Methods for the evaluation of direct and indirect flood losses

A. Thieken, V. Ackermann, F. Elmer, H. Kreibich, B. Kuhlmann, U. Kunert, H. Maiwald, B. Merz, M. Müller, K. Piroth, J. Schwarz, R. Schwarze, I. Seifert, J. Seifert

GFZ POTSDAM
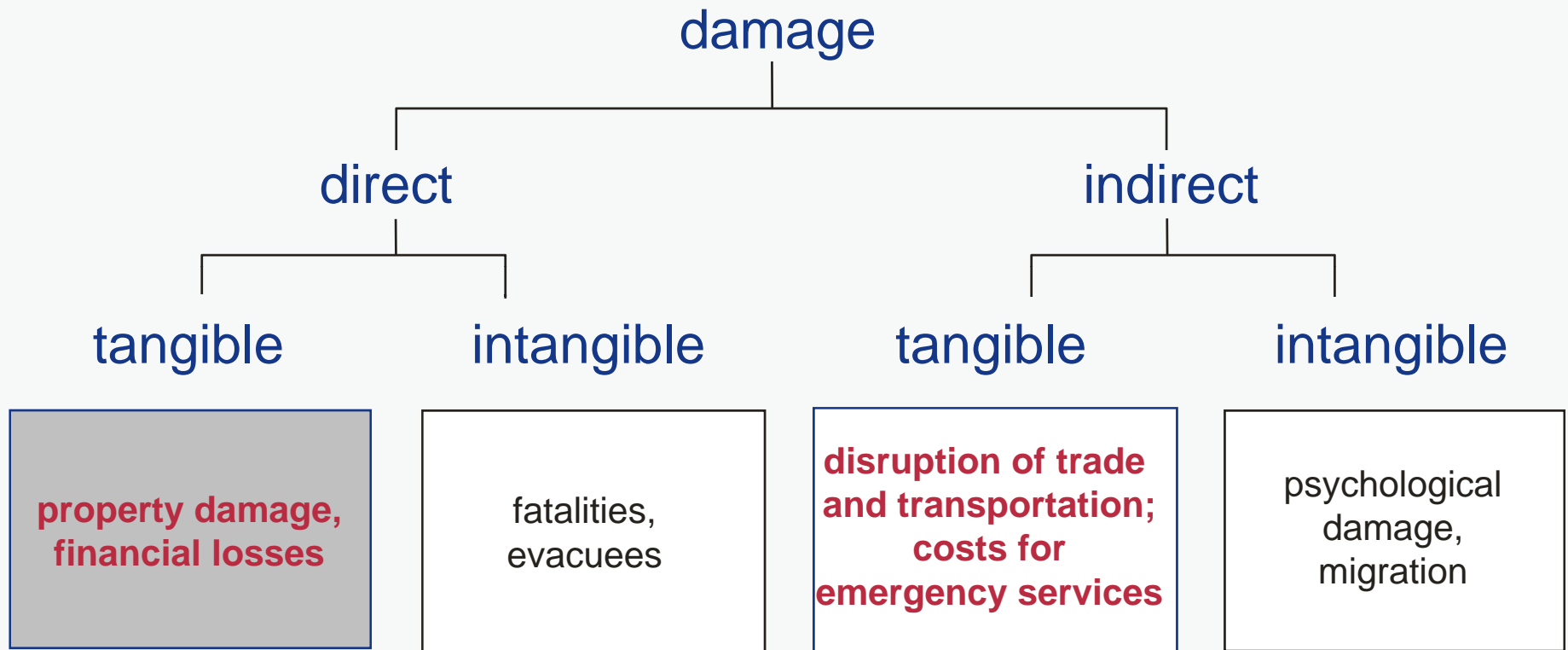
DIW Berlin
Deutsches Institut für Wirtschaftsforschung

Bauhaus-Universität Weimar
EDAC

ARCADIS

JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Deutsche Rück

Dresden.

alp·s

universität innsbruck

damage

direct

indirect

tangible

intangible

tangible

intangible

property damage, financial losses

fatalities, evacuees

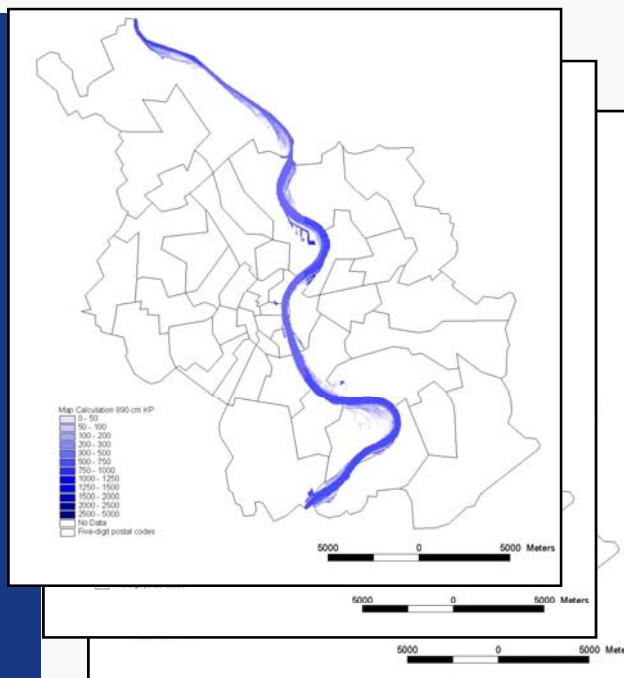**disruption of trade and transportation; costs for emergency services**
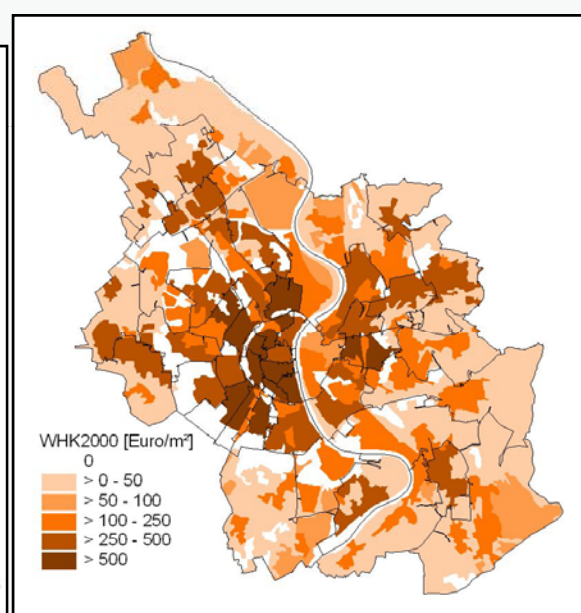
psychological damage, migration

Elements of
flood loss estimation

Inundation scenarios

Land use and
assets

Relative
loss model

Example: Loss ratio at
residential buildings
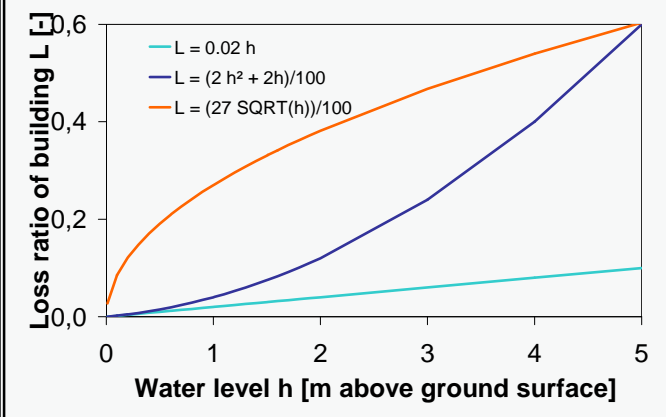
Estimated loss

Risk management of extreme flood events

Examples from the German flood loss database HOWAS
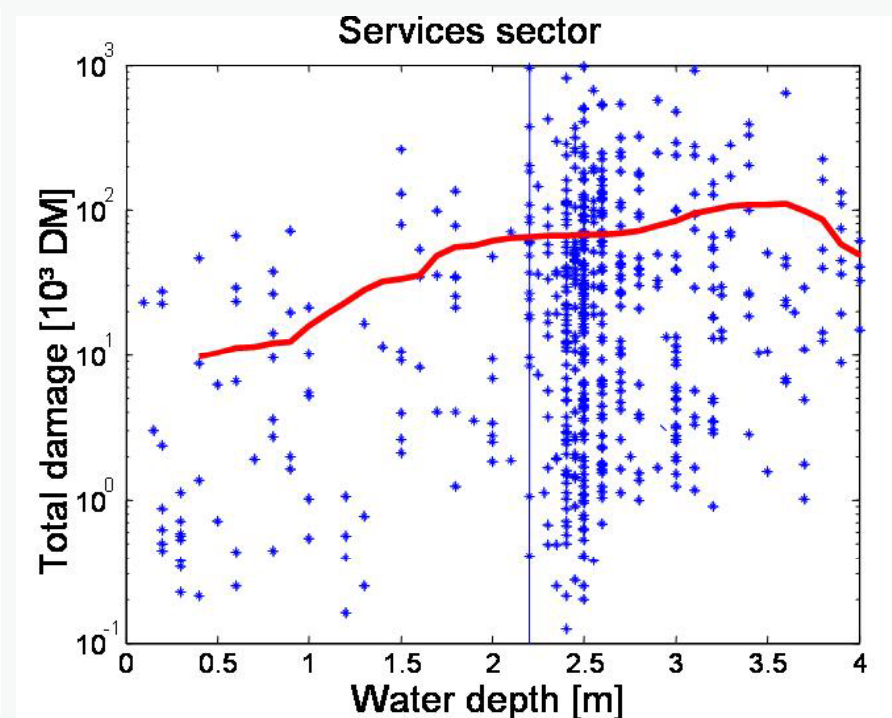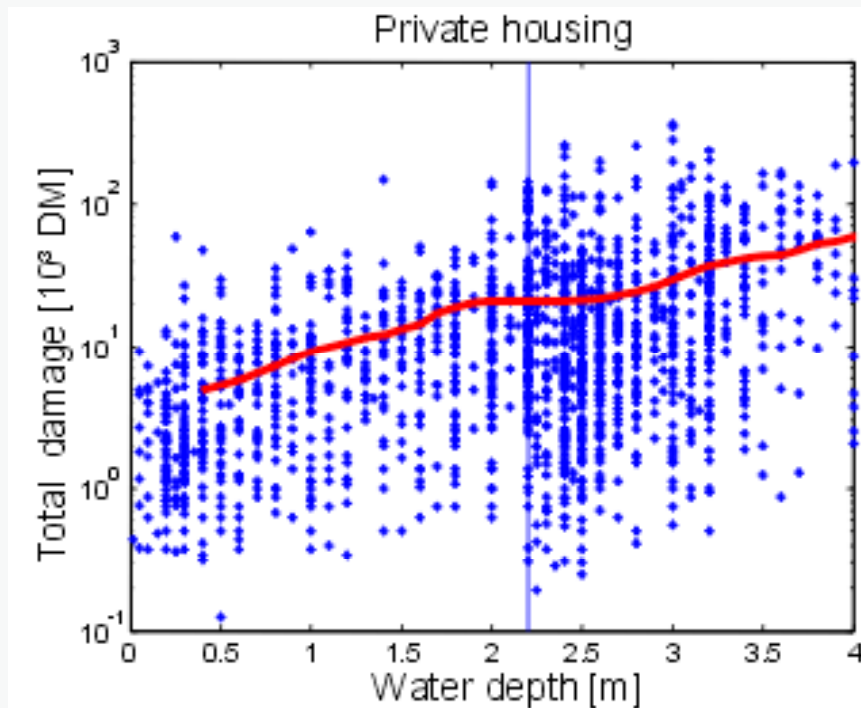
non-parametric regression (Epanechnikov-kernel, bandwidth = 0.6 m)
Merz et al. (2004) – NHESS 4: 153-163

Improvement of models for the estimation of
direct and indirect flood losses

Model validation and
application in water management

Evaluation of methods for the
collection of flood loss data

Knowledge transfer and risk communication

Collection of actual flood loss data (repair costs)

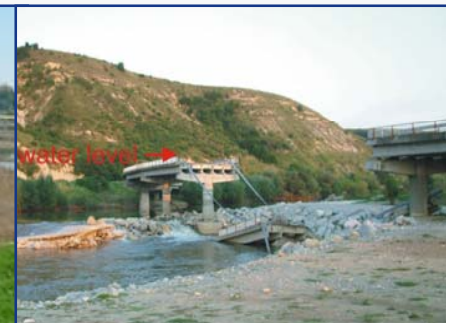**Development of loss models**

Model validation and application

Sectors:

Agricultural losses:
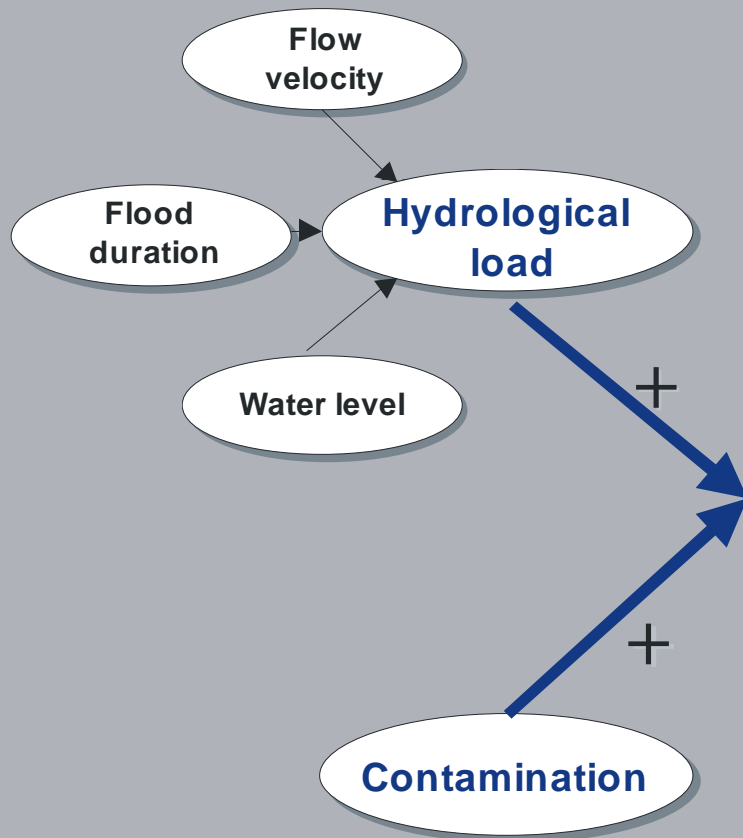Förster et al. (2008) –
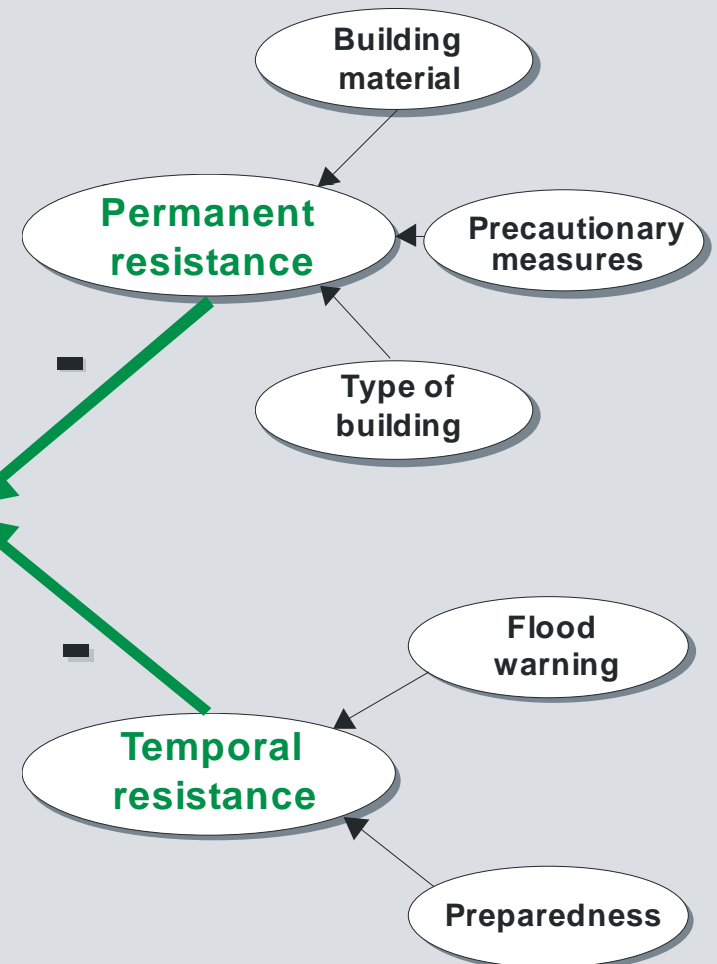NHESS 8: 311-322

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Flood losses and influencing factors

Class	Description
D1	No structural damage; Water penetration
D2	Small cracks, damaged doors and windows, replacement of some structural elements is necessary
D3	Bigger cracks in the walls, damage to foundation, subsidence
D4	Partial collapse of walls and ceilings
D5	Collapse of large parts of the building

- Derivation of vulnerability classes
- Linkage of vulnerability and construction
- Development of vulnerability functions

D3: Subsidence, cracks

D5: Collapse

Bauhaus-Universität Weimar

EDAC

PRESENTATION

Risk management of extreme flood events

Damage Class 2

Abb. A2: Münzgasse im August 2002; Quelle: Strasseninspektion I

Damage Class 4

Abb. A4: Freiberger Strasse im August 2002; Quelle: Strasseninspektion I

Data collected for 275 road sections in the city of Dresden

Most important factor for structural damage: Flow velocity

Computer-aided telephone interviews (CATI)

Flood event	2002	2005	2006
Private households	1697	305	156
Companies	479	102	61

Project Partner: GFZ, Deutsche Rückversicherung
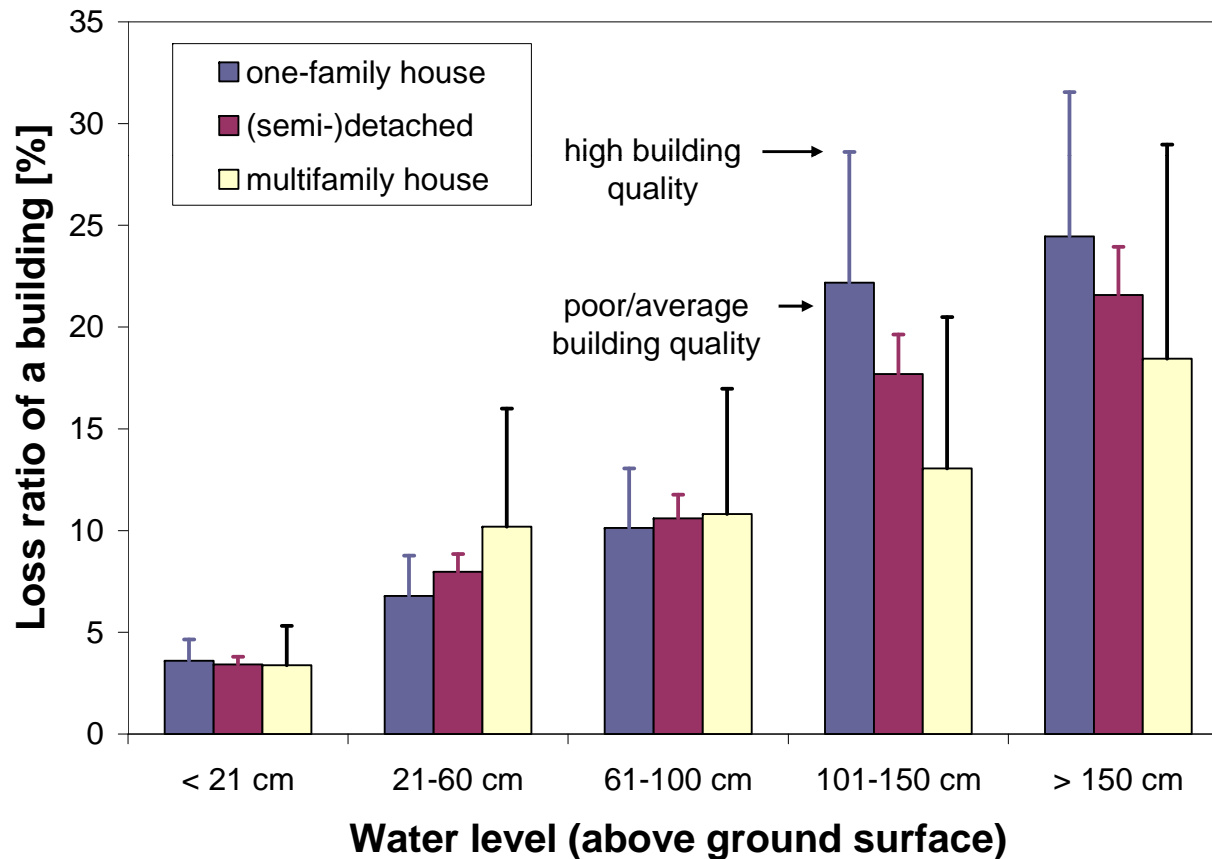Funding: Deutsche Rückversicherung, BMBF

Topics

- financial losses
- characteristics of the flood,
- characteristics of the building/company
- warning and emergency measures
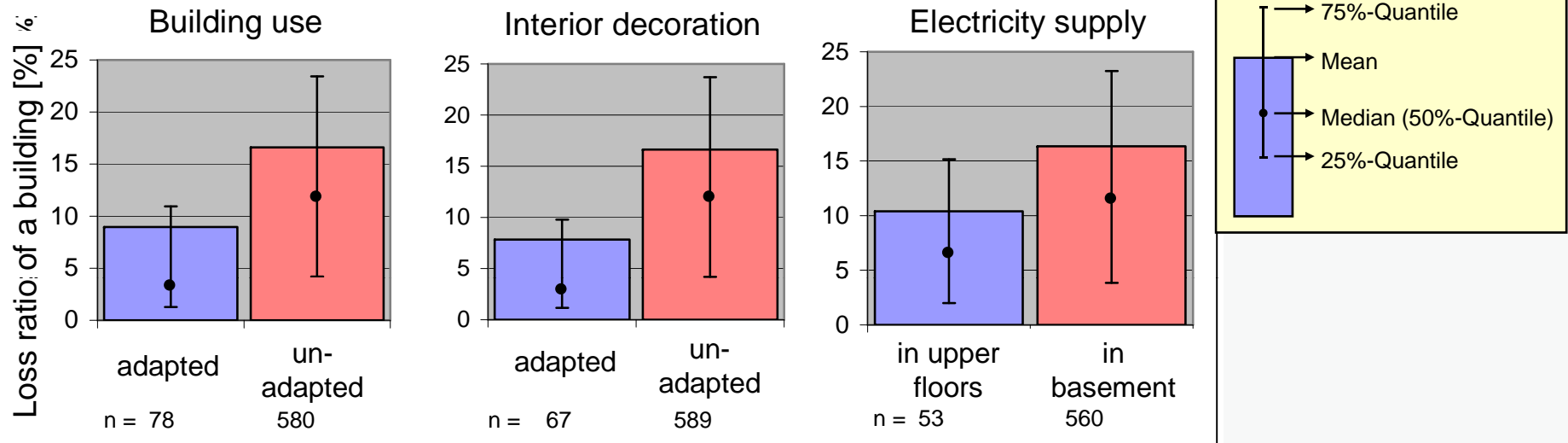- precautionary measures
- previously experienced floods

etc.

Lower Saxony

Saxony-Anhalt

Saxony

Bavaria
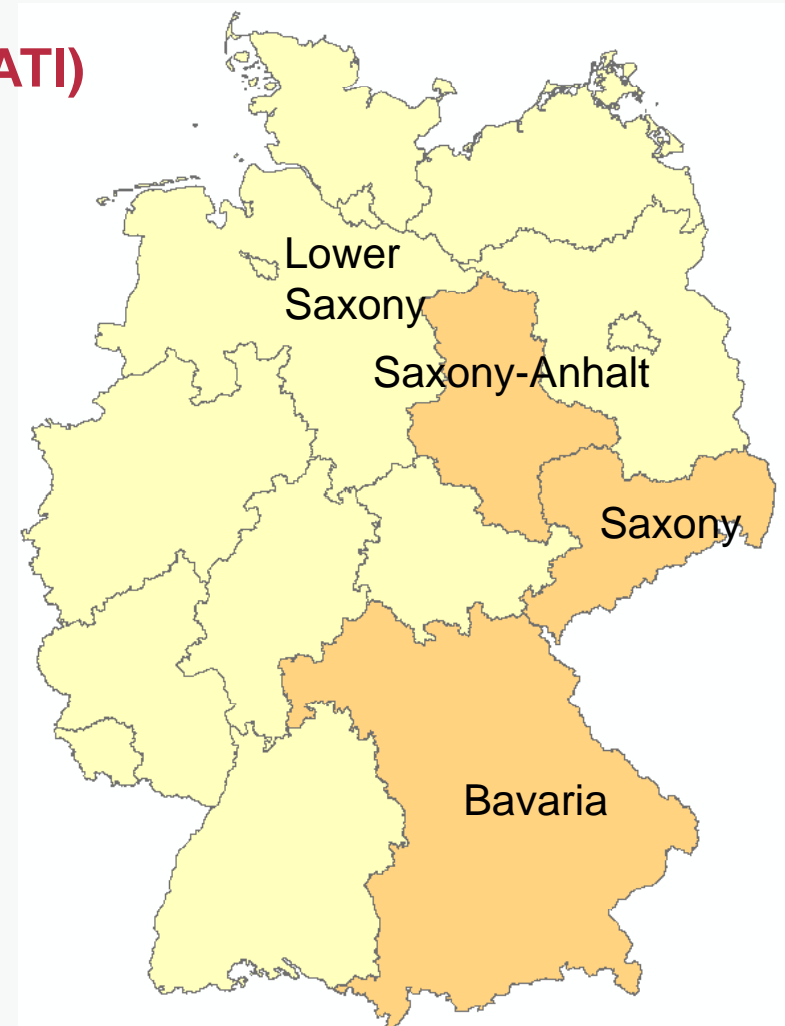
Modelling losses at residential buildings and household contents

Accounting for additional effects in FLEMOps+

Loss ratio of a building [%]
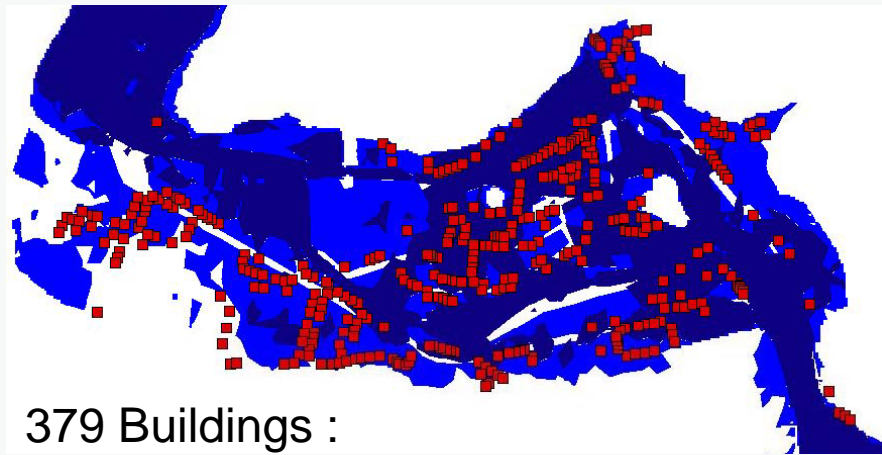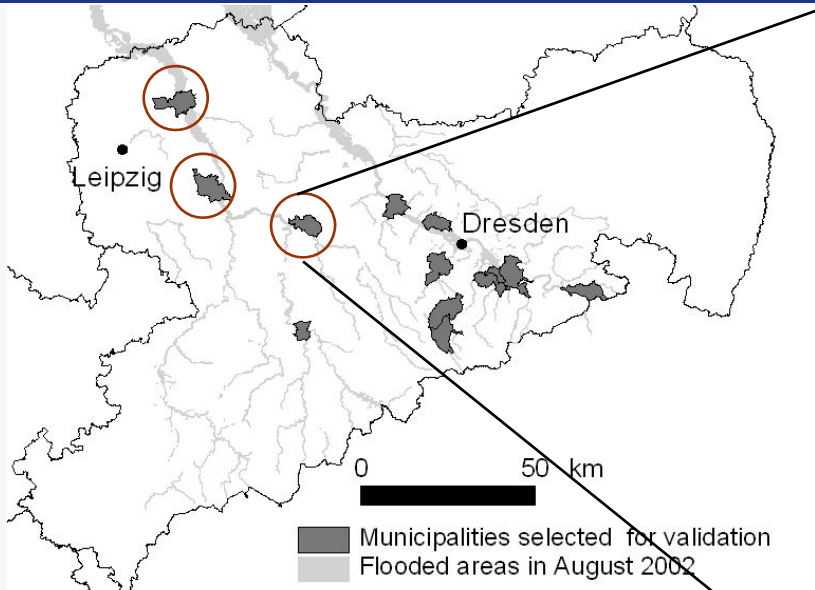
Building use

adapted   un-adapted

n = 78   580

Interior decoration

adapted   un-adapted

n = 67   589

Electricity supply

in upper floors   in basement

n = 53   560

Legend:
- 75%-Quantile
- Mean
- Median (50%-Quantile)
- 25%-Quantile

Sources:
Kreibich et al. (2005) – NHESS 5: 117-126.
Büchele et al. (2006) – NHESS 6: 485-503.

		Private precaution		
		none	good	very good
Conta-mina-tion	none	0.92	0.64	0.41
	moderate	1.20	0.86	0.71
	severe	1.58	---	---

379 Buildings :
- repair costs (2002 flood)
- building type
- observed water levels

Data sources: SAB, 2005; Kobsch, 2005; Apel 2007

	Recorded repair costs	FLEMOps Estimate
Döbeln	45.71 Mill. Euro 40.24 … 52.28 Mill. Euro	42.68 Mill. Euro ☺
Grimma	44.45 Mill. Euro 40.75 … 48.63 Mill. Euro	48.48 Mill. Euro 😐
Eilenburg	54.46 Mill. Euro 49.97 … 60.61 Mill. Euro	55.40 Mill. Euro ☺

Municipalities selected for validation
Flooded areas in August 2002

Flood Loss Modelling
on the meso-scale

Asset data per community
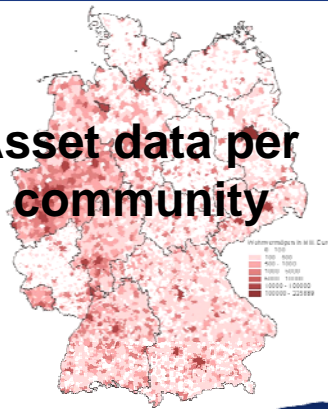
Land cover data (CLC2000)
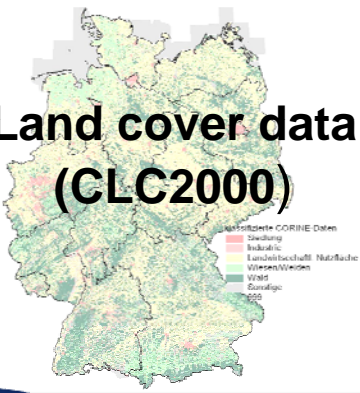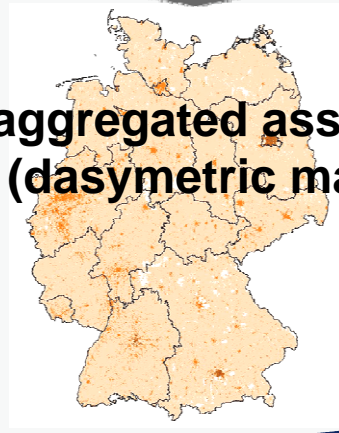
Characteristics of the municipal building stock
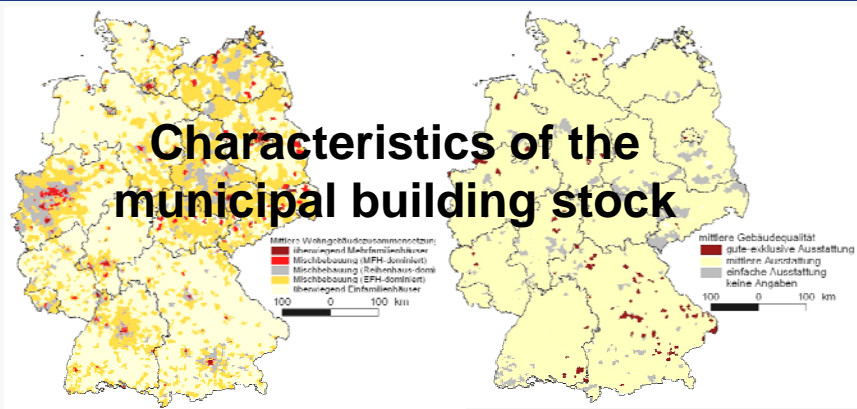
Dasymetric mapping

Loss model per building type

Information on contamination and precaution

dation enario
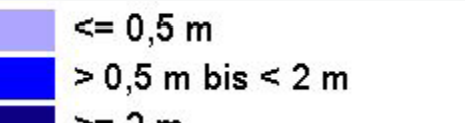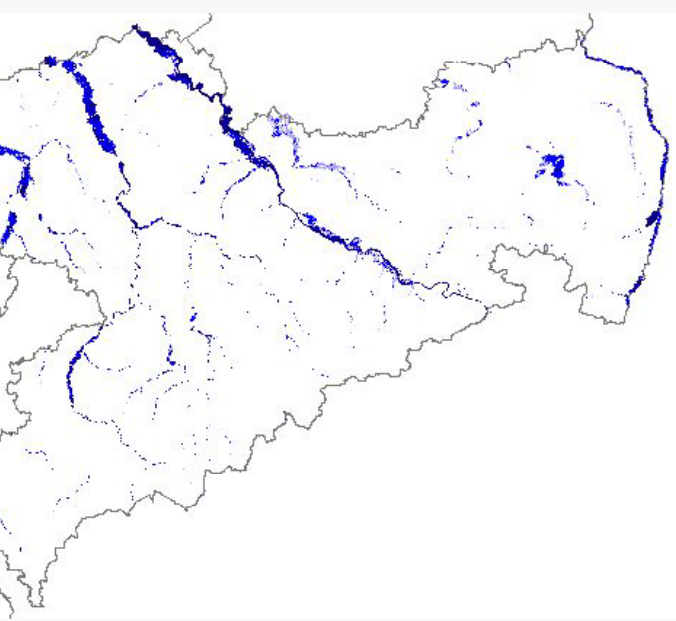
Disaggregated asset data (dasymetric map)

Intersection

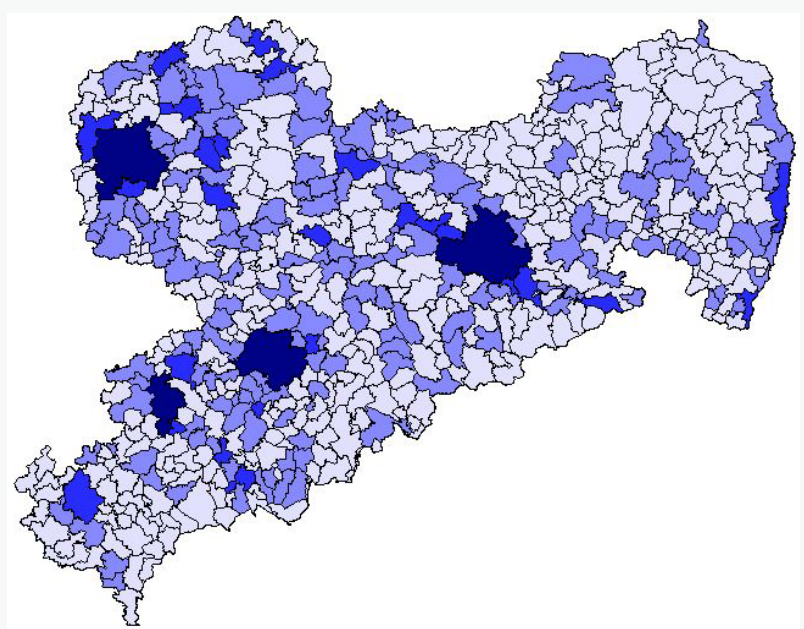**Mean loss model per community**

Intersection and Modelling

Application of FLEMOps in Saxony

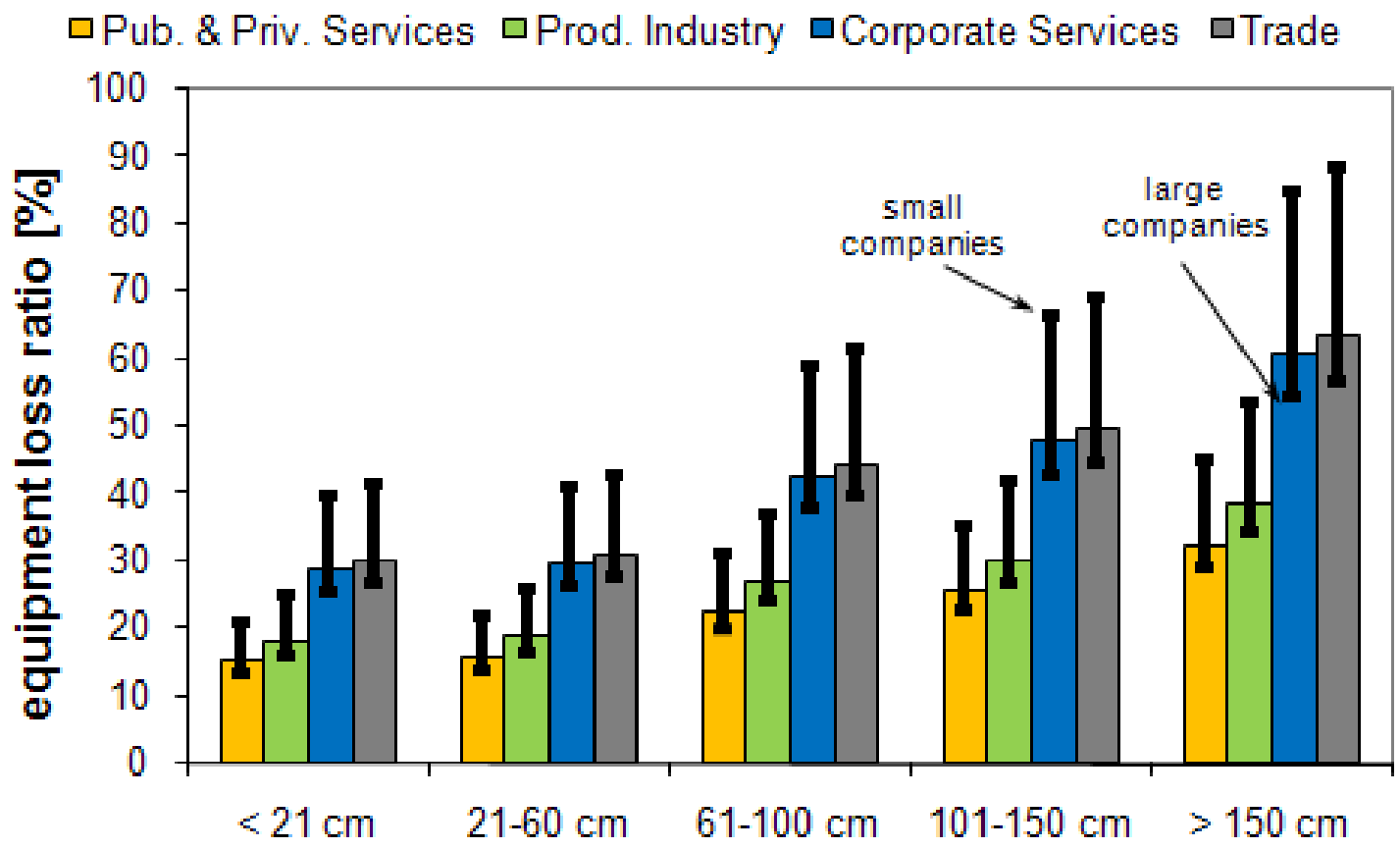ficial flood hazard maps T = 200 yrs.

ater depths   Building damage

	<= 0,5 m
	> 0,5 m bis < 2 m
	>= 2 m

	0
	WG-Schaden > 0
	WG-Schaden > 10 Mio. Euro
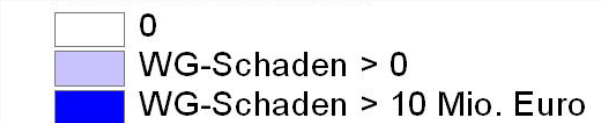
Flood Loss Estimation MOdel for the commercial sector - FLEMOcs

ses at buildings, equipment and goods/products/stock

Flood Loss Estimation MOdel for the commercial sector – FLEMOcs+

counting for precaution and contamination by scaling factors

g. equipment loss		precaution		
		none	good	very good
nta- nation	none	1.02	0.86	0.72
	moderate	1.03	0.87	0.73
	severe	1.33	1.12	0.94

so-scale application

mbination with asset data, i.e.

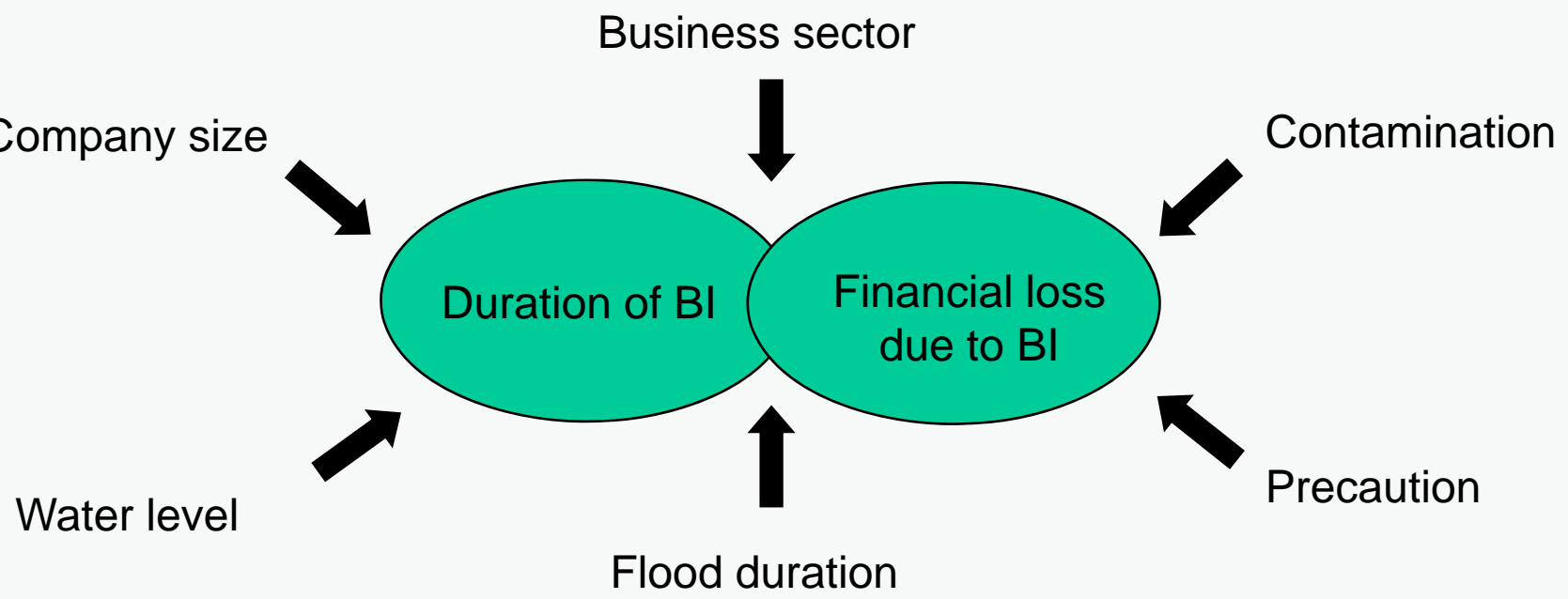oss/Net stock of fixed assets per municipality

Branches, 3 company sizes
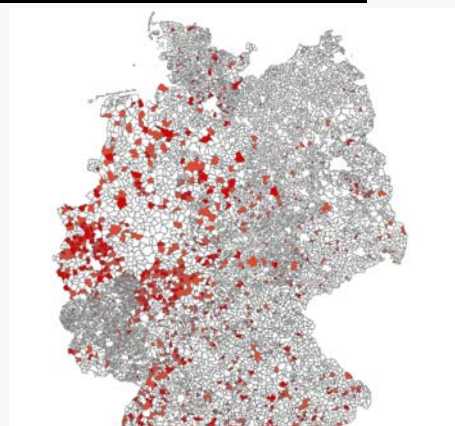
Micro-scale model Evaluation by Cross-Validation

ampling with bootstrap (10 000 samples): 2.5% - 97.5% confidence int.
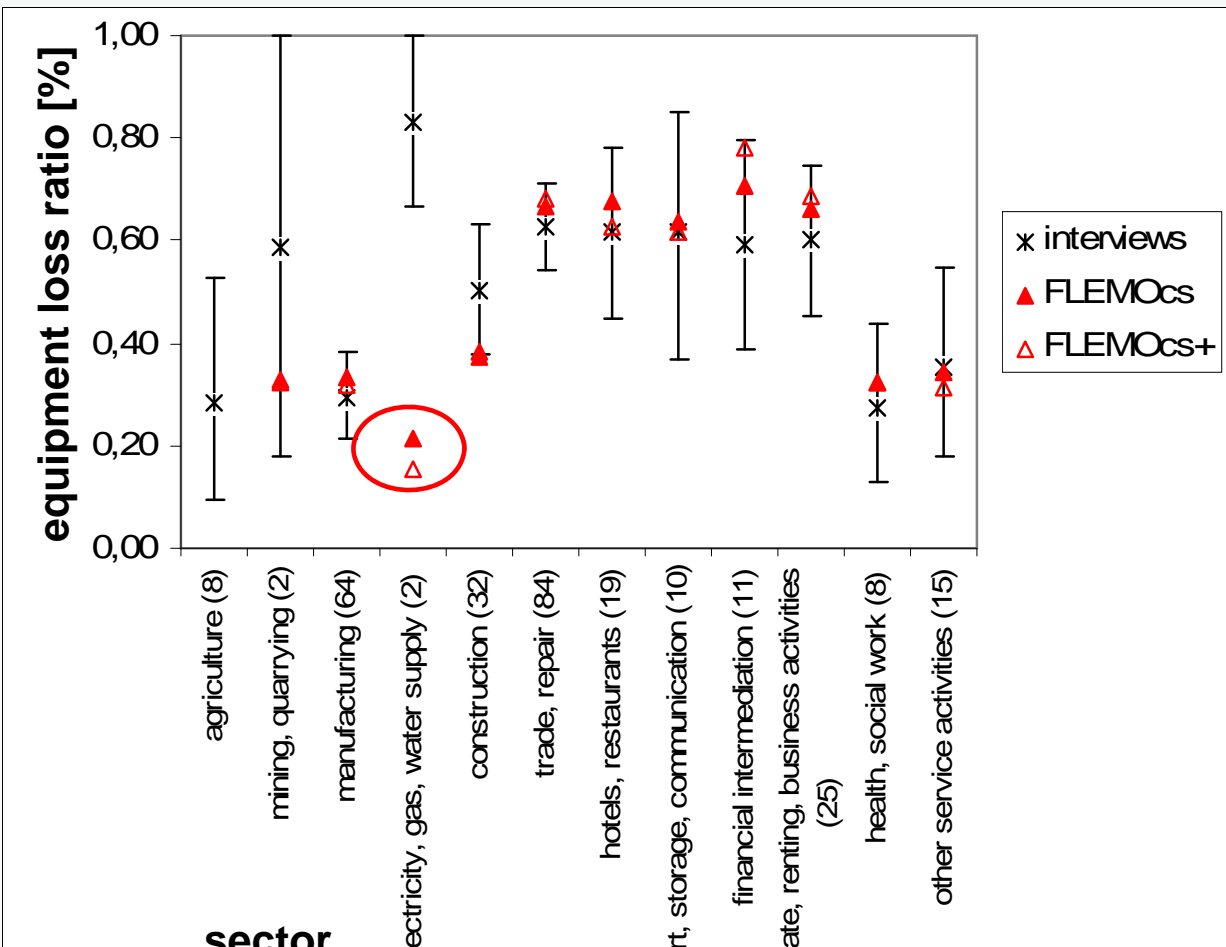
**rrently: development of a model for the estimation of losses due to
siness interruption and business restrictions**

Business sector

Company size

Contamination

Duration of BI

Financial loss
due to BI

Water level

Precaution

Flood duration

Risk communication and implementation of results

ssemination activities:

ve access to FLEMO via web-services

uideline for collection of loss data

ood loss data base HOWAS 21

**eb-based broschure about flood risk
d mitigation**

rimax Risikomanagement extremer Hochwasserereignisse

Workshop

Erfassung von Hochwasserschäden
Vergleich von Methoden aus Verwaltung, Versicherung und Wissenschaft

**Dresden
1. & 2. Dezember 2005**

Workshop des RIMAX-Projektes
MEDIS

Natural Disasters
Networking Platform

rovision of Information, Data and Models about

arthquakes, Tsunamis, Floods, Oil Spills, Storms and Storm Surges

http://nadine.helmholtz-eos.de

Provision of FLEMO via Web-Services

ultiple Layer"-System

sentation "Agent " Operating System

SOAP

Web-service

Perl

Arc ESRI GIS

MATLAB
(flemo.m)

Perl
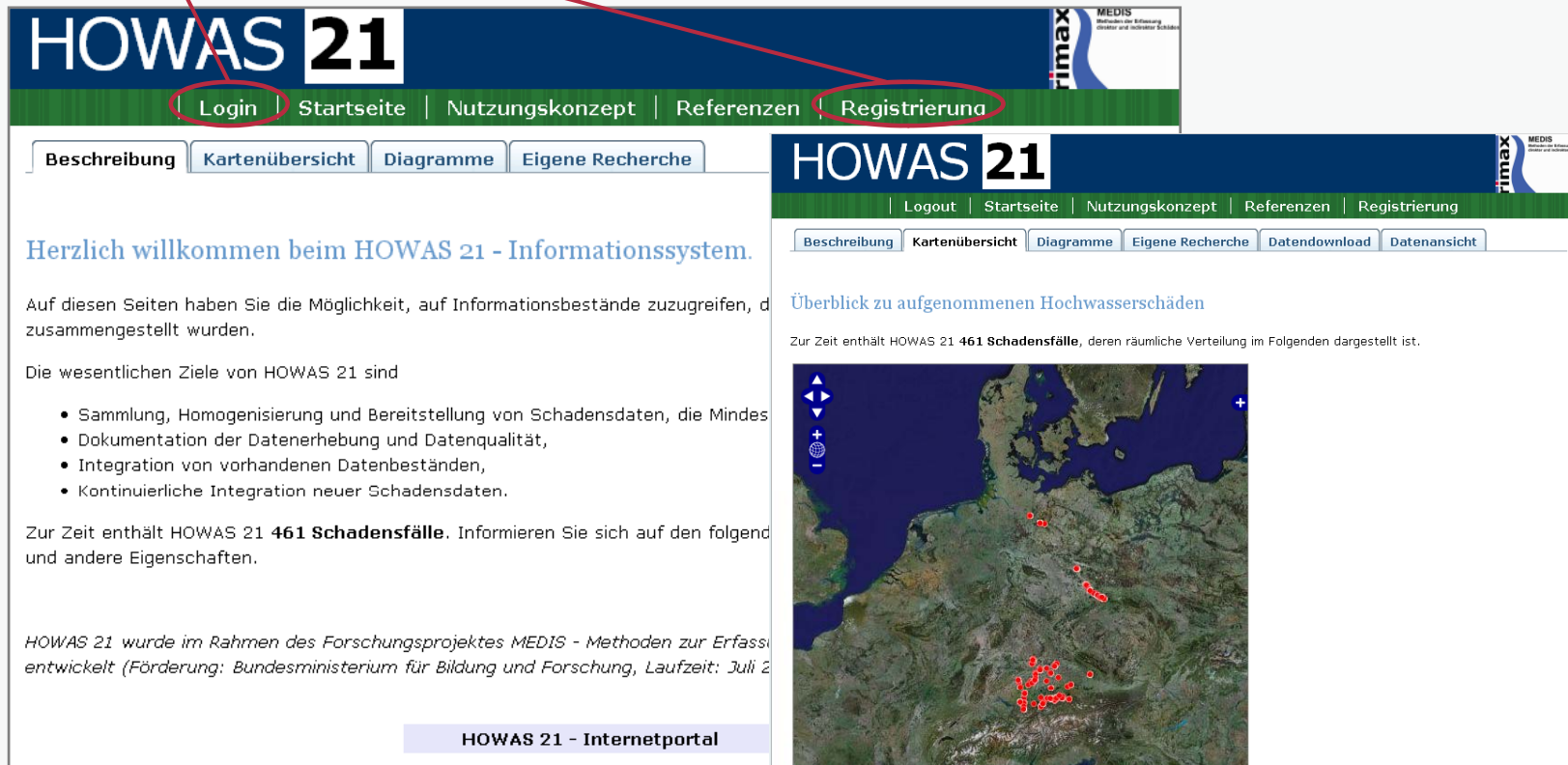
Output file
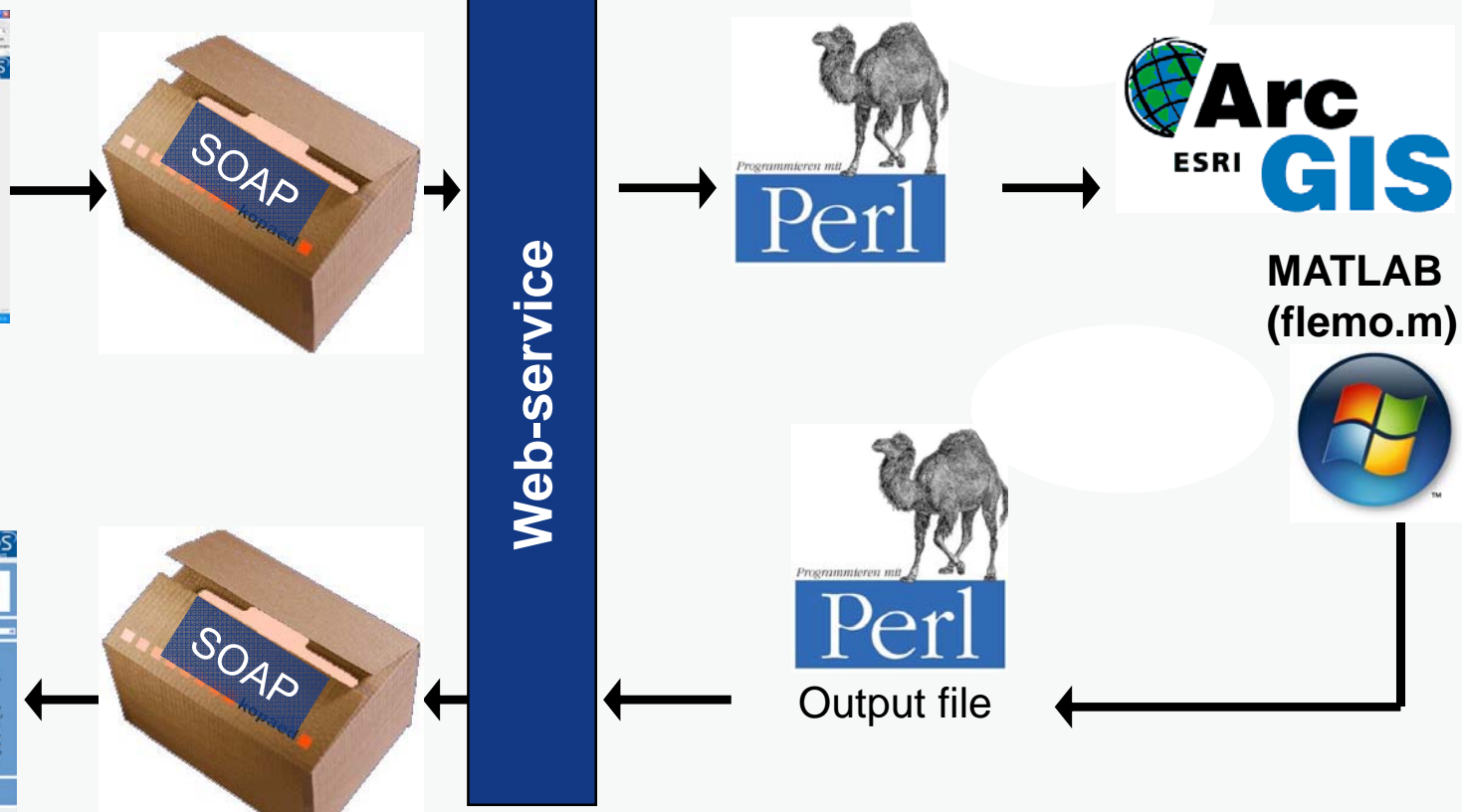
Flood loss data base HOWAS21

en access and restricted access for registered users

Web-based broschure
about flood hazard and loss mitigation
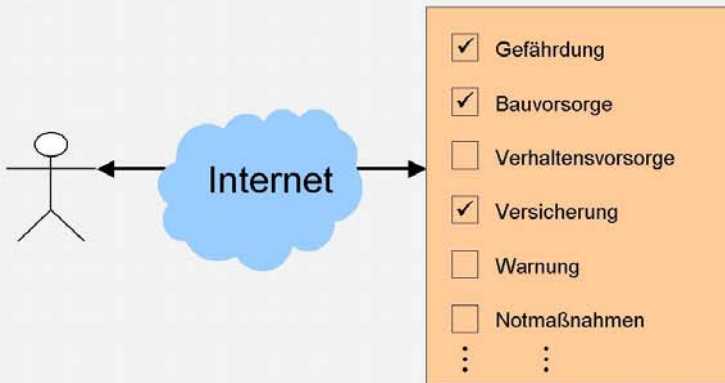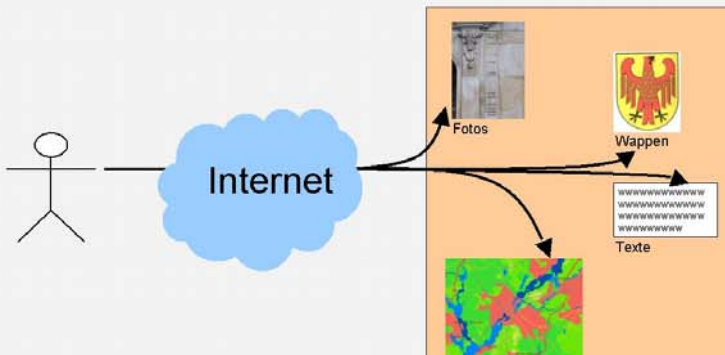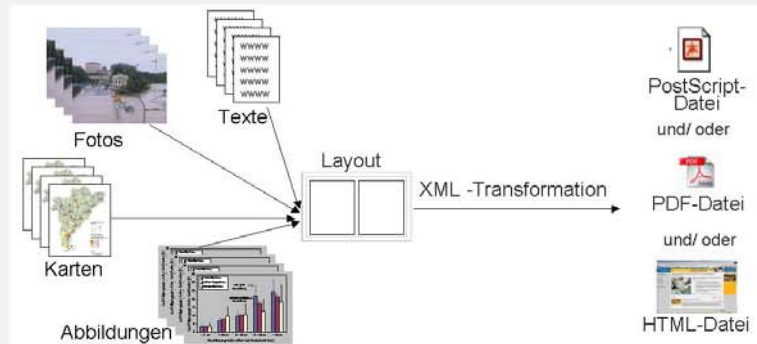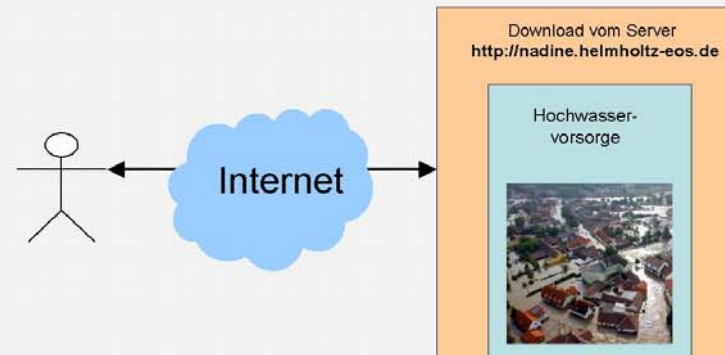
Conclusions / Summary

e data base about flood loss has been
nsiderably enlarged due to the MEDIS project.

w models for the estimation of direct flood
sses were developed and validated.

timation of indirect losses is still difficult.

ta, models and information are disseminated
the public and stakeholders using modern
chnology concepts.

Methods for the evaluation of direct and indirect flood losses

A. Thieken, V. Ackermann, F. Elmer, H. Kreibich, B. Kuhlmann, U. Kunert, H. Maiwald, B. Merz, M. Müller, K. Piroth, J. Schwarz, R. Schwarze, I. Seifert, J. Seifert

For more information: Annegret Thieken – thieken@alps-gmbh.com

Project Management   Coordination