

## NEWSLETTER OF THE GEOPHYSICAL INSTITUTE

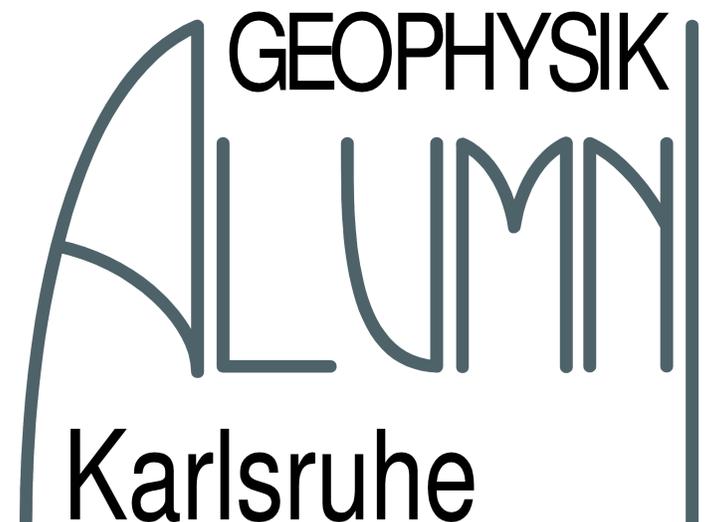
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### DEAR GPI ALUMNI

This Alumni Letter is very much dominated by the April 25, 2015 Nepal earthquake which kept and keeps the hazard and risk group busy. GPI works within the Center for Disaster Management and Risk Reduction Technology (CEDIM, [www.cedim.de](http://www.cedim.de)) with colleagues from other disciplines on rapid loss assessment aiming at the understanding of the course of disasters and factors that aggravate and relief socio-economic losses. In addition to providing good estimates of fatalities and economic losses within 2 days, GPI sent a field team in June to Nepal in order to investigate how shelters were established, why people stay in them and what influences their decisions to leave. The fear of aftershocks and of more landslides is an important factor in these decisions. As a response we are developing tools for estimating the threats of these effects better in the future. The currently available tools are not tuned to needs of relief organizations. We find that the prospects of direct help to endangered people through research is a strong incentive for students to become engaged in this type of research.

Friedemann Wenzel



### TEACHING

By Ellen Gottschämmer

The Geophysics programs at KIT have been revised within the last couple of months, which has resulted in new study and examination regulations, valid for students starting in winter semester 15/16. Within the Bachelor's program, a course on digital signal processing has now been included in the compulsory subjects. This and several other adjustments led to a workload for our students, which is now more equally distributed.

The concept of in situ lecturing is well established within the courses of the Geophysics programs at KIT, and two faculty prizes were won for in-situ-lectures within 2015, for the lectures *Geophysical deep exploration of volcanoes based on the example of Vogelsberg, Germany*, at the end of the winter semester 14/15, and for *Geophysical investigations of volcanic fields*, which was held in the summer semester 15. Further faculty prizes for the best exercise of the faculty were awarded to the *Exercises on Introduction to Geophysics 1 (winter semester 14/15)* and *Exercises on Introduction to Volcanology (summer semester 15)*.

An award will also be given to the Geophysics laboratory for pupils of secondary schools. The award ceremony will take place in November this year. The jury was convinced by the concept of the laboratory, which allows young people to study, work and experiment scientifically and get involved into interdisciplinary problems of social relevance like earthquakes, volcanic eruptions, but also non-destructive testing.

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### WORLD BANK PROJECT ON RISK ASSESSMENT IN AFGHANISTAN

By Friedemann Wenzel

Within a consortium headed by Deltares ([www.deltares.nl](http://www.deltares.nl)) GPI is responsible for the seismic hazard and risk modelling part including earthquake triggered landslides. The highly competitive project 'Multi-hazard risk assessment, cost-benefit analysis and resilient design recommendations' is financed by the World Bank in the context of reconstructing Afghanistan after the civil war. The risk models will be partially probabilistic using stochastic sequences of events but also include deterministic hazard footprints. With regard to structures specific consideration will be given to schools and government buildings. Main challenges include data availability and limited options to work in the country.

### COLLABORATIVE RESEARCH CENTER ON WAVE PHENOMENA ESTABLISHED

By Friedemann Wenzel

The Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) has been funding a new Mathematical Collaborative Research Center on Wave Phenomena at KIT ([www.waves.kit.edu/deutsch/index.php](http://www.waves.kit.edu/deutsch/index.php)) since July 1, 2015. Scientists from analysis and numerics of the Department of Mathematics but also researchers of optics and photonics, biomedical technology, and applied geophysics cooperate in the fields of developing new methods including the interfaces to applications. The geophysics project has been designed by Prof. Thomas Bohlen. The goal of the CRC "Wave Phenomena: Analysis and Numerics" is to analytically understand, numerically simulate, and manipulate the propagation of waves under realistic scenarios. The scientists focus on typical wave phenomena such as the emergence of standing and travelling waves or wave fronts, oscillations and resonances, dispersion, wave guidance, reflection, refraction, and scattering of waves. CRC spokesperson is Prof. Marlis Hochbruck, Head of the Numerical Analysis Research Group of the Institute of Applied and Numerical Mathematics (IANM).

### The NEPAL M7.8 EARTHQUAKE

By Friedemann Wenzel

On Saturday April 25, 2015, noon-time (local) a M7.8 earthquake, later referred to as Gurkha earthquake, shook large parts of Nepal, including the densely populated Kathmandu Valley. A CEDIM ([www.cedim.de](http://www.cedim.de)) team, with many GPI-researchers on board started immediately work on this event in order to provide early estimates on human and economic losses, understand the role of aftershocks, study gaps in information provided by governmental institutions to the public, look into the question how emergency shelters are handled, as compared to the emergency plans, study the specifics of induced landslides, and estimate losses to infrastructure. The entire procedure is called Forensic Disaster Analysis (FDA) and one of CEDIM's major scientific enterprises.

The first numbers on expected losses were published in the first report, 2 days after the event with death toll of 7560 but within limit of 3570 and 11970, total economic losses of 3450 mn. US\$ and replacement costs of 5330 mn. US\$. The current (July, 15) values are 8900 fatalities and 5170 mn. US\$ replacement costs. The proximity of initial estimates to the final numbers has its scientific basis in the estimation methodology developed in James Daniell's PhD thesis (\*) that utilizes historic loss data adjusted to nowadays conditions with the Human Development Index. When we compare it with other estimates provided shortly after the event it is - currently - the best one world-wide. The first and both follow-up reports can be found on [www.cedim.de](http://www.cedim.de). The poster shown on page 3 indicates how the FDA process emerged in this case. CEDIM dispatched a team of GPI-researchers to Nepal in June 2015 to study the shelter issue in detail in rural and urban environments (see the story by Susan Brink).

\* Daniell, J.E. [2014] "Development of socio-economic fragility functions for use in worldwide rapid earthquake loss estimation procedures", Doctoral Thesis, Karlsruhe Institute of Technology, Karlsruhe, Germany.

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## The 2015 Nepal Earthquake Data Sheet

A. Schäfer, J.E. Daniell, B. Khazai, T. Kunz-Plapp, J. Anhorn, T. Girard, S.-A. Brink, F. Wenzel

Magnitude: 7.8, Depth: 18 km

Fatalities: ca. 9000 in Nepal

25.4.: 8826 = Nepal (8665), India (130)

China (27), Bangladesh (4)

12.5.: 232 = Nepal (167), India (62)

China (1), Bangladesh (2)

10 Aftershocks with Fatalities

700-900 Fatalities via Landslides

230 Missing

Injured: 23,000 severe, 80,000 slightly

Homeless: 2.1 Million

Affected: 8 Million

Population: 28.5 Million

Destroyed Homes 500,000

Damaged Homes 250,000

Building Damage: 2.5 bn € (7% of Capital Stock)

Reconstruction Cost: 6-7 bn € (30% of GDP)

Compared to Karlsruhe:

Capital Stock of Karlsruhe 51 bn €

Capital Stock of Nepal 35 bn €



CEDIM-Team in Nepal



Shake Map and historic seismicity around Nepal



Emergency Shelters



Landslide destroyed village

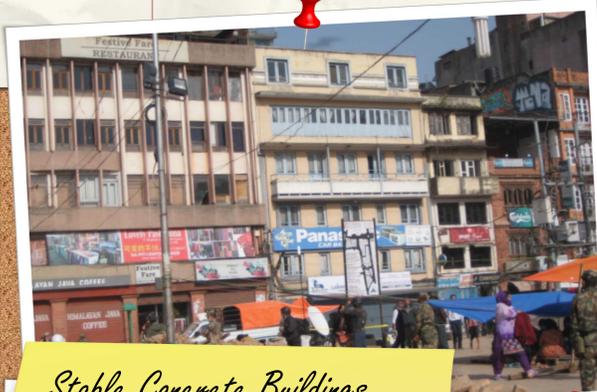


Collapsed Masonry Wall



Devastated Squares

Why was the death toll rather moderate?



Stable Concrete Buildings, Weak Masonry



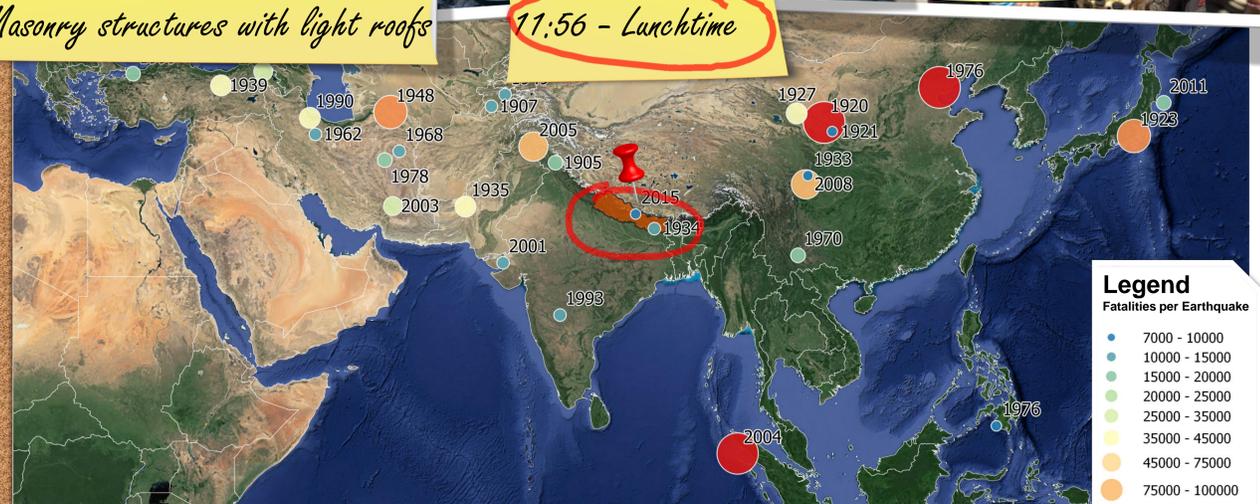
Masonry structures with light roofs



11:56 - Lunchtime



Telecommunication was working



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### RECONNAISSANCE FIELDWORK IN NEPAL

By Susan Brink

GPI researchers participated in a CEDIM organized reconnaissance trip to follow-up on the FDA reports for the 25 April 2015, 7.8 magnitude earthquake in Nepal. The main objective was to gather perishable data on population displacement and sheltering following the earthquake.

Susan Brink, Bijan Khazai and Trevor Girard from GPI together with Johannes Anhorn from the South Asia Institute at Heidelberg University traveled to Nepal June 6<sup>th</sup>-20<sup>th</sup>. The group developed a Household Shelter Survey and partnered with the National Society for Earthquake Technology-Nepal (NSET) which provided local context and translations.

The researchers conducted surveys in Kathmandu valley as well as in rural regions in Dhading, Nuwakot and Sindupalchowk. In addition the project was upscaled by hiring masters students from Tribhuvan University and workers from a local NGO AAROH which conducted additional surveys in Kathmandu, Lalitpur, Bhaktapur and Dolakha. In total, the team was able to survey 284 displaced households across the affected area.

Overall, displaced households reported that they were severely impacted by the earthquake with 80% stating that their houses were totally collapsed or severely damaged in the earthquake and 70% stating that their ability to generate income was affected a lot by the earthquake.



Our group with our local translator

Photo by S. Brink



Photo by S. Brink

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Photo by S. Brink

The shelter situation is variable across the country. The team observed that most households in urban areas were sheltering in tents or tarps with little protection from the elements while households in rural areas had mostly already built intermediate shelters using CGI sheets, timber or bamboo. Many households have begun to return home already, although tens of thousands are still in temporary shelter (Nepal PDNA). Particularly among households displaced by landslides, there are entire villages which have been temporarily relocated days from their place of origin limiting their ability to generate income and begin the recovery process.



Photo by S. Brink

The most immediate concern is the upcoming monsoon. Many temporary shelters have been built on agricultural land which is prone to waterlogging and are not strong enough for high winds. Additionally, the earthquake has opened up cracks in the land, leading to estimates of additional landslides across the earthquake affected area during the monsoon season. Landslides could lead to additional population displacement over the coming months and create transportation blockages limiting the flow of relief goods and the ability to recover from the earthquake.

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### GUEST RESEARCHERS IN THE HAZARD AND RISK GROUP

#### In 2015 GPI hosted and hosts three international guest researchers from Turkey, UK, and the USA

By Friedemann Wenzel

#### Prof. Dr. Hafiz Sebnem Düzgün

Prof. Hafiz Sebnem Düzgün won a Humboldt Georg Foster Research Fellowship that allows her to stay at KIT in GPI for one year. She is a professor in the Mining Engineering Department and the Informatics Department of Middel East Technical University (METU) in Ankara. Her research plan is entitled: Development of an integrated vulnerability assessment framework for critical infrastructure in case of multiple natural hazards. The recent Nepal earthquake (April 25, 2015 M=7.8) represents an interesting example where numerous landslides were triggered leading to loss of power supply and severe disruptions of the transportation system. Sebnem arrived in late June.

#### Prof. Dr. Christopher Zobel

Prof. Christopher Zobel is a Professor in the Department of Business Information Technology of Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, U.S.A. He won a Fulbright Scholarship that allowed him to visit GPI between March and June 2015. With us and colleagues of other institutes he worked on interdependency of critical infrastructures and their current and future systemic risks and susceptibility to external shocks such as natural disasters but also on the currently planned transformation process of the energy supply and distribution system in Germany and some neighboring countries in the direction of renewables and the changing resilience of the emerging system to natural disasters.

#### Prof. Dr. Katsu Goda

Prof. Katsu Goda (Bristol University, Faculty of Engineering) is spending his third term of his Humboldt Scholarship between June and September 2015 at GPI. A main research topic is the tsunami damage and loss after earthquakes with focus on the wealth of data from the March 2011 Tohoku earthquake. Katsu visited Nepal shortly after the May 25, 2015 M7.8 earthquake and studies the ground motion features as observed in the damage pattern. He also co-supervises two MSc theses dealing with ground motion correlation in and around Istanbul and the Kanto region in Japan.

#### Ms. Elnaz Karimi Mazidi

Ms. Elnaz Karimi Mazidi from Ankara University in Turkey, worked on strong ground motion data from Japan. She stayed at GPI on an Erasmus Work Placement Programme from March 27<sup>th</sup> 2015 to June 23<sup>rd</sup> 2015.

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### NEW PHD STUDENT AT GPI

By Joachim Ritter

Mr. Mohsen Koushesh, MSc (Tehran University), started a PhD study on the local seismicity and elastic structure of the lithosphere in the Eifel region. Mohsen will use seismological recordings of the Eifel Plume dataset, the permanent stations, and the currently recording DEEP-TEE project (deep Eifel earthquake project).

### 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:

Girard, T., Wenzel, F., Khazai, B., Kunz-Plapp, T., Daniell, J.E., Brink, S.A.: Near-Real-Time Analysis of Publicly Communicated Disaster Response Information, *International Journal of Disasters Risk Science* 5: 165–175, doi 10.1007/s13753-014-0024-3, 2014.

Khazai, B., Daniell, J. E., Düzgün, Ş., Kunz-Plapp, T., Wenzel, F.: Framework for Systemic Socio-Economic Vulnerability and Loss Assessment, in: Pitilakis, K., P. Franchin, B. Khazai, H. Wenzel (eds.): *Syner-G: Systemic Seismic Vulnerability and Risk Assessment of Complex Urban, Utility, Lifeline Systems and Critical Facilities: Methodology and Applications*, Geotechnical, Geological and Earthquake Engineering, Vol. 31, Springer, Dordrecht, Heidelberg, New York, London: 89-130, 2014.

Ritter, J.R.R., Gottschaemmer, E.: the Concept of In Situ Lecturing: *International Journal of Learning, Teaching and Education Research*, Vol. 11, No. 1, pp. 128-140, 2015.

Sokolov, V., Wenzel, F.: On the relation between point-wise and multiple-location probabilistic seismic hazard assessments, *Bulletin of Earthquake Engineering*, Vol. 13, Issue 5, pp 1281-1301, 2015.

Goda, K., Wenzel, F. and De Risi, R.: Empirical Assessment of Nonlinear Seismic Demand of Mainshock-Aftershock Ground Motion Sequences for Japanese Earthquakes. *Front. Built Environ.* 1:6. doi: 10.3389/fbuil.2015.00006, 2015.

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.: 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>, 2014.

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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) doi: 10.3189/2014AoG67A002, 2014.

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 Hazards and Risk*, doi: 10.1080/19475705.2014.960011, 2014.

Frietsch, M., Groos, J.C. and Ritter, J.R.R.: 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), 2014.

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

Barth, A., Ritter, J.R.R. and Wenzel, F.: Spatial variations of earthquake occurrence and coseismic deformation in the Upper Rhine Graben, Central Europe, *Tectonophysics*, 651-652, 172-185, doi:10.1016/j.tecto.2015.04.004, 2015.

Barth, A., Schmidt, B., Joswig, M., Baisch, S., Fritschen, R., Gaucher, E., Kracht, M., Lehmann, K., Rüter, H., Schlittenhardt, J. & Spies, T.: Empfehlungen zur Erstellung von Stellungnahmen zur seismischen Gefährdung bei tiefeingeothermischen Projekten, *Mitteilungen der Deutschen Geophysikalischen Gesellschaft*, 1, 5-7, 2015.

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### FEEDBACK

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