Content

Imprint

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State: November 2009

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Preface

The Center for Disaster Management and Risk Reduction Technology (CEDIM, www.cedim.de) is an interdisciplinary research center in the field of disaster management supported by Helmholtz-Centre Potsdam, German Research Centre for Geosciences and the Karlsruhe Institute of Technology (KIT). Research within CEDIM is focused on two research areas: ‚Natural Risks and Climate Change' and ‚Monitoring of the Global Risk Dynamics'. In both areas, we address risks from the perspective of natural hazards, vulnerability of society and mitigation of risks.

The research group ‚Natural Risks and Climate Change' develops the scientific basis for high-resolution modeling of future scenarios for extreme precipitation and flood events between 2021 and 2050 using an ensemble approach and analyzing the implications of flood protection. In addition, the ‚Natural Risks and Climate Change' investigates intensified hale risks for Southwest Germany and other regions, vulnerability of transportation infrastructure to floods and earthquakes, but also risk management for power supply breakdowns.

In the field of global risk dynamics, CEDIM research is focused on contributions to the international project ‚Global Earthquake Model' (GEM, www.globalquakemodel.com) which is initiated by the OECD as a ‚Private-Public-Partnership'. In addition to earthquake risk modeling for Germany, we work on the quantification of urban inventory including buildings and infrastructures using remote sensing technologies. This regional focus of this research is on Central Asia and India.

In 2009 CEDIM managed to achieve two strategic goals. First, we developed systematic relationships to the insurance and re-insurance industry including high level meetings with Munich Re on 27th July 2009 and SV Sparkassenversicherung on 23rd September 2009. Most importantly, CEDIM joined the 'Willis Research Network', an international research network under the umbrella of Willis, as a full member. The 'Willis Research Network' provides CEDIM access to the global insurance and re-insurance industry, and, at the same time, provides research funding.

The second strategic goal of CEDIM is the development of our research profile in the field of socio-economic vulnerability which makes us a respected partner for European projects (FP7) but also a key player in the socio-economic studies within the Global Earthquake Model.

In order to assure that scientific results of our work will integrate in the field of education, CEDIM started to participate in various educational activities. In Karlsruhe we supported the postgraduate master course ‚Resource Engineering' with lectures on disaster risk management. In cooperation with the Institute of Technology Bandung (Indonesia) and Kyoto University (Japan), CEDIM is developing an international master course on disaster management. With support of the Worldbank Institute (WBI Washington, D.C.), we elaborate an e-learning course for Indian Disaster Management Institutions.

Friedemann Wenzel

Bruno Merz

Christoph Kottmeier

I. Research activities

Natural Risks and Climate Change

Introduction

In 2007 the fourth IPCC status report stated, that it is “very likely” that the number of extreme weather events will increase due to the climate change caused by human activities. This means that protective measures will fail more frequently and that damage potential will increase in the future.

Also linked to climate change is a hazard shift to an increasing number of extreme events such as severe hail storms and the advent of new hazards such as heat stress or low water. Additionally, a shift of damage potential due to changing societal values and increasing cross-linked infrastructures can be expected. In consequence, the risk as a product of expose and vulnerability will increase significantly in the future.

The challenge of changing risk is met by the new research focus “Natural risks and climate change”. within CEDIM. In addition to flood risk, research projects like hail risk in southern Germany, flood vulnerability of transport infrastructure, indicators for the quantification of indirect damages as well as impacts and protection measures in case of a disruption in energy supply and telecommunication are integrated.

Across the associated project, methodologies for uncertainty estimation and information basis generation are developed. For the quantification of hazard and risk, changes in land use and scenarios of the changing asset distribution and vulnerability are taken into account. Disruption scenarios of transport networks or telecommunication facilities for instance are linked to climate change scenarios. By cross-linking works from different disciplines, future exposure and risk are simulated in detail andheir impacts are estimated. This way a tremendous added value of the individual works can be generated, which ensures CEDIM a unique position in the research community.

Project Status

In September 2009 an initial workshop was held in Karlsruhe, where essential contents and goals of the research focus were discussed. As a next step, the application of the indicator approach for quantification of indirect damages is prepared for various projects. Another workshop is planned in early 2010, where the needs and requirements of potential users will be discussed.

The following planed and ongoing projects are assigned to this focus:

- Climate change and flood risk
- Natural disaster and transport infrastructure
- Indicator approach for indirect damages
- Human as sensors
- HARIS-CC – Hail Risk and Climate Change
- Cross-linked HW-Simulation in urban areas
- Flood loss modelling and climate change scenarios
- Traffic route, public transportation and telecommunication
- Heat periods, drought and changes in land use

Flood hazard in a changing climate

Introduction

The CEDIM-project "Flood hazard in a changing climate" (Hochwassergefahr durch Klimawandel) is addressing the issue whether a change of risk for flood events of different severities has to be expected within a changing climate in the near future (2021-2050).

The focus is on small and medium sized river catchments in Germany. During this first year of the project, the major effort was to define the detailed steps of the project, hiring the required personnel and calibration/validation of the different models involved.

A first test case has been produced to test the model chain, ranging from global and regional climate models (RCMs) to hydrological models, and the results are promising. Evaluation simulations revealed the need for a bias correction of the RCMs (we use CLM at IMK-TRO, and WRF at IMK-IFU). A framework for performing such a bias correction was developed and tested at IMK-TRO.

Participating Institutes

Project management:

- Institute for Meteorology and Climate Research - Troposphere (IMK-TRO), Karlsruhe
- Institute for Meteorology and Climate Research - Atmospheric Environmental Research (IMK-IFU), Garmisch-Partenkirchen
- Institute for Water and River Basin Management (IWG), Karlsruhe
- Section 5.4: Hydrology - German Research Centre for Geosciences, Potsdam

Background

The fourth assessment report of the IPCC (2007) stated that an increase of frequency of extreme precipitation events was "very like-

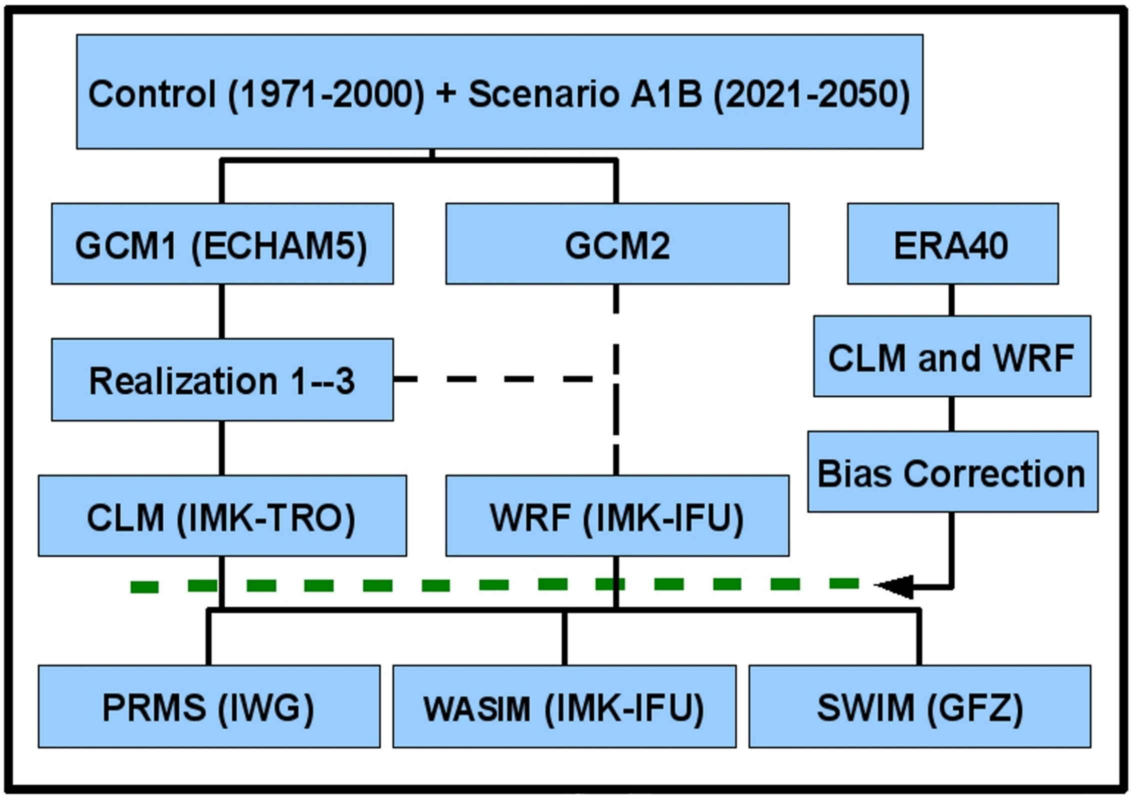

Fig. 1: Schematic of the structure of the model ensemble being constructed. The ECHAM model has been chosen as the first general circulation model (GCM) to be used. All three realizations (different initial conditions) of this model will be downscaled. The CLM RCM will be used for downscaling of all of the global simulations, and the WRF RCM will be used to simulate a smaller selection. Additional ERA40 reanalysis simulation are being carried out with both RCMs for validation purposes.

ly" in the near future. This implies also an increase in risk of flood events. However, the low spatial resolution of the models used in the IPCC report leaves room for a large variability, especially for precipitation, more than for other variables. So far, there has been no systematic study addressing future changes in the frequency and intensity of extreme precipitation regarding the spatial variability and the impact on discharge and the resulting frequency of flooding for Germany. It is the goal of this project to develop an ensemble of downscaled climate simulations for further simulations with hydrological models to assess changes in flood risk for small and medium sized river catchments in Germany. A schematic view of the ensemble to be constructed is shown in Figure 1.

Aims / Objectives

1. Definition of the catchment areas, set-up of the models, gathering of required data and definition of coupling regions for the regional climate models and hydrological models.
2. Validation: climate simulations of the control period with CLM and WRF
3. Validation: hydrological simulations of the control period
4. Validation: statistical analysis of step 2 and 3
5. Projections: climate simulations for the future scenario with CLM and WRF
6. Projections: hydrological simulations for the future scenario time period
7. Projections: statistical analysis of step 5 and 6
8. Changes between control and scenario periods

Project Status

We present here the major advances since the last report, following the first three milestones given above:

1. The three river catchments Ammer, Mulde and Ruhr were chosen as a representative selection of small and medium sized river catchments for Germany. This selection is based on the experience of the participating hydrological modelers in this project. Each member is appointed to lead the simulations for their own catchment. The RCM simulations were setup so that all three catchments are well inside the domain, minimizing the possibility of boundary effects in the results. A similar setup is being used for both CLM and WRF; an identical definition of the domains was not possible due to model differences. In a first step, the global climate simulations are downscaled to 50 km resolution for all of Europe, then to 7 km for a domain covering Germany and its surroundings, e.g. the Alps and the southern Baltic sea. The required data for the hydrological models (such as temperature, wind, precipitation, humidity, etc.) and a common output format were defined. The coupling between the RCMs and the hydrological models was successfully tested for a shorter test data set. A data base of observational data needed for the project was built up by the participants. Some of the observational data to be used in this project are: the PIK set of homogenized station data for Germany and the REGNIE, E-OBS, CRU and GPCP data sets of gridded precipitation and temperature data.

2. Several simulations with the CLM and WRF RCMs were performed in order to find an optimal setup of each model. The simulations were evaluated using the gridded observational data. Besides the simulations forced by the global climate data, it was agreed upon that ERA40 reanalysis (a data set of atmospheric data which is close to the observations for the second half of the 20th century) driven simulations were required in order to assess model biases. Initial test runs with the hydrological model PRMS (from IWG) showed that there is a need for a bias correction of the temperature and precipitation variables of the RCMs. A method for correcting the biases based on that of Hay et al. [2002] was successfully implemented by IMK-TRO and tested on a 30 year long data set of an earlier CLM simulation with a much stronger bias, see Figure 2.

3. The hydrological model SWIM has been setup for the Mulde catchment by GFZ. The subcatchments have been delineated, so that gauging stations coincide with subcatchment outlets and the subcatchment area does not exceed 100 km^2. First model runs already show reasonable results for the simulated discharge at four selected gauging stations not influenced by water management, and a comprehensive model calibration will be performed in the next step. The interface to the climate data provided by the two RCMs has been developed.

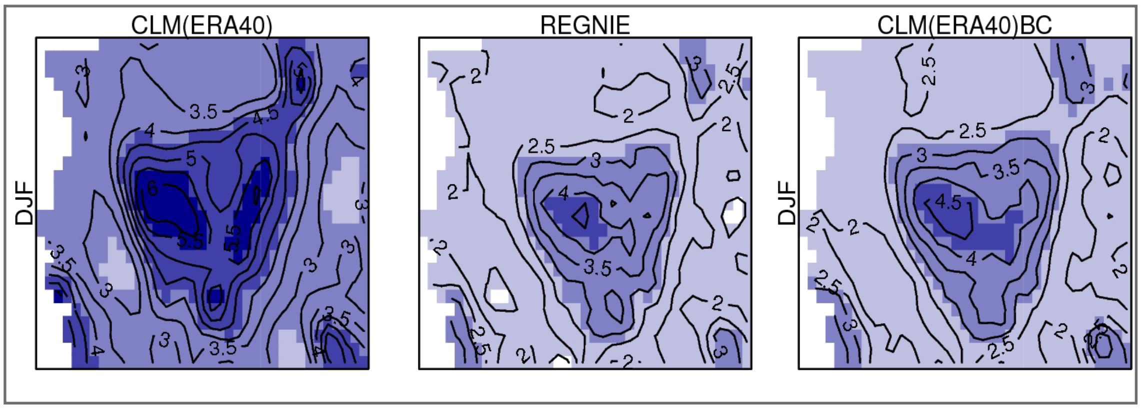

Fig. 2: (left) Climatological mean precipitation amount [mm/day] in the winter months of an old CLM simulation with a strong precipitation bias. The gridded REGNIE data for Germany was used as a validation data set (middle), and the histogram equalization method along with a precipitation frequency correction [Hay et al., 2002] leads to a bias corrected data with matching precipitation amounts, intensity distribution (not shown) and spatial characteristics.

The PRMS model has been setup for the Ruhr catchment by IWG. It has been used for several test simulations with the data from the RCM simulations.

Outlook

The next step after the configuration and validation of the RCMs is to downscale the global climate simulations. This is carried out in two steps, first for the control simulations with present day greenhouse gas forcing, and second for the future climate scenario. The second global model to be used will be defined, and the work on the interface between this model and the CLM model will be developed. The simulations with the hydrological models are carried out as soon as the climate data becomes available. In addition, the models will be set up for the second catchment that they should simulate. A recalibration will be needed for this case. In parallel to the model simulations, the work with defining the statistical procedures for analyzing the data is being carried out. The statistical package provided by IWG will be used, but there is also an initiative for developing a tool box for the ensemble statistics.

Core Science Team

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Doris Düthmann (from April 2009, Hydrology, GFZ)
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References

Hay, L.E., M.P. Clark, R.L. Wilby, W.J. Gutowski, G.H. Leavesley, Z. Pan, R.W. Arritt, and E.S. Takle (2002), Use of Regiona Climate Model Output for Hydrologic Simulations, J. Hydromet., Vol. 3, pp 571 - 590.

HARIS - CC

Hail Risk and Climate Change

Introduction

In the last decades, damage caused by severe hailstorms has significantly increased in Central Europe. In the Federal State of Baden-Württemberg, more that 40% of the building damage by natural hazards are associated with hail (1986-2008). For loss prevention and risk management purposes, comprehensive information about the local probability of hail and trends related to global warming is essential.

Due to their local-scale extent of a few hundred meters only, hailstorms are not captured accurately and uniquely by a single observation system. Also, numerical models are not able to simulate reliable thunderstorm occurrence. Therefore, data from different observations and models are combined and analyzed quantitatively by applying modern statistical methods to supplement the project HARIS-CC, which was initiated in June 2009 in CEDIM (see Fig. 1). The main purposes of the project are to assess the hail hazard and risk in a high spatial resolution and to quantify the impact of climate change.

Aims / Objectives

Scientific questions that will be addressed in the HARIS-CC are:

- What is the spatial distribution of the hail hazard and hail risk in Germany?
- Which methods are most appropriate for reliable hazard and risk assessment?
- What are the regions highly exposed to hail hazard? What are the reasons for this?
- To what extent does climate change influence occurrence and/or intensity of hailstorms?
- How will the hail hazard potential change in the next decades?

Based on radar data from German Weather Service and lightning data, tracks of severe hailstorms will be reconstructed in a long-term perspective by applying a cell tracking algorithm. To exclude events without damage-related hail on the ground, additional observations will be considered. This includes both aerological and surface-based observations, loss data from insurance companies, and web-based information (cf. project "Human as sensors" by D. Dransch). By means of stochastic modeling, synthetic storm tracks will be genera-

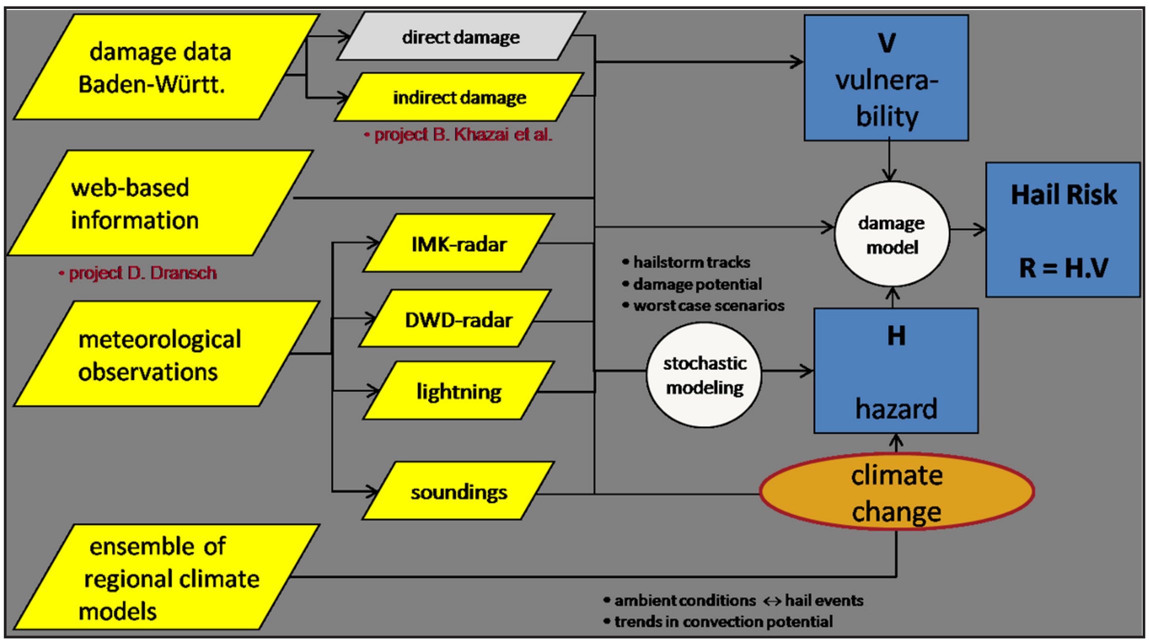

Fig. 1: Planned structure of HARIS-CC.

ted considering the prevailing meteorological boundary conditions. The aim of this approach is to enhance the number of samples within the grid cells to reduce statistical uncertainty. Employing an appropriate parameterization, radar reflectivity will be expressed in terms of hail-kinetic energy, which provides a measure for the damage impact of hail. The application of extreme value statistics to the samples enables determination of hail hazard maps for Germany. By applying the indicator model for indirect damage (cf. project B. Khazai et al.), it is aimed at quantifying the risk. Long-term changes of atmospheric characteristics related to hail occurrence are quantified from an ensemble of regional climate models (RCM). Past hailstorms will be described in a multi-dimensional parameter space of appropriate meteorological indicators (e.g., convective energy, moisture flux convergence, large-scale weather patterns) obtained from reanalysis-data and radio soundings. The methods developed and adjusted to real events will be transferred to highly resolved RCM simulations. Changes in the convective potential are quantified from changes in the parameter space of appropriate indicators between past (1971-2000) and future (2021-2050) climate conditions. To estimate

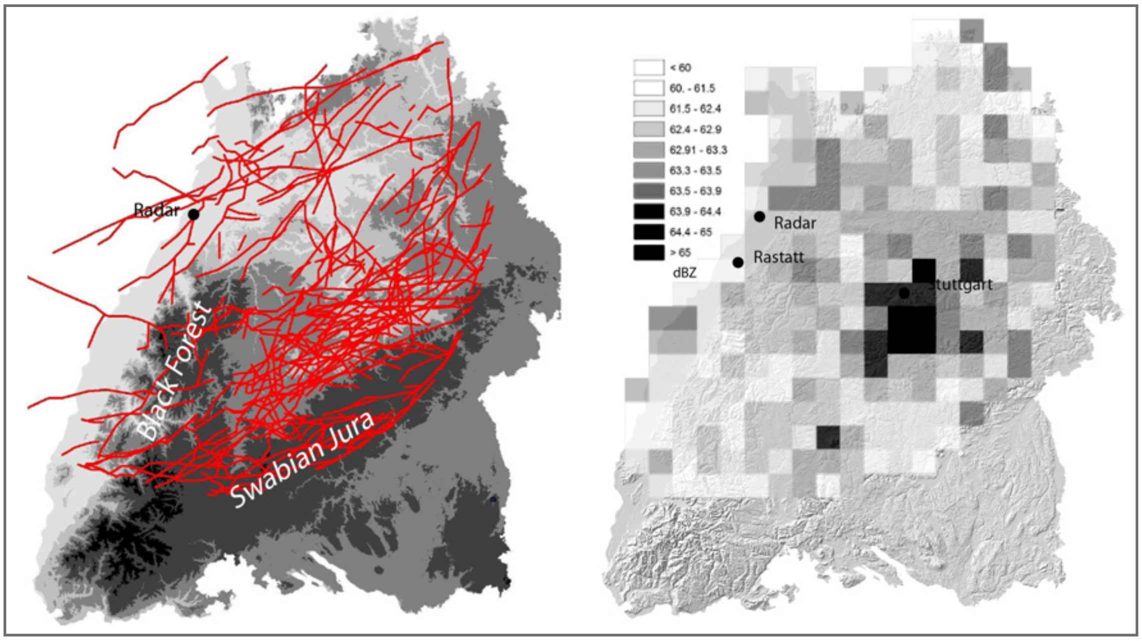

Fig. 2: Tracks of the most severe hailstorms between 1997 and 2008 (left) and radar reflectivity for a 1-year return period (right).

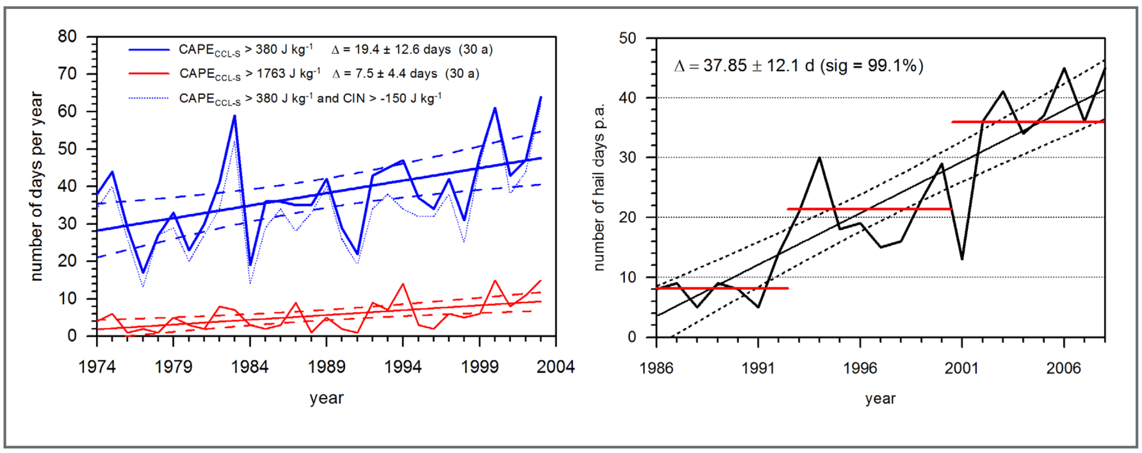

Fig. 3: Number of days per a year that exceeded a certain threshold of the convective potential energy (CAPE; left) and number of hail days per year based on damage to buildings in Baden-Württemberg (right), including the 95% confidence intervals.

the uncertainties inherent in each climate scenarios, the analyses will rely on an ensemble of different RCMs. Hail hazard under consideration of climate change will be projected from the current hazard and the climate change signal.

Project Status

First results were obtained for test a region of Baden-Württemberg, where different comprehensive data sets are available in a high spatial resolution. Tracks of the most severe hailstorms between 1997 and 2007 were reconstructed by merging insurance data of the SV Sparkassenversicherung with data from the IMK radar (location: Campus north of KIT). To obtain entire and sound hail tracks, a cell tracking algorithm was applied to the 3D reflectivity data. Hailstorm occurrence exhibits a distinct spatial variability that is supposed to be due to orographic modifications of the flow (Fig. 2, left). Lowest probabilities are found over the rolling terrain in the north as well as over the elevated terrain of Black Forest and Swabian Jura. Between the two mountain ridges, the probability of hail to occur is highest. The identified hailstorm tracks are projected on a 10 x 10 km² grid and modeled by extreme value statistics. The results in terms of radar reflectivity for specific return periods reveal that highest track densities agree well with the highest intensities (Fig. 2, right).

Severe hailstorms are related to distinct atmospheric conditions, which can be expressed by convective indices. We evaluated the indices, derived from 1200 UTC Stuttgart soundings that exhibit the highest skill to predict real thunderstorm occurrence. Most of the indices that depend upon near-surface temperature and moisture reveal a significant (95%) positive trend regarding both the annual extreme values and the number of days above/below specific thresholds (Fig. 3, left for the convective available potential energy, CAPE). A relationship can be established between these indices and the annual number of hail damage days (Fig. 3, right). The trend directions of the indices can be attributed to different temperature and moisture stratification in the various atmospheric layers probably as a consequence of climate change.

In July 2009, a press statement with the first results of HARIS-CC was released by the KIT press office. Several newspapers and radio/television reported about the project and its preliminary findings.

Outlook

In the next three years, the issues of the working plan described above will be put on action. Since Oct 2009 the project HARIS-CC is supported by Willis Research Network (WRN).

Publications

Kunz, M., and M. Puskeiler, 2009: High-resolution assessment of the hail hazard over complex terrain from radar and insurance data. Submitted to Met. Z.

Kunz M., J. Sander and Ch. Kottmeier, 2009: Recent trends of thunderstorm and hailstorm frequency and their relation to atmospheric characteristics in southwest Germany. Int. J. Climatol., 16 pp., DOI: 10.1002/joc.1865

Kunz, M., 2007: The skill of convective parameters and indices to predict isolated and severe thunderstorms, Nat. Hazards Earth Syst. Sci., 7, 327–342, DOI:www.nat-hazards-earth-syst-sci.net/7/327/2007/

Core Science Team

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Estimation of flood discharges in Saxony

Introduction

This study is part of the project „Synopsis of natural hazards in Saxony", in which the risks of three different hazards (earthquake, flood, storm) are compared. For a consistent comparison of these three natural hazards the overlap in the considered recurrence intervals should be maximised. Therefore, flood discharges also need to be estimated for very large recurrence intervals in the range of 100 to 1000 years. Due to the uncertainty in discharge estimates with recurrence interval > 100 years the existing methods need to be improved.

Aims / Objectives

The aim of this project is the derivation of extreme flood discharges with large recurrence intervals and the estimation of upper bounds of flood discharges using probabilistic regional and empirical envelope curves. In a second step, these upper bounds are to be integrated in distribution functions. By using the additional information of extreme discharges and their according recurrence intervals, the study is tailored to improve the estimation of flood discharges with a large recurrence interval.

Project Status

This project investigates envelope curves. These are boundary lines above all observed flood discharges in a region. This study is based on continuous measured discharge time series at evenly distributed gauges in Saxony. Preliminary studies revealed that the uncertainty of the existing approaches of empirical and probabilistic regional envelope curves needs to be thoroughly examined. Only then, an improved estimation of discharges with large recurrence intervals can be achieved.

The application of probabilistic regional envelope curves (Fig. 1) is completed. The suitability of two methods to derive homogeneous regions was investigated by a sensitivity analysis. The sensitivity analysis leads to an estimation of the variability of probabilistic regional envelope curves. The results of this study were both presented on international conferences (Guse et al., 2008a, 2009b) and published in a peer reviewed journal (Guse et al., 2009c).

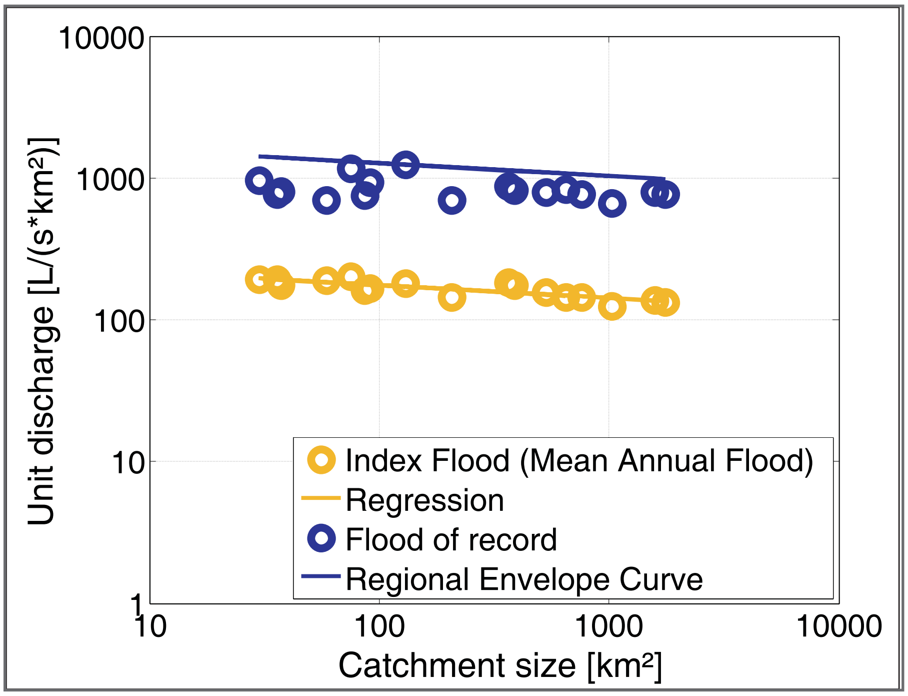

Fig. 1: Example of a regional envelope curve (modified from Guse et al., 2009a). A recurrence interval is assigned to the regional envelope curve. The recurrence interval is based on the overall sample years of annual maximum flood discharges and their correlation relationships. It is valid for the catchment sizes, which are covered by the regional envelope curve (here: 40-2500 km²).

The effects of cross-correlation among discharge time series on the recurrence interval of a probabilistic regional envelope curve were examined in another study and also published (Guse et al., 2009a).

Both studies improve the estimation of the extreme discharge and its according recurrence interval of a probabilistic regional envelope curve for the considered gauges.

The results of the probabilistic regional envelope curves can now be used as additional information in flood statistics. Whereas the traditional flood statistic only allows reliable estimates up to recurrence intervals of 100 years, probabilistic regional envelope curves provide additional points for recurrence intervals between 300 and 2000 years. By using them, it is possible to reduce the uncertainty in flood frequency studies.

An empirical envelope curve was derived for Saxony. This empirical envelope curve is considered in the context of extreme floods and outliers in the discharge time series of the Saxon gauges.

In a last step, the results of the envelope curves are integrated in a distribution function. The application of distribution functions with upper bounds is being discussed and developed in cooperation with the subproject „Real-time damage assessment of winter storms". Different variants of distribution functions with and without upper bounds were examined. One selected method is currently being checked on its applicability (Fig. 2). In this way, the significance of upper bounds derived by envelope curves on the flood estimates of recurrence intervals between 100 and 1000 years derived by a mixed distribution function is investigated. By integrating the upper bounds, the estimates of flood discharges can be limited and an unbounded increase up to discharges with unrealistic high values for high recurrence intervals is avoided (Fig. 2).

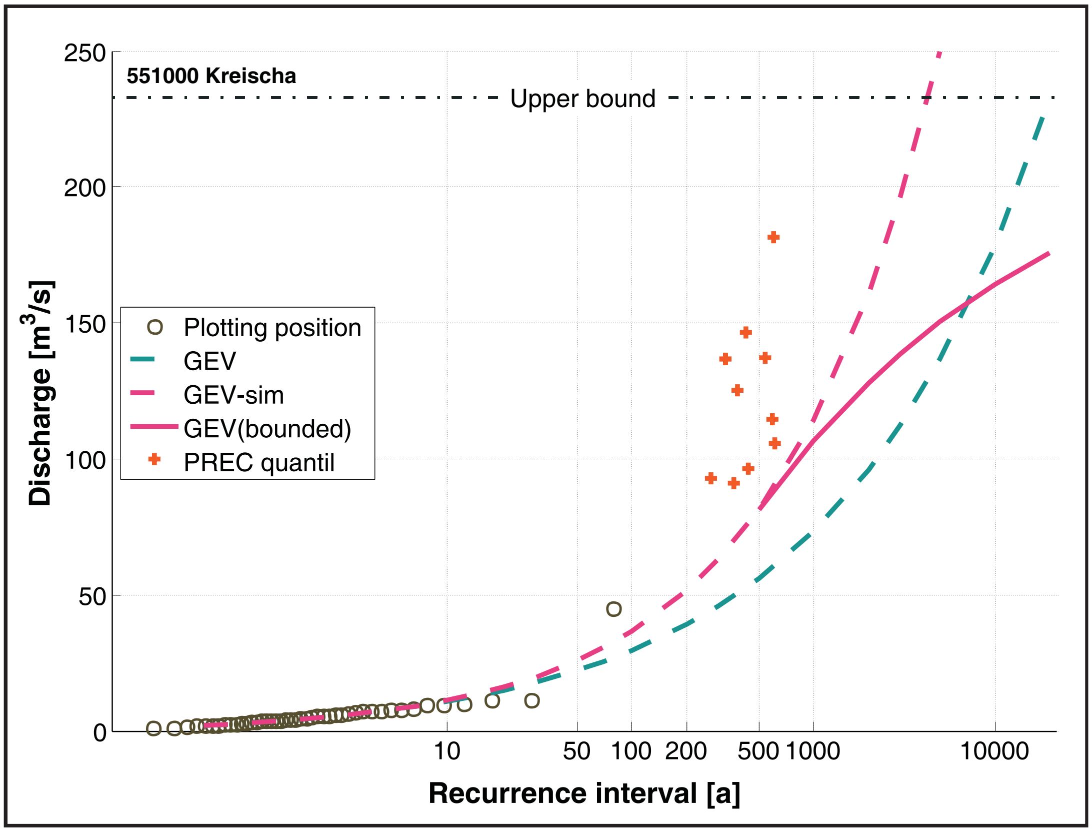

Fig. 2: Example for an integration of several probabilistic regional envelope curves and an empirical envelope curve in a mixed distribution function. In a first step, the flood discharges and their according recurrence intervals derived by probabilistic regional envelope curves (PREC quantiles) were combined with a generalised extreme value distribution (GEV) denoted as GEV-sim. In the second step, an asymptotic approach to the upper bound derived from an empirical envelope curve is considered for recurrence intervals larger than 500 years (GEV (bounded)).

Outlook

The application of probabilistic regional envelope curves is completed. The investigations on empirical envelope curves are anticipated to be completed within this year. The last part of this research project is the integration of upper bound discharges in an appropriate distribution function. This part should be completed at the beginning of next year. Further publications in international journals are scheduled.

Core Science Team

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Bruno Merz (GFZ, Section 5.4 – Hydrology)

Annegret H. Thieken (alpS – Centre for Natural Hazards and Risk Management, University of Innsbruck)

Publications

Guse, B., Castellarin, A., Thieken, A. H. and Merz, B. (2009a): Effects of intersite dependence of nested catchment structures on probabilistic regional envelope curves, Hydrology and Earth System Science, 13(9), 1699-1712.

Guse, B., Thieken, A., Castellarin, A. and Merz, B. (2008a): Probabilistic regional envelope curves in Saxony / Germany using two methods to form homogeneous regions, European Geosciences Union, General Assembly 2008, Talk (Vienna, Austria).

Guse, B., Thieken, A. H., Castellarin, A. and Merz, B. (2009b): Reliability of Probabilistic Regional Envelope Curves, European Geosciences Union, General Assembly 2009, Poster (Vienna, Austria).

Guse, B., Thieken, A. H., Castellarin, A. and Merz, B. (2009c): Deriving probabilistic regional envelope curves with different pooling groups, Journal of Hydrology, doi:10.1016/j.jhydrol2009.10.010, (accepted).

Guse, B., Thieken, A. and Merz, B. (2007): Estimation of upper bounds using envelope curves, Extended abstract No. 50, 8. Forum DKKV/CEDIM: Disaster Reduction in Climate Change, 15./16.10.2007, Karlsruhe University.

Guse, B., Thieken, A. and Merz, B. (2008b): Anwendung von Verteilungsfunktionen mit oberer Grenze in der Hochwasserstatistik, In: Haberlandt, U.; Riemeier, B.; Billib, M.; Verworn, H.-R.; Kleeberg, H.-B. (Editors), Hochwasser, Wassermangel, Gewässerverschmutzung – Problemlösung mit modernen hydrologischen Methoden: Beiträge zum Tag der Hydrologie am 27./28.03.2008 in Hannover, DWA Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V., 17-27.

Web service: Weather hazards – early warning

The web information service “Weather hazards – early warning” provides information about upcoming and past extreme weather events worldwide. The web page is 24 hours available and updated on a daily basis. The web service started operating on February 1, 2004 and was maintained continuously since then. At the moment, the number of daily hits is about 1500.

Examples of extreme weather events are:

- Intense low-pressure systems, if they represent a great hazard to the inland or the coast line
- Summer storm conditions, where severe storms are expected
- Strong rainfall and flooding conditions
- Extreme heat and cold periods
- Tropical storm and other events

Although the main geographical focus is on Middle Europe, floods in south-east Asia due to strong monsoons and tropical storms are considered as well. As a basis for decisions serve model calculations of various global (mainly of the GFS-model of the US), partly regional models. These models are employed operationally at the national weather service as well as other institutions and are available on the internet.

If an extreme weather event is forecasted by the model and verified by an authorized person, a prewarning or a warning is formulated one to four days in advance to the potential event. The warning includes information about the potentially affected areas and the potential impact of the event. These warnings are updated on a daily basis, in special cases several times per day. In the aftermath of an event, a detailed analysis is published on the web page. A comprehensive article provides an overview of the event including comprehensive information about its progress, measured velocities, temperatures and rain fall rates.

All past warnings and event analyses are stored in a constantly growing archive, which encompasses several hundred extreme weather events by now.

Furthermore, the web page offers all the information necessary to review an extreme weather event. This includes e.g. wind and storm scales, temperature and rainfall record-highs as well as detailed climatological information and maps. The warning service is going to be improved by implementing new early warning and visualizing methods. The "Weather hazards – early warning" project operates independently from the official warning sites of the National Weather Service and without guarantee.

For more information on weather hazards - early warning, please visit:

www.wettergefahren-fruehwarnung.de

Core Science Team

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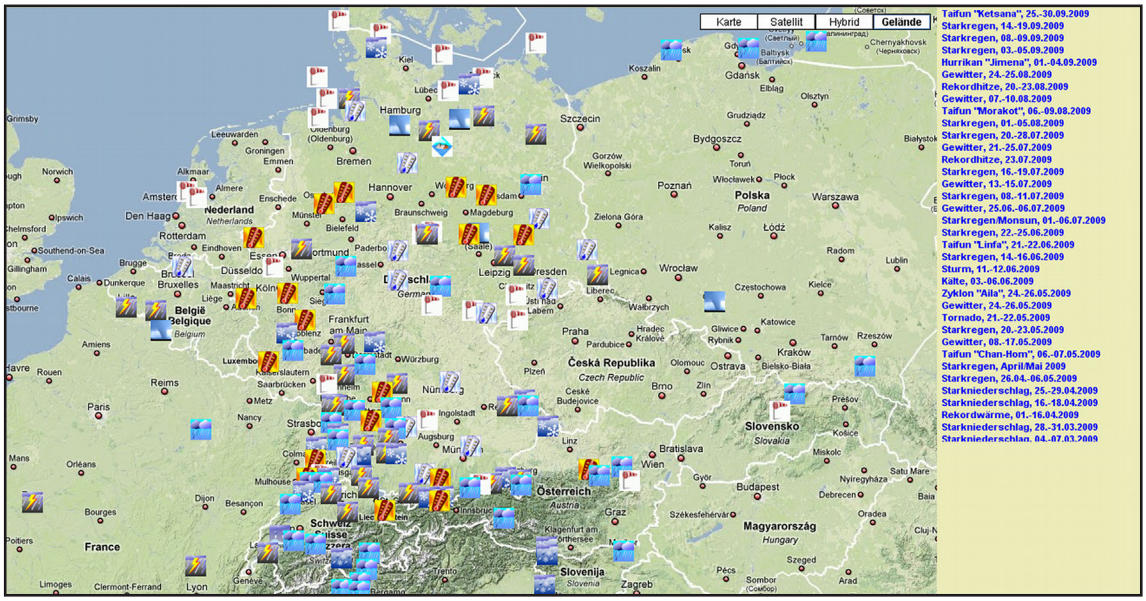

Fig. 1: Screenshot web information service

Global Earthquake Model

Central Asia Initiative

Introduction

The Central Asia Initiative is launched supported by the Federal Foreign Office Germany (through InWEnt Capacity Building International) under the title „Cross Border Natural Disaster Prevention in Central Asia“. The project aims at strengthening international and regional cooperation in the field of disaster prevention and disaster risk management, which can help to effectively minimize the consequences of future probable disastrous earthquakes in the region, taking into account that Central Asia is one of the most seismically active regions in the world (Fig.1).

The area under consideration covers the territories of the five former Soviet Republics of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan and Afghanistan. The total area of the region is approx. 4 million square kilometres with the combined population about 60 million. In the time of the former Soviet Union all the Republics used equal standards and rules for assessment and mapping of seismic hazard, for anti-seismic design and construction (though the past disastrous earthquakes, for example, Spitak, 1988, and Neftegorsk, 1995, showed mistakes in the seismic hazard zonation and revealed vulnerable types of buildings, which are common also for the communities in Central Asia).

After disintegration of the USSR for the period of about 20 years, all these new independent countries introduced into practice their own building codes (which differentiate considerably between each other), they developed national maps of seismic hazard (which show considerable discrepancies along the national borders), they participated in several international projects on seismic risk assessment (for example, RADIUS, NATO Science for Peace, CASRI), but the current analyses show that very high level of seismic risk still exists in the region. Therefore, all five Central Asia countries are very interested in participation in the project “Cross Border Natural Disaster Prevention in Central Asia” and the project has support on the governmental level.

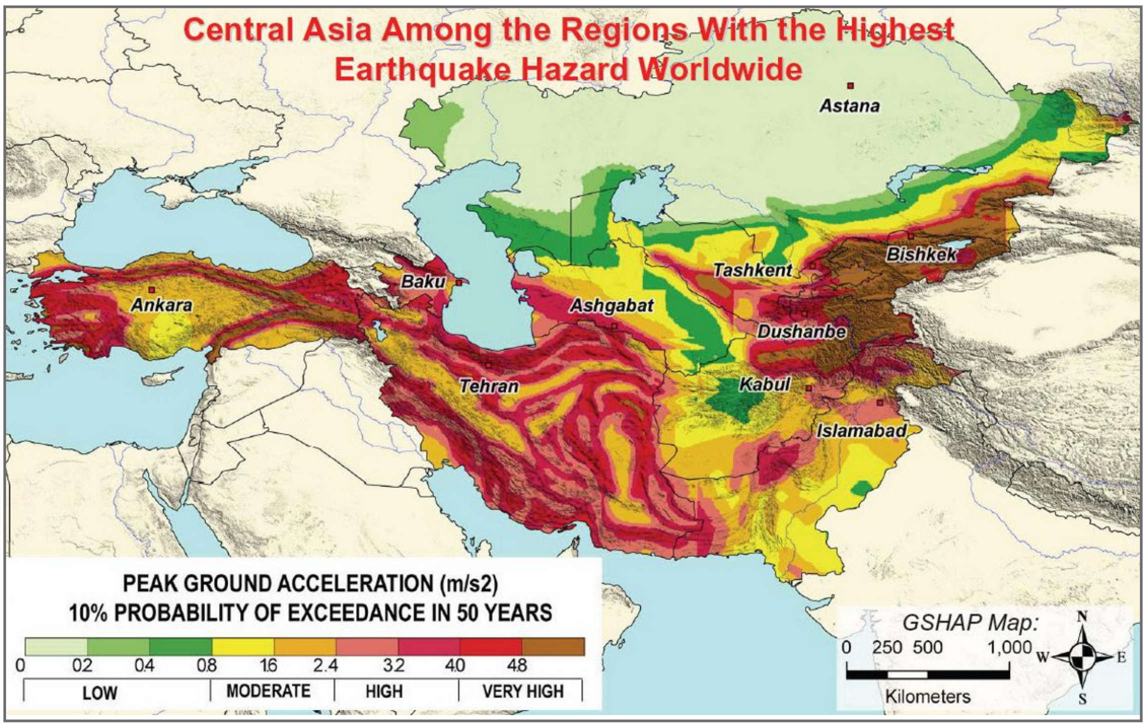

Fig. 1: Estimated Seismic Hazard in the Region (from the GSHAP)

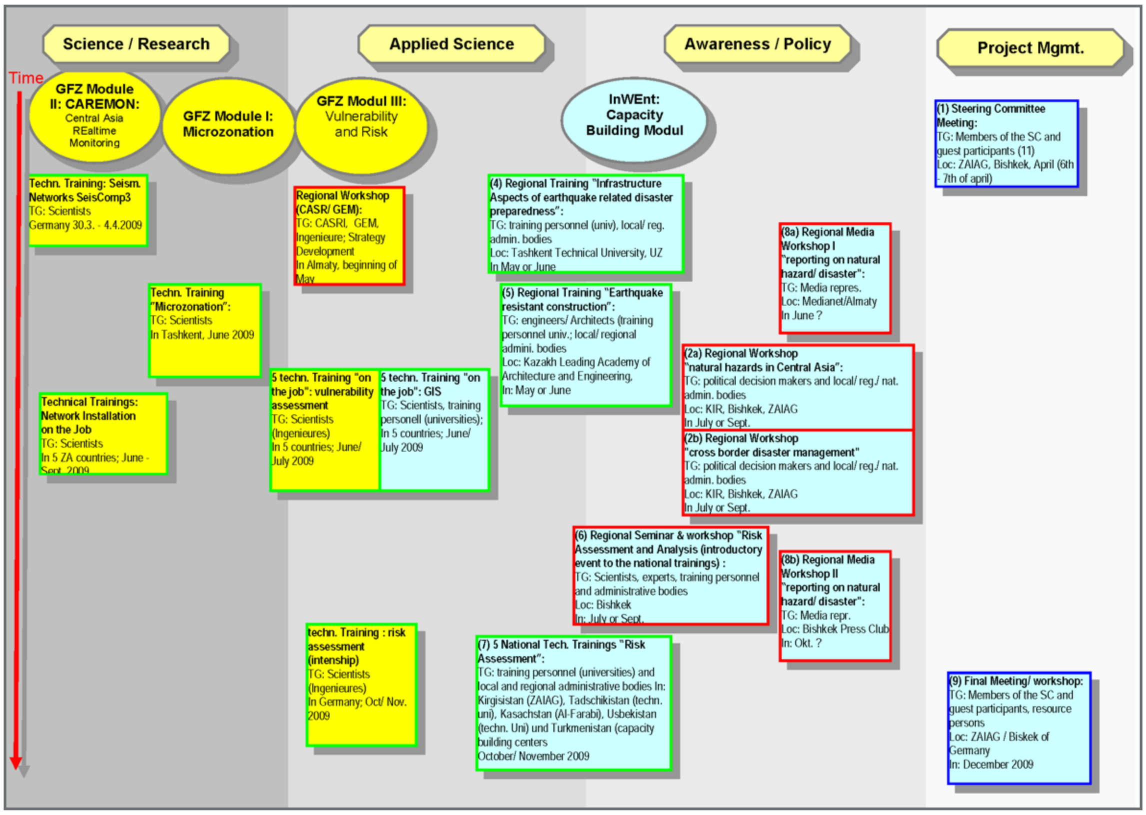

Fig. 2: Structure of the ongoing projects

Aims / Objectives

The ongoing project consists of two main parts:

1. Scientific and Technical Part, which includes development of a region-wide real-time earthquake monitoring network, seismic microzonation of urban areas and vulnerability and risk assessment on the local and regional scale;

2. Capacity Building Part, which includes development of training materials and conducting training courses on seismic risk for decision makers, regional planning authorities and civil society representatives. The structure and time schedule of the project are shown in Fig. 2. The activities of the Scientific and Technical Part are shown in yellow, and the activities of the Capacity Building Part are shown in blue.

The Scientific and Technical Part of the project is under responsibility of GFZ (Module I - Central-Asian Real-Time Earthquake Monitoring Network-CAREMON and Module II - Microzonation) and CEDIM (Module III - Vulnerability and Risk) and the three modules are implemented in close cooperation with all participating countries and local research institutes. The risk assessment activities in the region are implemented in coordination with the global initiative Global Earthquake Model (GEM).

In June and July 2009 four "on the job" vulnerability trainings were conducted in four countries: Uzbekistan, Kyrgyzstan, Tajikistan and Kazakhstan. The training course in Turkmenistan has been postponed for November 2009. The main goal of the vulnerability trainings as well as of further cooperative work in the field, is to develop a uniform (harmonised) vulnerability classification for the existing types of buildings to be used for constructing vulnerability composition models in urban and rural areas of the countries and for damage and risk analyses. During the trainings the national working groups have been formed which will participate in the GEM project. After the trainings, the working groups autonomously continue collecting the data about seismic vulnerability of the building stock in their countries. In December 2009 the leaders of the national working groups will come to a joint meeting in Germany (Karlsruhe/ Potsdam), for exchanging the collected data, discussion and planning of future activity in the region in the frame of the GEM project.

The Capacity Building Part of the „Cross Border Natural Disaster Prevention in Central Asia“ project is coordinated by InWEnt and CAIAG (Central Asian Institute for Applied Geosciences). Within the Capacity Building Part CEDIM, in particular, takes responsibility for the following activities:

- Development of a holistic concept for the seminars and trainings of the Capacity Building component into a whole stringent approach, including content related coordination of all involved local experts;
- Content-related preparation and implementation of several regional seminars and workshops in the region;
- Preparation of training materials for the National Trainings on seismic risk;
- Implementation of five National Trainings „Seismic Risk“ for scientists, experts, training personnel (universities) and local and regional administrative bodies (i.e. planning authorities and other important administrative unites) in the five countries;

The National Trainings on Seismic Risk are to be conducted in the five Central Asian countries in October-November, 2009. The Target Group of the trainings (10 to 12 participants) intentionally includes emergency specialists, architects, planners, representatives of administrative bodies of different level (local, regional, national), who are not directly involved in the earthquake research, but would be able to use the gained knowledge for taking into consideration the existing seismic risk in their professional activities, as well as university teachers and local trainers, who would be able to disseminate the knowledge.

The designed program of the National Trainings consists of 5 days (Day 1: Seismic Hazard; Day 2: Seismic Vulnerability; Day 3: Seismic Risk; Day 4: Disaster Preparedness and Risk Management; Day 5: Sharing Experiences). The Trainings will be conducted by the international trainer (CEDIM) with the help of local experts representing seismological and engineering institutions of the participating countries.

The work program of the current project covers the period until the end of 2009. Afterwards it is planned that experts of CEDIM (including representatives of both GFZ and KIT) will continue activities in the Central Asia region in the frame of the GEM project, jointly with the formed national working groups. Within GEM the following objectives are planned to be achieved in the region:

Hazard part:

- Cross-border zonation of seismic hazard for the whole region,
- Microzonation of seismic hazard for selected cities (Almaty, Ashgabat, Bishkek, Dushanbe, Tashkent),
- Determination of parameters of probable earthquake scenarios.

Vulnerability and Risk part:

- Harmonised vulnerability classification,
- Seismic vulnerability models for different scale (microzonation, region),
- Cross-border zonation of seismic risk for the whole region,
- Microzonation of risk for the same selected cities,
- Assessment of damage and losses for the probable earthquake scenarios.

Core Science Team

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Remote Sensing in Earthquake Loss Estimation

Introduction

Earthquake Loss Estimation is a convolution of 4 key components – Exposure * Vulnerability * Hazard * Damage Loss Conversion. Remote sensing used for the estimation of exposure is intrinsically linked to the other 3 components, because it defines the level of loss detail that can be found. The estimation of exposure relies on a variety of inventory information regarding buildings, infrastructure and socioeconomic parameters. A range of applications of optical methods such as LiDAR, hyperspectral and multispectral images such as ENMAP and Quickbird or RADAR such as INSAR have been employed over the recent years. However, these applications have a strong focus on the extraction of physical measures related to urban inventory such as number of assets, building type, footprint and height. In a joint project by GFZ, DLR and the University of Basilicata., a methodology for classifying reinforced concreate buildings from satellite images is tested for the city of Potenza for which ground truth data are available. On a city or regional level, urban characteristics are required in order to produce suitable exposure data, building details and materials, including location of lifelines and also building stock details. One of the most important aspects to be found by remote sensing in an exposure inventory production is that of the lifelines within the region being analysed. These lifelines are intrinsically linked into the specific cost section: however, they must be identified for rapid loss estimation procedures in order to ensure that utility (potable water, waste water, oil (crude and refined), natural gas, electric power and communication) and transportation systems (highway, railway, light rail, bus, port, ferry and airport) can remain in place during a disaster. Critical systems (essential and high potential loss facilities) must also be identified for rapid response and calculation during the loss estimation module such as medical care facilities (hospitals and medical clinics), schools (primary and secondary, colleges and universities) and emergency services (fire stations, ambulance, police stations, army and civil service). In addition, industrial, commercial and residential areas should also be identified for urban settings. On a country or region level, simpler algorithms and urban/rural land cover discrimination filters can be applied. The choice of how to create an inventory (exposure data) is generally dependent on the loss estimation technique/software used and thus essentially the building vulnerability function used within it. The table (Tab.1) below summarises the various building parameters required by different vulnerability methods for loss determination using damage ratios (see CEDIM ELE Series Research Report 2009-01 available at www.cedim.de for more).

Vulnerability Method	Building details	Material	Mechanical
DPM and Vuln. Curve/Index	No., Age, No. Storeys	Type	none
Screening Methods	No., Age, No. Storeys	Type, Walls, floor, roof, plan, detailing	Depends on if P25, walk-down etc.
Capacity Spectrum Method	No., Age, No. Storeys	Type, assumption of quality	none
Displacement-Based	No., Age, No. Storeys	Type, irregularities, fM, ε_M	H_T, L_c, L_b, h_c, h_b, ef_h, h_s

Table 1: f_M, ε_M = yield strength and yield & limit state strain for the material type, H_T = total building height, L_c, L_b, h_c, h_b = lengths and depths of columns and beams, ef_h = effective SDOF height, h_s = ground floor (soft-storey) height.

In addition, post-earthquake management and post-earthquake damage assessment can be conducted using remote sensing information taken quickly after a disaster. If soil topography and type information can be derived, this is also useful for the geotechnical site classification which contributes to infrastructure damage ratios. Having accurate population and occupancy data is essential to all these methods for creation of an accurate damage-loss conversion estimate for social losses i.e. the convolution of population with damage state gives the total number of dead, injured, homeless and evacuated.

Despite the fact that Earthquake Loss Estimation incorporates a socio-economic dimension, the application of remote sensing to the estimation of socio-economic parameters as part of an comprehensive inventory has been disregarded so far. There is a strong need for a methodology that allows generating basic, socio-economic parameters using remote sensing and secondary data. In cooperation with Image Cat Inc., CEDIM is developing a methodology, to meet the requirement for basic socio-economic inventory data for a range of application in the field of earthquake disaster management.

Aims / Objectives

In order to meet the data requirement of different applications, a multi-tier system is developed. This system will range from regional down to per-building scale. From the earthquake loss estimation perspective, the primary impact of concern is life safety. It is evident from large deadly historic earthquakes that the distribution of vulnerable structures and their occupancy level during an earthquake control the severity of human loss. As a consequence the most recent earthquake risk models and loss estimation techniques incorporate casualty estimation functions. In addition to pre-event casualty modeling, the importance of population data is further stressed by the fact that there is a need for loss estimated immediately after earthquakes because injured people trapped in collapsed buildings can only be rescued during the first hours to days. Therefore the first part of this project is focused on developing a multi-tier system for population estimation.

Project Status

The multi-tier system for population estimation is developed for a test site in India – the city of Ahmedabad. In 2001 a M7.9 earthquake in 2001 struck the Kutch region. The far-reaching ground motions also affected Ahmedabad, approximately 225 km east of the Kutch area. According to the Census in 2001 3.520.085 people lived in Ahmedabad. In the last year we completed the development of a regional model on city scale using Quickbird and Landsat data. Since the satellite image were acquired for the year 2008, the existing census data and other statistical information needed to be projected to 2008 for the methodology to be consistent. The next steps include the development of a population estimation methodology for sample areas in Ahmedabad on a smaller scale.

Core Science Team

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Socio-Economic Module

Introduction

A working group was formed at a September 16 workshop, organized at the OECD headquarters in Paris, France, to develop a “road map” for the development of a socio-economic impact module of the Global Earthquake Model (GEM). The working group includes members from the World Bank, Applied Insurance Research (AIR), Munich RE, Oxford University, and CEDIM. The working group members representing CEDIM are Mr. James Daniell, Dr. Bijan Khazai and Prof. Friedemann Wenzel. The Paris workshop was preceded by a Preliminary Socio-Economic Module Workshop at the GEM Outreach Meeting from 8-9 June in Munich, Germany, where Dr. Bijan Khazai presented possible socio-economic indicator tools and strategies for such a framework.

Aims / Objectives

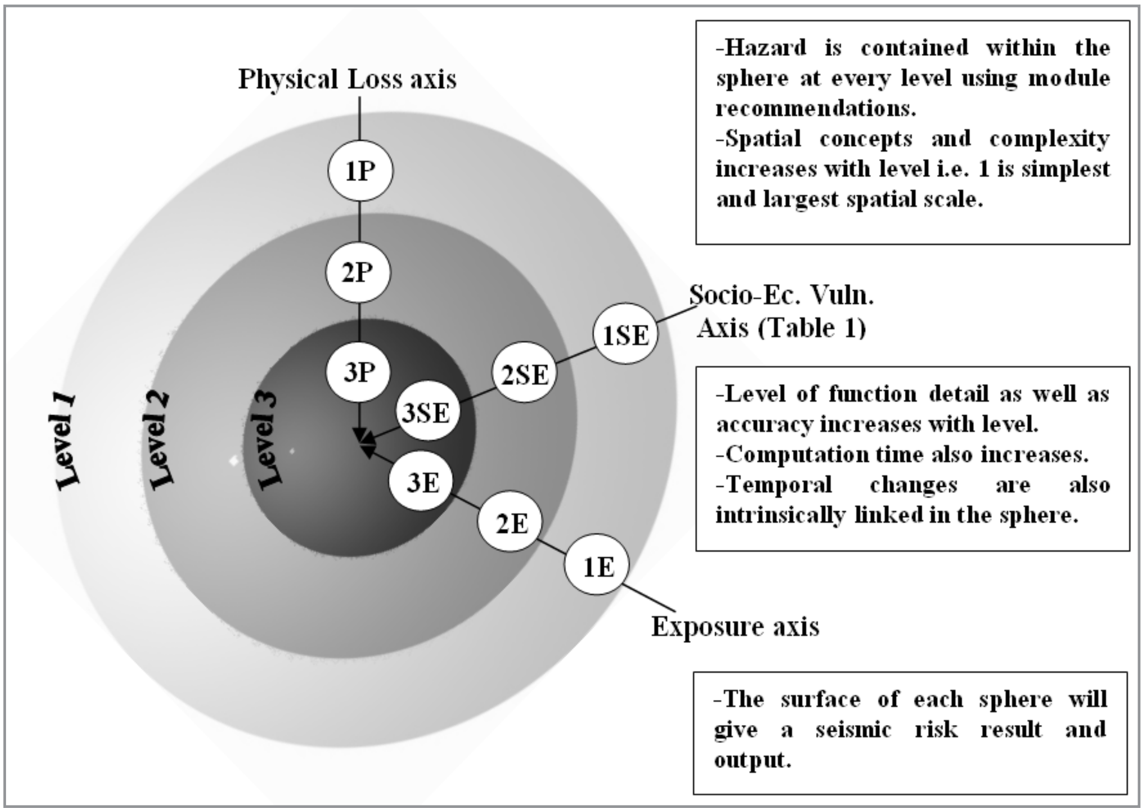
There are three different input components for the GEM (Global Earthquake Model) Socio-Economic Impact (SEI) module should be addressed

a. Direct conversion of damage to fatalities, injuries, homeless and economic impact which is undertaken by the physical loss (risk focus) module

b. Direct and indirect socio-economic impacts and complex indicators describing social and economic vulnerability.

c. Economic data which can be linked to macro-economic modelling of earthquakes and the associated disruption ripple effects in the economy.

The GEM SEI Module should also produce as output components a range of indirect impacts which enable meaningful planning and policy analysis. Considering the dependency on spatial scale, impact/consequences of interest and user needs, an appropriate hierarchy structure for direct and indirect losses can be derived based on a multi-tier system with increasing quality of results at the expense of data availability and modelling complexity. A multi-tier structure can be envisaged for the physical loss (P), exposure (E) and socio-economic (SE) compon-



Scale	1SE) National	2SE) Grid	3SE) City/District specific
Indicators	Participatory Modelling	Participatory Modelling	Participatory Modelling
Databases	Identified databases and country specific	Identified databases and country specific	Case study basis and below
Analysis Unit	National	Geocell based	City or District – smaller cell
SE components	CEDIM-GEM tool	To be determined	To be determined
P Data needed	Level dependent	Level dependent	Increased Level, but dependent
Test cases	Countries from low, lower middle, upper middle and high background, Continental differences.	Grid section in any country, grouping over borders, to check algorithms.	City-based system, test cases for Ahmedabad, India, Manila, Phillippines, and other worldwide locations.
Type of Exposure data	Residential	Residential, Industrial, Commercial, Large Loss (schools, hospitals etc.), Transportation and Utility Systems, Critical lifelines.	As grid, but with greater definition within each group if required. Accounting for interconnectedness of systems should also be looked at.

ents of GEM, by applying differing complexities of the direct and indirect losses to each of these levels and capturing these through indicators at a global, grid and city/district scale. Accordingly, for each level the complexity and data needed to quantify the “input components” of the SEI will be able to correspond to the data available on that level. Consequently, social and economic models can be implemented at each level and applied to compute the desired “output components” of interest based on the particular user needs and impacts/consequences which are relevant for each level (e.g., the scenarios for policy analysis for a city/district vary considerably in detail and scope from those of a nation and involve different stakeholders).

Defining the SEI effort in terms of the multi-tier approach, a first-year effort can be limited to the simplest level of analysis – National (1-SE) level.

SE Module „Input Components“

The first-year effort will require the definition of a hierarchy for the “input components” of GEM 1-SE:

a. SE indicators based on direct conversion of damage,

b. SE indicators describing social and economic impact and disturbances, and

c. SE indicators which can be linked to macro-economic modelling at this level.

The development of a socio-economic index of user-specified country/countries (Level 1SE – as seen in Figure 2) based on user-driven selection of ranking criteria and weights is envisaged. Various global socio-economic databases may be used to compare the potential impact of disasters in different countries due to differing vulnerability conditions. These data sets are more or less overlapping but data from different databases and different countries are hard to compare due to different conditions which lead to vulnerability in different places. To enable a geographical comparison of direct and indirect socio-economic impacts a taxonomy of the indicators is necessary. Additionally, strength and weaknesses of the descriptive capability of each indicator should be studied according to a set of proxies for disaster consequences (mortality, GDP loss, etc.)

A global database of 201 (73 economic and 128 social) indicators has already been constructed from existing databases such as the CIA, World Bank, UNDP, etc. at CEDIM. As part of the first-year effort a core ontological model for the indicators based on relationship functions such as aggravating effect, spatial distribution, time dependencies, inter-dependencies, etc. should be developed. The ontology core model should be used in a software platform to generate a subset of socio-economic impact indicators from the global database based on the best match for a multiple set of criteria defined in the core ontological model (e.g., short-term, medium-term and long-term impact). To ensure that the semantic details are sufficiently expressed by the used ontology representation language, there is a need of integrating several domain ontologies (economy, social, health and environmental sciences) to better represent indicators related to socio-economic impact.

SE Module „Output Components“

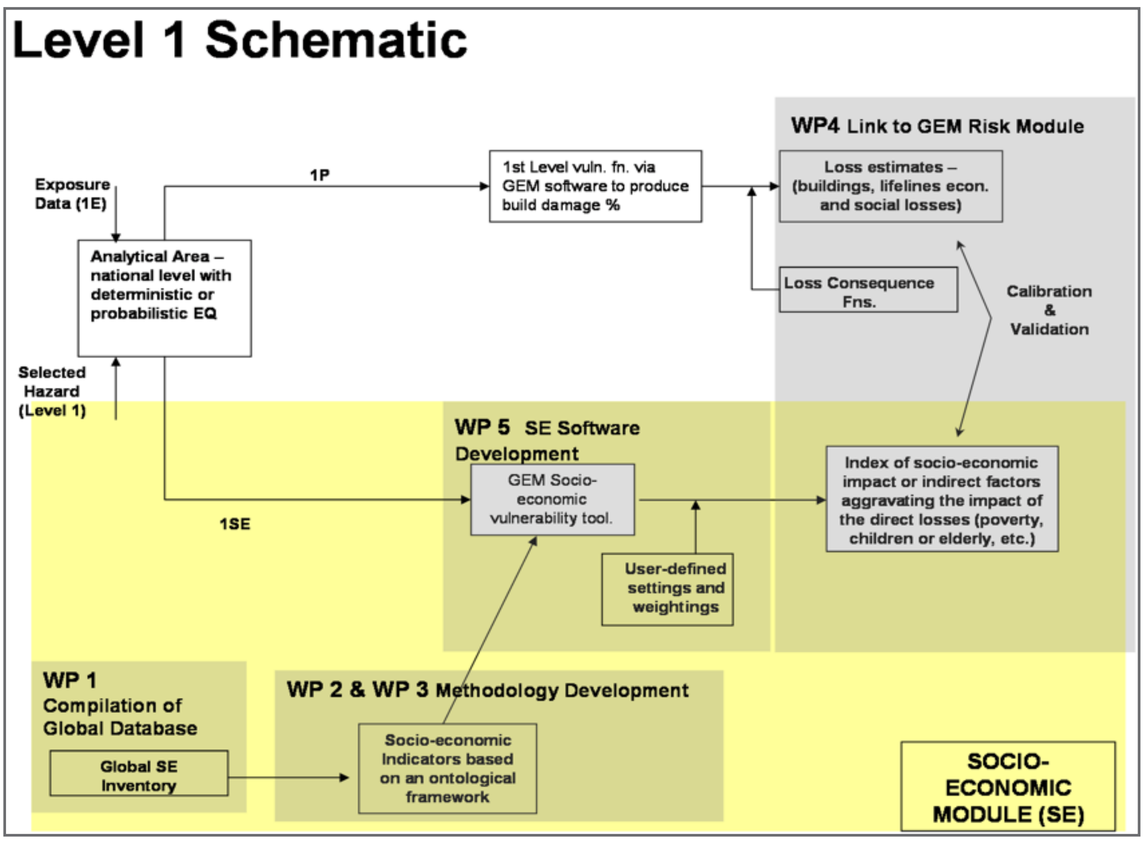
User-need surveys and investigation of various models should also be carried out in the first year to define the exact structure of the output components of GEM 1-SE, identify the appropriate models to be used, and calibrate these models. Using the “input components” of GEM 1-SE, a multi-use index method can be integrated in a multi-criteria decision support management structure for policy-relevant planning such as:

a. Short-term and medium-term SE impacts and recovery potential ranking of countries,

b. Long-term SE impacts and recovery potential ranking of countries, and

c. Ranking of specified baseline and intervention scenarios

A software package should be designed to encompass a number of policy-relevant output components in a multi-criteria decision support framework with a simple to use analytical tool which allows the user to define the level of detail, make decisions as to the indices wanted or if few indices are available, to the degree of confidence of these indices. It should be open source, in line with GEM principles. There is a need for such a tool to be dynamic and to link to existing databases. A multi-tier system should be applied to the socio-economic module in order to align with a multi-tier approach in a global earthquake modelling setup for their physical loss (vulnerability and corresponding loss results) and exposure components. The first-year effort will be a pilot stage for development of a more in-depth district or suburban study. This will also align well with a timeline of GEM projects, as each level can be achieved, results can be shown, and then as regional data and initiatives become present, levels 2 and 3 can be implemented.



Disaster-Management

Scenario-based decision support for flood risk management

Introduction

Thus far, current flood protection is mainly based on hazard rather than on vulnerability. “This is problematic due to the fact that climate change implies changes within the frequency and intensity of flood events. Thus the static focus on a 100-years flood event is misleading. Therefore it is essential to shift the focus and to take into account the vulnerability of society and that of different land uses” (Birkmann 2008: 5). The challenge is to operationalise and integrate the concept of vulnerability using instruments of regional planning.

Aims / Objectives

The work assesses the vulnerability of different land uses in selected councils within the Greater Stuttgart Region (Stuttgart and Esslingen) due to flood risk. Built-up areas with high flood risk in these councils will be taken into greater account.

The project uses scenario-based techniques to assess, analyse, and communicate the impact of mitigation and adaptation measures on the vulnerability of areas with high flood risk. As such, a major thrust of the project is to create information which supports the stakeholders’ decision making processes in deriving strategies to prevent losses and damages induced by floods.

Research questions are:

- What are the subjects requiring protection? Which of these are notably vulnerable to floods?
- What are the characteristics determining their vulnerability (derivation of indicators)?
- What are the driving forces which increase or decrease the vulnerability level? Which of these can be influenced by regional or urban planning tools?
- How does vulnerability of these subjects change, in the case of alternative planning scenarios, as well as different design floods?
- What are the implications that arise for regional and urban planning authorities?

The work is subdivided as follows into four work packages:

1. Identify built-up areas with a high flood risk and assess their vulnerability

Article 80 of the Water Act in Baden-Württemberg (WG) defines build-up areas with high flood risk “as those areas that become flooded or inundated during a 100-year flood event” irrespective of any available protective measures (Ministry of the Environment Baden-Württemberg 2005: 12). Flood hazard maps represent these areas. Scientists at the Institute for Water and River Basin Management have developed them for the stretch along the Neckar River. After consulting the Regional Administrative Authority of Stuttgart, the conclusions of the flood hazard maps will be implemented in the project.

The work aims to operationalise the vulnerability of different land use patterns through adequate protection goals and indicators. We will use the outcome as a raster to estimate the effectiveness of measures to prevent or protect built-up areas for potentially harmful consequences of floods.

2. List measures to be taken to reduce risk of flooding

The federal states regulate the measures required for areas with a high flood risk to avoid or minimise significant negative consequences to the general well-being as a result of flooding. In this section, these measures will be collected.

3. Develop scenarios at the regional level, combing and estimating the measures to reduce risk of flooding

In this context, a scenario means a possible combination of measures and their impact on vulnerability. The basis for the development of scenarios is the vulnerability assessment. The raster developed in work package 1 will be used to expose the strength and weaknesses of the flood risk management measures, collected in work package 2 and to identify further need for action to reduce the regional flood damage. The expected outcome of this work package is a ranking of measures due to their impact on reducing the flood risk in built-up areas. Therefore we will discuss their benefits (vulnerability reduction) and costs (land use restrictions, investment costs) with representatives of the regional and local authorities in the case study area and visualize the results in an adequate manner.

4. Implementation in the region

We aim to fit our results into the development of the “flood risk management plans” established by the regional administrative authority due to the Directive 2007/60/EC of the European Parliament. Therefore, we aspire to meet and consult with representatives of the regional and local authorities, and present our findings.

Project Status

The following tables provide an overview of the work packages, including the expected time frame. The yellow highlighted line marks the current status of the project.

Outlook

Where appropriate, we plan a scientific exchange with other working groups in CEDIM (e.g. with the Vulnerability group) as well as with regional planning authorities in Baden-Württemberg.

Core Science Team

Juliane Lüke (GPI, KIT)

References

Birkmann, Jörn 2008: Globaler Umweltwandel, Naturgefahren, Vulnerabilität und Katastro-

Work package	Expected time frame
Concept	January - Sept. 2009
Identification of built-up areas with a high flood risk, operationalization of the vulnerability concept	Oct. 2009 – Mar. 2010
Pre-assessment, inventory (e.g. flood hazard maps, land use planning)	Oct. 2009
Definition of vulnerability dimensions	Nov. 2009
Definition of protection goals	Feb. 2010
Derivation of indicators, Application of indicators	Mar. 2010
Catalogue of measures to be taken to reduce risk of flooding	April - June 2010
Analysis of current measures	April 2010
Estimation, discussion of alternative measures	May 2010
List of measures in a catalogue	June 2010
Development of scenarios at the regional level, combing and estimating the measures to reduce risk of flooding	July 2010 – March 2011
Impact assessment of measures on the vulnerability	Aug. 2010
Integration into the model	Nov. - Feb. 2011
Visualization	Mar. 2011
Implementation in the region	April/May 2011

phenresilienz. Notwendigkeit der Perspektivenerweiterung in der Raumplanung. In: ARL: BBR (Hrg.) 2008: Raumforschung und Raumordnung, 1/2008: 5-22. Köln: Carl Heymanns

Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks. File: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:288:0027:0034:DE:PDF, 04.09.2009

Crisis management for large-area power blackouts – the example of Baden-Württemberg

Introduction

Project duration: January 2008 – September 2009

Project Partners:

- Federal Office of Civil Protection and Disaster Assistance (BBK)
- Ministry of the Interior of Baden-Württemberg
- Ministry of Economics of Baden-Württemberg
- Energie Baden-Württemberg AG (EnBW AG)

Although German power grids meet high security standards, electricity supply systems can be disrupted by technical failure, human failure, sabotage or natural disasters. During the last years several power blackouts occurred, e.g., the power blackouts in Switzerland and Italy 2008 and the power disruption in the central and southern part of Europe in 2006, causing large-scale and long-term supply disruptions.

In 2005, in the north-western part of Germany heavy snowfall in combination with extremely low temperatures caused a power blackout, lasting for up to seven days in some regions.

Depending on their spatial and temporal dimension power disruptions can result in serious economic and social impacts (Figure 1.1) Within the private and public sector power blackouts often result in the disruption of critical infrastructure systems, due to the high degree of interdependencies among the different networks. For instance, communication networks (e.g., telecommunication, mobile networks) and transportation systems (e.g., rail systems, traffic lights) are disrupted during power blackouts. Furthermore, important supply infrastructures, such as water supply systems, food supply networks or medical care systems, are not able to operate without sufficient electricity supply.

Within industrial companies power blackouts can cause long-term economic impacts. Here, the negative impacts of production downtimes can propagate through highly interconnected supply chains in companies and sectors which have not been affected by the original power disruption. If safety systems and control installations (e.g. cooling systems, safety valves) are affected by the power disruption, within some industrial sectors secondary hazards (e.g., release of hazardous materials) might be caused.

Real power blackouts as well as power disruption scenarios, practiced in crisis management exercises, showed that in order to reduce potential impacts of power disruptions, a clearly structured and well planned crisis management strategy is necessary. Within the crisis management process especially the cooperation between private and public stakeholders plays an important role. Here communication and the exchange of information is often a challenging task.

Aims / Objectives

The main objective of the project was the development of a handbook, which can be used for decision support within operative and strategic crisis management in the event of large-scale power blackouts. The handbook should be used by power suppliers and public authorities as well as by companies and social institutions, affected by supply disruptions. The handbook

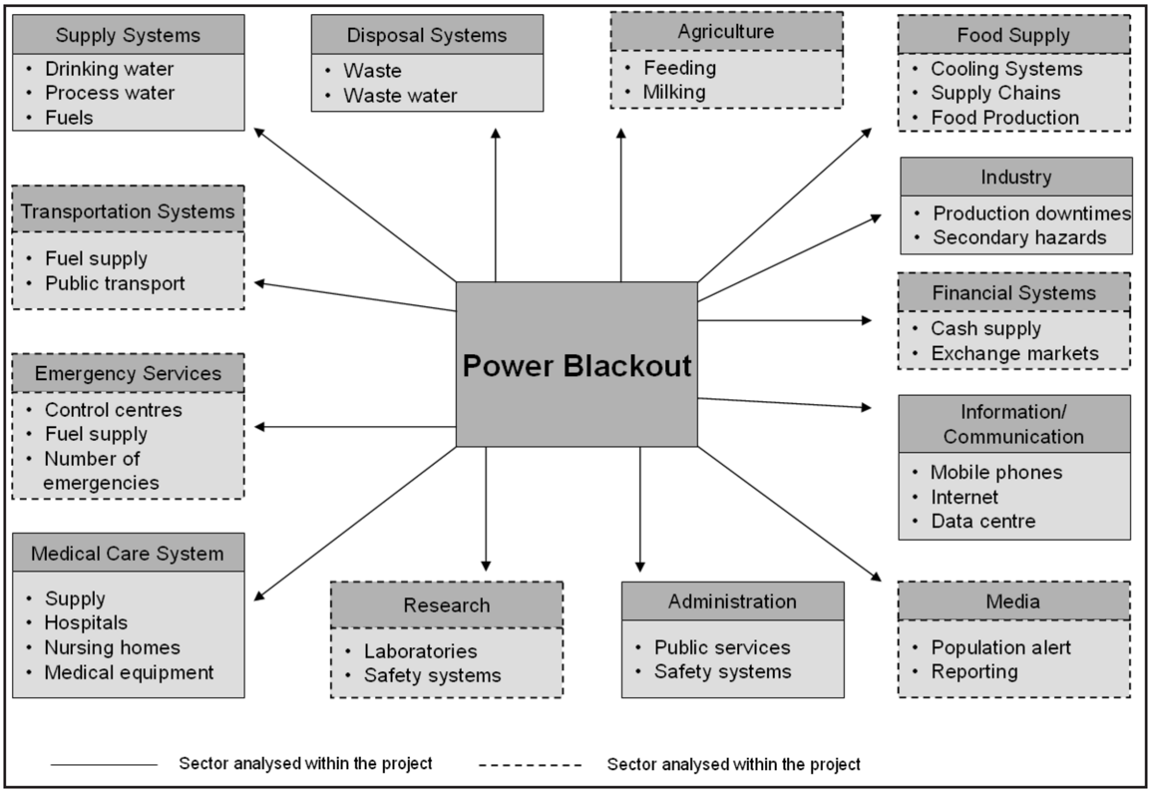


Fig 1.1: Impact of power blackouts on critical infrastructures and social systems

contains background information on electricity system, legal regulations and crisis management structures as well as a detailed impact analysis. Furthermore, the handbook contains checklists, supporting the identification and planning of crisis management measures.

The reported results of the LÜKEX 2004 exercise have been the starting point of the project. Within this strategic crisis management exercise (conducted by the Federal Office of Civil Protection and Disaster Assistance (BBK)) a scenario with power blackouts initiated through an extreme weather event in various regions of Germany was practised. Beside four Federal States of Germany (Bavaria, Baden-Württemberg, Berlin and Schleswig-Holstein) and eight Federal Ministries, 100 external actors, such as power producers, meteorological service, telecommunication companies, discounters and German Railway were involved in the exercise.

In order to provide a detailed impact analysis of power blackouts within four selected sectors (“medical care system”, “supply and disposal systems”, ”industry”, “information and communication systems”) moderated workshops and expert interviews have been held. Based on the potential impacts of power blackouts, identified within these workshops and interviews for the analysed sectors, potential crisis management strategies and measures have been defined. The results pointed out, that for a successful crisis management in the event of large-scale power disruption, preventive mitigation measures as well as emergency measures must be planned. Furthermore, it became evident that in the aftermath of a power blackout specific crisis management measures are necessary as well. Therefore, the handbook contains checklists, supporting all three temporal phases of the crisis management process.

Impacts of power blackouts on industrial companies can cause serious economic damage both to single companies and regional economies. Thus, the project especially focused on the analyses of impacts on industrial systems.

Within industrial companies, the type and the dimension of the disruption impact extremely depend on the type of the production processes, the type of the production equipment and the dependency of the processes on electricity supply. Therefore, the impacts of power blackouts to industries are highly sector specific. However, some general mechanisms how industrial systems are affected by electricity interruptions, can be identified (see Figure 1.2) .

Results of expert interviews with various industrial stakeholders showed that within industrial production sites production downtimes, secondary hazards and additional costs are mainly caused either by the direct interruption of the production equipment or the disruption of supply chain processes and other critical infrastructure systems.

Project Status

The handbook was finished in October 2009 and handed over to the responsible project partners.

Outlook

At present the publication of the handbook is in preparation. It is planned to distribute the handbook to the authorities of the federal state of Baden-Württemberg and other federal states of Germany as well as to federal authorities of Germany. In a later stage the potential other users (e.g., companies, operators of critical infrastructures, IHK, LVI) will be provided with the handbook as well.

Publications

Merz, M., Hiete, M., Rostal, D. and Bertsch, V. (2009). Multi Criteria Decision Support for Business Continuity Planning in the Event of Critical Infrastructure Disruptions, International Journal of Critical Infrastructures, 5 (1/2), 156-174.

Merz, M., Hiete, M. and Bertsch, V. (2008). Management of Critical Infrastructure Disruptions in Industrial Supply Chains, in Ammann, W.; Poll, M.; Häkkinen, E.; Hoffer, G (Hrsg.), Proceedings of the International Disaster and Risk Conference, Davos 2008, 388-390.

Core Science Team

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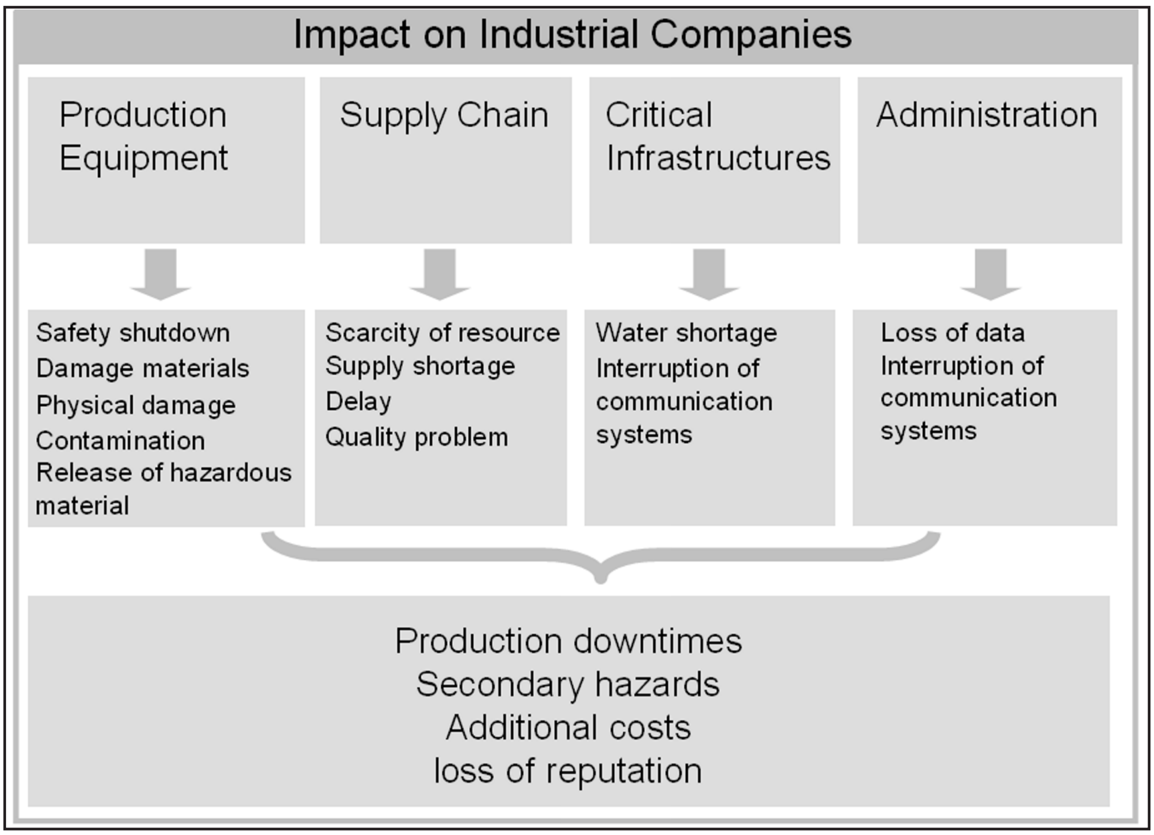

Fig 1.2: Disruption impact of power blackouts on industrial companies

Security2people

Security Research Program sponsered by the Federal Government

Introduction

As part of a high-tech initiative, a national security research program was initiated by the Federal Government. On the one hand, the program aims at taking into account the increased threat potential of natural disaster, technical accidents and terrorist attacks, and on the other hand, it aims at encouraging the development of research-intensive and deliverable products.

Through CEDIM, KIT is represented by the Institute for Technology and Management in Construction and the Institute for Nuclear and Energy Technologies in the consortium „Secure IT-based Disaster Management" that successfully participated in the tender "Protection and rescue of people" within the framework described above. The project started on June, 1st 2009 and funding is granted for three years. Besides the two institutes of KIT mentioned above, consortium partners include CAE Elektronik GmbH as the consortium manager, PRO DV Software AG, the Federal Office of Civil Protection and Disaster Assistance (BBK) and DIALOGIK – non-profit institute for communication and cooperation research.

The generation of the research project's results and their validation is assisted scenario-based by partners from practice. In this context, this includes for instance the Interior Ministry of North Rhine Westphalia, the regional government of Cologne, the airport Cologne-Bonn, the Koelnmesse, the fire-department of Cologne, the Agency for Technical Relief, the German Red Cross and the Order of Malta Volunteers.

Aims / Objectives

The goal of the project is the research and the development of basic principles of a worldwide so far non-existing integrated, IT-based crisis management system, which

- enables a consistent, comprehensive information supply and decision support for crisis manager on an operative-tactical as well as on a strategic level,
- jointly addresses and links crisis manager at authorities and organisations with security responsibilities and operator of critical infrastructure
- can be used for emergency planning as well as in training and practice of crisis management and thus, can achieve maximum economic efficiency and user acceptance

With the SECURITY2People approach, proof of feasibility of such a system shall be provided and requirements for an optimal system configuration shall be identified. The final step of the project will not deliver a completed product, but a functional demonstrator based on a selected crisis scenario. Thereby, the project is consulted by a representative selection of end users from different decision levels and areas mentioned above.

The current state of research and technology shall be pushed significantly by the following innovations:

- Institution-, region- and nationwide information supply for a standardised, consistent data, conception of appropriate interfaces considering existing IT-standards and if necessary, conception of new interface standards
- Implementation of a modular, interoperable and service-oriented architecture (SOS), which allows for the first time integrating existing, planned and other future components. This includes geo information systems, simulation models, 3D-visualization tools, head-of-operation systems, sensors and others.
- Conception of an ergonomic human-machine interface, that enables simple, secure and intuitive access to the system functions, according to the field of application (emergency planning, training, practice, operation), level (operative-tactical, strategic) and the user.

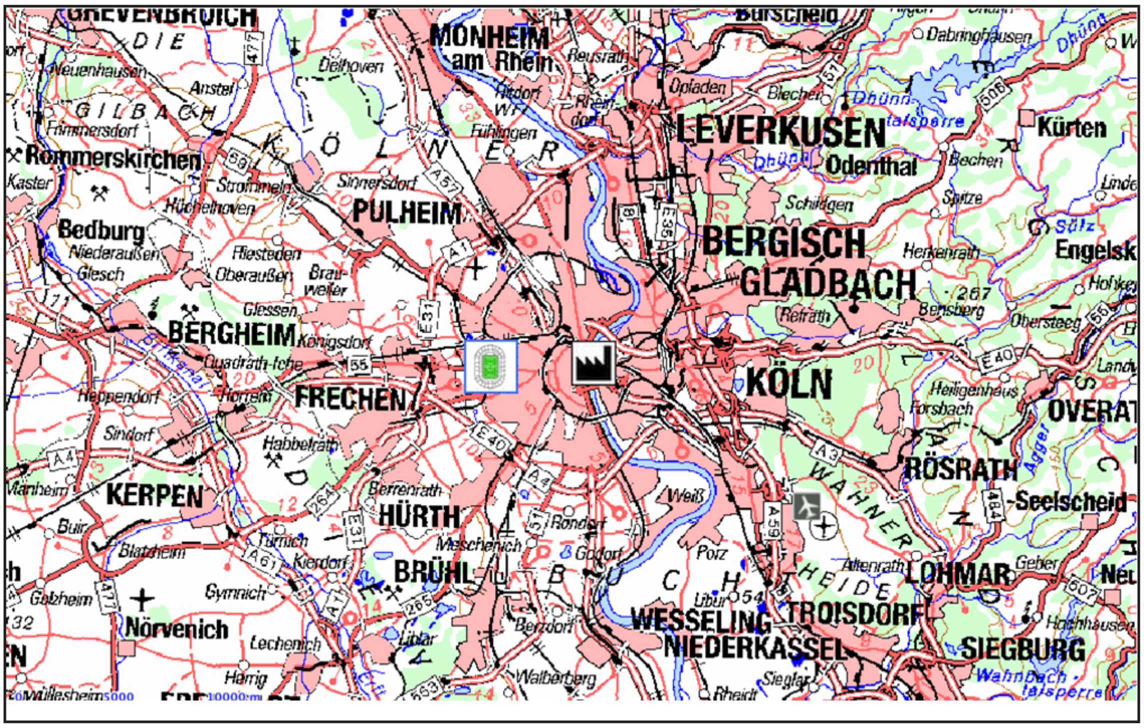

Fig.1: Test scenario

- Investigation of new decision making components that are able to develop and justify independently optimized strategies for action.
- Exemplarily development and integration of simulation models for the illustration of leadership decisions in crisis management and the situation development resulting from this decisions
- Development of valuation models in order to determine the impacts of alternative actions in terms of loss of persons, property and environment

Test scenario

A storm event in the Cologne area served as a test scenario. Based on this exemplarily event, potential threats to the population were analysed (e.g., floods, disruptions in road and rail traffic due to wind blow, aircraft accident and building losses at the airport, extensive blackout and others). Thereby together with participating users, the requirements for the SECURITY2People system will be identified, depending on the users' role and level. In the model scenario, all conditions for a general system approach will be included, so that transferability of the system to other crisis scenarios and users, including international ones, is given.

System Architecture

SECURITY2People wants to improve considerably the emergency prevention and leadership of staff and head of operations in terms of situation determination, decision-making and coordination of task forces. For this reason, the missing technological and scientific basics for an open system approach shall be developed, providing necessary information for various decision-makers and supporting them with their decision-making. Every public and private organisations involved in the event, shall be linked by the SECURITY2People approach on a platform.

SECURITY2People uses a modular, open system approach in form of an interoperable, service-orientated architecture (SOA). SOA stands for the structuring and use of shared functionalities, which are accounted for by different owners. Fig.2 shows the desired system configuration.

The system approach consists of the following main components:

- The interoperability platform: From the beginning, it will be developed as a SOA in an open framework. Therefore, other components, systems and web-based services can be added, for instance those on the market and in practical use or those yet to be developed. Via the interoperability platform, all the components and users of every decision-level involved in the total system will be linked.

- The surface level: Basically, it contains a scalable illustration of the situation, based on a geo information service (GIS) including an input mask. This will be completed, among others, by 3-D-visualizing components for detailed views, a messaging component for information exchange of the participants and interfaces for extern visual components like existing head-of-operation systems.

- The service level: Basically, it consists of geo information services for data storage and management, simulation components for the illustration of emergency measures and their impacts on the disaster area and decision-making components. This approach is based on methods of Artificial Intelligence (AI) for generating unassisted proposals for solution, valuation components for determination of the extent of loss depending on the taken emergency measures and interfaces of extern service components, like expansion simulation of toxic substances loads or flood events

- The human-machine interface: A standardised graphic user interface, orientated on the decision-making process, aims at supporting the fast, secure and intuitive use of the system and its components. According to the portal-principle, necessary information and functionalities shall be provided for the user, depending on the application (emergency planning, training, operation) and their role in the system.

Contributions of CEDIM to Security2people

The essential contributions of both KIT-institutes to the project are

- Process analyses, modelling and simulation of remedial measures and their impacts on the disaster area

- Process analyses of decision-making and the development of decisions and support components

- Basic research in the fields of interoperability and human-machine interface.

The contribution of the Institute for Technology and Management in Construction (tmb) base on the experiences obtained from the subpro-

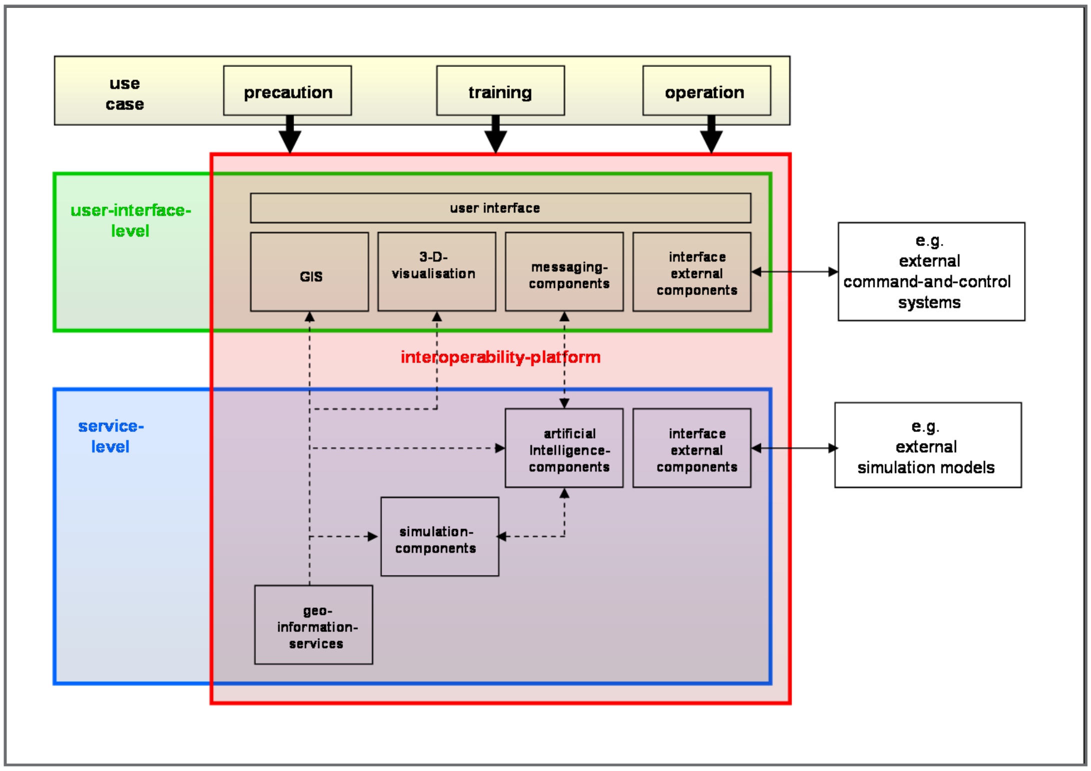

Fig. 2:System configuration

ject "Planning and implementation of remedial measures: Modelling and Simulation", and have been so far limited to the operative-tactical level. The subproject is part of the Collaborative Research Centre 461 „Strong earthquakes", funded by the German Research Foundation.

So far, the works of the Institute for Nuclear and Energy Technologies exclusively took place on a strategic level and base to a great extent on the RODOS project (Real-time On-line Decision Support System), funded by the European Union.

Within the framework of SECURITY2People the works of both institutes are linked project-based. Here, the ability of level-crossing networking of decision-making processes and the scaling of related data and information is of great interest.

Geoinformation Management

Web-based information system: RiskExplorer – Risk comparison for Saxony

Introduction

A consistent analysis of all relevant risks is necessary for the risk management of natural hazards. The multi-risk study that was developed by the CEDIM research group "Synopsis of Natural Hazards" offers a comparison of all risks due to flooding, winter storm and earthquakes for every community in Saxony, based on a consistent methodology. These results need to be communicated in a sound and comprehensible way in order to be used for decisions concerning risk reduction and loss prevention. Maps form an appropriate for spatial risk comparison. However, a multi-risk study including various return periods cannot be displayed in a simple map. Therefore, results of the CEDIM work group "Synopsis of natural hazards" are published using an interactive web information system. This web information system "RiskExplorer – risk comparison in Saxony" aims at expanding and completing the CEDIM RiskExplorer platform.

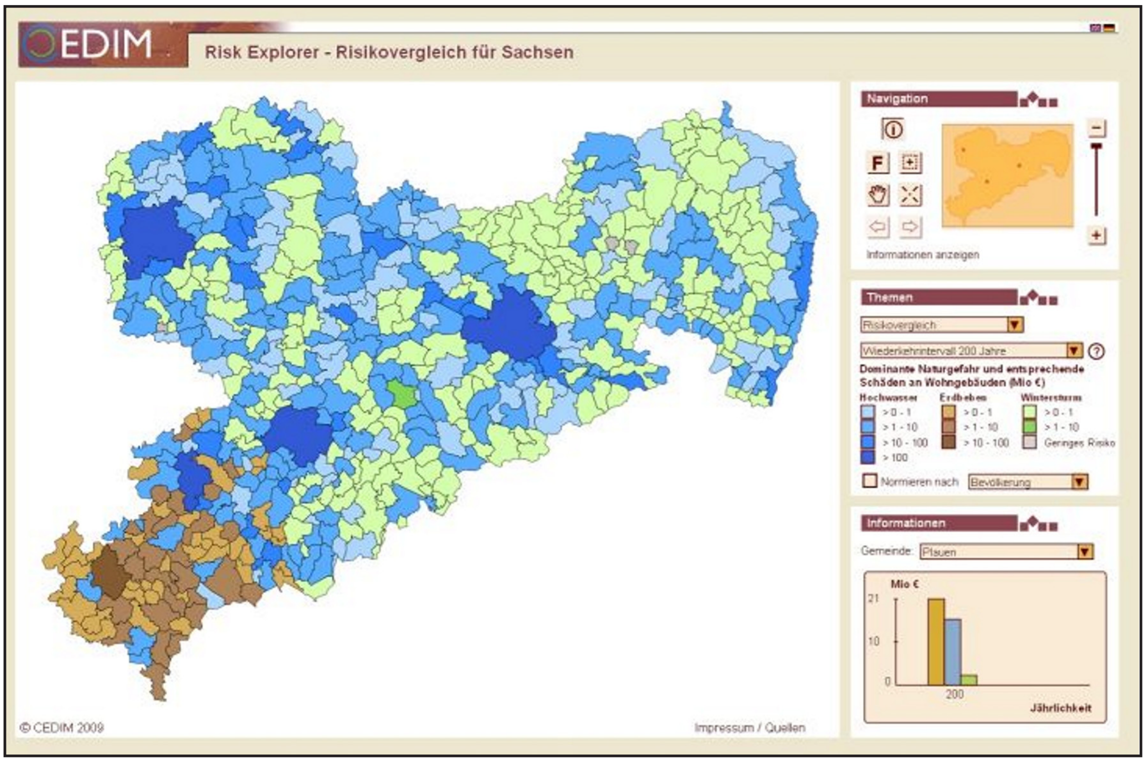

Fig. 1: The RiskExplorer – Risk comparison for Saxony

Aims / Objectives

An interactive web information system is developed which allows detailed access to results in order to present the risk comparison for Saxony and to be utilized in science and technology. The user can display individual thematic maps with the spatially distributed risk for various hazards and return period intervals as well as the dominant natural hazard. In addition to these maps, a statistical comparison for each return period for a specific hazard or a comparison based on 200 years return period is provided.

Furthermore, data can be scaled to population, area and recovery value of the buildings to enable a risk assessment that can be useful for the comparison of different communities.

Project Status

The "RiskExplorer – risk comparison in Saxony" is conceptually and technically completed. The layout is aligned to RiskExplorer Germany to attain the recognition effect. As soon as the final results of the working group are available, RiskExplorer – risk comparison Saxony will be published.

Core Science Team

Kathrin Poser (Section Earth system modelling, GFZ)

Humans as sensors

Integration and valuation of information from the affected population for flood risk management

Introduction

For disaster management and rapid loss estimation, it is important to obtain an overview of loss and linked disturbances as comprehensive as possible. The necessary information is provided by various sources (e.g., observations of task forces, different sensors, aerial and satellite images) and needs to be consolidated and jointly evaluated in order to be used for disaster management decisions and post-event analysis.

In the past, observations of eye witnesses and the local population were rarely integrated in disaster management and rapid loss estimation. However, this information can contribute significantly to the assessment of the post-event situation, particularly for events of larger geographical extent or those with parameters that are hard to measure.

Aims / Objectives

The aim of the project is to utilize information of the affected population for risk management. Taking the rapid loss estimation after flood events as an example, methodologies and techniques for quality evaluation of such data are developed. The tangible research questions are:

- Which of the required information can be observed by the population in a sufficient quality? How can this information be collected?
- How can the quality of this information be reviewed and controlled? How can the quality assessment be automated?

The approach consists of two parts. In first part, the observation quality of the affected population is analysed on the basis of existing data obtained from telephone interviews. The results of this analysis are used in the second part to develop an automated approach for quality evaluation for a web-based flood survey and to implement in a prototype.

The quality evaluation of existing data is based on telephone interviews which were conducted with people affected by the Elbe and Donau flood events in 2002 and the Elbe catchment area in 2006. In over 2000 interviews, affected people were asked about flood parameters, private prevention measures and loss due to the flooding. This work focused on information regarding water-level and flow velocity, since the water-level is of great importance as it constitutes the most important parameter for

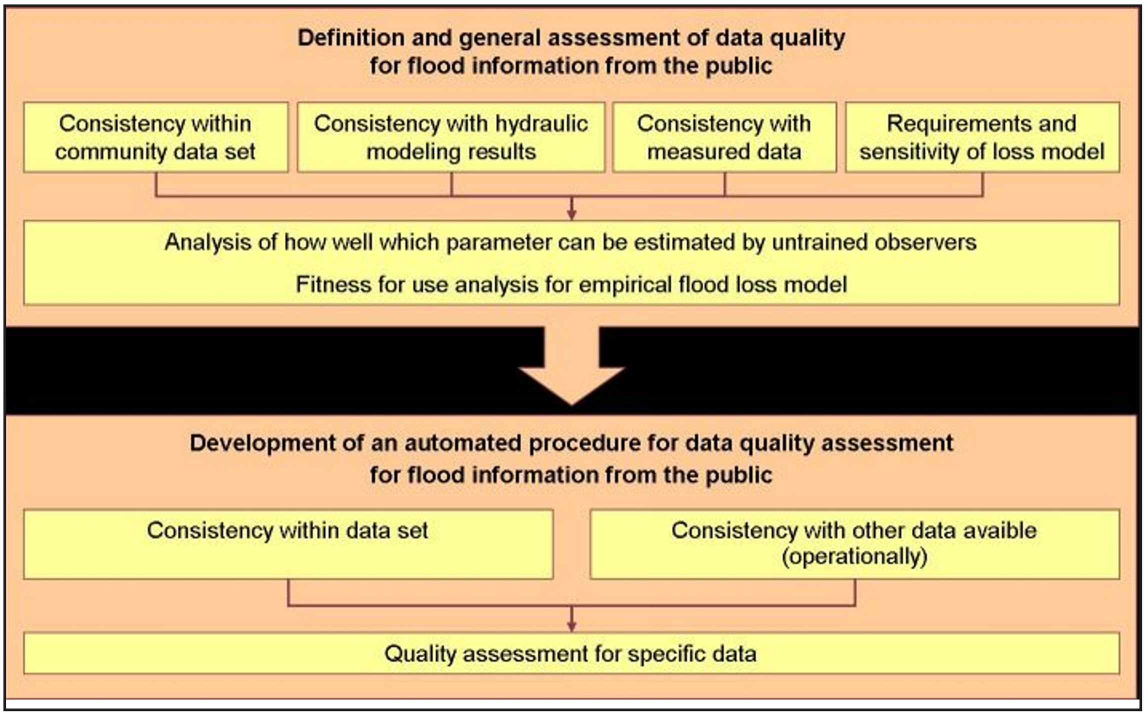

Fig. 2: Project approach

loss estimation. The data from these telephone interviews is checked for consistency within the data set, for consistency with measured water-levels and results of hydraulic models. Afterwards a fitness-for-use analysis is carried out in order to see whether the observations of the population are suitable to encourage an empirical loss model that enables rapid loss estimation after a flood event. Based on the results, an automated approach is developed, which allows the affected population to evaluate the available data in a prototypic, web-based system and to estimate the loss due to the flood event.

Project Status

Up to now, data from the telephone interviews were checked upon their consistency within the data set, their consistency with model results and their consistency with measured water-levels. Results of the intern consistency check and comparison with results of hydraulic models show, that water-level estimations indeed deviate considerably from the modelled results. However, the modelled data deviated from the measured water levels to the same extent. The assessment of flow velocity by verbal description deviates strongly from measured data, however no measured data exists here, so that the reliability of data cannot be judged either. Results show that the estimated water-levels possess a similar deviation to the levelled ones as the modelled ones.

The usability of observation by the population for loss estimation was analysed by means of empirical models for the community of Eilenburg an der Mulde as an example. Eilenburg was severely affected by the flood event of 2002. This study revealed that loss estimation with these data only deviates slightly from data of hydraulic models. Although the deviation from reference data is significantly stronger, but considering the generally high uncertainties with empirical loss modelling these results can be classified suitable for these estimations.

Outlook

After analysing the existing data from the telephone interviews, an automated quality evaluation method is developed, which is supposed to be used in a web-based survey of flood data.

Publications

Poser, K., Kreibich, H., Dransch, D. (2009): Assessing volunteered geographic information for rapid flood damage estimation. In: Proceedings of the 12th AGILE International Conference on Geographic Information Science: Advances in GIScience.

Poser, K., Dransch, D. (2009): Volunteered Geographic Information for Disaster Management with Application to Rapid Flood Damage Estimation. Geomatica (In review).

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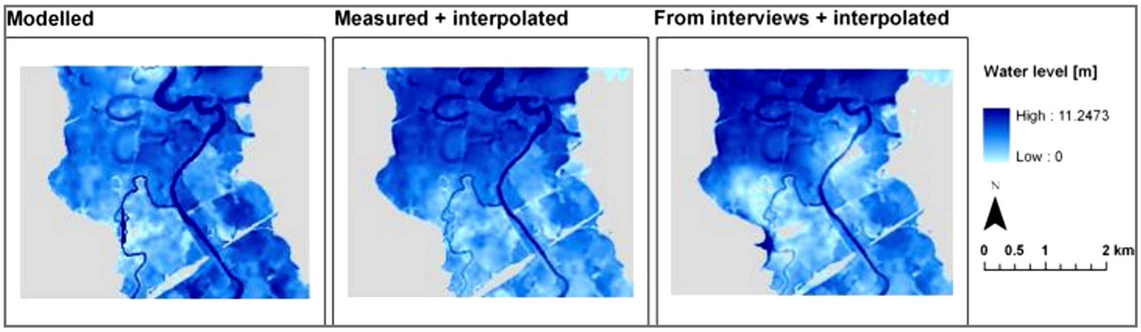

Fig. 3: Comparison of flood depths for the community of Eilenburg from modelled, measured and observation data.

Megacity Indicators System for Disaster Risk Management

Implementation in Istanbul

Introduction

City officials need tools to understand the priorities and to set up benchmarks and track progress in their disaster management systems, so that they can justify decisions and investments in disaster risk reduction. The models and methodology referred to here as the “Megacity Indicator System” (MIS) is a tool to communicate risk and promote discussion around relevant local-level risk parameters that enable DRM professionals and decision-makers to develop appropriate Disaster Risk Management (DRM) strategies. It also sets up benchmarks and enables tracking progress on these benchmarks, thus providing a possibility to correct, review and decide on where to invest resources. In this work the main focus is on development of megacity-relevant indicators, application of the methodology and indicators in an interactive tool, and building a reproducible framework which cities and other institutions can use to measure their own DRM state-of-practice and evaluate progress in urban DRR.

Approach

The Megacity Indicators System (MIS) is composed of three separate but complimentary indicator sets. The first component of the MIS is the Urban Seismic Risk Index (USRi), which is based on the work of Cardona et al. (2005) and provides an overview of not only the expected direct damages, but also the potential for aggravating impact of the direct damages by the social fragility and lack of resilience of different districts in Istanbul. Evaluation of the potential direct damage of expected physical damage to buildings and infrastructure from existing loss scenarios produces the “physical” risk indicators as the first step of this method. The potential direct impact of an earthquake, for example, is denoted as Physical Risk, RF. The indirect effects are given by an impact factor (1+F), which is based on an aggravating coefficient, F. The impact factor (F) consists of a set of indicators describing inherent factors of fragility of a person or group (i.e., personal attributes, living situations, finances) as well as factors of resilience, such as available means of disaster preparedness and risk mitigation, solidarity and social networks, savings and other buffers and resources for reconstruction and recovery. Thus, the total Urban Seismic Risk Index (USRi) at the level of the municipality (m) is given by the following expression:

$$USR_m = \sum_{i=1}^{m} R_{F_i} \times (1 + F_i)$$

The indicators in the Istanbul implementation for social vulnerability were derived through an iterative process with a local group of investigators and reviewed in several workshops with experts at the Kandilli Observatory and Earthquake Research Institute (KOERI) and at the Middle Eastern Technical University (METU) in Ankara, Turkey. Some of social vulnerability indicators come from census surveys and routinely gathered data. However, a second group is typically not subjects of data collection, yet they represent the critical facets of resilience or capacity which are required to overcome vulnerability. This data comes primarily from a 30-point social structure survey, designed as part of this research and is due to be conducted in early 2010 by the Istanbul Metropolitan Municipality of 35,000 households in Istanbul. This survey is further augmented by several other sources, which include the Transportation Planning Department, Health Ministry, KOERI Disaster Preparedness Education Program (AHEP), Civil Defense and a number of NGOs.

While the USRi is developed for the whole of Istanbul and can be used by any interested stakeholder, the Coping Capacity Index (CCi) is developed by considering the functional and operational mandates of disaster management of the Istanbul Metropolitan Municipality. The Coping Capacity at the level of the municipality is the weighted sum of four areas where the Metropolitan Municipality has major responsibilities. These include: debris removal, rescue and relief operations (including fire fighting, search and rescue, emergency medical support, and burial support), lifeline restoration, and shelter site support. These indicators are

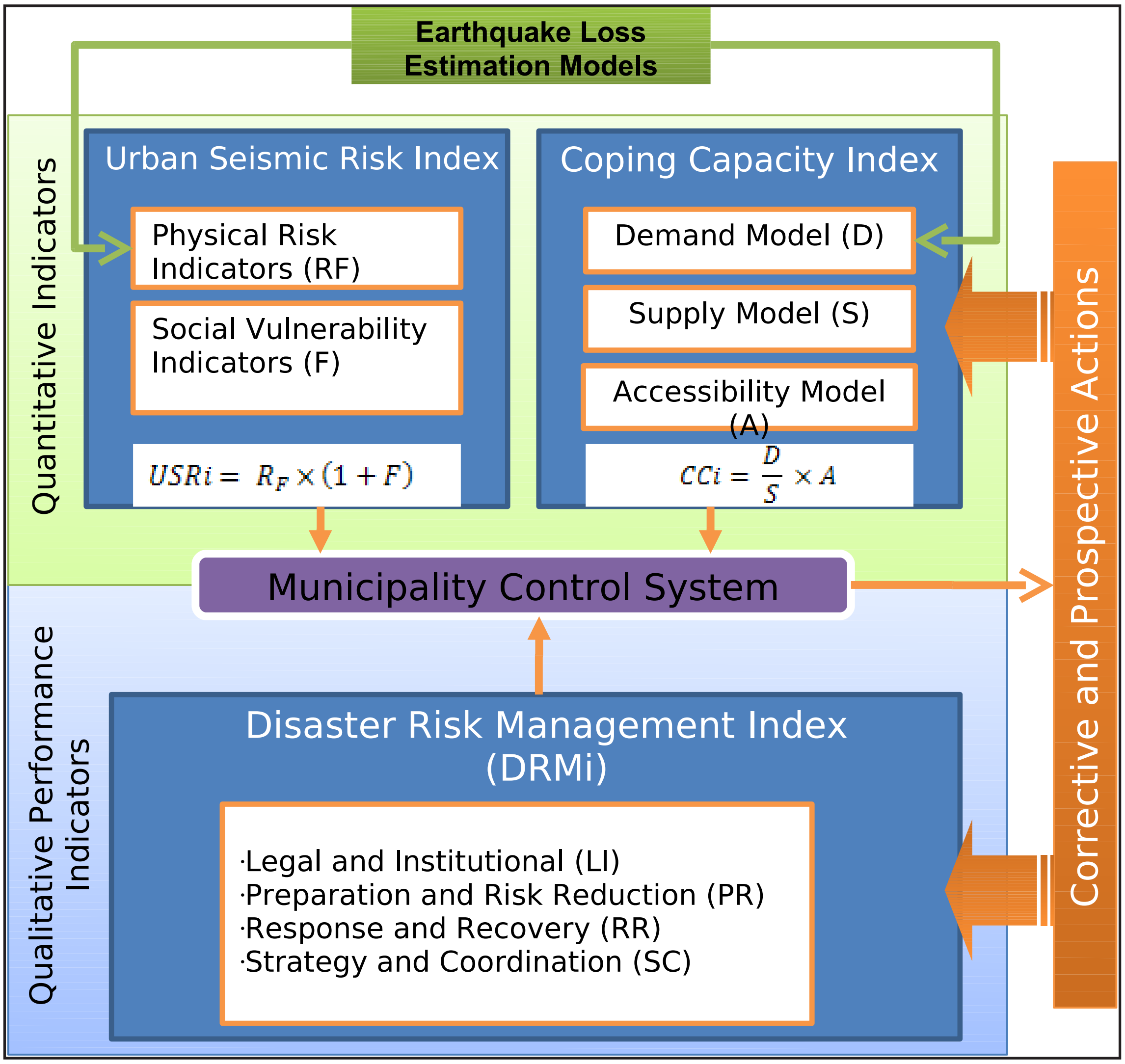

Fig. 1: Concept for Indicator System

derived quantitatively in terms of a capacity function which considers (a) the supply of available resources (b) demand made on these resources and (c) accessibility of these resources (e.g., ability to reach desired services, logistical centers, activities and destinations). The supply is determined from an extensive survey of resources e.g., manpower, machinery, etc. of respective departments of the municipality, and demand is derived from the loss estimation analysis of the earthquake scenarios for each indicator. Accessibility is determined as a time-cost factor through analysis within a Geographic Information Systems (GIS) environment.

A final step in the MIS approach is to capture the potential for disaster risk management through a set of descriptive performance indicators and track progress (or lack of progress) on pre-defined benchmarks of corrective and prospective intervention. This resulted into the development of the Disaster Risk Management Index (DRMi), which like the CCi is developed to address the mandates of policy- and decision makers at the Istanbul Metropolitan Municipality and its institutions. The DRMi performance indicators enable tracking progress of the Istanbul Metropolitan Municipality on benchmarks and strategic outcomes derived from the 2002 Istanbul Earthquake Master Plan, the recommendations of the Earthquake Council Report in 2004 and the Strategic Vision of IMM on disaster risk reduction for 2007-2014. The DRMi have been developed into a handbook for the Municipality and will be scored in a future workshop with key stakeholders at the Istanbul Metropolitan Municipality to obtain performance evaluations along key functional activities. The project implementation group has worked in close collaboration with

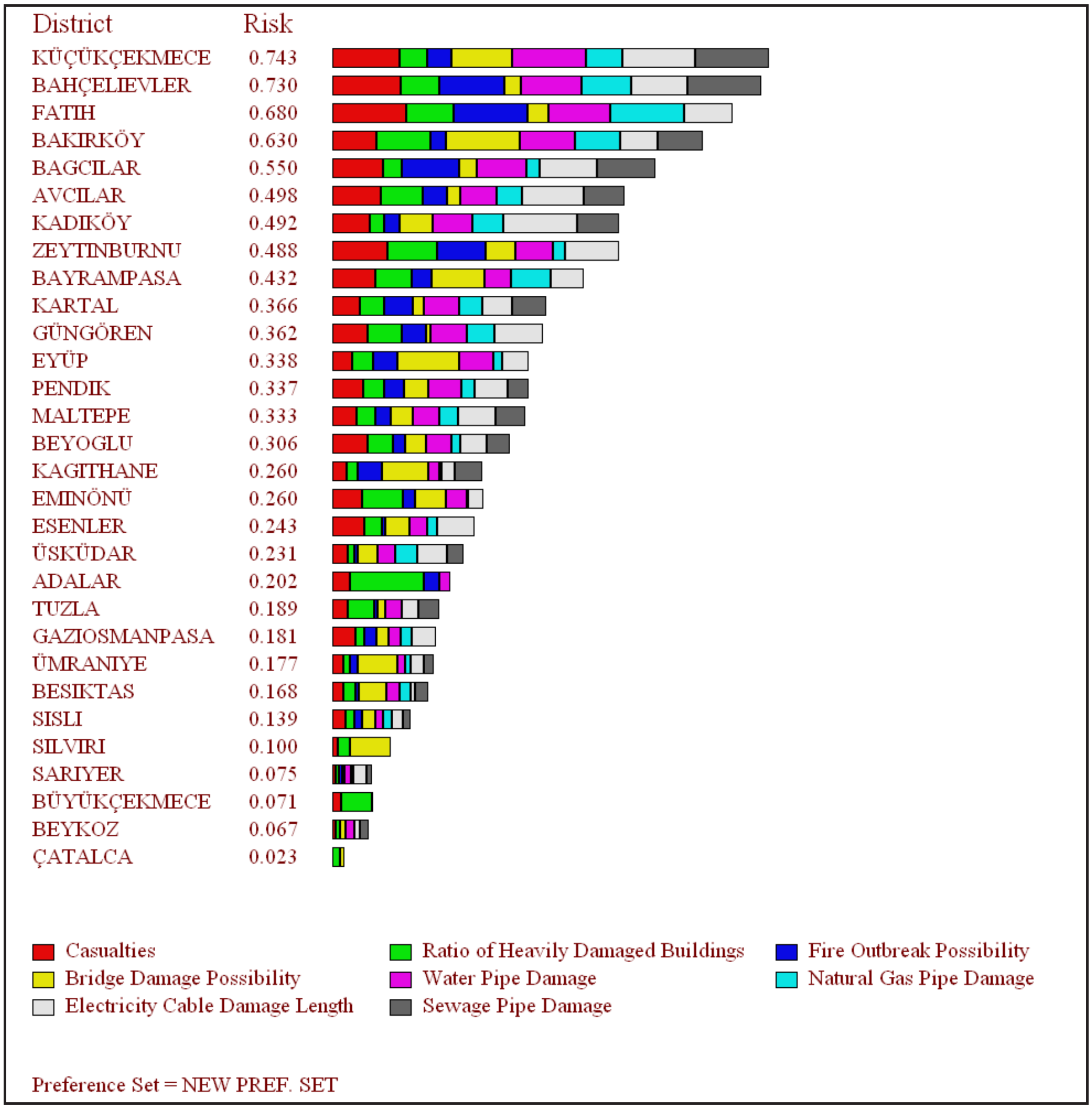

Fig. 2: Impact factor and the physical risk rankings in the district for the Urban Seismic Risk Index

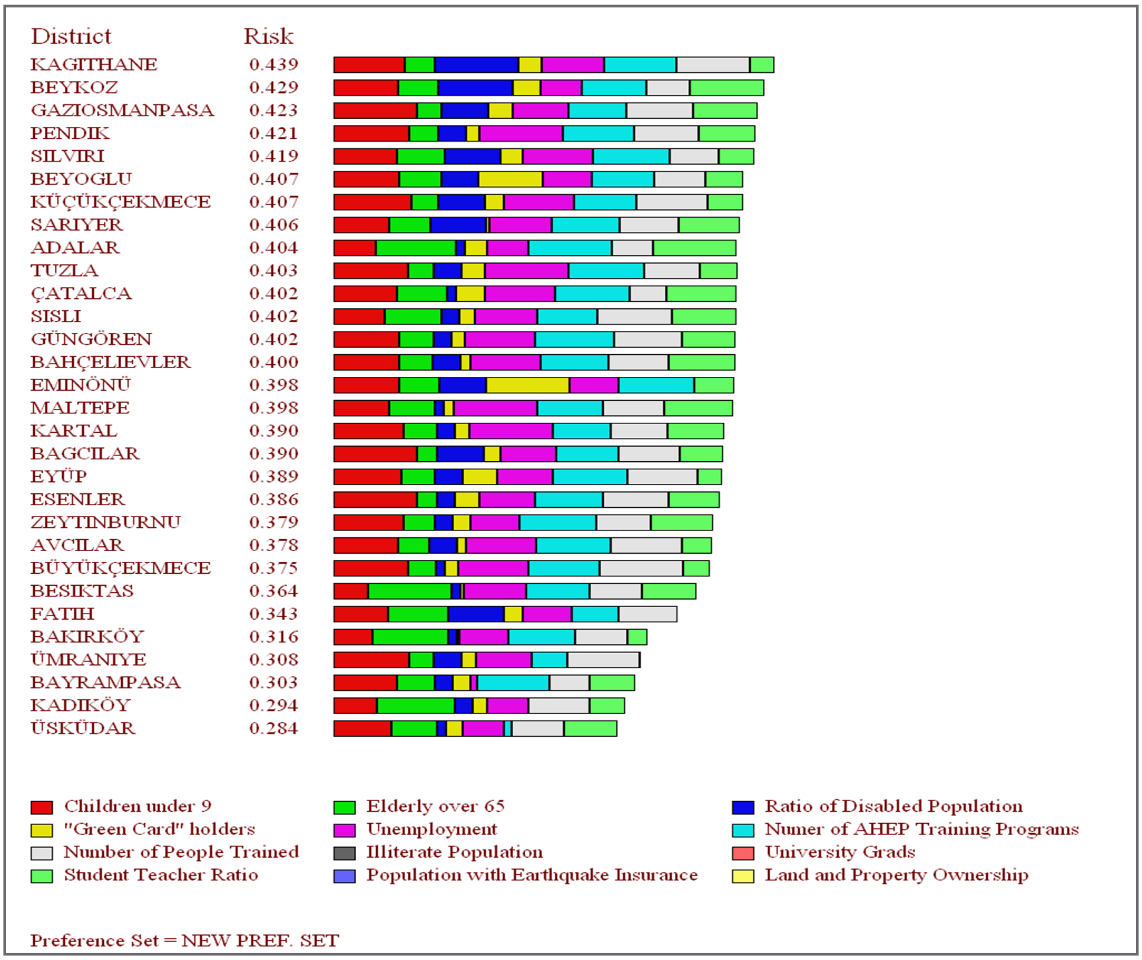

Fig. 3: Impact factor and the social vulnerability rankings in the district for the Urban Seismic Risk Index

contributors from AKOM (the Municipality's disaster management facility) to develop the structure and handbook of the DRMi indicators which has so far been validated in two internal workshops.

Project Status

In the MIS implementation of Istanbul, to date, all physical risk indicators and all available social vulnerability (impact factor) indicators at the district level have been implemented in a multi-criteria software tool to obtain total urban risk rankings in the districts of Istanbul. The implementation process consists of organizing and working with a key group of stakeholders at the Municipality in evaluating the indicators and discussing the outcomes of the MIS. The MIS application in Istanbul will rely or pre-defining the importance weights and scores of the DRM indicators with a group of experts. This allows the workshop with the stakeholders to focus on communication of the results, and translating them into specific policy recommendations. The weights and transformation functions of the indicators have been evaluated and indicators were qualified by examining the effects of their weights upon the total output. Figure 2 shows the impact factor and the physical risk rankings in the district for the Urban Seismic Risk Index (USRi). A one-day workshop planned for 2010 will be used to evaluate the USRi and CCi indicators and generate scores for the DRMi indicators with a target group of stakeholders from the Metropolitan Municipality. The MIS tool allows for the interactive implementation of several weighting methodologies, and will allow the participants to look at the sensitivity of different weighting schemes in real time. Currently additional data is being collected for completing the Coping Capacity Index. Further methodological work is also necessary in estimating the demand-side of operations such as restoring lifeline services given the available data and resources. Furthermore, results of the social structure survey are still pending, which have to be compiled for a final valuation of the USRi.

Publications

Khazai, B., Bendimerad, F., Kilic, O., Khazai, B., Konukcu, A., Basmaci, E, Mentese, E. Y., Sunday, B., 2009, “Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul”, Los Angeles International Earthquake Conference, Session 2D: How to Assess Seismic Risk and Policies, Los Angeles, USA, November 12-14, 2008.

Khazai, B., Kilic, O., Khazai, B., Konukcu, A., Basmaci, E, Mentese, E. Y., Sunday, B., 2009, “Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul”, Asian Megacities Forum 2009, Mainstreaming Disaster Risk Management in Urban Development and Governance, Mumbai, India, April 22-24, 2009.

Khazai, B., 2009, “Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul”, 5. Tagung des Katastrophennetzes “Vulnerabilitaet und Resilienz im Entwicklungszusammenhang”, 18.-20. Juni, 2009 an der Katastrophenforschungsstelle in Kiel.

Mahmut, B., Kilic, O., Khazai, B., Konukcu, A., Basmaci, E, Mentese, E. Y., Sunday, B., 2009, “Istanbul Megacity Indicator Systems Project “, International Earthquake Symposium, Kocaeli 2009, August 17-19, 2009.

Khazai, B., Wenzel, F., Kilic, O., Basmaci, A., Konukcu, B., Mentese, E. Y., Sungay, B., 2009, “Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul”, International Conference on Megacities: Risk, Vulnerability and Sustainable Development, September 7-9, 2009, Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany.

Core Science Team

The project is a joint scientific activity between CEDIM, Earthquake and Megacities Initiative (EMI), Istanbul Metropolitan Municipality (IMM) and Bogazici University’s Center for Disaster Management (CEDNIM). The project is undertaken within the Directorate of Ground and Earthquake Research of the IMM.

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SOSEWIN - early warning system

Since July 2008 a first test-bed deployment of the SOSEWIN early warning system is operative in the Ataköy district of Istanbul. The network of 20 stations provides a continuous streaming of data that a Seiscomp Server at GFZ collects in real time, and distributes them to third parties (e.g. KOERI, Humboldt-Universität zu Berlin, and lat/lon Bonn). In cooperation with the colleagues of the Humboldt-Universität zu Berlin the performance of the network is monitored. None the less, since during this period of time no relevant seismicity has been observed close to Istanbul, the preliminary tests about the test-bed network performance focused on the various aspects of communication.

Main positive results are:

- The performance and the long-term stability of the sensor nodes as strong motion sensors, which have proven to be running stable for several months;
- The performance of the installed network and its self-organization capability.

During this period we faced and solved also some problems, as:

- in a first moment, problems with the WLAN drivers were observed, and the rate of the transmission for the accelerometric data had to be throttled to 1MBit/s. However, it is worth noting that, despite the low rate of transmission, there is still enough bandwidth for streaming all data out of the network with SeedLink. The WLAN driver problems have been solved from our colleagues of the Humboldt-Universität zu Berlin by modifications of the SOSEWIN's software, so that we can increase the data rate from 1 MBIT to a higher value.
- in the long period we observed problems with the performance of standard, commercial CompactFlash (CF) cards (which act as the hard-disk of the SOSEWIN stations). In order to solve these problems, we tested a new industrial grade CF cards. These new hardware components showed a higher level of reliability. Moreover, the colleagues of the Humboldt-Universität zu Berlin optimized the SOSEWIN's software for the new CF cards.

A manuscript dealing with the description of the SOSEWIN philosophy, hardware, and software, as well as an overview of the communication performance for the first test-bed SOSEWIN deployed in Istanbul, has been accepted for publication by *Seismological Research Letters (Fleming, K., Picozzi, M., Milkereit, C., Kuehnlenz, F., Lichtblau, B., Fischer, J., Zulfikar, C., Özel, O., and the SAFER and EDIM working groups. The Self-Organising Seismic Early Warning Information Network (SOSEWIN)) Seismological Research Letters, Vol. 80, N 5 September/October 2009, doi: 10.1785/gssrl.80.5.750.)*

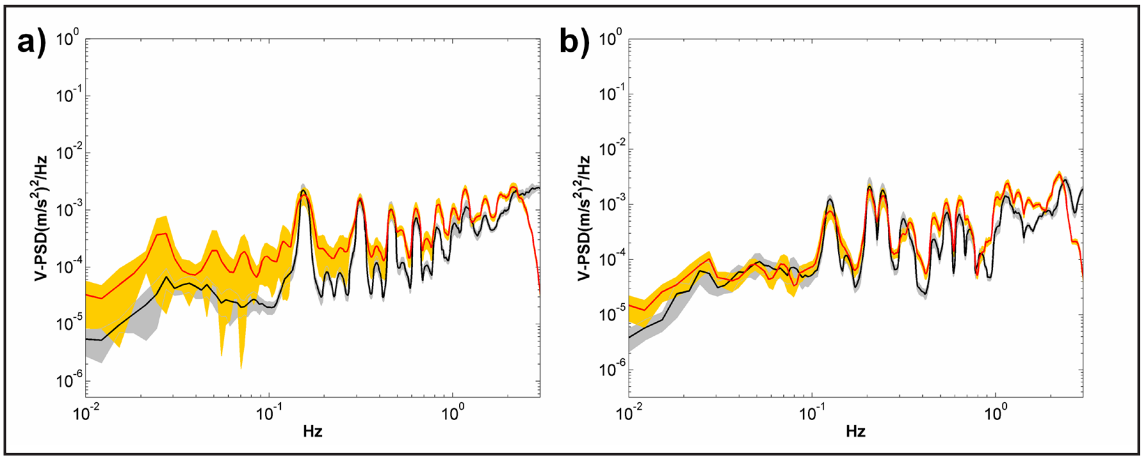

Figure 1: Power Spectrum Density (PSD) functions for the vertical components of motion. Average PSD plus +/-95% confidence interval for SOSEWIN (red and yellow, respectively) and Guralp (black and grey, respectively). (a) Sensors located on the middle of the bridge's deck (i.e. WSUs over the deck, and Guralp within the deck). (b) Similar to (a), but with nodes located at about 1/3 of the way along the bridge's deck.

Testing the SOSEWIN system for the monitoring of the Fatih Sultan Mehmet Suspension Bridge.

We tested the suitability of the SOSEWIN system for the monitoring of the vibration characteristics and dynamic properties of strategic civil infrastructures. In particular, we performed an ambient vibration recording field test on the Fatih Sultan Mehmet Bridge in Istanbul, Turkey.The bridge is also equipped by a traditional vibration monitoring system encompassing five Guralp Systems CMG-5TD instruments. These instruments are located inside at the edges of the deck and provide continuous data by transmission to the Kandilli Observatory and Earthquake Research Institute (KOERI).

One of the main goals of the experiment was to compare the signals recorded by the SOSEWIN and Guralp sensors. Figure (1) shows the corresponding Power Spectrum Density (PSD) functions computed for the vertical components of motion at the sensors located approximately in the middle and one-third of the bridge's deck. Despite the WSUs lying over the bridge's deck while the Guralp sensors are installed inside the deck, the agreement between their PSDs is still strong. Figure (2) provides an overview of the ambient vibration analysis results for a pairs of SOSEWIN stations installed at characteristic locations on the bridge (i.e. the deck, and the towers, respectively). When comparing the average spectral ratio (SR) curves (Figures 2c, and 2d) for pairs of sensors installed at different points, it is clear that SOSEWIN stations provide consistent and robust results, with a clear image of how the diverse parts of the bridge react differently to the ambient vibrations. Moreover, SR spectrograms (Figures 2e, and 2f) show that ambient vibrations have a stationary character, and indicate that the SOSEWIN stations provide stable estimates.

Comparisons with standard instrumentation and results obtained in terms of modal properties of the bridge indicate an excellent performance of the low-cost WSU. The results were found to be consistent with those from the studies of Brownjohn et al. (1992), Apaydin (2002), Stengel (2009).

A manuscript dealing with the testing of SOSEWIN for the monitoring of the Fatih Sultan Mehmet Suspension Bridge has been accepted for publication by *Bulletin of Earthquake Engineering (Picozzi, M., Milkereit, C., Zulfikar, C., Fleming, K., Ditommaso, R., Erdik, M., Zschau, J., Fischer, J., Safak, E., Özel, O., and Apaydin N., (2009). Wireless technologies for the monitoring of strategic civil infrastructures: an ambient vibration test on the Fatih Sultan Mehmet Suspension Bridge in Istanbul, Turkey. In press on Bulletin of Earthquake Engineering, DOI 10.1007/s10518-009-9132-7).*

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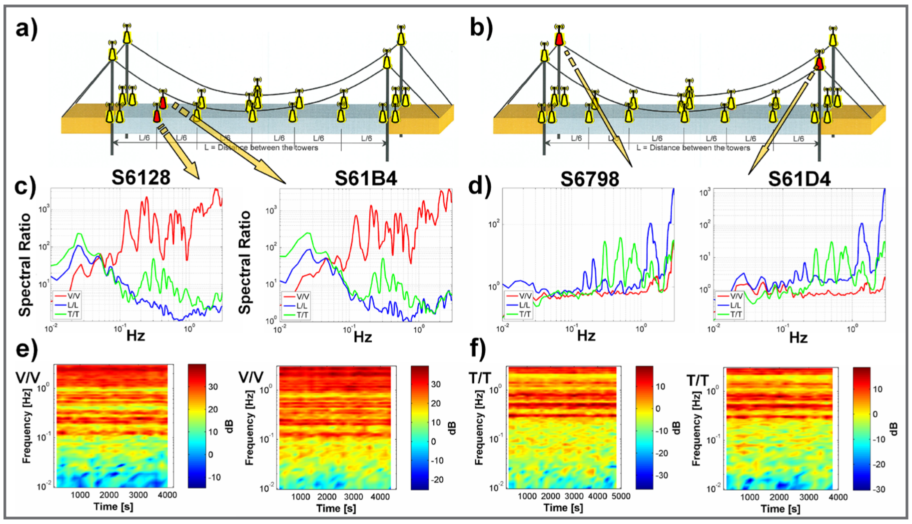

Figure 2: Results for pairs of WSUs. (a) Selected sensors (red symbols) placed at the bridge's deck. (b) similar to (a) but of sensors placed on top of the bridge's towers. (c) and (d) Spectral Ratio (SR) functions for the vertical (red), longitudinal (blue), and transversal (green) components of motion. (e and f) SR spectrograms for the different components of motion.

Vulnerability and Critical Infrastructures

Natural disasters and transportation

Introduction

Transportation networks, especially road networks, are of great importance to many private and commercial activities. What happens if crucial parts of a road network are suddenly unavailable due to, for example, natural disasters has been experienced many times in the past. In 2006, for example, a rockslide at the Gotthard-Tunnel killed several people and the road was closed for days in both directions. The Alp transit traffic consequently congested the alternative route and generated additional emissions and delays. The society's dependence on a reliable transportation network increases its vulnerability. To keep potential losses low, it is therefore essential to detect critical vulnerable links and identify risk minimizing measures. The EU Commission also acknowledged this need in its Directive 9403/08 „on the identification and designation of European Critical Infrastructure and the assessment of the need to improve their protection".

Aims / Objectives

The aim of the project is the quantification of indirect losses caused by a road closure and the identification of road sections, where these losses are extremely high. Indirect losses are entailed by direct damages (like e.g., a collapse of a bridge) and comprise, for example, costs for detouring the disrupted link.

Baden-Wuerttemberg's road network serves as a case study. Each individual link of motorways and federal roads is successively removed and the additional costs of road users due to the withdrawal are calculated via transport modelling. The costs include monetized time, environmental and operational costs differentiated by trip purpose and vehicle type. The calculations vary depending on the duration of the interruption. If the disruption of a network element is short-term, people are likely to stick to their original trip destinations but vary their routes. In the long run, however, road users may also decide to change their trip destination.

The monetary valuation of time or emissions is often criticised for its subjectivity and strong influence on the results. Therefore, a sensitivity analysis on the prices will be carried out to identify network sections that are robust against the valuation methodology.

In contrast to the plans mentioned in the last CEDIM report, the results will not be implemented in a Multi-Criteria-Software, because the amount of road sections exceeds a workable magnitude.

Two different transport models are used for the calculations. First there is the Institute's European macro model VACLAV. The second model VISUM is provided in cooperation with the PTV AG and operates on a micro scale. Both models have to be adjusted to the purpose of the project and need to be complemented with network data and routines.

It can be expected that the simultaneous interruption of different network sections may entail losses of a scale nonlinear to the losses of an individual disruption. A multi-section closure can be considered as a likely consequence of an extreme natural event. These two aspects are captured in two scenarios inspired by historical events, assessing their indirect losses. One scenario is based on the preliminary works on earthquakes and transport infrastructure together with the Institut für Massivbau und Baustofftechnologie at the KIT. It is assumed, that an earthquake in Baden-Wuerttemberg would not entail a total collapse of a bridge or tunnel but would rather cause the temporary closure of structures for inspections. Another scenario is based on the indirect losses by the storm Lothar in the Northern parts of the Black Forest in 1999. The necessary data is generated in collaboration with the Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg in Freiburg.

Project Status

Literature research and the development of the formulas for calculating the indirect losses are completed. The transport models are still being adjusted to the purpose of the study, which will probably still take until the end of 2009. First results are expected by then. The earthquake scenario will be created by the beginning of 2010 on the basis of up-to-date fragility curves for German tunnels and bridges. Negotiations on the user rights of the Lothar storm data are still ongoing with the Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg. Depending on the outcome the storm scenario is planned to be completed by spring 2010.

Outlook

All activities are scheduled to be finalized in the middle of 2010. Everything will be documented in form of a PhD thesis. Further publications on certain aspects of the thesis are planned.

Publications

Schulz, C. and Khazai, B. (2008): An indicator-based approach for critical road infrastructure identification. Conference contribution at IDRC 2008, 25.-29.08.2008 in Davos, Switzerland.

Schulz, C. (2009). The identification of critical road infrastructures - The case of Baden-Wuerttemberg. Conference contribution at the winterseminar of the German-speaking section of the Regional Science Association International, 22.-28.02.2009, Igls/Innsbruck, Austria.

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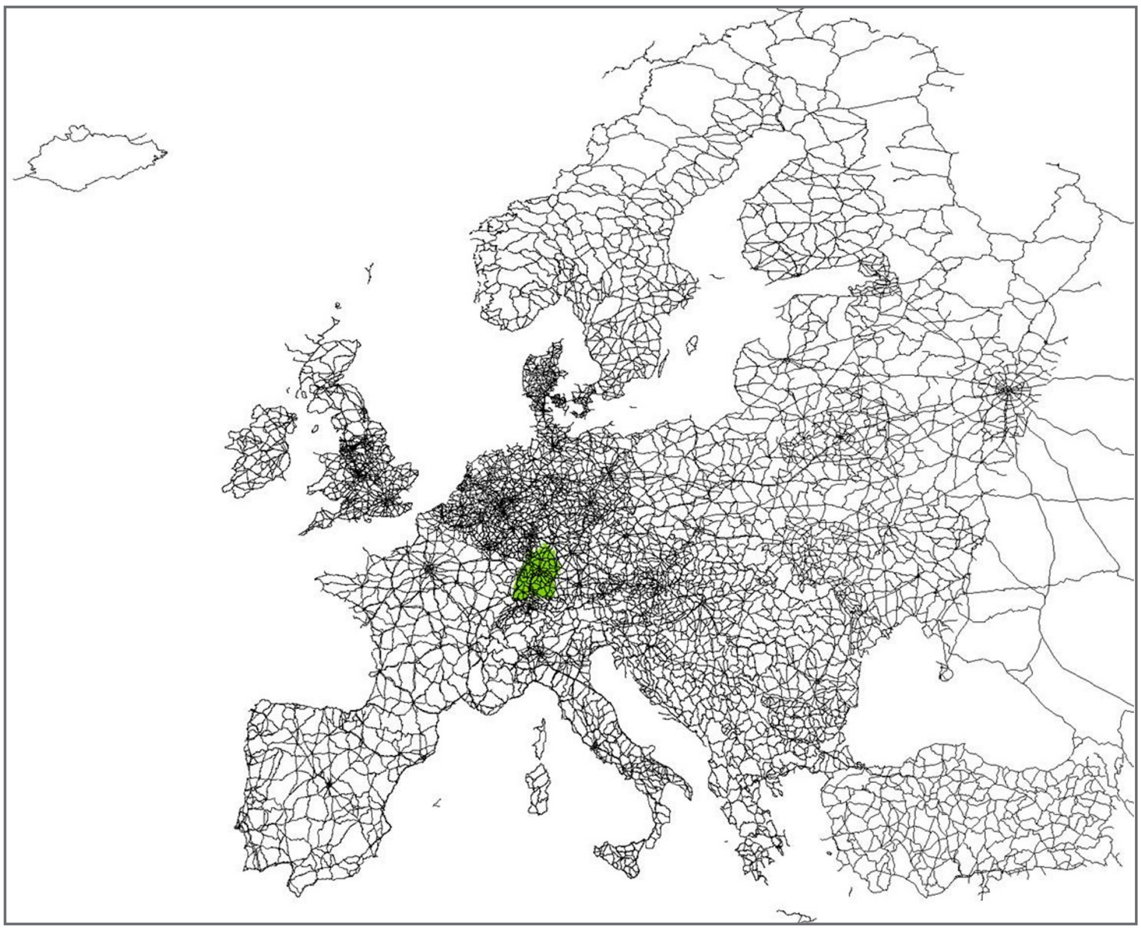

Fig. 1: The European road network in the transport model VACLAV with the study area of Baden-Wuerttemberg

SIMKRIT

Simulation of critical infrastructure for crisis management

Introduction

Project duration:

- June 2009 – December 2009

Project partners:

- Institute for Industrial Production (IIP), KIT,
- Instiute for Nuclear and Energy Technologies (IKET), KIT,

"The population of highly developed societies, which is the main subject and client of government actions, is nowadays more than ever dependent on technical, economical, social and administrative services and the availability of comprehensive infrastructural utility services"[1]. Extreme events like the Elbe flood in 2002, the summer heat wave in 2003, the power blackout in Münsterland in 2005 and the disruption of rail traffic caused by Kyrill winterstorm in 2007 have shown, that events of this extent have large impact on the existing critical infrastructure. Critical infrastructures encompass power supply, drinking water and food supply, hazardous material, authorities and administration, telecommunication and information technology, transportation, finance, insurance industry and others, such as large-scale research institutions, symbolic buildings, cultural assests and media.

There is need for sound decisions in the management of critical incidents to assure the functionality of the state und to re-establish the functionality of critical infrastructures. Critical infrastructures have complex interior dependencies and are strongly cross-linked, which became particularly obvious with the breakdown of power supply during major incidents. In such a situation, the scope of action for decision makers is limited by the general lack of resources and their limited availability and performance, but also by insufficient understanding of the impacts of considered measures on a complex crisis situation.

An comprehensive understanding of the crisis situation as well as an overview of the estimated impacts and of the available resources is required to develop a sound decision strategy in crisis management. In addition, the understanding of the behaviour of each affected critical infrastructure in terms of their dominant support measures and their impact on the entire systems is another prerequisite for a successful crisis and emergency management.

The major problem with existing approaches is the missing interlinkage. Simulations of traffic flow, electricity networks or transportation routes are available worldwide. However, these systems are neither linked nor interact with each other.

Aims / Objectives

This project aims at (1) reviewing the state of art in the field of simulating critical infrastructures and their grid failure, (2) formulating a practical simulation model for mapping the dependencies between the critical infrastructures and (3) meeting methodical challenges of decision support. Moreover, the project wants to place all project-related components within KIT and CEDIM to create an improved basis for applications in a national (e.g., safety research BMFB) or a international (e.g., FP7 – Security) research framework.

Additionally, potential partners for these applications outside of KIT will be identified and involved. As a first step, there have been discussions with representatives of the Federal Office of Civil Protection and Disaster Assistance (BBK).

In detail the goals of the project addresses the following :

- What approaches and models exist for mapping critical infrastructures and their networking that can be used in loss recovery but also in planning, and which requirements are associated with them.

- Which decision support approaches are able to communicate the complex relationships among critical infrastructures to a decision-maker, e.g., causal Maps.

1 BBK 2008, Nationales Krisenmanagement im Bevölkerungsschutz, Bonn, Federal Office of Civil Protection and Disaster Assistance

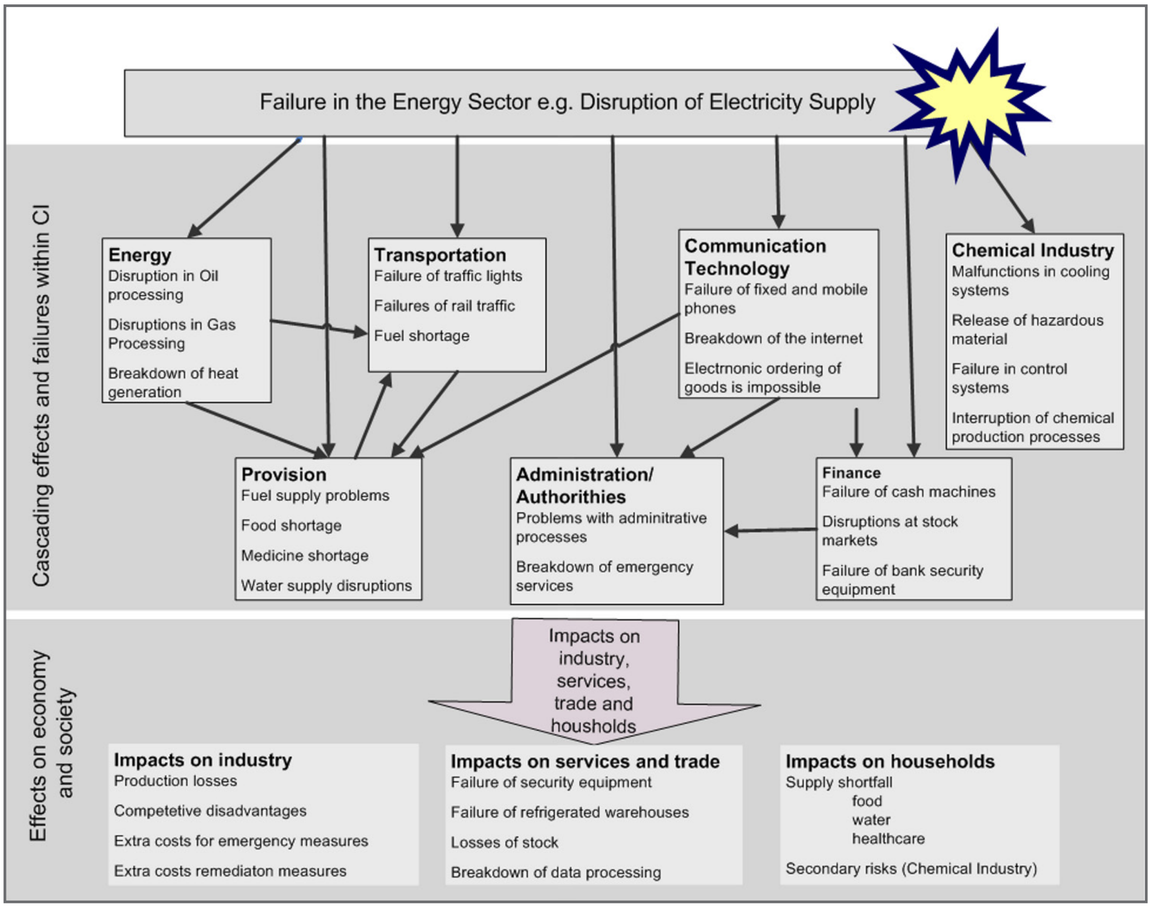

Fig. 1: Blackout impacts on critical infrastructure

- Which project-related components exist in KIT and CEDIM
- Which strategic partners in industry and administration can participate in a research project (Identification of a stakeholder constellation for research applications).

Project Status

In a first step those KIT institutes which have expertise in the field of critical infrastructure were identified. Other organisations within and outside CEDIM were considered in a second step. A contact with the BBK was established. A comprehensive literature research about the state of art in simulation technology was carried out in the project framework.

The first results have shown that there are initial simulation approaches for interactions of critical infrastructure (e.g., IRRIS (Integrated Risk Reduction of Information-based Infrastructure Systems, Fraunhofer). However, the simulation component of critical infrastructure has to deal with two problems: (1) the simulations appear to be very complex, mapping only fractional part or (2) they describe the whole problem but with a coarse level of detail. From this, two potential working field arise:

- Investigation of the information content in terms of critical infrastructure behaviour, so that decision-makers can take the necessary actions in case of major incidents
- Development of simulation models, that aggregate the complex dependencies in such way, that their results can be used as a basis for decision support

However decision support is modelled, vulnerability analyses, risk estimations and risk maps are an integral part of decision support. Thus, current works of CEDIM will be completed by further simulations of critical infrastructure dependencies and will be used as a basis for an integrated risk and decision support system that can be employed in case of major incidents. The need for such a system is beyond all question (e.g., KRITIS Project of BBK; National Infrastructure Protection Plan (NIPP) of the US). However, adjusted simulation models are yet to be developed. The expertises within the CEDIM are manifold and offer thus an ideal starting point for the development of such simulations.

Core Science Team

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Analysis of the Indirect Disaster Vulnerability

Introduction

The project-spanning working group "Analysis of the Indirect Disaster Vulnerability" (VAG) was founded in May 2008. Its focus is the understanding of indirect losses of disasters and their complex underlying processes at different spatial levels in the context of climate change. For this purpose, the field of industrial losses of the former Cedim working group "Asset estimation" is extended towards the vulnerability regarding indirect effects and combined with the assessment of social vulnerabilities within society as further drivers of indirect effects. For the work of VAG know-how within Cedim is used from the field “Vulnerability of Networks and Critical Infrastructures (projects “Traffic Infrastructure” and “Crisis management for large-area power blackouts”) as well as from indirect business interruption losses (former sub-project of “Megacity Istanbul”) and from social fragility and coping capacities of mega-cities.

Aims / Objectives

The interdisciplinary project team currently develops an integrated indicator model which aims at the analysis of the industrial and social vulnerability against indirect disaster losses on the regional level. Such an indicator framework is useful for dealing with the complexity of the vulnerability concept since it facilitates the combination of the different sub-systems (industrial and social system) and bringing together results of different levels of granularity in an effective manner. Furthermore indicator based approaches can be extended easily. This allows, for example, the future integration of other sub-systems (e.g., agriculture, ecology). Regarding the dynamic changes in vulnerability due to climate change, the indicator model gives the possibility to take future changes of singe factors and forecast data into account in order to gain results on the future vulnerability of the sub-systems.

Within this integrated system of indicators, industrial and social factors are incorporated which have a major positive or negative effect on the indirect loss potential of a region. The model is built by the means of a software tool for multi-criteria decision analysis (“Logical Decisions for Windows”) supporting stakeholder-driven weighting of singular factors, in which

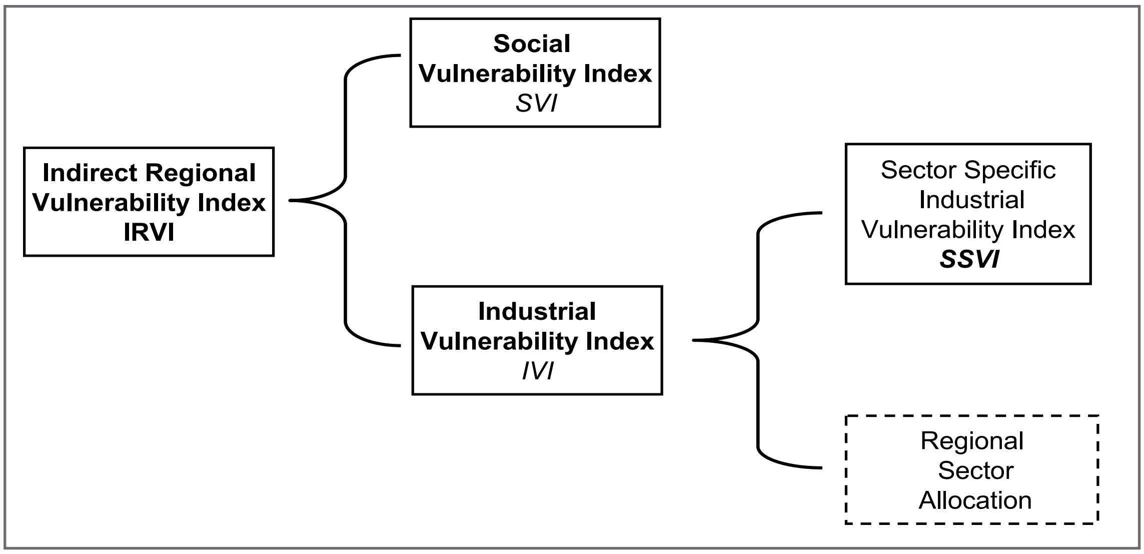

Fig.1: Overwiew of the indicator system

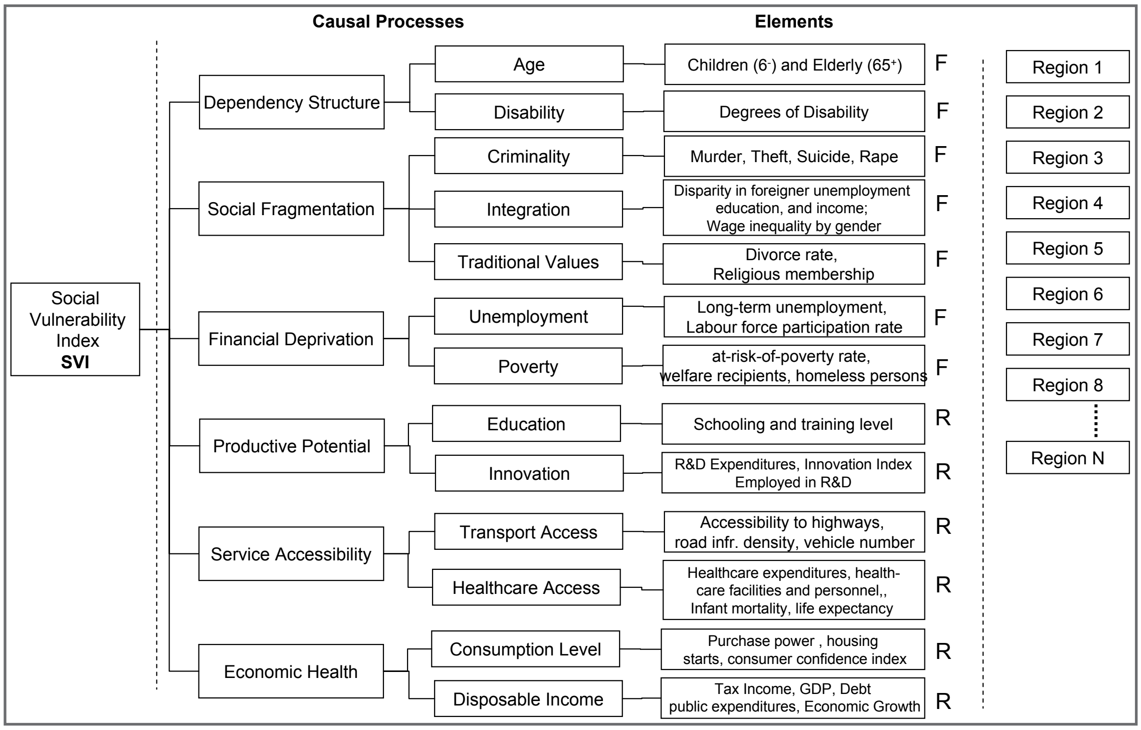

Fig. 2: Processes and indicators of sub-system “Society”

the results are calculated and displayed. Besides weighting the software tool also supports sensitivity analysis and visualization of results, which are very important tasks of the analysis and facilitate the communication of the results to political or industrial stakeholders.

By aggregating results for all the factors from the different dimensions, the indirect loss potential is quantified allowing a comparison of different regions and the identification of especially vulnerable hotspot regions. Furthermore, the approach helps to identify particular vulnerable processes and points out where mitigation measures can be implemented most effectively. Therefore, the results of the methodology supplies decision-makers with a multifacet picture of losses for a foresighted disaster management and the overall reduction of risk.

The assessment is conducted on the spatial level of NUTS 3 (Landkreise) within the federal state of Baden-Wuerttemberg which, as one of the most important economic states of Germany, has a high indirect economic loss potential and, therefore, is an ideal pilot area for testing this methodology for indirect loss assessment.

Approach

To realize the objective of the project to develop an integrated indicator model, the following procedure has been chosen:

1. Developing a theoretical indicator framework
2. Selection of indicators and sub-indicators
3. Data gathering for selected indicators
4. Standardization
5. Weighting and Aggregation
6. Sensitivity analysis
7. Presentation of indicators (interactive software tool)

The development of the theoretical indicator framework (step 1) contained the specification of the dimensions to be covered i.e., the subsystems of industry and society, as well as the spatial scale of assessment (cf. figure 1).

The sub-systems are made up of causal processes influencing vulnerability by their effects on the singular elements like (groups of) people, industrial sites etc.. Within these, there exist fragility and resilience factors coincidently increasing and decreasing the system’s vulnerability, respectively. According to the importance of the processes and the possibilities to depict and measure them, indicators and subindicators were chosen (step 2). For an illustration of the interrelations of the identified indicators in the society sub-system cf. to figure 2.

The social sub-system consists of indicators for the fields of “dependency structure”, “social fragmentation” and “financial deprivation” which basically increase vulnerability and the “productive potential”, “service accessibility” and “economic power” potentially decreasing it. For the industrial dimension, “capital and labor dependency”, “infrastructure dependency” and “supply chain dependency” are covered, all containing both fragility and resilience factors. The industrial fields are first assessed on the sectoral level for different industrial branches and then regionalized on the spatial level according to the sector share representing the relative economic importance of the different industrial sectors in a region.

Based on data already available in Cedim resulting from former works as well as further external, mostly statistical data, the values of individual indicators were determined (step 3). For this task, a conversion of raw data regarding the aimed spatial level as well as the combination of different data sets had to be undertaken. Furthermore data were standardized to formats compatible with each other for the aggregation process in the indicator model.

An especially important aspect for the quality of results of the integrated indicator system is marked by the weighting of individual indicators and offsetting them against each other. For the first on-work testing of the framework, equal weighting was used at each aggregation level of the system. This is planned to be improved in the process of further development of the approach.

The following figure 3 shows first results of the integrated approach the vulnerability of different industrial sectors.

Status Project

Steps 1-3 have been almost finished during the last months. For further development of the approach results from sensitivity analyses shall be used which will be conducted following the current testing of the system’s functionalities (including inspections of the quality of input and output data).

Outlook

Currently a publication on the methodological aspects of the approach and the first results of the test application in Baden-Württemberg are prepared. The calculations for whole Baden-Württemberg and the sensitivity analysis will be completed by June 2010.

Publications

Hiete, M. and Merz, M. (2009): An Indicator Framework to Assess the Vulnerability of Industrial Sectors against Indirect Disaster Losses. In: Landgren, J., Nulden, U. & Van der Walle, B. (eds.), Proceedings of the 6th International ISCRAM Conference – Gothenburg, Sweden, May 2009, Nr. 131.

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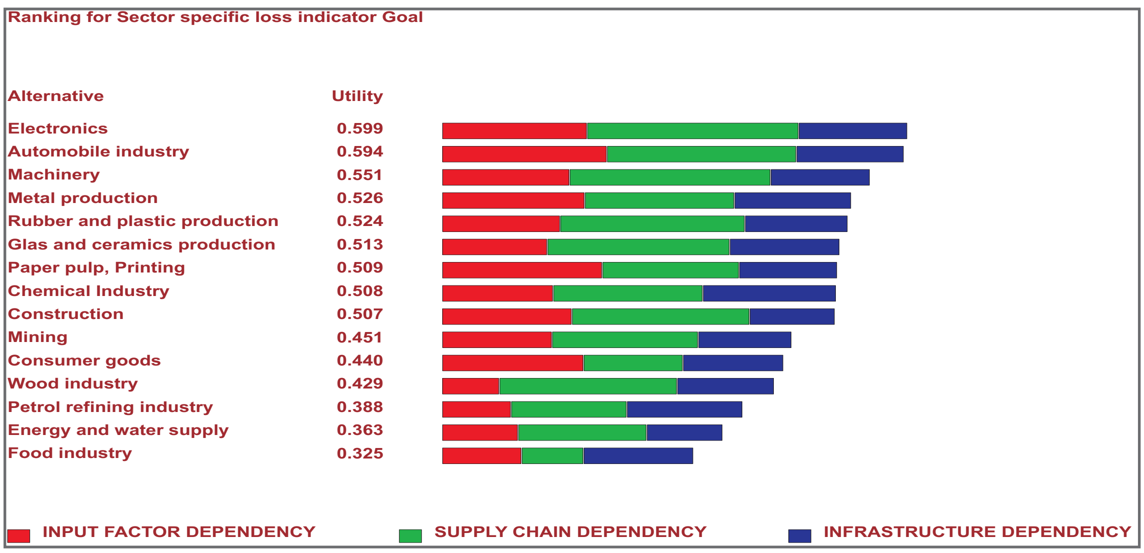


Fig. 3: Industrial vulnerability of different sectors

II. Partnerships

cedimAG

cedimAG

Since its spin-off from CEDIM in 2004, the cedimAG provides risk management consulting and services for public and private clients. After the acquisition of the exclusive rights for the distribution of ORTIS in Germany in august 2008, cedim AG focussed increasingly on communal clients.

ORTIS acquisition

The risk management system ORTIS was specifically developed for communities by alpS – Centre for natural hazards and risk management GmbH (Innsbruck, Austria). This easy and intuitive to use software provides the structural framework for the risk management of communities and supports all sub-processes in the field of risk analysis, risk control and risk monitoring. With ORTIS, not only natural hazards, but also technical and man-made risks are addressed.

ORTIS pilot community Malsch

In the pilot community of Malsch, ORTIS was implemented in 2009 and thereby, the process of risk management in the community was established. Procedures could be made transparent and were specified by systematic inventory and resulting communication of all participants. An active analysis of local risks and the collection of information in ORTIS will provide certainty for decision-makers in their judgement concerning the preparedness of the community in case of an emergency and what needs to be done to avoid future crisis.

Acquisition in the communal sector

For acquisition of new communal customers, cedimAG introduced itself on the mayor congress in Bad Neuenahr in 2009 and was also represented at the KOMCOM Süd in Karlsruhe. At the „Brennpunkttage Schweinegrippe“ in Düsseldorf, initiated by the Behördenspiegel, cedim AG could also present itself as a competent partner for communal risk management. Through intensified acquisition in 2009, numerous close contacts to communities and districts emerged and, based on these contacts, further future projects are expected in the communal sector.

Research

Furthermore, cedim AG is part of the research project “Development of fixing systems and elements for the use of earthquake wall paper also on supporting walls”, which is funded by the Central Innovation Programme Small Businesses (ZIM) of the Ministry of Economics and Technology.

cedim AG

Cooperation with the Insurance Industry

In 2009 CEDIM developed a systematic approach to interact with the insurance and re-insurance industry. The core of the strategy is the membership of the Willis Research Network (WRN, www.willisresearch). WRN is a partnership between Willis – the largest global insurance broker – and academia. Founded in 2006, WRN has entered long-term partnerships with 18 world's leading research institutions.

An initial workshop of WRN and CEDIM was held on May 28, 2009 in Karlsruhe. Topics like atmospheric and flood risk modelling, remote sensing and risk, geo-visualisation and risk communication were identified to be of common interest.

As a next step, CEDIM was invited to the annual WRN global clients meeting in London on July 8-9, 2009. This meeting brought together the research institutions associated with WRN and 15 of the world's largest insurance organisations. Becoming a member of the WRN, CEDIM will receive funding for a full research position within the hail-risk project for a 3 years period. In addition, it is anticipated that WRN will organise a meeting with CEDIM and the German insurance and re-insurance community in May 2010 at the German Research Centre for Geosciences (GFZ) in Potsdam.

Other important milestones of CEDIM's cooperation with the insurance sector were reached in 2009 with two strategic meetings, one with Munich Re on July 27, 2009 in Munich and the other with SV Sparkassenversicherung on September 23, 2009 in Karlsruhe. At both meetings specific topics of common interest were identified and will lead to joint activities, data exchange and potential future funding.

RiSk 09

Application of Remote Sensing to Risk Workshop in Karlsruhe

The Karlsruhe Institute of Technology established a range of competence areas to provide a forum for interdisciplinary scientific research. Within the competence area "Earth and Environment", research projects are related to the structures and processes characterizing the earth system. In 2009, the competence area "Earth and Environment" released a call for funding initiatives to generate connections and synergies for potential trans- and interdisciplinary work within KIT and with leading international research institutions.

The Institute of Photogrammetry and Remote Sensing and CEDIM submitted a joined proposal on organizing an international workshop on the "Applications of Remote Sensing to Risk". The proposal was approved by the review committee of competence area "Earth and Environment".

The workshop aims at linking various KIT researchers from the "Earth and Environment" competence area with each other as well as with industry and international partners to develop a network of scientists in the field of remote sensing and risk.

The RiSk 09 workshop will be held on the 11th to 13th November 2009 at the Karlsruhe Institute of Technology. About 25 KIT and international scientists are invited to discuss critical issues and open research questions related to remote sensing and risk. The workshop also aims at exploring future collaborations including student exchange programs. A web platform is developed to ensure easy communication between the participants of the workshop. This "risk network" will help to consolidate resources at KIT and its partners in one place. For further information please visit www.risk09.kit.edu/.

RiSk09

Sonderforschungsbereich Transregio

Karlsruhe Institute of Technology and Potsdam University

In July 2009 a concept paper for a SFB/Tranregio on extreme events has been submitted to the Deutsche Forschungsgemeinschaft by Karlsruhe University (Friedemann Wenzel) and Potsdam University (Axel Bronstert):

Topic:

Extreme Events - Methodologies for a rational approach to cope with extreme natural disasters under limited knowledge

Additional Participating Institutions:

- Helmholtz-Centre Potsdam German Research Centre for Geosciences - GFZ
- Forschungszentrum Karlsruhe in the Helmholtz Association – FZK
- Potsdam -Institute for Climate Impact Research – PIK

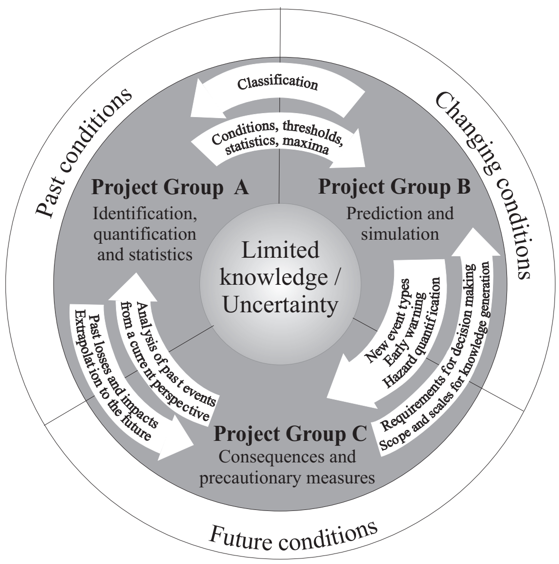
Rationale:

Understanding and mitigation of extreme events and their impact on society can be identified as a major challenge for research and politics, today and in the future. We focus on extreme natural events, specifically geological and hydro-meteorological events, but also economic/financial events where we can build on long-term previous research in Potsdam and Karlsruhe, international acknowledgement of future research efforts by international scientific bodies such as the International Concil of Science (ICSU) and on an international frame for disaster reduction lead by the U.N. International Strategy for Disaster Reduction (ISDR).

In general, the definition of an extreme event is context dependent. Here we refer to low probability, high impact events with return periods outside the time frame, in which standard regulations apply (residual risks), with significant societal impact (lives, property, social structures, environment, economy) that disrupt functions in large areas and cause great losses compared to the Gross National Product (GNP) of a country.

The risks (i.e. potentials for future losses) associated with these events are not only high but also very difficult to quantify, as they are characterized by high levels of uncertainty. Uncertainties may relate to frequency, time of occurrence, strength and impact but also to coping capacities of society in response to them. The characterization and quantification, reduction of the uncertainties to the extent possible are inherent topics of extreme event research.

However, they will not disappear and therefore a rational approach to extreme events must include more than reducing uncertainties. It requires assessing and rating the irreducible uncertainties, to evaluate options for mitigation under large uncertainties, and their communication to societal sectors. Thus: The primary objective of the research programme is to develop methodologies that aim at a rational approach to extreme events associated with high levels of uncertainty.



Addressing this objective requires (a) novel methodologies in natural and social sciences to quantify and to reduce uncertainties in data, models, and predictions; (b) the consideration of several types of disasters as the comparison of impacts is a constitutive part of a rational approach; (c) interaction with social sciences for rationalizing uncertainties in the context of societal values, in communication with societal sectors with the aim of rational mitigation strategies.We organize the science around our key questions in three Project Groups:

(A) Project Group A “Extreme past events – Identification, quantification and statistics” provides answers to what we can learn from past events, what are implications for today and what cannot be concluded from them? (B) Project Group B “Extreme events - Prediction and simulation” responds to what models can tell us? What are their limitations? How they should be used and not be used in a societal discourse? (C) Project Group C “Extreme events - Consequences and precautionary measures” addresses what kind of impact scenarios can be developed, how they should be tuned to needs of different users or groups in society, how they should be communicated and how we can relate catastrophic prospects and options for mitigation to other societal and ethical values and develop criteria and procedures for a societal discourse? The figure indicates the contextual frame for the project groups and fields of interaction.

Some of the leading scientists, including the coordinator, are associated with CEDIM.

CAPACITY BUILDING PROGRAM

Application of Methods and Technologies to Disaster Risk Reduction

A new class of educated disaster management professionals is starting to emerge. However, at this important stage, the development of human resources in disaster risk management is in need of tactical support. Much of the existing capacity building programs in disaster risk reduction aimed at professionals and practitioners in developing countries is offered at a high-level and is often too generic to meet the current demands of professionals. CEDIM and the German Aerospace Agency (DLR) are seeking to work together in developing a core set of new hands-on and applied training programs which are based on state-of-the-art methods, tools and technologies used in the assessment, analysis and reduction of disaster risk. The ultimate goal of the sought capacity building program is to improve the skills of practitioners and professionals in developing countries and elevate their value in society.

The capacity building program will pay particular attention to engaging the input and ownership of cities in this process through working closely with the Earthquake and Megacities Initiative (EMI), an international organization with in-depth knowledge of urban disaster risk reduction, experience in supporting local government authorities and developing modular training programs. Through a strategic collaboration with a network of local government organizations like United Cities and Local Governments (UGLG), Metropolis, CITYNET, and Local Governments for Sustainability (ICLEI),the project also has the key ingredients in place to reach the right target audience and ensure a delivery mechanism which is sustainable. The partners will consolidate their cumulative experience and collaborate in the project, to achieve the following three aims:

- Strengthening the learning infrastructure and capacity of training institutions in South Asia
- Increasing the number of professionals capable of using scientific methods and tools to implement effective risk reduction measures
- Enhancing the capacity of local government and state institutions to develop modular training programs and institutionalize their delivery.

Dr. Bijan Khazai from CEDIM and Mr. Jan-Peter Mund and Dr. Hannes Taubenböck from DLR are actively seeking external funding for the development and delivery of the capacity building program. An initial investment is required to establish the capacity building program, test it, and sustain it in the first two years. In a longer term, the demand driven program should be become financially self-sustainable by direct contributions from benefiting governments and institutions. A large portion of the initial funding will go to developing world by supporting the institutionalization of the training program and training of trainers.

Natural Disaster Managemet Learning Program

Course Development in Risk Analysis for the World Bank Institute

In June 2009, CEDIM obtained funds from the World Bank Institute (WBI) to develop a comprehensive 5-week modular learning program,pertaining to the techniques and applications for risk identification and risk analysis with a focus on earthquakes and floods. This includes the development and organization of both a global module and region-specific case studies reflecting the experience and conditions in India and South Asia. Both modules will include presentations of developed content, case studies, readings and knowledge checks, course flow, document preparation, course review, learning process, and tracking consistent with the WBI e-learning structure.

Upon completion of the program, participants will be able to understand the fundamental elements of earthquake and flood hazard, exposure and vulnerability analysis. Practitioners will also become familiar with methodologies used for carrying out flood and earthquake risk analysis and are introduced to up-to-date tools to estimate losses. The final learning program will be validated by technical experts in risk analysis and developed on the WBI e-learning platform. E-learning as well as other distance learning courses are required to meet a certain standard of pedagogical quality which differs from pure face-to-face courses. The goal will be to develop the technical content into educational material which provides flexible and engaging learning experiences for students and has downstream functionality suitable to blended learning. Dr. Bijan Khazai, a CEDIM senior researcher, is the Course Director for the Risk Analysis course and is collaborating with several flood and earthquake experts within CEDIM in the development of the course material.

The learning tool is considered most useful for the following groups:

- Personnel from nationally and locally responsible agencies dealing with disaster risk management, mostly with an engineering background
- Public officials in charge of development planning and policy reform in the realm of disaster risk reduction
- Local groups and NGOs working in emergency response and recovery planning

SYNER-G

Systemic Seismic Vulnerability and Risk Analysis for Buildings, Lifeline Networks and Infrastructures Safety Gain

SYNER-G was approved by the European Commission in the framework of its Environment Programme - Call FP7-ENV-2009-1. The SYNER-G research project has the following main goals: (1) To elaborate, in the European context, appropriate fragility relationships for the vulnerability analysis and loss estimation of all elements at risk, for buildings, building aggregates, utility networks (water, waste water, energy, gas), transportation systems (road, railways, harbors) as well as complex medical care facilities (hospitals) and fire-fighting systems; (2) To develop social and economic vulnerability relationships for quantifying the impact of earthquakes; (3) To develop a unified methodology and tools for systemic vulnerability assessment accounting for all components (structural and socio-economic) exposed to seismic hazard, considering interdependencies within a system unit and between systems, in order to capture the increased loss impact due to the interdependencies and the interactions among systems and systems of systems.

The methodology and the proposed fragility functions will be validated in selected sites (urban scale) and systems. It will implemented in an appropriate open source and unrestricted access software tool. Guidelines will be prepared and the results and outputs will be disseminated in Europe and world wide with appropriate dissemination schemes. SYNER-G is integrated across different disciplines with an internationally recognized partnership from Europe, USA and Japan. The objectives and the deliverables are focused to the needs of the administration and local authorities, which are responsible for the management of seismic risk, as well as the needs of the construction and insurance industry.

Aristotle University of Thessaloniki is the coordinator of the 14 participating organizations of the SYNER-G research consortium which represent a variety of organizations, from universities and academic institutions to research foundations and SMEs.

CEDIM is the work package leader for the analysis of socio-economic impacts and losses in SYNER-G. Together with other participants in this work package, social and economic vulnerability relationships due to seismic damages on buildings, utility networks, transportation infrastructures and critical facilities will be investigated on a European scale. Dr. Bijan Khazai is the coordinator for the work package on socio-economic impacts and losses. The SYNER-G project will start on November 1, 2009 and a kick-off meeting is held with all the participating organizations Thessaloniki on November 19-20, 2009.

Cooperation with the Federal Office of Civil Protection and Disaster Assistance (BBK)

The Federal Office of Civil Protection and Disaster Assistance (BBK) was established in 2004 within the remit of the Federal Ministry of Interior. The BBK is the central organisational element in Germany working in the field of civil protection and disaster assistance, although most of the administrative responsibilities are with the federal states. On a project basis CEDIM cooperates with BBK in the context of crisis management in case of a large-scale power supply interruption with Baden-Württemberg as an example. In addition to this continuous work, on a strategic meeting on May 19, 2009 further potential fields of interaction were identified.

- **Risk Map for Germany**

BBK develops a risk map for Germany. The federal states provide information and data with regard to natural hazards but also technological accidents and update and improve those on an annual basis.

BBK designed a method for the evaluation of the risks associated with these hazards based on a definition of societal assets that deserved to be protected including the item of environment. The risk map includes all types of disasters and will be integrated in the deNIS II tool. The results of the risk matrix will be mapped spatially in a GIS environment. BBK relies on a network of institutions which provides continuous information that is funnelled into the risk maps. These institutions include the German Weather Service, the Federal Office for Cartography and the Robert-Koch Health Service Institute and many others.

- **Early warning for meteorological hazards**

CEDIM developed a risk damage map for residential damage for the entire Federal Republic. A workshop to be organised by BBK in 2010 will clarify the options to utilize CEDIM's scientific approaches for expanding it to more comprehensive, predictive damage and impact information service. This would allow the German Weather Service (DWD) to not only announce severe weather warnings with meteorological parameters but would also provide facts and indicators for the potential impact. The workshop should include disaster response organisations such as fire, rescue and civil protection institutions in order to assure that the most useful type of information will be developed and appropriate communication channels used.

- **Security research**

The results of the project LÜKEX 2004, which quantify the implications of a large-scale power supply interruption in Baden-Württemberg, can form a basis for a joint project of CEDIM, BBK, commercial companies and other institutions to develop a simulation tool for decision support. Financial support for this activity has to be clarified with BMBF and the State of Baden-Württemberg.

III. Publications 2009

Apel, H., Merz, B. and Thieken, A.H:. Influence of dike breaches on flood frequency estimation. Computers & Geosciences, 35(5): 907-923, doi: 10.1016/j.cageo.2007.11.003. (2009)

Guse, B., Thieken, A. H., Castellarin, A. and Merz, B:. Deriving probabilistic regional envelope curves with two pooling methods. Journal of Hydrology., accepted (2009)

Guse, B., Castellarin, A., Thieken, A.H., and Merz. B:. Effects of intersite dependence of nested catchment structures on probabilistic regional envelope curves, Hydrology and Earth System Sciences. Hydrology and Earth System Sciences Discussion, 6(2), 2845-2892. (2009)

Guse, B., Thieken, A. H., Castellarin, A. and Merz, B.: Reliability of Probabilistic Regional Envelope Curves. European Geosciences Union, General Assembly 2009, 19. – 24. April 2009, Vienna, Austria, Geophysical Research Abstracts, Vol. 11, EGU2009-4838. (2009)

Khazai, B., Bendimerad, F., Kilic, O., Khazai, B., Konukcu, A., Basmaci, E, Mentese, E. Y., Sunday, B.: "Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul", Los Angeles International Earthquake Conference, Session 2D: How to Assess Seismic Risk and Policies, Los Angeles, USA, November 12-14, 2008.

Khazai, B., Kilic, O., Khazai, B., Konukcu, A., Basmaci, E, Mentese, E. Y., Sunday, B.:, "Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul", Asian Megacities Forum 2009, Mainstreaming Disaster Risk Management in Urban Development and Governance, Mumbai, India, April 22-24, 2009

Khazai, B.: "Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul", 5. Tagung des Katastrophennetzes "Vulnerabilitaet und Resilienz im Entwicklungszusammenhang", 18.-20. Juni, 2009 and der Katastrophenforschungsstelle in Kiel

Khazai, B., Wenzel, F., Kilic, O., Basmaci, A., Konukcu, B., Mentese, E. Y., Sungay, B.: "Megacity Indicator Systems (MIS) for Disaster Risk Management in Istanbul", International Conference on Megacities: Risk, Vulnerability and Sustainable Development, September 7-9, 2009, Helmholtz Centre for Environmental Research – UFZ, Leipzig, Germany.

Hiete, M. and Merz, M.: An Indicator Framework to Assess the Vulnerability of Industrial Sectors against Indirect Disaster Losses. In: Landgren, J., Nulden, U. & Van der Walle, B. (eds.), Proceedings of the 6th International ISCRAM Conference – Gothenburg, Sweden, May 2009, Nr. 131.

Hofherr, T, and Kunz, M:. Assessment of extreme wind climatology for Germany. Submitted to Climate Research. (2009)

Kunz M., Sander, J. and Kottmeier, Ch.: Recent trends of thunderstorm and hailstorm frequency and their relation to atmospheric characteristics in southwest Germany. International Journal of Climatology, 16 pp., DOI: 10.1002/joc.1865. (2009)

Kunz, M., and Puskeiler, M:. High-resolution assessment of the hail hazard over complex terrain from radar and insurance data. To be submitted to Meteorologische Zeitschrift. (2009)

Kunz, M., and Mohr,S.: Application of extreme value statistics to wind speeds from climate models. Submitted to Natural Hazards Earth System Science. (2009)

Lüke, J., Wenzel, F. and Vogt, J.: Scenario-based impact analysis of disaster risk exploring potential implication for disaster prevention strategies in spatial and urban planning. European Geosciences Union, General Assembly 2009, 19. – 24. April 2009, Vienna, Austria, Geophysical Research Abstracts, Vol. 11, EGU2009-9423. (2009)

Mahmut, B., Kilic, O., Khazai, B., Konukcu, A., Basmaci, E, Mentese, E. Y., Sunday, B.: "Istanbul Megacity Indicator Systems Project ", International Earthquake Symposium, Kocaeli 2009, August 17-19, 2009

Merz, B., Elmer, F. and Thieken, A. H.: Significance of "high probability/low damage" versus "low probability/high damage" flood events. Natural Hazards and Earth System Sciences (NHESS), 9, 1033 – 1046. (2009)

Merz, M., Hiete, M. and Bertsch, V.: Multicriteria decision support for business continuity planning in the event of critical infrastructure disruptions. Int. J. of Critical Infrastructures, Vol. 5, Nos. 1/2, pp 156-174 (2009)

Petrow, Th., and Merz, B.: Trends in flood magnitude, frequency and seasonality in Germany in the period 1951 – 2002. Journal of Hydrology, 371, 129 – 141 doi: 10.1016/j.jhydrol.2009.03.024. (2009)

Petrow, T., Zimmer, J. and Merz, B.: Increase in the flood hazard through changes in frequency and persistence of circulation patterns. Natural Hazards and Earth System Sciences (HNESS), (submitted). (2009)

Poser, K., Kreibich, H., Dransch, D. (2009): Assessing volunteered geographic information for rapid flood damage estimation. In: Proceedings of the 12th AGILE International Conference on Geographic Information Science: Advances in GIScience.

Poser, K., and Dransch, D.: Volunteered Geographic Information for Disaster Management with Application to Rapid Flood Damage Estimation. Geomatica (In review). (2009)

Vorogushyn, S., Merz, B. and Apel, H.:. Development of dike fragility curves for piping and micro-instability breach mechanisms. Natural Hazards and Earth System Sciences (NHESS), 9, 1383-1401, www.nat-hazards-earth-syst-sci.net/9/1383/2009. (2009)

Petrow, T. K., Merz, B., Zimmer, J.: Trends in flood magnitude and circulation patterns in Germany in the period 1951 – 2002. Tag der Hydrologie 2009: Hydrologische Systeme im Wandel, 26. – 27.03.2009, Kiel. (2009)

Poser, K., Kreibich, H., Dransch, D.:. Assessing volunteered geographic information for rapid flood damage estimation. In: Proceedings of the 12th AGILE International Conference on Geographic Information Science: Advances in GIScience. (2009)

Poser, K., Dransch, D:.:Volunteered Geographic Information for Disaster Management with Application to Rapid Flood Damage Estimation, Geomatica, (in review)

Schulze, C.: Winterseminar der Gesellschaft für Regionalforschung. The identification of critical road infrastructures - The case of Baden-Wuerttemberg. Innsbruck, Österrreich. Vortrag. (2009)

Thieken, A. H., Merz, B., Apel, H:. Assessment of large-scale flood events by different indicators. European Geosciences Union, General Assembly 2009, 19. – 24. April 2009, Vienna, Austria, Geophysical Research Abstracts, Vol. 11, EGU2009-12460. (2009)

Uhlemann, S., Zimmer, J., Thieken, A. H., and Merz, B.: Understanding trans-basin floods. European Geosciences Union, General Assembly 2009, 19. – 24. April 2009, Vienna, Austria, Geophysical Research Abstracts, Vol. 11, EGU2009-0. (2009)

Vorogushyn, S., Apel, H., Lindenschmidt, K.-E., Merz, B. : Analysis of flood hazard under consideration of dike breaches. European Geosciences Union, General Assembly 2009, 19. – 24. April 2009, Vienna, Austria, Geophysical Research Abstracts, Vol. 11, EGU2009-5156-1. (2009)

Wenzel, F., Bendimerad, F., Merz, B.: Risk Estimates for Germany. International Conference on the 250th Anniversary of the 1755 Lisbon Earhquake, Lisbon, Portugal, 01. – 04. November 2005, In: Mendes, V., Oliveira, CS., Azevedo, J., Ribeiro, A.: 1755 Lisbon Earthquake:revisited, Bookseries: Geotechnical, Geological and Earthquake Engineering, Vol. 7, 187 – 196 . (2009)