Karlsruhe Institute of Technology

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NEWSLETTER OF THE GEOPHYSICAL INSTITUTE

Issue 6, December 2014

DEAR GPI ALUMNI

This is the sixth newsletter for our alumni's covering events in the second half of the year 2014 with relevance for GPI.
The most exciting topic for most of us was the participation of Dr. Alexander Gerst in the Blue Dot Mission. Alexander received the diploma degree of Karlsruhe University in 2003 for experimental work on Ruapehu Volcano in New Zealand with Friedemann Wenzel and Martha Savage as Supervisors. Simultaneously he earned a master's degree in Earth sciences from the Victoria University of Wellington, New Zealand. Both degrees were awarded with distinction. After having been assigned to fly to the International Space Station in 2011 he served as a flight engineer for Expeditions 40 and 41. He was launched on a Soyuz spacecraft from the Baikonur Cosmodrome in Kazakhstan in May 2014 and returned safely to Earth, after 166 days in space, in November 2014. During this time he conducted a demanding research program on ISS. We are very happy to have him back on earth and hope that, next year, he can share his experience with us.

Friedemann Wenzel

GEOPHYSIK ALUMNI Karlsruhe

TEACHING

By Ellen Gottschämmer

Currently, almost 100 students are enrolled in the Geophysics degree courses offered at KIT: There are a bit over 60 students in the Bachelor's program, 30 students in the Master's program and still 4 students in the Diplom program.

Due to the fact that, starting last year, Geophysics can be chosen as elective subject in the KIT Physics Bachelor's degree course, we registered a small but significant number of former Physics students as lateral entrants into the Geophysics Bachelor's program. However, the number of students in the first year of the Bachelor's program has significantly decreased in 2014, as it was the case for many disciplines at KIT this semester.

As in recent years, the Master's program is attractive for our own Bachelor's students, but also for students from other universities or from varying fields of study: We received applications not only from students holding a Bachelor's degree in Geophysics, but also in Physics, Mathematics or Geosciences.

In addition, there are about 50 KIT Geoscience students which attend the course Introduction to Geophysics 1 as compulsory subject, and about 30 of them who continue their geophysical education choosing courses from our Bachelor's program as elective subject.

Since many years, teaching at KIT is evaluated by the students, and the result of the evaluation is expressed in a quality index (Lehrqualitätsindex, LQI), ranging from 0 – 100. In recent years, the LQI for the courses given by GPI staff has always been in the high 90's, but during last summer semester there was no single course at GPI with a LQI below 100.

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This reflects the high quality of teaching at GPI which was also underlined by the fact that the exercise 'Introduction to Geophysics 2' yet again won the teaching award for the best exercise of the Faculty of Physics during summer semester 2014.

Several lectures were taught as a combination of classroom- and field-lecture. This new teaching format is established as *in situ lecturing* at GPI: In April 2014, students had the opportunity to study the importance of historical records in seismology for seismic hazard assessment, a lecture which was partly performed at the Museum of Seismology and Earth Magnetism, Strasbourg, and selected sites in the Upper Rhinegraben. In July 2014, the effects of induced seismicity and its monitoring were investigated in the mining region Thüringen after an intensive preparation of the subject in the classroom during the summer semester. Finally, in November 2014 investigations of the deep structure of a volcanic complex were addressed by the students during a four-day *in situ lecture* at the Vogelsberg, Germany, again preceded by preparatory classes at GPI. For 2015, further *in situ lectures* are planned, e.g. about geophysical exploration of volcanic fields in the Eifel volcanic region.

Vogelberg: Students on the Bilstein, a cliff made of black basanite originating from a volcanic eruption.

Photo: Ellen Gottschämmer

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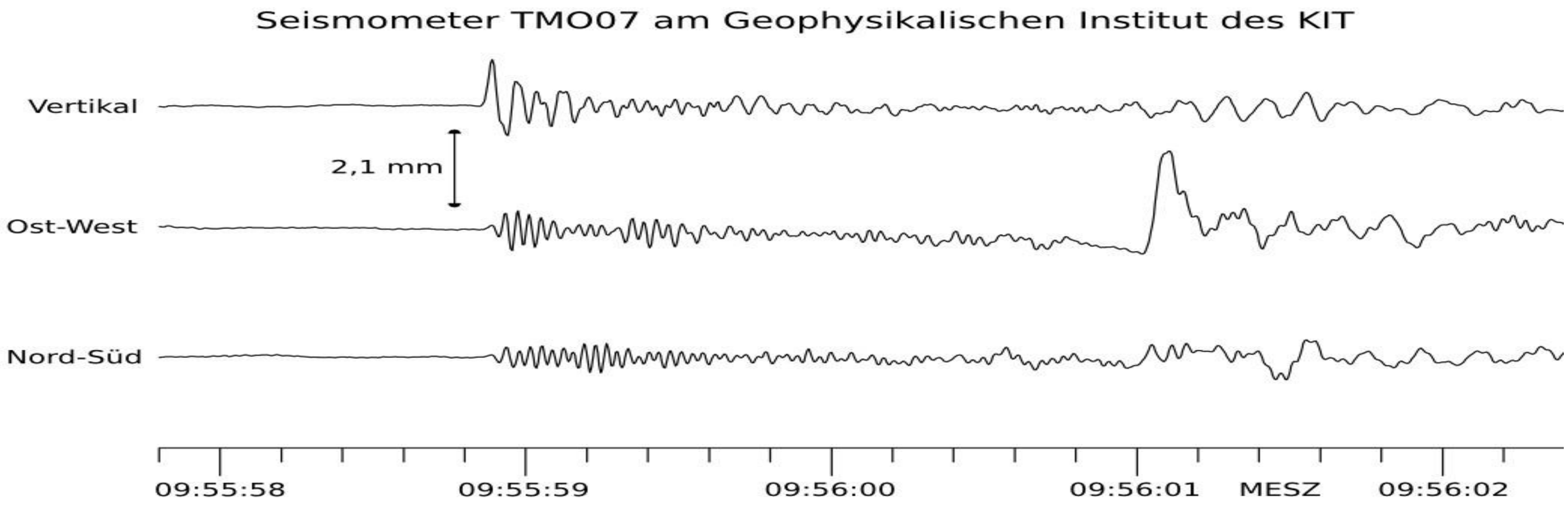
EARTHQUAKE BELOW THE CITY OF KARLSRUHE

By Andreas Barth

In the morning of September 24, 2014 at 9:55 local time (MESZ) a magnitude M_L 2.3 earthquake occurred below the city of Karlsruhe. Earthquakes of this magnitude have an average return period of 9 months in the central Upper Rhine Graben between Freiburg and Karlsruhe. The analysis of 36 P- and 26 S-wave arrival times at local seismic stations of the Karlsruher Broadband Array (KABBA) and permanent stations in Germany and France results in a hypocentral depth of 8 km below the urban district of Daxlanden/Rappenwörth. The seismic recording at the Geophysical Institute - where the earthquake was felt by a few people - shows a maximum ground displacement of 2.1 mm.



GUESTS HOSTED BY GPI

Mr. Ahmed Zemmar

Mr. Ahmed Zemmar joined the Hazard and Risk Group of GPI for one month with a scholarship of his home university: University of Chlef (Hassiba Ben Bouali), Algeria. He is an architect with magister degree in urban planning and prepares a doctorate in urban planning at the University of Biskra (Mohamed Khider), Algeria. His work focusses on an indicators system for the evaluation of seismic risk and its induced effects for Algerian cities. It aims to the identification of indicators able to allow the assessment of vulnerability to seismic hazard and the identification of the factors that contribute in its increase.

Dr. Mostafa Toni

Dr. Mostafa Toni from the Faculty of Science of Helwan University in Cairo is spending 6 months at GPI as a postdoctoral fellowship from the Egyptian Ministry of Higher Education and Scientific Research. During his stay at GPI he works on probabilistic seismic hazard and risk analysis for the Western coast of Rad Sea and Gulf of Suez.

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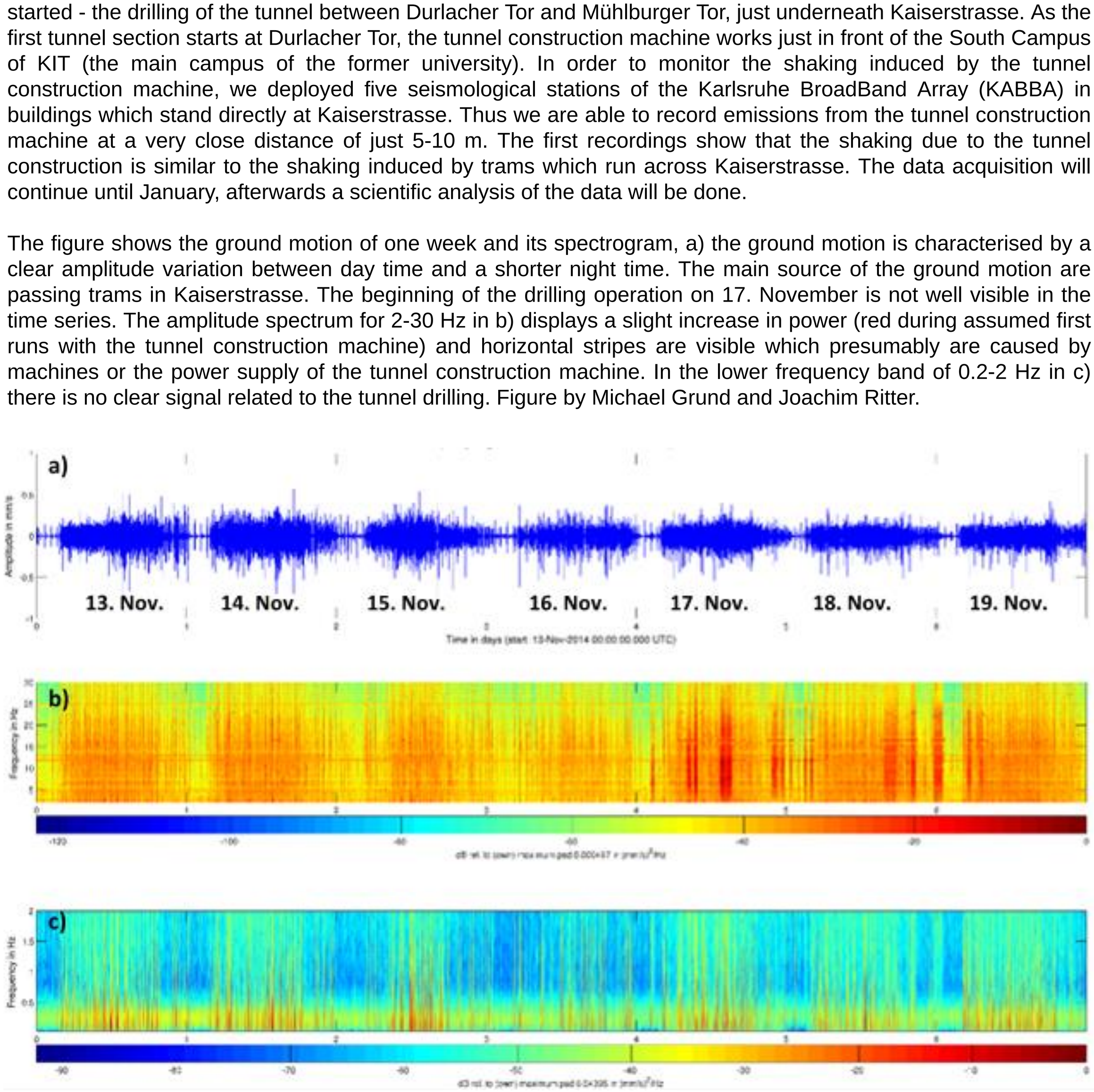
MONITORING THE TUNNEL BORING IN KARLSRUHE

By Joachim Ritter and Michael Grund

A tunnel for an underground tram is currently built in Karlsruhe. This approx. one-billion euro project is one of the most important issues going on in the city during the last years. In November a main part of the construction was started - the drilling of the tunnel between Durlacher Tor and Mühlburger Tor, just underneath Kaiserstrasse. As the first tunnel section starts at Durlacher Tor, the tunnel construction machine works just in front of the South Campus of KIT (the main campus of the former university). In order to monitor the shaking induced by the tunnel construction machine, we deployed five seismological stations of the Karlsruhe BroadBand Array (KABBA) in buildings which stand directly at Kaiserstrasse. Thus we are able to record emissions from the tunnel construction machine at a very close distance of just 5-10 m. The first recordings show that the shaking due to the tunnel construction is similar to the shaking induced by trams which run across Kaiserstrasse. The data acquisition will continue until January, afterwards a scientific analysis of the data will be done.

The figure shows the ground motion of one week and its spectrogram, a) the ground motion is characterised by a clear amplitude variation between day time and a shorter night time. The main source of the ground motion are passing trams in Kaiserstrasse. The beginning of the drilling operation on 17. November is not well visible in the time series. The amplitude spectrum for 2-30 Hz in b) displays a slight increase in power (red during assumed first runs with the tunnel construction machine) and horizontal stripes are visible which presumably are caused by machines or the power supply of the tunnel construction machine. In the lower frequency band of 0.2-2 Hz in c) there is no clear signal related to the tunnel drilling. Figure by Michael Grund and Joachim Ritter.



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DEEP – DEEP EIFEL EARTHQUAKE PROJECT

By Joachim Ritter

In September 2013 two subcrustal earthquakes occurred below the East Eifel volcanic field, about 12 km west of Koblenz. The hypocentre depths of about 40-43 km are a German depth record! Besides this unusual depths, the earthquakes are not well understood, because we expect an ambient temperature of about 900 °C near the hypocentre – this means a petrophysical regime in which brittle deformation should not occur. To learn more about these unusually deep earthquakes, GPI together with the Landesamt für Geologie and Bergbau, Rheinland-Pfalz and the Deutsches GeoForschungsZentrum Potsdam started a seismological experiment to monitor the seismicity below the East Eifel. Ten short-period recording stations from Potsdam and two KABBA stations were deployed since August 2014. These recording stations were placed between permanent stations to achieve an increased detection capability and a high precision for event locations.

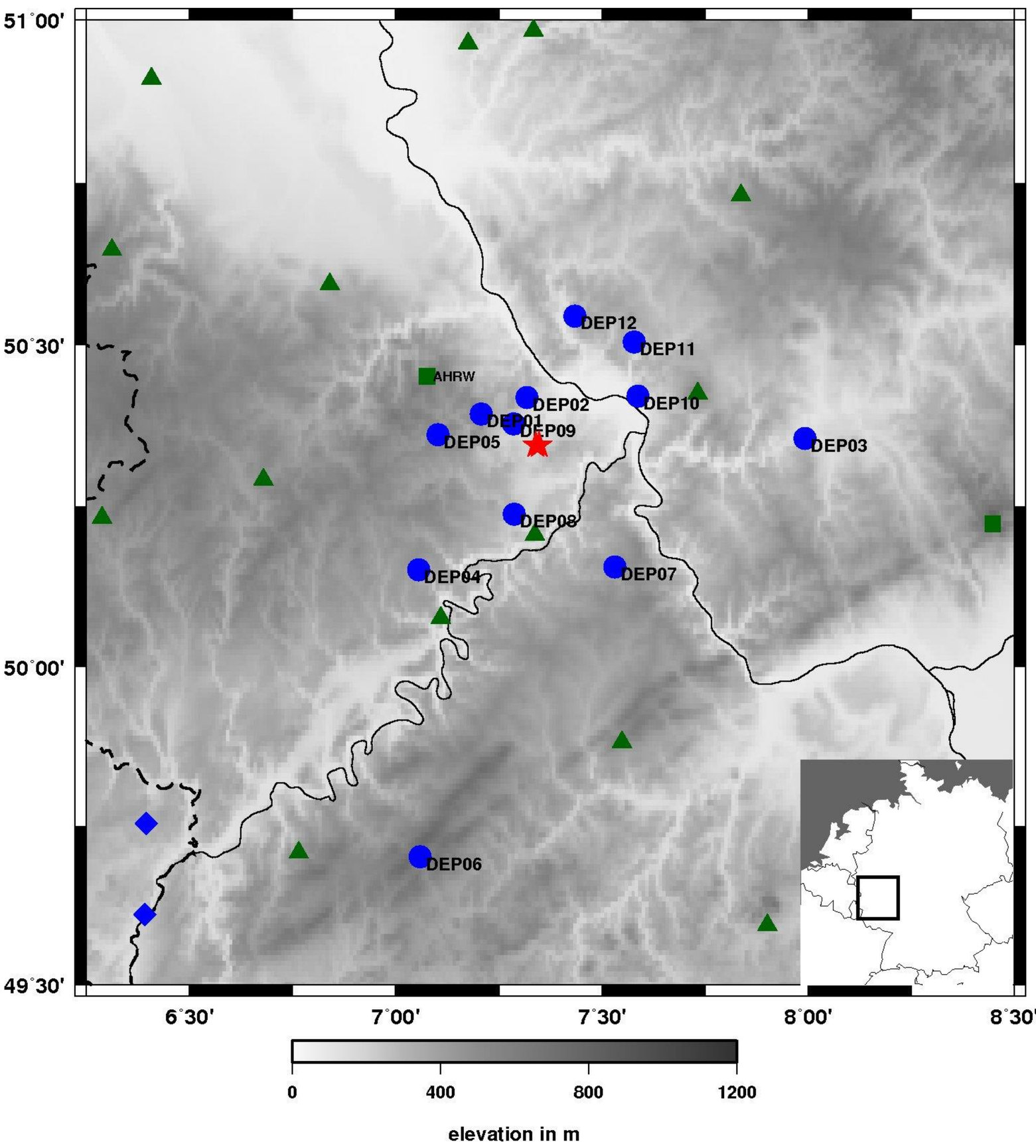

Figure: Map with the DEEP experiment. Blue dots are temporary DEEP stations, blue diamonds are KABBA stations in Luxembourg (LuxBB experiment), green triangles are permanent short-period stations and green squares are permanent broadband stations. The red stars indicate the epicentres of the subcrustal earthquakes in 2013.

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INNOVATIVE SOLUTIONS FOR CRITICAL INFRASTRUCTURE PROTECTION AND SOCIETAL RESILIECE

By Bijan Khazai and Friedemann Wenzel

Responding to the *European Commission Call DRS-07-2014-2015: Crisis Management Topic 7: Crises and disaster resilience – operationalizing resilience concepts*, Bijan Khazai and Friedemann Wenzel coordinated a multi-disciplinary consortium of 18 partners ranging from civil protection to risk modelling, disaster science and communication. The key aim of the proposed project, named ROBUST (Resilience Operationalization for BUilding Secure CriTical Infrastructure in Europe), is to develop validated, pragmatic and operationalized resilience frameworks, principles and management guidelines for Critical Infrastructure in the European Union. The approach proposed in ROBUST is firmly grounded in the EU Risk Assessment and Risk Management Guidelines (ISO31000) and meets the key elements of the new approach to European Program for Critical Infrastructure Protection (EPCIP). It addresses Critical Infrastructure (CI) resilience in Europe from a systems and multi-disciplinary risk-based perspective that considers CI interdependencies and cascade processes across, and within, CI sectors. The approach is embedded in a stakeholder-led process for resolving inconsistent resilience concepts to build Europe-wide management guidelines and principles that can be operationalized at local, regional, national and cross-border and cross-sectoral levels.

In particular we proposed to investigate CI disruptions by bringing together model-based (simulations) and knowledge-based (stakeholder input) through an innovative interactive dynamic scenario planning tool and game, which takes into account feedback loops (including, organizational responses, cascading effects, etc.). Building on the back of past EU Projects (SYNER-G, SENSUM, MATRIX), the use of scenario planning as an aid to policy making in ROBUST is the core proposition for the integration of quantitative and qualitative approaches, as a way to involve multiple stakeholders in policy decisions.

In ROBUST, the energy (electricity and gas) and transport sectors as well as CI disruptions impacting the emergency services sector (emergency management and first response areas) stemming from a range of natural and man-made hazards, including floods, earthquakes, tsunami, terrorism and industrial accidents are considered as the key focus areas. Concepts and principles for operationalizing resilience were proposed for testing in a pilot case study at the Karlsruhe Institute of Technology (Germany), which replicates a small community including emergency responders. In addition, two integrated demonstration ‘use cases’ - Istanbul (Turkey) and Groningen (Netherlands) were proposed for testing, validating and enhancing Guidelines for operationalizing resilience for selected Critical Infrastructure (CI) sectors. ROBUST also put together a unique Stakeholder Board of multi-national emergency management, critical infrastructure operators and policy-makers, and a strong emphasis on stakeholder engagement across Europe in building the way forward for operationalizing CI resilience beyond the use cases of Istanbul and Groningen to cross-border levels and cross-sectoral networks.

Photo:Wikipedia

Istanbul was proposed as a use, with a focus on transport, energy and water sector in ROBUST. As a result of existing risk studies and data available in Istanbul, it is possible to explore the interdependencies and interactions within and between the infrastructures and services to extend risk assessments to a resilience perspective. The Istanbul Metropolitan Municipality (IMM) is an active partner in ROBUST allowing the project team to engage with a broad range of stakeholders (e.g., gas company, water company, transportation authority, fire brigade, municipal police, crisis response unit), which are all owned and operated by IMM.

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SUGAR III

By Thomas Bohlen

With the start of the third phase of the project SUGAR (SUbmarine GAs hydrate Resources) on October 1, 2014, the group of applied geophysics joins a team of national companies and research facilities to support the development of strategies for the production of natural gas from methane-hydrate deposits. During the next 3 years we will apply and develop our acoustic and elastic full waveform inversion software to derive high fidelity subsurface models from ocean bottom seismometer data which was recorded at the Danube Delta fan in the Black Sea. The work within the subproject „geophysical exploration and data analysis“ with our partners GEOMAR, TEEC and Terrasys is aimed at a joint inversion of geophysical parameters combining seismic, electro-magnetic and gravimetric measurements. Results will contribute to the characterization of the gas hydrate deposits and lead to determining a location for a planned test drill site.

RECENT PUBLICATIONS

In this section we would like to inform those of you who are still active in Geophysics about recently published peer-reviewed journal papers authored by current members of GPI:

Kappas, M., Kubanek, J., Nolte, E.-M., Taubenböck, H. and Wenzel, F.: Capacities of Remote Sensing for Population Estimation in Urban Areas, pages 45-66; ISBN:978-94-007-7980-8, 01/2014

Fleming, K., Khazai, B., Komendantova, N., Mignan, A., Mrzyglocki, R., Patt, A. and Wenzel, F.: Multi-hazard and multi-risk decision support tools as a part of participatory risk governance: feedback from civil protection stakeholders. International Journal of Disaster Risk Reduction. 01/2014.

Daniell, J.E., Goda, K. and Wenzel, F.: “Insurance and Re-insurance Models for Earthquake”, Chapter 29, eds. Michael Beer, Edoardo Patelli, Ioannis Kougioumtzoglou and Ivan Siu-Kui Au in “Encyclopaedia of Earthquake Engineering”, Springer, 2014.

Daniell, J.E., Wenzel, F.: “The production and implementation of socioeconomic fragility functions for use in rapid worldwide earthquake loss estimation,” Paper No. 490, 15th ECEE (European Conference of Earthquake Engineering), Istanbul, Turkey, 2014.

Daniell J.E., Khazai, B., Santiago J.G., Schäfer A., Wenzel, F.: “A worldwide seismic code index, country-by-country global building practice factor and socioeconomic vulnerability indices for use in earthquake loss estimation,” Paper No. 1400, 15th ECEE, Istanbul, Turkey, 2014.

Daniell, J.E., Wenzel, F.: “The Economics of Earthquakes: A reanalysis of 1900-2013 historical losses and a new concept of capital loss vs. cost using the CATDAT Damaging Earthquakes Database,” Paper No. 1505, 15th ECEE (European Conference of Earthquake Engineering), Istanbul, Turkey, 2014.

Daniell, J.E., Reiss, A. and Wenzel, F.: “Measuring Residual Risk in Earthquakes”, Paper No. 853, 15th ECEE (European Conference of Earthquake Engineering), Istanbul, Turkey, 2014.

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Sokolov, V., Wenzel, F.: On the modeling of ground-motion field for assessment of multiple-location hazard, damage, and loss: example of estimation of electric network performance during scenario earthquake, Nat Hazards, DOI 10.1007/s11069-014-1262-9, 2014

Groos, L., Schäfer, M., Forbriger, T., Bohlen, T.: 2014: The role of attenuation in 2D full-waveform inversion of shallow-seismic body and Rayleigh waves. Geophysics, 79(6), R247-R261. (doi: 10.1190/geo2013-0462.1) http://dx.doi.org/10.1190/geo2013-0462.1

Diez, A., Eisen, P., Weikusat, I., Eichler, J., Hofstede, C., Bohleber, P., Bohlen, T., Polom, U.:
Influence of ice crystal anisotropy on seismic velocity analysis, Annals of Glaciology 55(67) 2014 doi: 10.3189/2014AoG67A002

Dipok, K. B., Sokolov, Y. V., Wenzel, F.: Validation of strong-motion stochastic model using observed ground motion records in north-east India, Geomatics, Natural Hauards and Risk, 2012 http://dx.doi.org/10.1080/19475705.2014.960011

Frietsch, M., Groos, J.C. and Ritter, J.R.R., 2014. Detection and delineation of a fracture zone with observation of seismic shear wave anisotropy in the Upper Rhine Graben, SW Germany. *Pure Appl. Geophys*., DOI 10.1007/s00024-014-0899-3 (16 pp).

Gaßner, L., Groos, J.C. und Ritter, J.R.R., 2014. Herdflächenanalyse induzierter Erdbeben in der Südpfalz: Reaktivierung präexistenter Bruchflächen und Spannungszustand, *Mainzer geowiss. Mitt.*, 42, 195-214.

FEEDBACK

If you have any comments, questions or remarks, please do not hesitate to contact us. We appreciate your feetback.

HISTORY OF GPI

Here you can have a look at the lively history of the Geophysical Institute:

http://www.gpi.kit.edu/download/GPI-50Jahre-Inhalt.pdf

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GPI wishes you all

Happy Holidays

and a wonderful und prosperous

2015