zednik (Institute of Geophysics, Czech Academy of Science)
  Professional ANTELOPA software for data acquisition and analysis; its use in the Czech national seismic network
- Dec 19: V. Plicka (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Slip inversion by the Patch Method (after M. Vallee and M. Bouchon)

2004

- Feb 20: I. Oprsal (Department of Geophysics, Faculty of Math. and Phys., Charles University & ETH Zurich)
  3-D hybrid earthquake modeling
- Feb 27: K. Zacek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Wavefield decomposition into optimalized 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 afect 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

2005

- Jan 7: P. Franek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Numerical modeling of seismic movement in the Volvi Lake sedimentary valley in Greece by the FD method
- Jan 14: S. Miller (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Omori's law and fluid-driven aftershocks
- Feb 8: A. Serpetsidaki (University of Patras, Greece)
  Athens 1999 earthquake - ground motion analysis

- Feb 25: A. Serpetsidaki (University of Patras, Greece)
  Analysis of Athens 1999 earthquake
- Mar 4: P. Adamova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Iterative deconvolution of regional seismographs of earthquakes in the west Greece
- Mar 18: A. Emolo (University of Naples, Federico II., Italy)
  Seismic hazard assessment for a characteristic earthquake scenario: integrating probabilistic and deterministic approaches
- Mar 25: Z. Roumelioti (Aristotle University of Thessaloniki, Greece)
  Modeling earthquakes in Greece
- Mar 29 (in Geoph. Inst. of Czech Acad. of Sci.): D. Rossler (University of Potsdam, Germany)
  Inversion of moment tensors in anisotropic media
- Apr 1: M. Galis (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Numerical simulation of the rupture formation and propagation and seismic motion modeling
- Apr 8: P. Kolinsky (Institute of Rock Structure and Mechanics, Czech Academy of Sciences)
  Analysis and inversion of surface waves - demonstration of a programming code
- Apr 15: T. Fischer (Geophysical Institute, Czech Academy of Sciences)
  Possible effects of tidal stress on earthquake triggerring: application on swarms in the west Bohemia
- Apr 22: P. Kalenda, J. Malek (Institute of Rock Structure and Mechanics, Czech Academy of Sciences)
  Earthquakes and tides, part II
- May 6: J. Jansky, V. Plicka, O. Novotny (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  One-dimensional model for the area of Egion and location of earthquakes
- May 13: F. Gallovic (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Probability estimate of seismic hazard by aftershocks
- May 20: J. Brokesova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  On rotational components of seismic movement I
- May 27: J. Brokesova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  On rotational components of seismic movement II
- Jun 3: A. Caserta (INGV Rome, Italy)
  Statistical features of the seismic noise
- Oct 19 (in Geoph. Inst. of Czech Acad. of Sci.): Ch. Chapman (Schlumberger Cambr. Res., United Kingdom)
  The Asian Tsunami in Sri Lanka – a personal experience (or Airy functions in action!)
- Oct 26 (in Geoph. Inst. of Czech Acad. of Sci.): Ch. Chapman (Schlumberger Cambr. Res., United Kingdom)
  Modelling of Scattering of Seismic Waves from a Currugated Rough Sea Surface: a comparison of 3 methods
- Nov 2 (in Geoph. Inst. of Czech Acad. of Sci.): K. Helbig (Hannover, Germany)
  The structure of the elastic tensor: A study of the possibilities opened up by Kelvin 150 years ago
- Nov 4: T. Fischer (Geophysical Institute, Czech Academy of Sciences)
  Dynamics of westbohemian earthquake swarms
- Nov 11: F. Gallovic (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Deterministic and probabilistic model of the Irpinia, 1980 earthquake
- Nov 18: A. Caserta (INGV Rome, Italy)
  Soil shaking features in the city of Rome, Italy
- Nov 25: P. Adamova, E. Sokos, J. Zahradnik (Dept. of Geophysics, Fac. of Math. and Phys., Charles University)
  Software ISOLA for the moment inversion of seismograms
- Dec 2: S. Richwalski (GeoForschungsZentrum Potsdam, Germany)
  Site effects in urban areas
- Dec 9: P. Adamova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Moment inversion of complete seismograms and some intrumental defects
- Dec 13: H. Lyon-Caen (ENS Paris, France)
  Corinth Rift Laboratory, seismic studies

- Dec 14: O. Kulhanek (Uppsala University, Sweden)
  Seminar on b-value
- Dec 16: J. Vilhelm (Department of Applied Geophysics, Faculty of Natural Sciences, Charles University)
  Applied geophysics on the Faculty of Natural Sciences: information on pedagogical and scientific work

6.6. Main literature produced

6.6a Lecture notes

- Z. Martinec, Continuum Mechanics, http://geo.mff.cuni.cz/staff/zm/continuu.pdf
- C. Matyska, Mathematical Introduction to Geotermics and Geodynamics, http://geo.mff.cuni.cz/staff/cm/geoterm.pdf
- C. Matyska, Selected Chapters on Partial Differential Equations, http://geo.mff.cuni.cz/documents/CM-PDE.pdf

6.6b Abstracts of the visitors' talks

For abstracts of visitors' talks, see http://geo.mff.cuni.cz/magma, links "List of visitors".

6.6c Publications produced by the MAGMA staff

Counting both published and submitted publications, research output by the MAGMA staff in 2003-2005 comprises more than 200 items (see Attachments B - "Publications" of Periodic Reports 2003-2005, http://geo.mff.cuni.cz/magma, links "Documents"). 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 the visitor stays and their work at the Charles University, either completely, or partially. Obviously the percentage of such a production (listed below) cannot be more but just a small fraction of the whole MAGMA staff production.

Papers with acknowledgement to MAGMA

- Bergant K., M. Belda and T. Halenka, 2005. Systematic errors in simulation of European climate (1961-2000) with RegCM3 driven by NCEP/NCAR Reanalysis, *Int. Journal of Climate* (submitted).
- Burjánek J., F. Gallovič and J. Zahradník, 2005. Seismological predictions: reality and dreams (in Czech), *Čs. čas. fyz.,* 55, 127-134.
- Červený V., T. J. Moser, 2005. Simplified construction of 4x4 ray propagator matrices in ray-centered coordinates, In: *Seismic waves in complex 3-D structures, Report 15*, Charles University, Prague, 173-187.
- Červený V., T. J. Moser, 2006. Ray propagator matrices in 3-D anisotropic inhomogeneous layered media, *Geophys. J. Int.* (submitted).
- Čížková H., 2005. Numerical simulation of lithospheric subduction process (in Czech), *Čs. čas. fyz.,* 55, 135-140.
- Moser T. J., V. Červený, 2005. Paraxial ray methods for anisotropic inhomogeneous media, *Geophysical Prospecting* (submitted).
- Pauer M., K. Fleming K., O. Čadek, O., Modeling the dynamic component of the geoid and topography of Venus, *J. Geophys. Res.* (submitted).
- Rössler D., I. Pšenčík, F. Krüger and G. Rümpker, 2005, Retrieval of source parameters for local earthquakes in anisotropic media. In: *Seismic Waves in Complex 3-D Structures, Report 15*, Charles University, Prague, 333-344.
- 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., J. Burjánek and F. Gallovič, 2005. Physical research of earthquakes (in Czech), *Čs. čas. fyz.*, 55, 120-126.

- Zahradník J., A. Plešinger, 2005. Long-period pulses in broadband records of near earthquakes, *Bull. Seism. Soc. Am.*, 95, 1928-1939.
- Zahradník J., A. Serpetsidaki, E. Sokos and G-A. Tselentis, 2005. Iterative deconvolution of regional waveforms and a double-event interpretation of the 2003 Lefkada earthquake, *Greece Bull. Seism. Soc. Am.*, 95, 159-172.

LIST OF ATTACHMENTS

Attachment A RESEARCH OVERVIEW 2005

Department of Geophysics, belonging to the Faculty of Mathematics and Physics, Charles University, Prague, has its roots seated as deep as in the 20's of the last century. Its structure and priorities have evolved from nearly pure seismology to the present-day broad scope covering nearly all main branches of the physics of the Earth and, most recently, comprising also planetary aspects. Research is tightly coupled with education at bachelor, master and doctoral levels. In 2005, there were 19 staff members at the department (counting permanent and temporary positions), and 13 PhD students.

The MAGMA center, i.e. the Prague Center of Mathematical Geophysics, Meteorology, and their Applications, a 3-year project (2003-2005) supported by the European Commission, has been successfully completed. We hosted many researches and students from Europe; the total length of both short visits and stays longer than 1 month at the Department of Geophysics reached 67 person-months altogether in 2003-2005. For more details, see http://geo.mff.cuni.cz/magma.

In a close relation to MAGMA, the Department of Geophysics takes part in three more EC projects in 2005: SPICE, 3HAZ-CORINTH and IMAGES. SPICE (2004-2007) is the pan-European Marie Curie Reseat Training Network involving 14 universities and specialized in theory of seismic wave propagation. 3HAZ-CORINTH (2004-2006) is a research project specifically targeted on 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.

In 2005, we participated in submission of two new proposals for the EC Marie Curie Research Training Networks: ITSAK-GR and REAP. The REAP project (coordinated at the University of Ulster), a continuation of the previous successful PRESAP project, will involve 7 European and 1 US institution engaged in stress transfer after strong earthquakes and prediction of their aftershocks. ITSAK-GR is a new project launched by the leading engineering-seismology institution of Greece, focused on the transfer of knowledge in the earthquake strong ground motion analysis and prediction.

Fruitful cooperation with several major oil companies, lasting since 1993, has continued in 2005 in the framework of the project Seismic waves in 3-D media (SW3D) coordinated at the Department of Geophysics.

International workshop Seismic waves in laterally inhomogeneous media VI was organized, jointly with the Geophysical Institute of the Czech Academy of Sciences, at the Castle of Hruba Skala on June 20-25, 2005. The 61 participants from 14 countries presented 58 oral and poster contributions. Proceedings will be published in two special issues of Studia Geophysica et Geodaetica.

Intensive popularization of the Earth science was performed in 2005. In addition to already standard presentations at the Faculty Day of Open Door and the Day with Physics, more than five large public lectures and several TV interviews were made in connection with the disastrous mega-earthquake and tsunami in Sumatra, Dec 26, 2004. Three popularization articles were published in the Czech physical journal, viz Cizkova (2005), Zahradnik et al. (2005) and Burjanek et al. (2005).

In connection with the currently reformed study structure of the Faculty, dozens of topics were suggested for bachelor studies of the physics of the Earth, and, consequently, 7 new students appeared at our department with the potential to continue in their studies towards higher degrees.

Two MSc theses (Soucek, 2005; Rezba, 2005) and one PhD thesis (Zacek, 2005) were defended at the Department of Geophysics in 2005.

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

Glacial isostatic adjustment of the Earth

Martinec and Wolf (2005) inverted the Fennoscandian relaxation spectrum by adapting the spectral finite-element method, originally developed for a 3-D self-gravitating spherical Earth model (Martinec, 2000), to an axisymmetric viscosity distribution. The free parameters used in the inversion are either the central-lithosphere thickness (below the former Fennoscandian ice sheet) and the upper-mantle viscosity or the peripheral-lithosphere thickness and the peripheral-asthenosphere viscosity (surrounding the former Fennoscandian ice sheet). We demonstrate that

a model featuring a central lithosphere with a thickness of 200 km and a peripheral lithosphere with a thickness of 80 km underlaid by an asthenosphere satisfies the relaxation-time spectrum. We also show that the spectrum can be explained on the basis of a spherically symmetric model featuring a 100-km thick lithosphere, but no asthenosphere. Fleming and Martinec (2005) examined the dependence of GIA on the underlying viscosity structure for the Vatnajökull Ice Cap, Iceland. A four-layer spherical earth model was used, consisting of a thin elastic lithosphere, LVZ, and an upper and lower mantle. They compared the predicted GIA response arising from changes in the Vatnajökull Ice Cap with vertical-displacement rates found by GPS campaigns conducted between 1991 and 2000. The underlying viscosity structure that provides the optimum predictions consists of an elastic lithosphere whose thickness lies between 46 to 16 km, a LVZ whose viscosity is between 10^{18} to 10^{19} Pa s, and whose depth extends to between 175 to greater than 400 km. They found that the very low viscosity values sometimes evoked for Iceland are not necessary to account for the rapid uplift rates. Inter-annual variability in the mass balance of the ice cap strongly affects vertical-displacement rates. This means that values inferred from GPS surveys will depend upon the epoch at which the measurements are made, with more frequent surveys required to differentiate between inter-annual and longer-term trends.

Effect of glacial isostatic adjustment on present-day sea level change

Hagedoorn, Wolf and Martinec (2005) studied the influence of GIA caused by the last Pleistocene deglaciation on the present-day sea level. The viscoelastic deformation caused by the time-variable ice and ocean loads is simulated by computing the resulting perturbations for a spherical, self-gravitating, incompressible, Maxwell-viscoelastic Earth model. The associated variation of the earth rotation is described in terms of the Liouville equation, which is solved by means of the MacCullagh formulae. This allows the determination of the vertical displacement and geoid height and, thus, the solution of the sea-level equation. They tested several viscosity and ice models and evaluate them by comparison of the computed response with the Holocene sea-level history. Using the optimum combination of viscosity and ice models, they then estimated the influence of the last Pleistocene deglaciation on the tide-gauge measurements. A comparison between the observational and residual linear trends for the tide-gauge measurements shows a significant reduction of the variance and geographical variability for the latter, in particular for the formerly ice-covered regions of North America and Scandinavia. The favored value determined for the global mean sea-level rise is (1.46±0.2) mm/y. Soucek (2005) developed a new theory of ice-loads dynamics, which is based on fundamental laws of thermodynamics and is planed to be incorporated into the present-day sea level change modeling.

Heat generated by ice-sheets loading and unloading

Hanyk et al. (2005) studied dissipation of heat generated by ice sheets loading and uloading. They have focused 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. They used a discretization method based on the method of lines for integrating the time-dependent evolutionary equations of self-gravitational, viscoelastic flow. They have found that shear heating from the transient viscoelastic flow can represent a non-negligible mantle energy source with cryogenic origins. Volumetric heating by viscous deformation associated with these flows can be locally greater than chondritic heating by radioactivity. In the presence of an abrupt change in the ice loading history, the time average of the integral of the dissipation over depth corresponds to a mantle heat flow of the order of magnitude of mW/m^2 below the periphery of ancient ice sheets or below their central areas. However, the peak values of this integral in time are almost two orders higher. These results would suggest that some degree of volcanism may be associated with dramatic episodes in ice loading.

Rotation of the Earth

Rotation of the Earth undergoes changes due to time-varying surface load and internal mass redistribution. For a spherically symmetric viscoelastic Earth model, the movement of the rotation vector during a glaciation cycle has conventionally been computed in the Laplace-transform domain. The method involves multiplication of the Laplace transforms of the second-degree surface-load and tidal-load Love numbers with the time evolution of the surface load followed by inverse Laplace transformation into the time domain. The newly developed method by Martinec and Hagedoorn (2005) offers the possibility to model the rotational response of the Earth induced by glacial-isostatic adjustment (GIA) by time integration of the linearized Liouville equation. The theory presented there derives the temporal perturbation of the inertia tensor, required to be specified in the Liouville equation, from time variations of the second-degree gravitational-potential coefficients by the MacCullagh's formulae. This 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 GIA and the induced rotational response of the Earth is readily combined with a time-domain solution of the sea-level equation with a time-varying shoreline geometry.

Lateral viscosity changes in the upper mantle of the Earth

The large-scale gravitational signal of the Earth, together with the seismic tomographic image, provide clues to estimate the viscosity structure of the mantle. The attention of the geodynamics group was mainly paid to determination of the lateral viscosity changes in the upper mantle and to new data which could reduce strong non-uniqueness of this inverse problem. In close cooperation with L. Fleitout from ENS in Paris, O. Cadek incorporated two new pieces of information in the inversion for viscosity, namely the estimate of surface dynamic topography (i.e., deformation of the surface induced by flows in mantle) and the constraint on orientation of mantle flow from the seismic anisotropy measurements. Although these new data sets have not yet led to a significant improvement of the Earth's mantle viscosity structure (mainly because of large data errors), their potential is obvious, and their interpretation is a challenging task for the next years.

Mantle convection models with new post-perovskite phase change and radiative transfer of heat

Quite recently, a new phase change in the deep mantle was revealed. This new phase (post-perovskite) could be the source of anomalous behaviour of the D" layer at the mantle bottom. The dynamical consequences of this deep-mantle phase transition on mantle convection with particular emphasis on the effects on lower mantle plume structures was studied in papers by Matyska and Yuen (2005 a,b). Our results show that favourable for the development of superplumes is exothermic phase transition and radiative thermal conductivity. Smaller unstable plumes are found for exothermic phase transition and constant thermal conductivity. This aspect is especially emphasized, when the radiative thermal conductivity is restricted only to the post-perovskite phase. These results revealed a greater degree of asymmetry is produced in the vertical flow structures of the mantle by the phase transitions. Mass and heat transfer between the upper and lower mantle will deviate substantially from the traditional whole-mantle convection model. Streamlines revealed that an overall complete communication between the top and lower mantle is difficult to be achieved.

Seismic resolution of the mantle flows

Behounkova et al. (2005) presented results of a 2-D tomographic inversion of synthetic data that examines the ability of seismic tomography to reveal structures created by mantle dynamic processes. The seismic velocity anomaly model was based on the density heterogeneities obtained from models of thermal and thermo-chemical convection. Both layered and whole-mantle models are employed into the study. The resolving power of the inversion of P and pP arrival times was shown and the influence of parameterization and regularization (damping) in generation false images of mantle heterogeneities was described in detail. The effect of regularization was found to be substantial and the optimum damping depended upon the wavelength of the input structures. The resolution of the inversion decreases considerably at depths greater than 1000 km, therefore the ability of the kinematic inversion to distinguish between whole-mantle and layered flows (coupled via thermal coupling) may be limited. At present, fully 3-D problem is studied, which focuses mainly to the choice of parameterization.

Conductivity of the Earth from surface and satellite measurements

Electromagnetic induction in the Earth is studied through modeling the surface and satellite measurements in order to understand the 3-D internal conductivity structure. Velimsky and Everett (2005) have created a database consisting of hourly means of the geomagnetic field components observed on quiet days in years 2001-2002 on ground observatories and Orsted and CHAMP satellite measurements covering the same time intervals. In the first part of our study, we use the potential method to estimate the model of external inducing field. Following 3-D simulations are used to evaluate the effect of heterogeneous surface conductance map on Örsted and CHAMP satellite measurements and to compare the results with observations. Improvement of up to 15 % with respect to the best 1-D model was observed in surface observatory data as well as in the Orsted and CHAMP measurements.

Velimsky et al. (2005, submitted) applied a recent time-domain approach to the global electromagnetic induction problem to vector magnetometer data observed by the CHAMP satellite. Data recorded during 11 storm events in 2001-2003 are processed track by track, yielding time series of spherical harmonic coefficients. The data are then interpreted in terms of 1-D layered electrical conductivity models. The inversion is performed by full search of model parametric space which yields sensitivity of misfit with respect to conductivities of layers and positions of interfaces. In the upper 50 km the inversion solidly recovers a conductive layer corresponding to averaged surface conductance. The conductivity of the lower mantle is established at 6 S/m assuming the upper-lower mantle interface is fixed at the seismic-based 670 km boundary. However, the satellite data favor the models with a large jump at 970 km to conductivity values exceeding 100 S/m. The resolution of the method in the resistive upper mantle sandwiched between conductive crust and lower mantle is poor. Nevertheless, an upper bound of 0.01 S/m is suggested by the data. A conductivity increase in the transition zone is not observed.

The recently published time-domain spherical-harmonic finite-element approach to the electromagnetic induction problem (Velimsky and Martinec, 2005) is beeing further developed to allow combined use of magnetic data recorded at the Earth's surface and satellite altitudes.

GRACE (Gravity Recovery and Climate Experiment)

GRACE is a joint US-German partnership mission within NASA's Earth System Science Pathfinder program. The mission is chaired by the Center for Space Research of Texas University in Austin in cooperation with NASA's Jet Propulsion Laboratories and GFZ Potsdam. Sasgen, Martinec and Fleming (2005) derived a spatial averaging method based on the Wiener optimal filtering, and described its application to the GRACE gravity solutions. In contrast to the more commonly used Gaussian filter, no specification of the spatial width of the filter is required. Instead, the optimal filter is designed directly from the least-square minimization of the difference between the desired and filtered signals. This requires information about the power spectrum of the desired gravitational signal and the contaminating noise. This information is inferred from the average GRACE degree-power spectrum. The Wiener optimal filter determined from the GRACE gravity-field solutions closely corresponds to a Gaussian filter with a spatial half width of 4 degree (approx. 440 km).

Planetary physics

New information on the physics of the terrestrial planets and moons provided by recent space missions is a strong motivation to apply the research techniques developed for investigation of the Earth to other Earth-like bodies. Pauer, Fleming and Cadek prepared a paper in which they presented results of their analysis of the gravity and topography on Venus in terms of mantle flow models. They demonstrated that the long-wavelength anomalies of the gravity field can be well explained by dynamic processes in the Venus mantle provided that the vioscosity increases with depth in a similar way as in the Earth. The most remarkable bodies in the Solar System are the icy satellites of Saturn and Jupiter (Enceladus, Titan, Europa). The dynamics of these bodies, which are potential candidates for hosting life's origin, is probably mainly driven by intense tidal forces. In cooperation with the researchers from the Laboratory of Planetology and Geodynamics, University in Nantes, a new project was started with the aim to develop a realistic model of heat dissipation generated by the tides in these satellites. Another project, related to Mars, will attempt to answer the question of whether Mars is still an actively convectiong body, or whether the dynamic processes in its interior died out already long ago.

Theory of seismic waves

Recent developments in seismic ray method

Important developments in seismic ray method achieved during last 20 years have been described in an extensive invited review paper by Cerveny, Klimes and Psencik (2005, in press). The paper is devoted to the basic features of the seismic ray method, its recent extensions, and future possibilities. 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.

Application of Hamiltonian ray tracing, dynamic ray tracing and corresponding equations for travel-time perturbations can considerably simplify the equations for the propagation of electromagnetic waves in the general theory of relativity (Klimes, 2005c, 2005d; Tarantola, Klimes, Pozo and Coll, 2005).

Seismic waves in anisotropic viscoelastic media

Considerable attention has been devoted to homogeneous and inhomogeneous harmonic plane waves propagating in anisotropic viscoelastic media. Cerveny and Psencik (2005d, 2005e) studied, theoretically and numerically, the slowness vectors of these waves. Both inhomogeneous and homogeneous plane waves are considered. The main attention was devoted to the phase velocities, amplitude decay along the propagation direction, attenuation, attenuation angle and polarization vectors. Analysis of the obtained results reveals certain

phenomena unfamiliar from studies of plane-wave propagation in perfectly elastic anisotropic or viscoelastic isotropic media.

Cerveny and Psencik (2005c) also studied the properties of the energy flux of plane waves, propagating in viscoelastic anisotropic media. A great attention was devoted to the energy velocity and to the loss factor. Both P and S waves were investigated. Numerical examples were presented.

Cerveny and Psencik (2005a, 2005b, submitted 2005) studied the polarization of plane waves, propagating in viscoelastic anisotropic media. They demonstrated that the polarization is, in general, elliptical. For homogeneous plane waves, the polarization is usually nearly linear, with large eccentricity. The eccentricity decreases with increasing inhomogeneity. Many numerical examples are presented.

Anisotropic ray theory

A simplified construction of the 4x4 paraxial propagator matrix in ray-centred coordinates has been proposed (Cerveny and Moser, 2005). In this construction, dynamic ray tracing in ray-centred coordinates is not needed, only conventional dynamic ray tracing in Cartesian coordinates is exploited. The 4x4 paraxial propagator matrix in ray-centred coordinates is then obtained by simple transformations at the initial point of the ray and at any other point of the ray, wherever it is needed.

A new algorithm of surface-to-surface paraxial ray tracing in anisotropic inhomogeneous layered media was proposed (Moser and Cerveny, submitted 2005). The algorithm is fully based on dynamic ray tracing in Cartesian coordinates. Certain important applications of the proposed algorithm in seismology and seismic exploration are discussed in detail.

Klimes (submitted 2005b) derived explicit equations for the perturbations and spatial derivatives of amplitude in isotropic and anisotropic media. The perturbations and spatial derivatives of the amplitude exponent can be calculated by numerical quadratures along an unperturbed ray in the reference medium, analogously as the perturbations and spatial derivatives of travel time.

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 2005a).

Coupling ray theory

Coupling ray theory is required for modeling propagation of S waves in heterogeneous weakly anisotropic media. 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 (Klimes, submitted 2005c). The method was applied to the calculation of coupling-ray-theory seismograms (Klimes and Bulant, submitted 2005).

Klimes and Bulant (2005, submitted 2005) derived the equations for calculating the second-order perturbation expansion of travel time along the anisotropic common S-wave ray. The second-order terms in the perturbation expansion from the anisotropic common S-wave ray to the anisotropic-ray-theory rays can be used to estimate the errors due to the anisotropic-common-ray approximation of the coupling ray theory. The authors took advantage of their experience with calculating the analogous second-order perturbation expansions along the reference isotropic-ray-theory rays.

Velocity macro models and numerical ray tracing

Construction of velocity models suitable for ray tracing from field VSP measurements and from sonic velocity logs was tested. A possibility to determine the medium correlation unction from sonic velocity logs was also studied.Capabilities of the ray tracing software developed at the Department of Geophysics have further been extended (Klimes and Bulant, 2005).

Numerical ray tracing has been tested on various 3-D synthetic structures, including the smoothed SEG/EAGE Salt Model. The finite-difference seismograms in the elastic SEG/EAGE Salt Model were compared with the ray-theory seismograms calculated using the SW3D software (Bucha, 2005).

Gaussian-packet prestack depth migration

Optimization of the shape of Gaussian beams (Zacek, submitted 2005a) enables the Gaussian-packet prestack depth migration to be applied to more complex velocity models, its accuracy to be improved.

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, 2005b, submitted 2005b).

The theory used for the Gaussian packet common-shot migration was described and a numerical test was performed in the Marmousi model (Zacek, 2005a, 2005c, 2005d, submitted 2005c). The numerical test includes examples of both a single common-shot migrated section and a stacked common-shot migrated section.

K. Zacek defended his PhD thesis Gaussian packet prestack depth migration (Zacek, 2005e) on September 21, 2005.

CD-ROM with SW3D software, data and papers

Compact disk SW3D-CD-9 (Bucha and Bulant, 2005) contains the revised and updated versions of the software developed within the consortium research project Seismic Waves in Complex 3-D Structures (SW3D) together with input data used in various calculations. Compact disk SW3D-CD-9 also contains over 220 complete papers from journals and from SW3D consortium research reports. From new features of the SW3D software, let us mention the calculation of the second-order terms in the perturbation expansion from the anisotropic common S-wave ray to the anisotropic-ray-theory rays, which can be used to evaluate the errors due to the anisotropic-common-ray approximation of the coupling ray theory.

Earthquake and structural studies

Seismic stations of the Charles University in Greece

Four stations in Greece are jointly operated by the Charles university Prague and the Patras University since 1997. Each station is 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, and 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 southwest of the Pelloponesos.

Long period disturbances on broad-band records

Strange long period pulses occasionally present on the CMG 3-T broadband records of small nearby earthquakes have been explained as normal instrumental response to a specific 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, 2005). We found similar effects also on records of STS-2 and Le-3D/20s broadband instruments. The disturbances like that are very dangerous because they are not always readily "visible" in the records, but, anyway, they may significantly bias the seismic source studies (in particular during routine automatic procedures not specifically adjusted to these problems). A simple way how to detect presence of the long-period disturbances has been suggested, and a method how to "clean" the records prior any further use in seismic source studies has been proposed.

ISOLA (isolated asperities) code

Main use of our data mentioned above (combined with data from National Observatory of Athens) has focused in 2005 on a set of 6 selected small earthquakes (M<4.5), studied within framework of the EC project 3HAZ-CORINTH, coordinated by P. Bernard, IPGP, Paris. Particular attention was paid not only to the practical source-parameter retrieval, but also on further development of our new code ISOLA. The code serves for multiple point-source moment tensor inversion based on full waveform data at regional and/or local distances. The Fortran part of the code (author J. Zahradnik) has been released for public use (http://geo.mff.cuni.cz/~jz/tmp/ISOLA05C), including simple documentation and a test example. In parallel, a user friendly graphic interface in Matlab has been elaborated by E. Sokos in Patras, and its public release is expected in the beginning of 2006.

The ISOLA code was successfully applied to the 2003 Lefkada earthquake of M6.3 (Zahradnik et al., 2005). The retrieved 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.

Z. Roumelioti from the University in Thessaloniki worked with us in Prague for six weeks as a guest of the EC project MAGMA, and successfully applied the ISOLA code to another earthquake. It was the 2001 earthquake of M6.5 at Skyros Island, Greece, previously studied by her slip inversion method based on empirical Green's functions. A paper under preparation will include also work of V. Plicka whose nonlinear slip inversion code (based on patch method of M. Valee) provided results close to the latter two methods.

Strong-ground motion simulation

I. Oprsal and J. Zahradnik made and submitted (http://geo.mff.cuni.cz/~io/tf_2005/tf_2005.htm) their strong-motion "blind" prediction within the Turkey-Flat, California, international experiment on the site-, path- and source effects. The experiment is devoted to the Parkfield, California, M6 earthquake of Sep 28, 2004. In contrast to the weak-motion "blind" experiment carried out at the same site 15 years ago, we focused on the finite-extent source effects at near-source distances and performed our composite-source modeling based on a published slip distribution. Comparison with true ground motions (existing, but kept secret till the end of this experiment) will be possible in 2006.

Two strong-ground motion simulation techniques were investigated as regards their directivity (Gallovic and Burjanek, submitted). It was a composite-source model with fractal subevent size distribution and an integral k-squared model with k-dependent rise time, where k stands for the wavenumber. We check the simulations in 1-D layered crustal model against empirical PGA attenuation relations. We assume that any synthetic model for a particular earthquake should not provide PGA scatter larger than scatter observed in a large set of earthquakes. As a test example, the 1999 Athens earthquake (Mw=5.9) was studied. In the composite method, the synthetic data have their scatter lower than that of the empirical attenuation relations. On the other hand, the k-squared method provides a larger scatter, related to a very strong (perhaps not realistic) directivity at high frequencies. It is shown how to reduced the high-frequency directivity by a formal spectral modification.

F. Gallovic and J. Brokesova (posters at AGU 2005 and a paper under preparation) combined the integral source model at low frequencies and the composite-source model at high frequencies. They also employed their finite-extent source and numerical ground-motion simulations into framework of the probabilistic seismic hazard assessment (PSHA). Main practical application was focused on simulation of the 1980 Irpinia earthquake of M6.9, Southern Italy, using a complex multiple source model. This work was done in a close cooperation with the University of Naples (A. Zollo, A. Emolo). When comparing to the classical PSHA method based on empirical attenuation relations, the hazard maps obtained with the hybrid simulation provide considerably more detail, and allow separate analysis of the involved physical effects, such as those of the slip heterogeneity, the radiation pattern, and the directivity. The availability of synthetic waveforms also enables much easier and full consideration of realistic site effects in comparison with simple amplification factors used in the classical PSHA method. Moreover, the hazard analysis can be extended to any ground motion parameter that can be retrieved from synthetic seismograms and spectra, not necessarily just peak values.

J. Burjanek (poster at AGU 2005) further tuned his codes for calculating dynamic stress field on the fault whose slip is described by a kinematic source model. It was found that none of the studied models whose slip function has k-dependent rise time is in contradiction to recent models of the earthquake source dynamics. The strength excess, dynamic stress drop and fracture energy strongly correlate with static stress-drop distribution. However, since results are quite sensitive to spatio-temporal filtering, unavoidable in any practical retrieval of the slip distribution of real events, one has to be very careful in interpreting stress-time histories obtained from such kinematic models.

The 3-D hybrid earthquake modeling

The 3-D modeling based on a hybrid combination of the source, path and site effects, being methodically developed since 2002, has been again 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 site effects are modeled by the 3-D finite-difference method (I. Oprsal). The hybrid modeling proved to be an efficient tool up to frequencies of engineering interest. As such, it was successfully applied to study several deterministic strong-motion scenarios of a hypothetical future strong M6 earthquake in Basel, Switzerland (Oprsal et al., 2005). The work resulted from fruitful cooperation with ETH, Zurich, where I. Oprsal completed in 2005 his 4-year post-doc stay.

Location and structural studies

One-dimensional qP wave velocity model of the upper crust for the West Bohemia/Vogtland earthquake swarm region was developed (Malek et al., 2005). Analytical partial derivatives of the phase- and group velocities for Rayleigh waves propagating in a layer on a half-space, needed in various inversion schemes, were derived by Novotny et al. (2005). Various methods and their combinations were developed and extensively tested to simultaneously invert arrival times of seismic waves into earthquake location and 1-D crustal structure by O. Novotny, J. Jansky and V. Plicka: (i) Nearest Neighbour Algorithm (code of M. Sambridge) to search for 1-D models composed of layers with constant velocity (location performed by the conjugate gradient method), or 1-D models composed of layers with constant velocity gradients (location by the grid search), and (ii) The conjugate gradient method for both location and structural model.

Structural studies in the Gulf of Corinth, Greece

New 1-D models of the upper crust in the Egion region, Greece, were suggested (Novotny et al., submitted). They were inferred from arrival times of simultaneously relocated 133 events of the 2001 earthquake sequence, based on data of the so-called Corinth Rift Laboratory (CRL) project, and the on-going 3HAZ-CORINTH European project. For standard earthquake locations, CRL uses the HYPO algorithm and a special structural model derived from a passive seismic experiment in an broader area around the western part of the Corinth Gulf. We used an improved version of the conjugate gradients method for both structural models and location. Analytical formulae have been derived for the arrival-time partial derivatives, needed in the method. Only models composed of 4 homogeneous layers with velocity increasing with depth have been considered. A set of satisfactory models based on minimization of the travel time residuals have been found. The main result is that their velocities are higher than those in the CRL model and the recently published tomographic models.

Attachment B PUBLICATIONS IN 2005

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Attachment C SEMINARS IN 2005

Geodynamics Seminar

- Jan 5: T. Pergler (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Three-dimensional finite elements
- Mar 16: C. Matyska (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  PPP
- Mar 16: J. van Summeren (Utrecht University, The Netherlands)
  On the survival of a heterogeneous deep mantle reservoir: constraints from evolutionary numerical mantle convection models
- Mar 23: H. Schmeling (Frankfurt University, Germany)
  The problem of modeling subduction in numerical codes
- Mar 30: M. Pauer (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Is the Martian crust thin or thick?
- Apr 6: G. Marquart (Frankfurt University, Germany)
  A numerical approach to model the accretion of Icelandic crust
- Apr 13: A. van den Berg (Utrecht University, The Netherlands)
  Mars from crust to core: some global physical considerations
- Apr 20: J. Pek (Geophysical Institute, Czech Academy of Sciences)
  Magneto-telluric methods of electric conductivity investigation
- May 4: J. Velimsky (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  EM induction: modeling in the time domain, 1-D a 2.5-D data inversion from satellite CHAMP
- May 25: I. Sasgen (GeoForschungsZentrum Potsdam, Germany)
  Geodetic signatures of glacial changes in Antarctica
- Oct 12: N. Tosi (GeoForschungsZentrum Potsdam, Germany)
  Spherical harmonic-finite element approach to present-day mantle convection
- Oct 26: R. Hengst (GeoForschungsZentrum Potsdam, Germany)
  The continental water storage - variations of the Earth's rotation caused by hydrological effects
- Nov 2: F. Nemec (Department of Electronics and Vacuum Physics, Faculty of Math. and Phys., Charles Univ.)
  Influence of earthquakes on intensity of electromagnetic waves in the upper ionosphere
- Nov 9: J. Velimsky (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  (In)finite elements in modeling viscoelastic response of the Earth
- Nov 16: M. Behounkova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Relationship between temperature anomalies and seismic velocities in the lower mantle
- Nov 23: H. Cizkova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Stress in subducting lithospheric plates - influence of a boundary condition in a numerical model
- Dec 7: G. Kocurek (University of Texas at Austin, USA)
  Sedimentary Geology on Mars: Aeolian Dune Patterns and Signs of Ancient Water Bodies
- Dec 14: O. Cadek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Constraints on mantle flow from geoid, dynamic topography and seismic anisotropy
- Dec 19: Ch. Sotin (University of Nantes, France)
  News from Mars and Titan

Seminars of Czech Meteorological Society

- Mar 8: J. Zahradnik (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Preliminary findings on the Sumatra earthquake
- Mar 22: P. Pisoft (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  Pseudo-2D wavelet transformation of NCEP/NCAR reanalyses: first results
- Apr 19: J. Miksovsky (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  Chaos and nonlinearity in climatic time series
- May 17: T. Halenka (Department of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  On the influence of solar activity on processes in Earth atmosphere
- Dec 20: A. Farda (Czech Hydrometeorological Institute), T. Halenka (Dept. of Meteorology and Env. Prot., Fac. of Math. and Phys., Charles University)
  First experience with regional climate model ALADIN-CLIMATE, project ENSEMBLES

Seismology Seminar

- Jan 7: P. Franek (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Numerical modeling of seismic movement in the Volvi Lake sedimentary valley in Greece by the FD method
- Jan 14: S. Miller (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Omori's law and fluid-driven aftershocks
- Feb 8: A. Serpetsidaki (University of Patras, Greece)
  Athens 1999 earthquake - ground motion analysis
- Feb 25: A. Serpetsidaki (University of Patras, Greece)
  Analysis of Athens 1999 earthquake
- Mar 4: P. Adamova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Iterative deconvolution of regional seismographs of earthquakes in the west Greece
- Mar 18: A. Emolo (University of Naples, Federico II., Italy)
  Seismic hazard assessment for a characteristic earthquake scenario: integrating probabilistic and deterministic approaches
- Mar 25: Z. Roumelioti (Aristotle University of Thessaloniki, Greece)
  Modeling earthquakes in Greece
- Mar 29 (in Geoph. Inst. of Czech Acad. of Sci.): D. Rossler (University of Potsdam, Germany)
  Inversion of moment tensors in anisotropic media
- Apr 1: M. Galis (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Numerical simulation of the rupture formation and propagation and seismic motion modeling
- Apr 8: P. Kolinsky (Institute of Rock Structure and Mechanics, Czech Academy of Sciences)
  Analysis and inversion of surface waves - demonstration of a programming code
- Apr 15: T. Fischer (Geophysical Institute, Czech Academy of Sciences)
  Possible effects of tidal stress on earthquake triggerring: application on swarms in the west Bohemia
- Apr 22: P. Kalenda, J. Malek (Institute of Rock Structure and Mechanics, Czech Academy of Sciences)
  Earthquakes and tides, part II
- May 6: J. Jansky, V. Plicka, O. Novotny (Department of Geophysics, Faculty of Math. and Phys., Charles Univ.)
  One-dimensional model for the area of Egion and location of earthquakes
- May 13: F. Gallovic (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Probability estimate of seismic hazard by aftershocks
- May 20: J. Brokesova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  On rotational components of seismic movement I
- May 27: J. Brokesova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  On rotational components of seismic movement II
- Jun 3: A. Caserta (INGV Rome, Italy)
  Statistical features of the seismic noise
- Oct 19 (in Geoph. Inst. of Czech Acad. of Sci.): Ch. Chapman (Schlumberger Cambr. Res., United Kingdom)
  The Asian Tsunami in Sri Lanka – a personal experience (or Airy functions in action!)
- Oct 26 (in Geoph. Inst. of Czech Acad. of Sci.): Ch. Chapman (Schlumberger Cambr. Res., United Kingdom)
  Modelling of Scattering of Seismic Waves from a Currugated Rough Sea Surface: a comparison of 3 methods
- Nov 2 (in Geoph. Inst. of Czech Acad. of Sci.): K. Helbig (Hannover, Germany)
  The structure of the elastic tensor: A study of the possibilities opened up by Kelvin 150 years ago
- Nov 4: T. Fischer (Geophysical Institute, Czech Academy of Sciences)
  Dynamics of westbohemian earthquake swarms
- Nov 11: F. Gallovic (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Deterministic and probabilistic model of the Irpinia, 1980 earthquake
- Nov 18: A. Caserta (INGV Rome, Italy)
  Soil shaking features in the city of Rome, Italy
- Nov 25: P. Adamova, E. Sokos, J. Zahradnik (Dept. of Geophysics, Fac. of Math. and Phys., Charles Univ.)
  Software ISOLA for the moment inversion of seismograms
- Dec 2: S. Richwalski (GeoForschungsZentrum Potsdam, Germany)
  Site effects in urban areas
- Dec 9: P. Adamova (Department of Geophysics, Faculty of Math. and Phys., Charles University)
  Moment inversion of complete seismograms and some intrumental defects
- Dec 13: H. Lyon-Caen (ENS Paris, France)
  Corinth Rift Laboratory, seismic studies
- Dec 14: O. Kulhanek (Uppsala University, Sweden)
  Seminar on b-value
- Dec 16: J. Vilhelm (Department of Applied Geophysics, Faculty of Natural Sciences, Charles University)
  Applied geophysics on the Faculty of Natural Sciences: information on pedagogical and scientific work