

13th Meeting of the Working Group "Flood Protection" of the International Commission for the Protection of the Elbe River, 6-7th December 2006, Dresden

Research Projects on Flood Risk Management in the Elbe River Basin – FLOODsite and VERIS-Elbe

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Member of the Dresden Flood Research Center (D-FRC)





Contents

1. Flood risk management – A European approach
2. FLOODsite – Pilot study „Elbe River basin“
3. VERIS-Elbe – Changes and management of risks due to extreme flood events in large river basins – e.g. Elbe River
4. Probable interfaces with activities of the International Commission for the Protection of the Elbe River
5. Outlook and Conclusions



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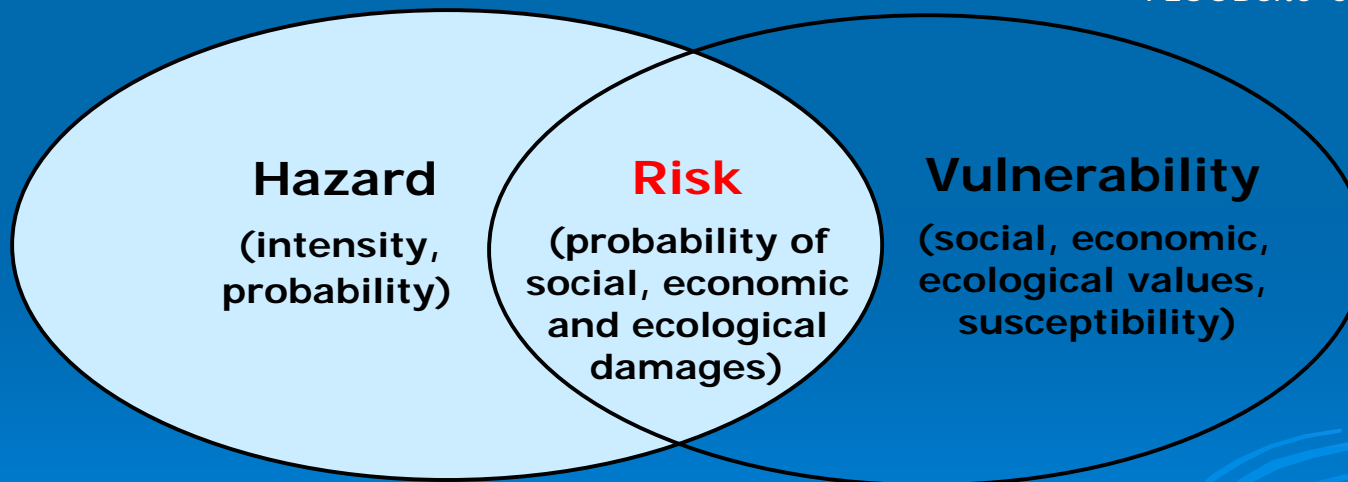




„Risk“ in terms of Floods

- ▶ Overall term: $\text{Risk} = \text{Probability} * (\text{negative}) \text{Consequence}$
- ▶ Flood risk = Flood hazard * (exposure) * Flood vulnerability
whereof
vulnerability = value * susceptibility

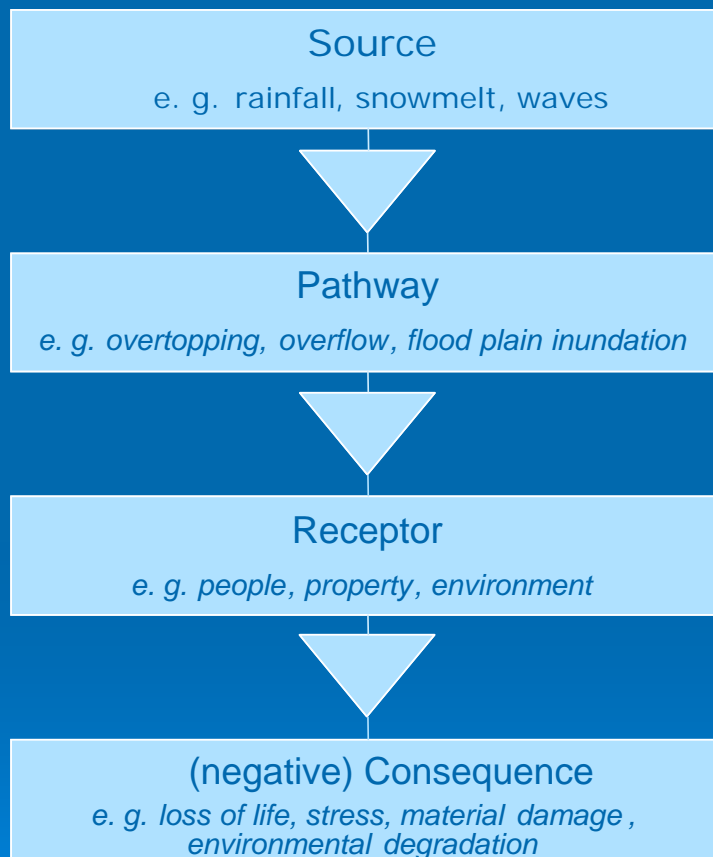
FLOODsite-Consortium (2005)



(Exposure)



Principal causal relations of flood risks



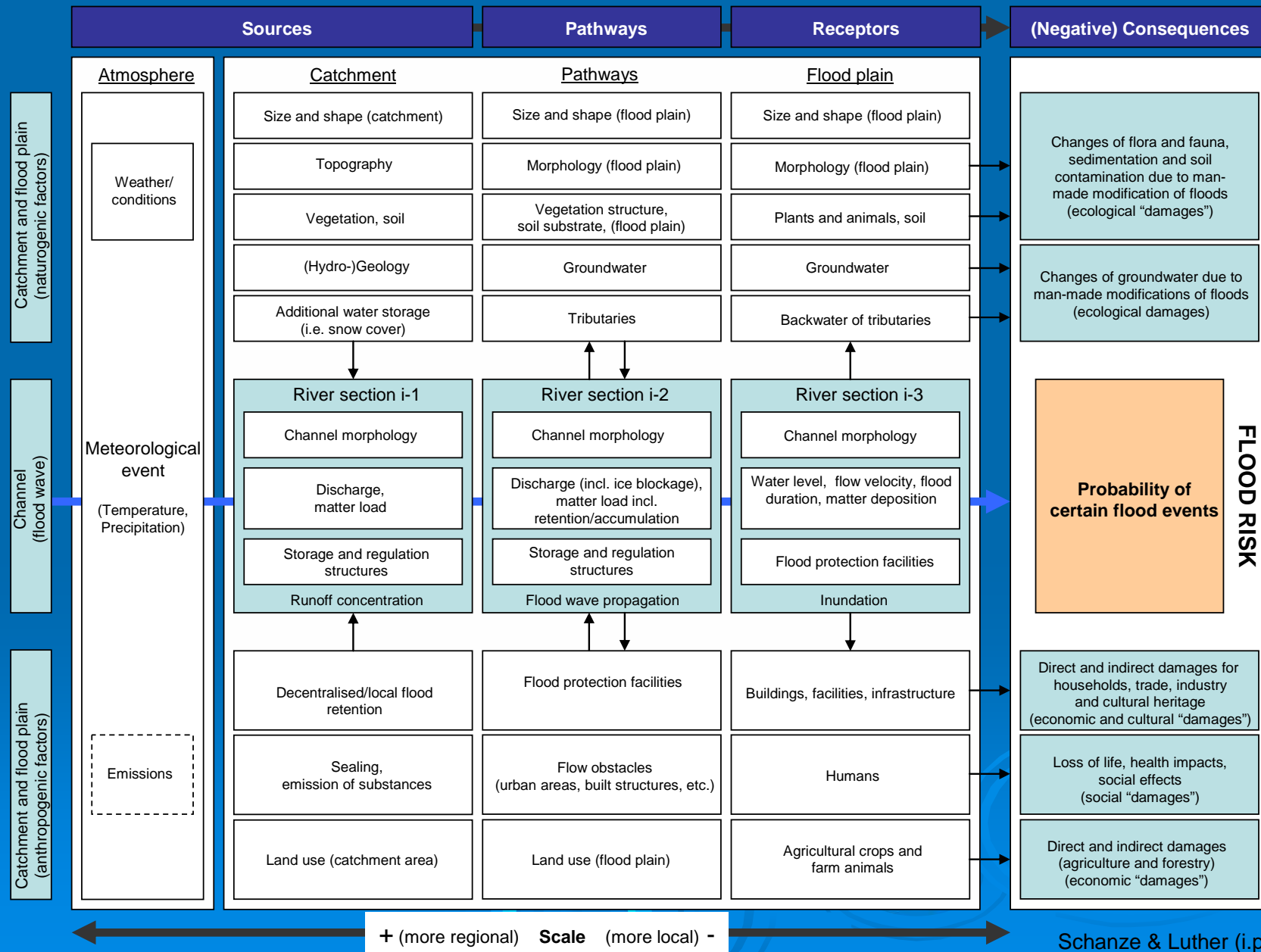
“Source-Pathway-Receptor-
Consequence” (SPRC-Model)

Kundzewicz, Samuels
(1997), ICE (2001)

“Flood risk system”

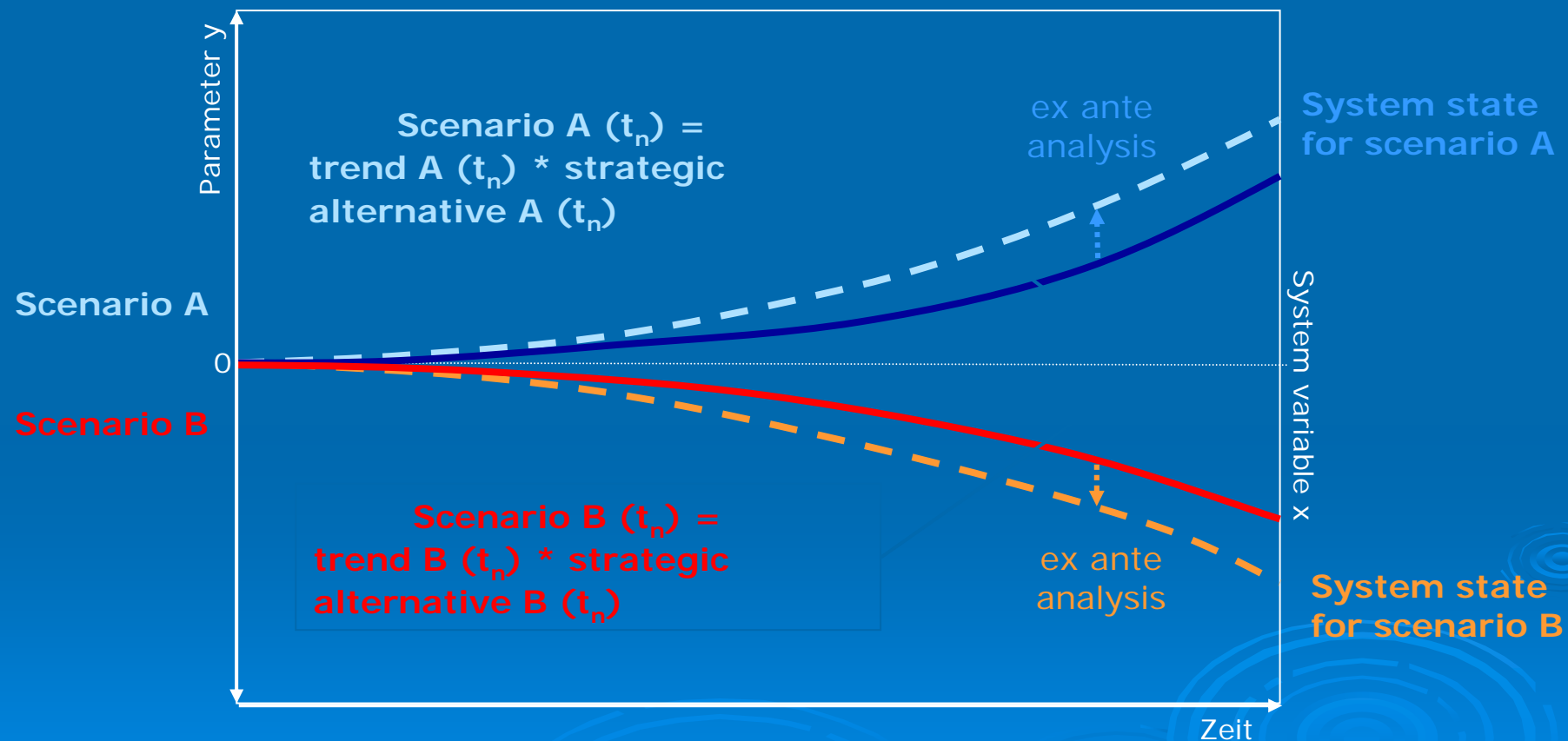
Schanze (2005, 2006)

Model concept of the "flood risk system"



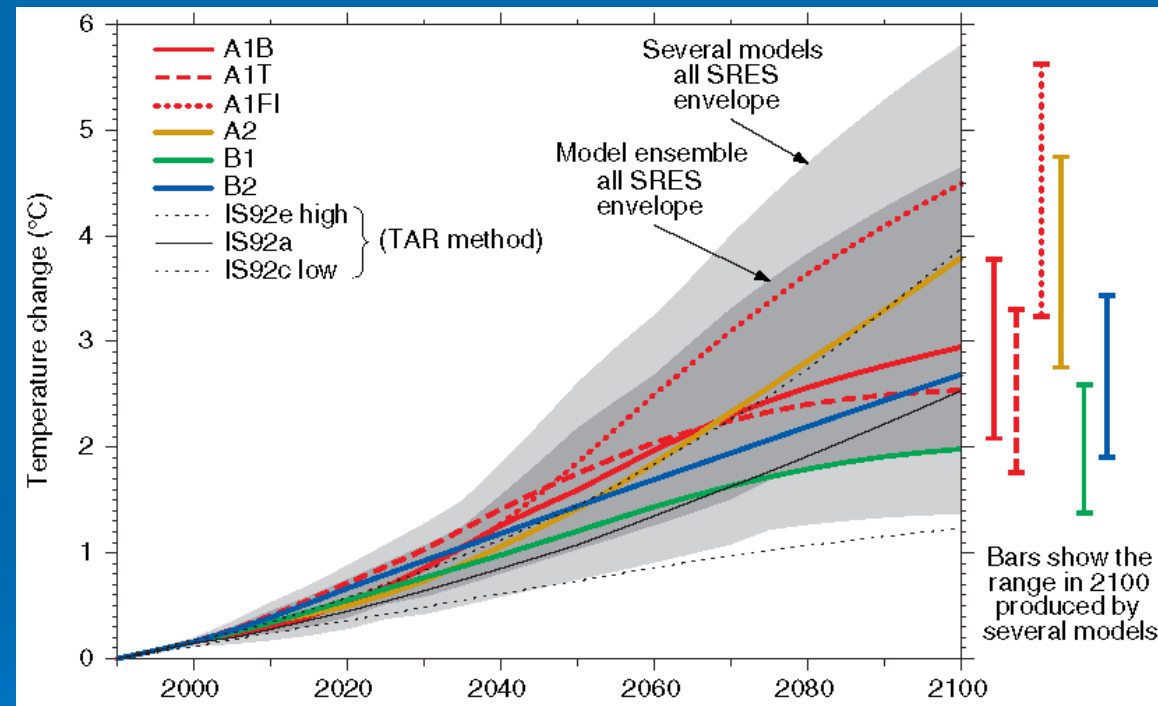


Exploration of future flood risk systems using consistent cross-sectoral scenarios





Example of explorative climate change scenarios



Predicted climate change with respect to temperature for various scenarios calculated with different Global Circulation Models (GCM) (IPCC 2001)

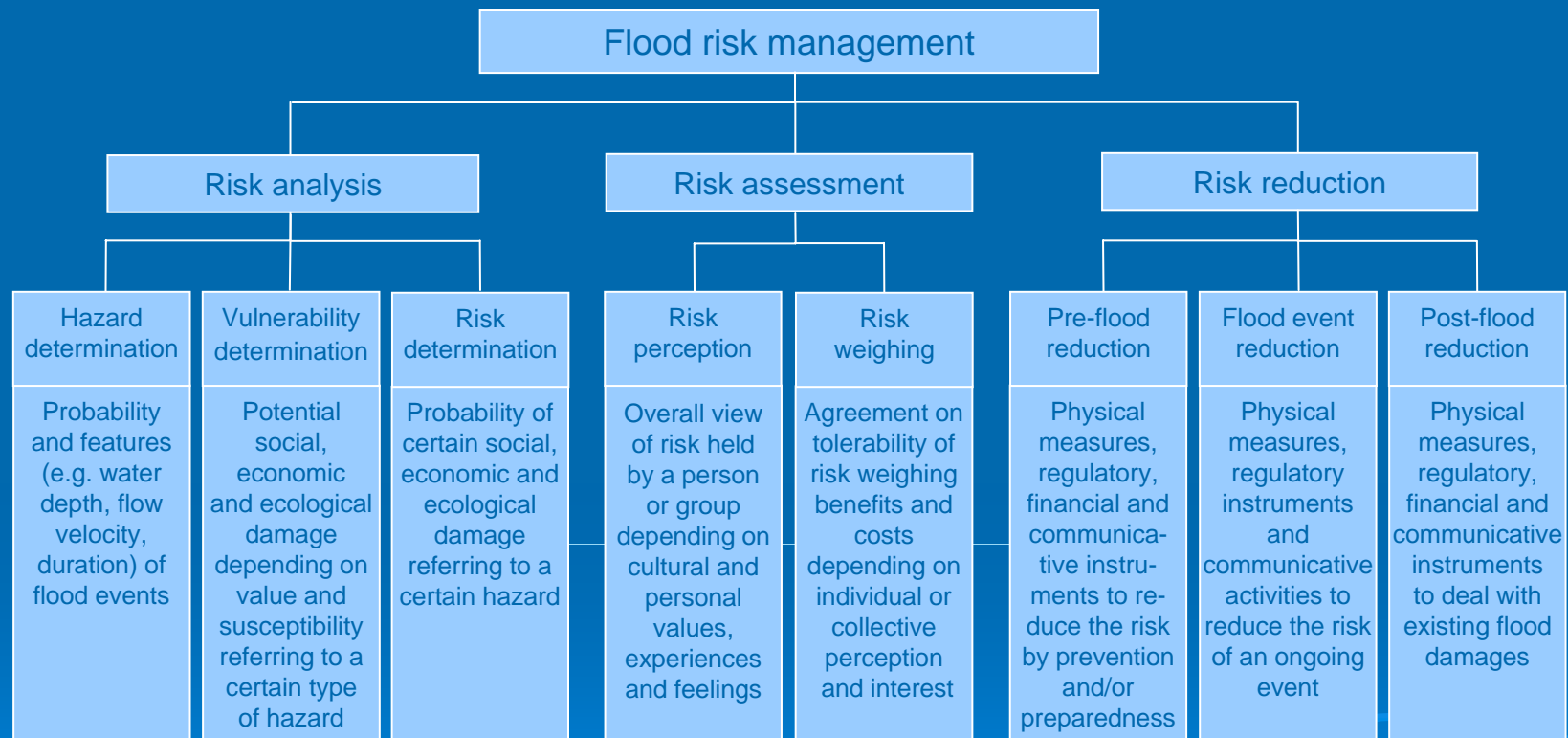


Dynamic factors of flood risk systems (overview)

	Source (Atmosphere and catchment)	Pathways	Receptors	Consequences
Trends (autonomous developments through specific drivers)	<ul style="list-style-type: none"> - Climate change - Land-use change 	<ul style="list-style-type: none"> - Land-use change - Technical and economic development (defences) 	<ul style="list-style-type: none"> - Land-use change - Technical and economic development 	<ul style="list-style-type: none"> - Technical and economic development - Values and attitudes
Strategic alternatives (combinations of physical measures and policy instruments)	<ul style="list-style-type: none"> - On-site flood retention - Spatial planning - Land management 	<ul style="list-style-type: none"> - Reservoirs - Flood polders - River training - Flood defence - Spatial planning 	<ul style="list-style-type: none"> - Dikes, walls - Building construction - Spatial planning - Land management - Warning, evacuation 	<ul style="list-style-type: none"> - Insurance - Other compensatory aid
Other assumptions		<ul style="list-style-type: none"> - Dike breach 		<ul style="list-style-type: none"> - Overlap with other risks



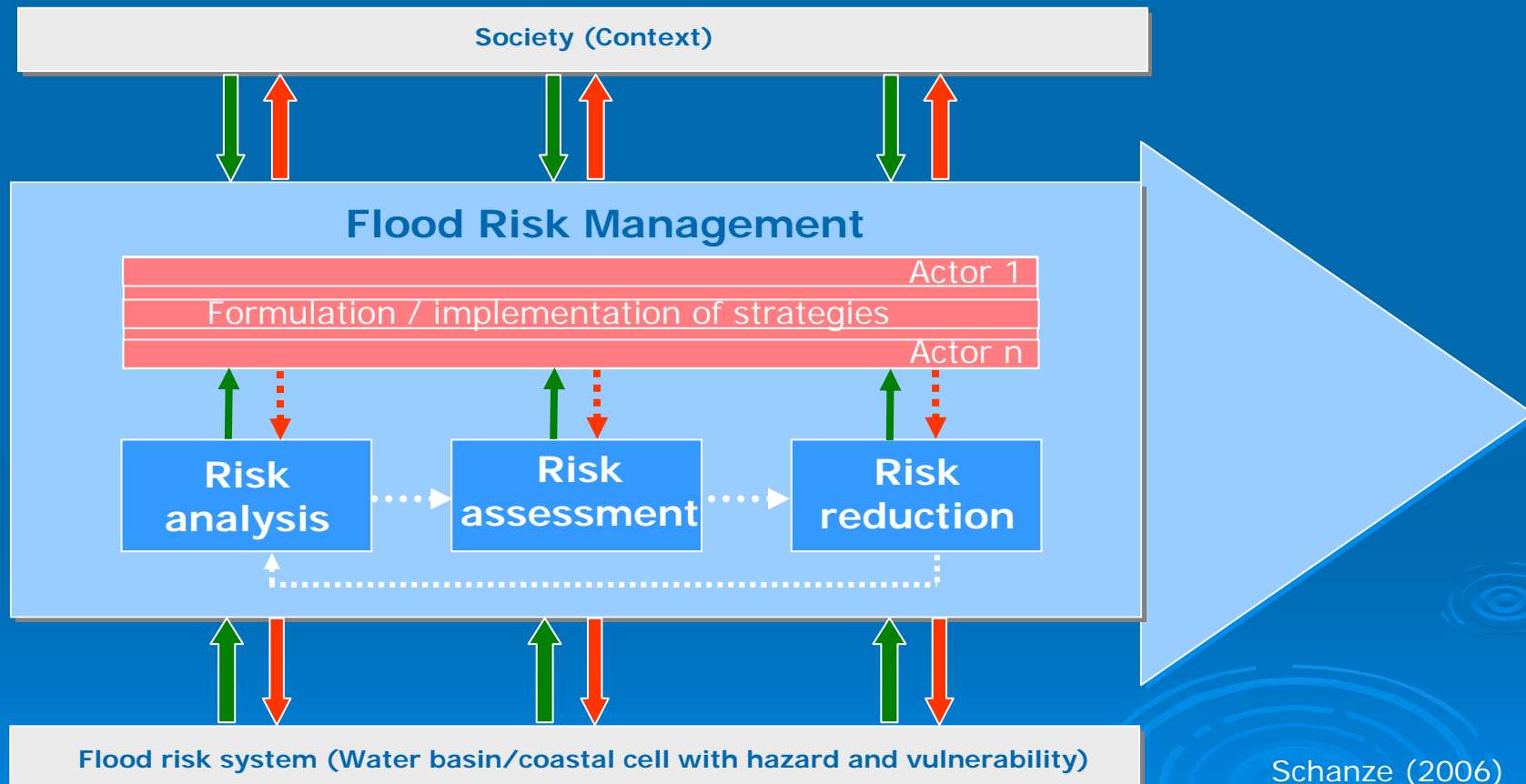
Tasks and Components of Flood Risk Management



Schanze (2006)



Process model of flood risk management



Schanze (2006)



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FP 6 Integrated Project

Integrated Flood Risk Analysis and Management Methodologies (FLOODsite)

- ▶ 37 Partners from 13 European countries
- ▶ EC funds 9.68 m., duration 3/2004 – 2/2009
- ▶ 7 themes with 35 work packages

Objectives

- ▶ An integrated European approach to flood risk analysis and management
- ▶ Consistent approach to the whole system of cause, control and impact
- ▶ Framework from high level planning through to operational management
- ▶ Build upon EC and national research



Theme Structure

Theme 6 – Project Networking & Harmonisation

Rivers & estuaries

Theme 1 – Advancing Scientific Knowledge & Understanding

Risk Analysis

1.1 – Hazard (Sources)

1.2 – Hazard (Pathways)

1.3 – Vulnerability: receptor exposure & consequences

Theme 2 – Innovative Mitigation & Sustainable Management

2.1 – Pre-Flood Measures

2.2 – Flood Event Management

2.3 – Post-Event Activities

Risk Management

Coasts & estuaries

Theme 7 – Project Management

Theme 3 – Integration (Rivers, Estuaries & Coasts)

Theme 4 – Pilot Application Sites *Estuaries*

Theme 5 – Training Activities Knowledge Transfer, Training and Uptake, Guidance & Tools



European Commission
Community Research



Pilot Study Sites of FLOODsite

1. River Elbe Basin
2. River Tisza Basin
3. Flash flood Basins
4. River Thames Estuary
5. River Scheldt Estuary
6. River Ebro Delta Coast
7. German Bight Coast



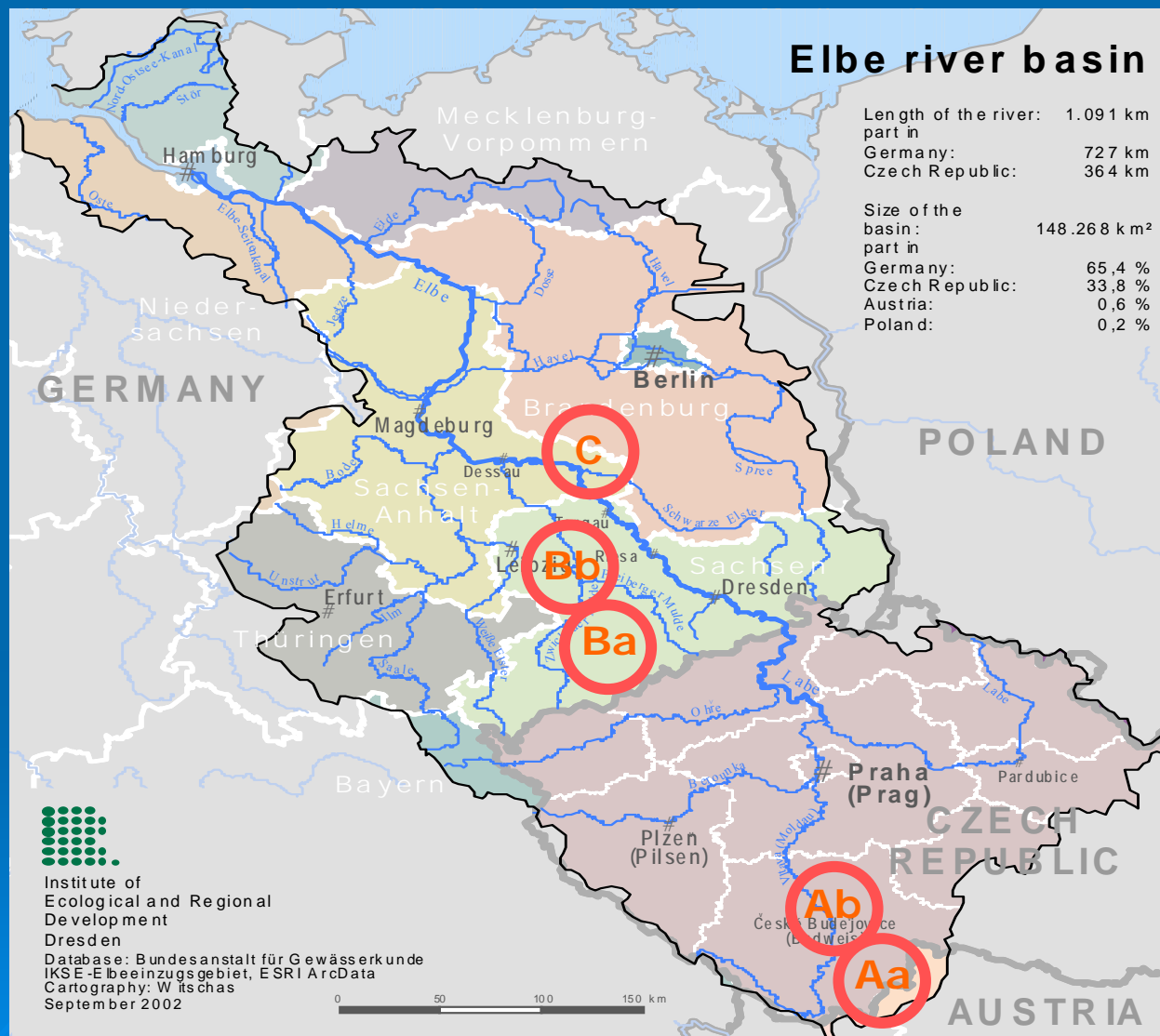
Dresden Flood Research Center



Elbe River Basin

Locations of Pilot Areas

- A. Moldawa River
 - a. Horní Stropnice River
 - b. Trebon Basin
- B. Mulde River
 - a. Upper Mulde River
 - b. Lower Mulde River
- C. Lowland Elbe River





Overall objectives of the Elbe river pilot

Developing and testing the FLOODsite methodology for **long-term flood risk management** of river basins.

- ▶ To analyse the impacts of **climate and land-use change** on the flood hazard and flood vulnerability
- ▶ To analyse and assess the **social, economic and ecological flood risks**
- ▶ To analyse and assess the **effects of risk mitigation measures** (e.g. detention areas) and instruments (e.g. spatial plans)
- ▶ To identify the requirements for **strategy development and implementation** in terms of flood risk management

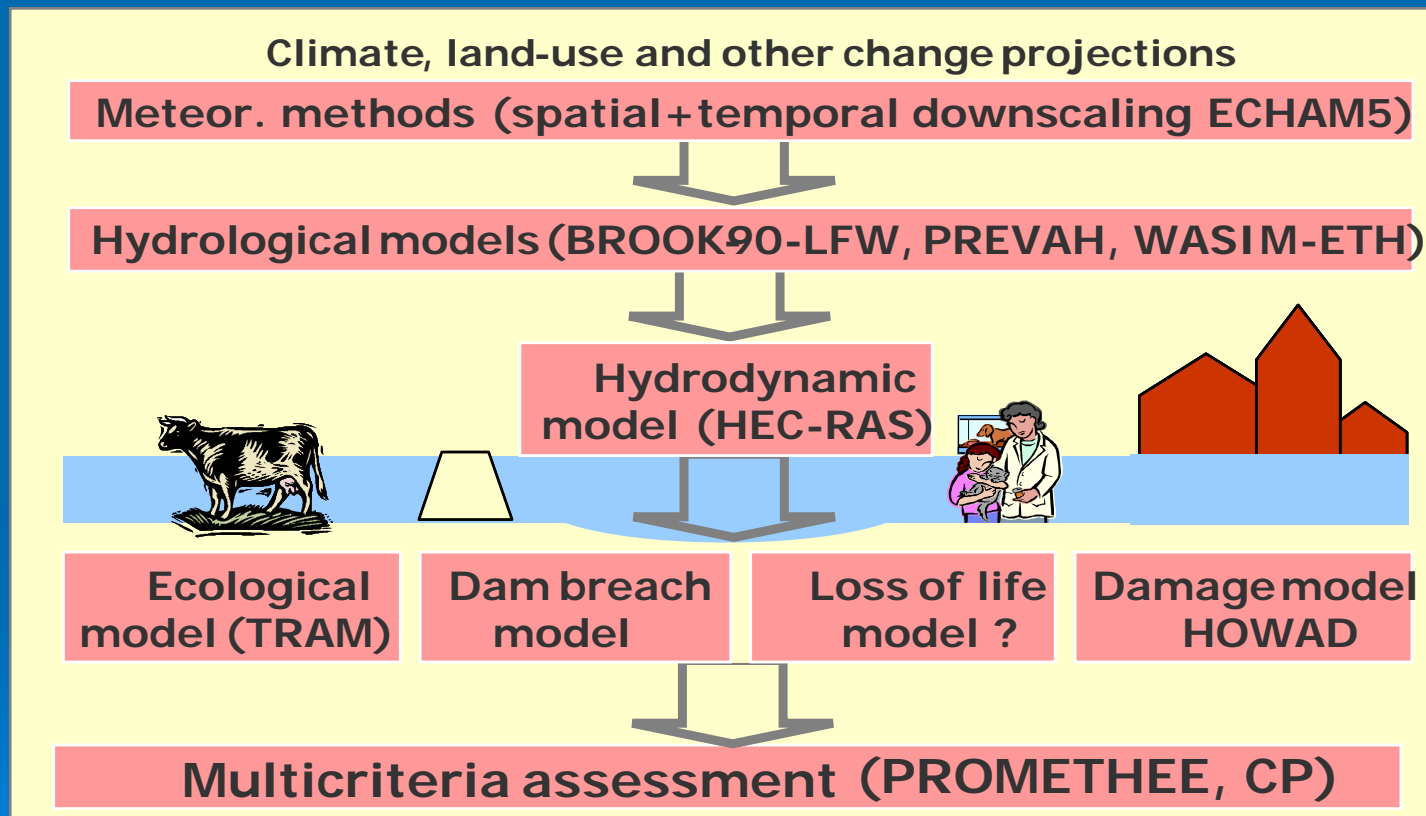


Principal approach of the Elbe river pilot

- ▶ Modelling of meteorological and hydrological processes of sources, hydraulic processes of discharge and inundation as well as damages by physical impacts on elements at risk
- ▶ Formulation of climate change and land-use scenarios
- ▶ Multi-criteria assessment of social, economic and ecological flood risks
- ▶ Ex-ante evaluation of effects, effectiveness and efficiency of pre-flood measures and instruments
- ▶ Technological integration of all tools in a DSS
- ▶ Investigation on local and regional strategies on flood risk management

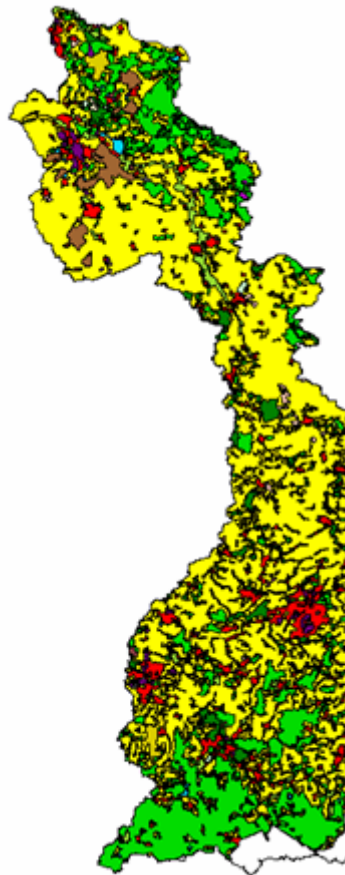


Model system to simulate the flood risk system (Elbe river pilot, Mulde River pilot area)





Mulde river pilot area (7600 km²)



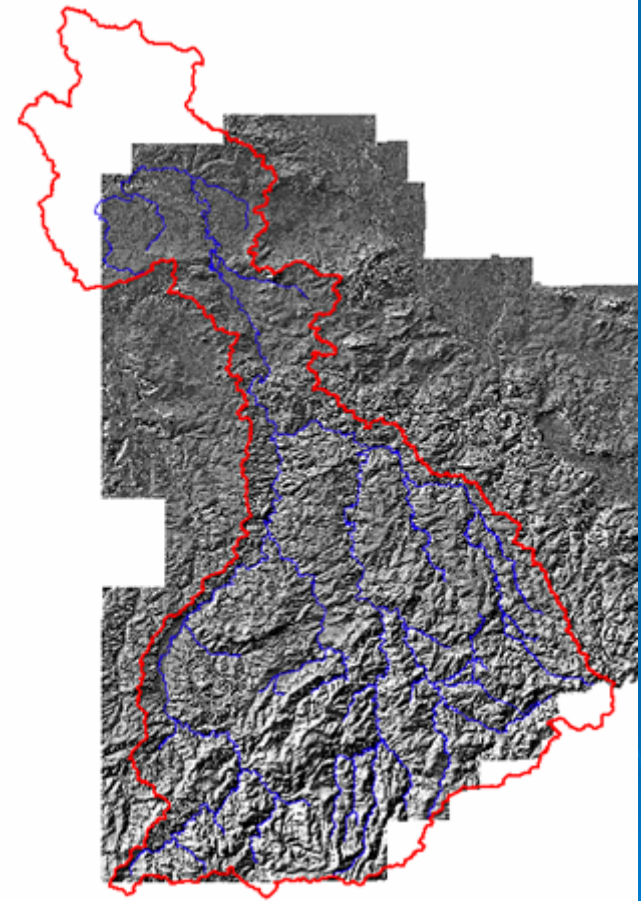
Land use



Soils



Precipitation



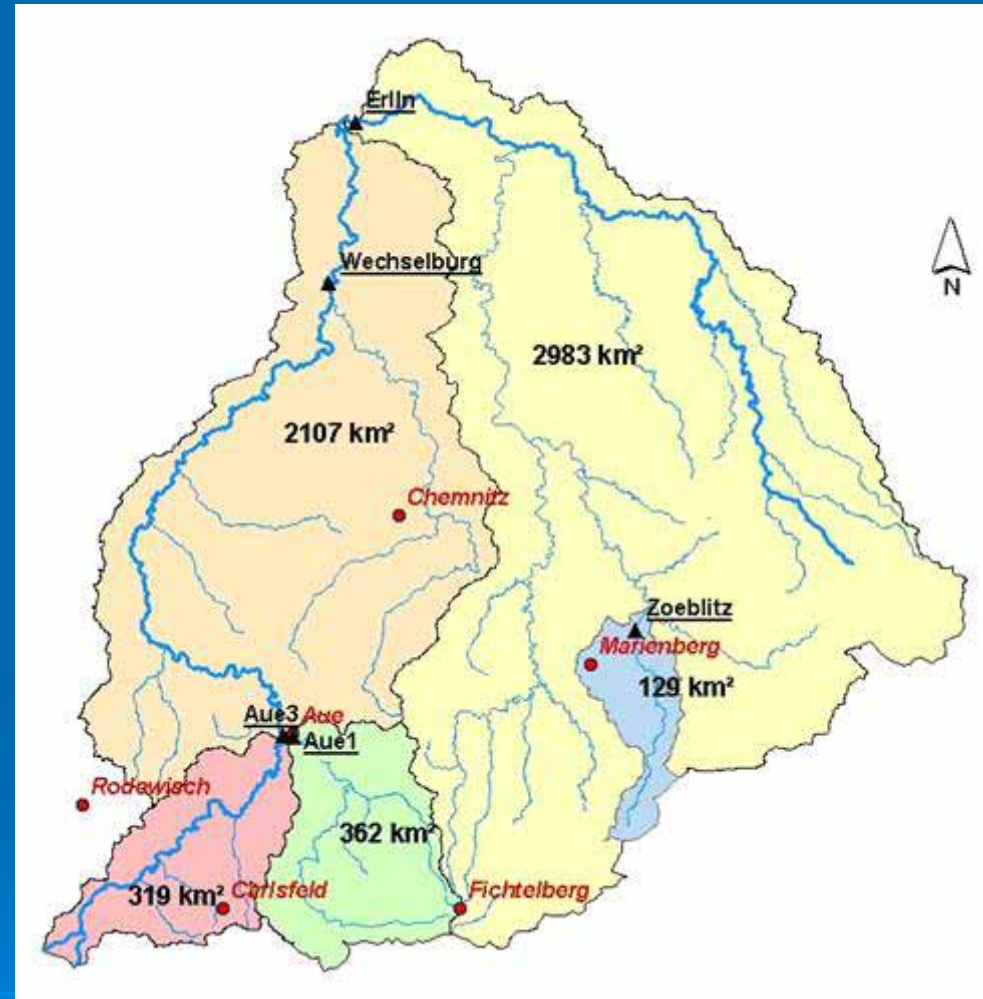
Topography

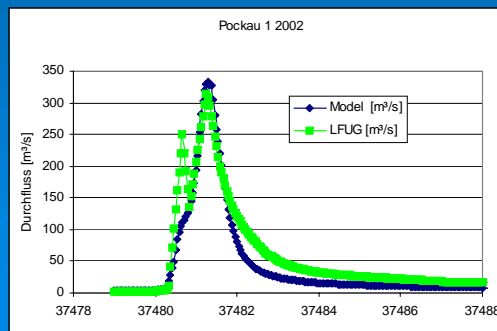
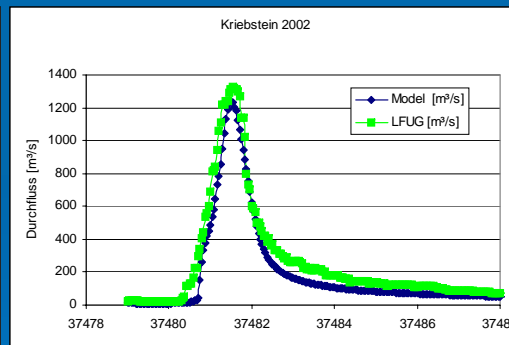
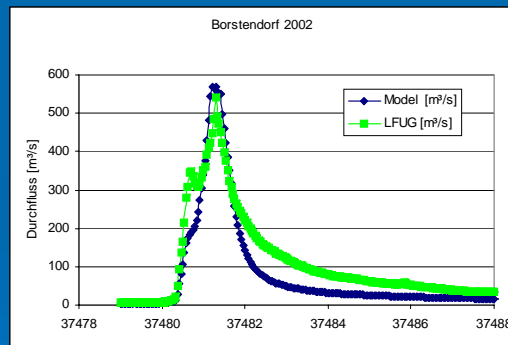
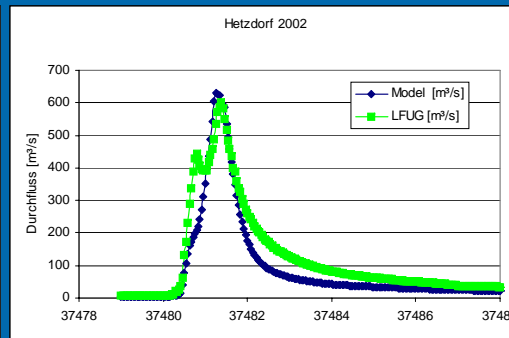
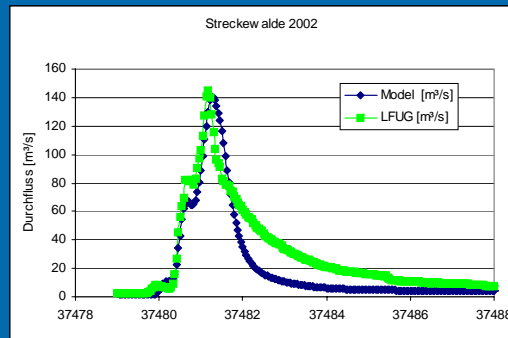
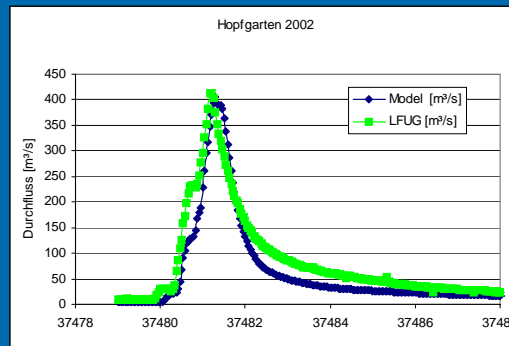
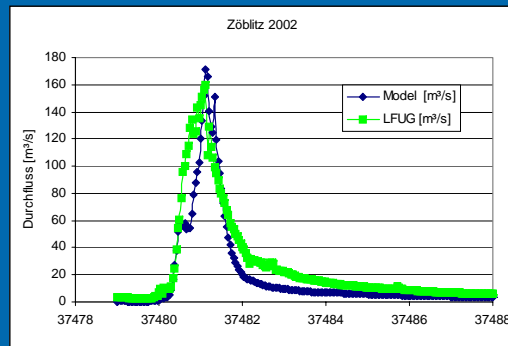


Catchment of the Freiberger and Zwickauer Mulde

Approach:

- Downscaling climate change
- Rainfall-runoff-modelling
- Modelling the influence of land-use change



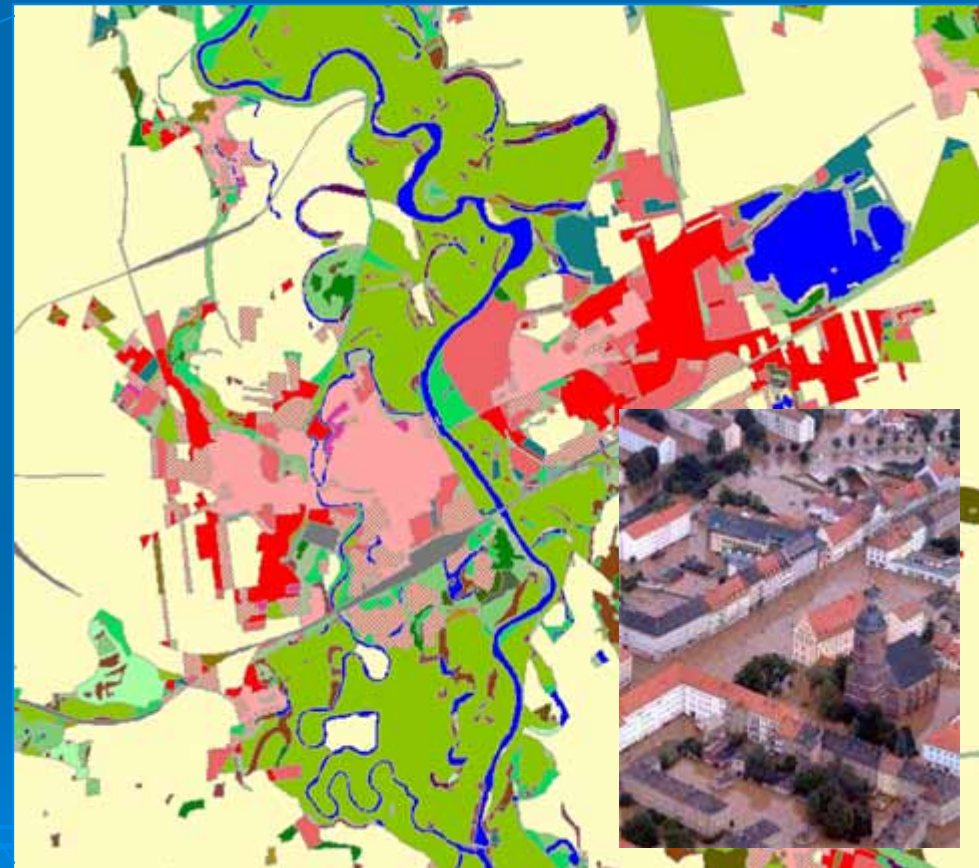
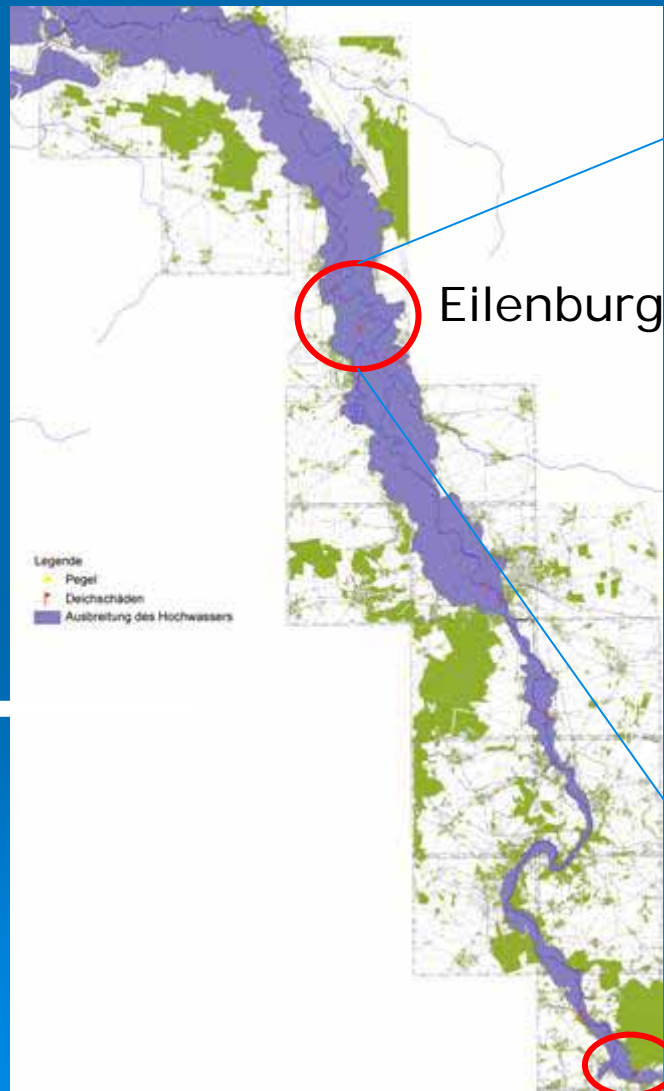


**PREVAH model
calibration for
2002 flood event**

Lennartz (2005)



Probable study area for risk analysis at Vereinigte Mulde

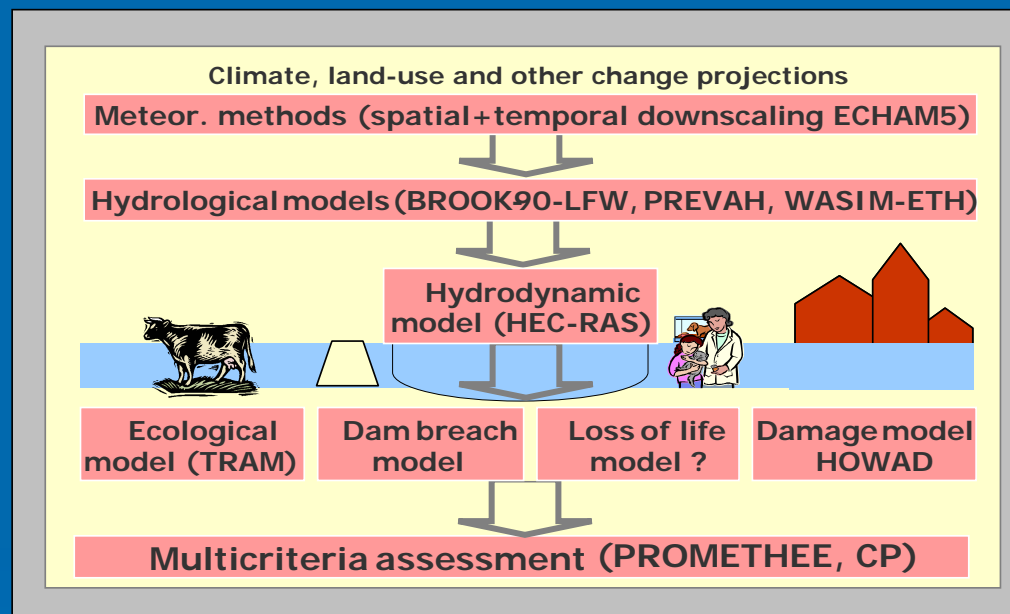


Haase (2005)



Technological integration of the methodology for simulating the flood risk system in a DSS tool

Different
thresholds of
tolerable risks



Risk
reduction
options

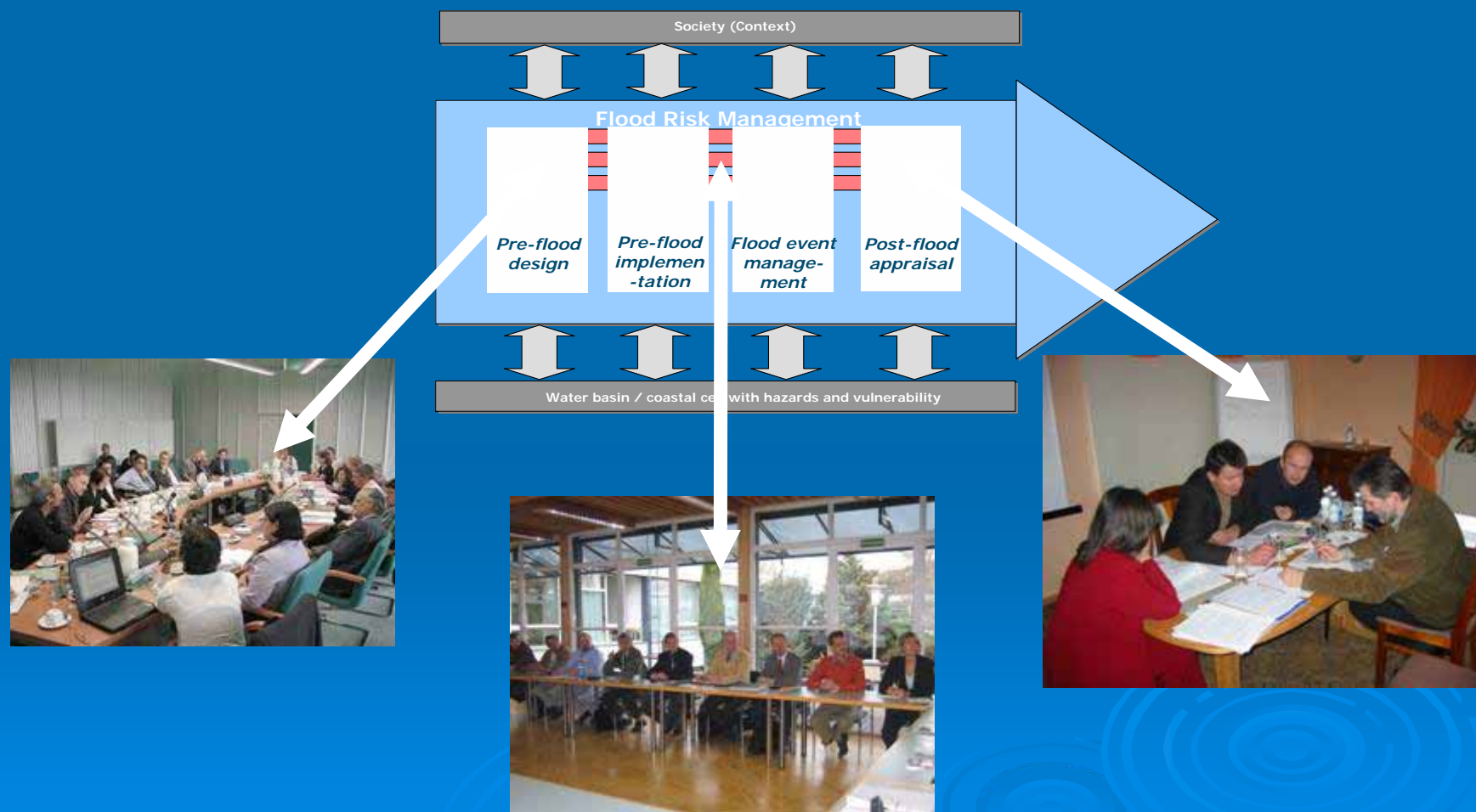


Mulde DSS

FLOODsite Pilot Study "Elbe River Basin"



Testing the applicability of the framework and the methodology in a series of workshops with practitioners





Moldawa River pilot area

Objectives

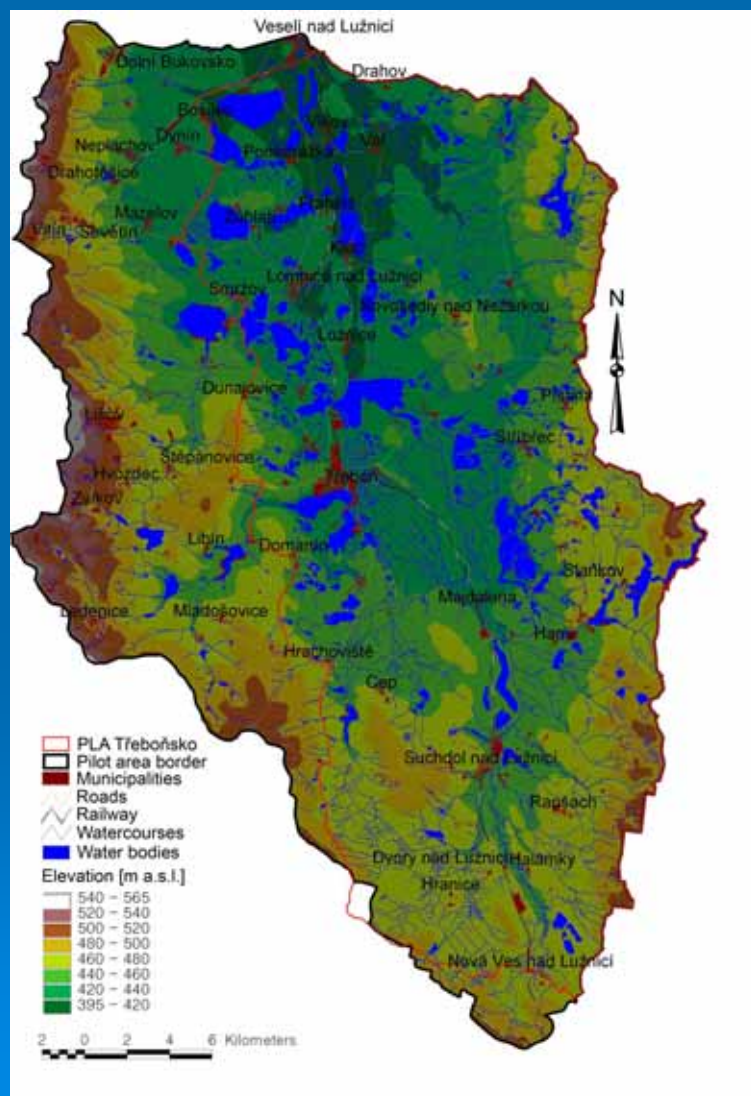
- ▶ To analyse the impacts land-use change on the flood occurrence
- ▶ To assess the **ecological vulnerability**

Approach

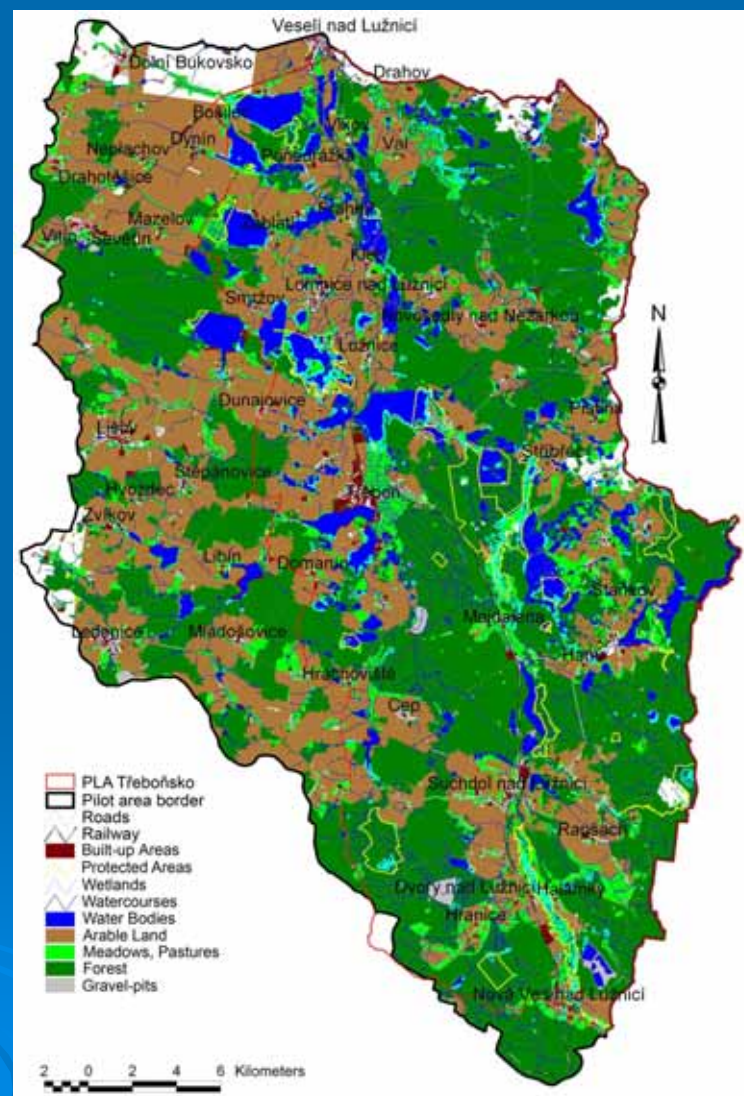
- ▶ Land-use changes analysis based on historical and current data
- ▶ Assessment of the **detention capacity**
- ▶ **Ecological vulnerability assessment** based on carefully selected factors such as protected territories, flooded areas or arable land



Moldawa River pilot area



Zikmund & Kodrova (2006)



Zikmund & Kodrova (2006)



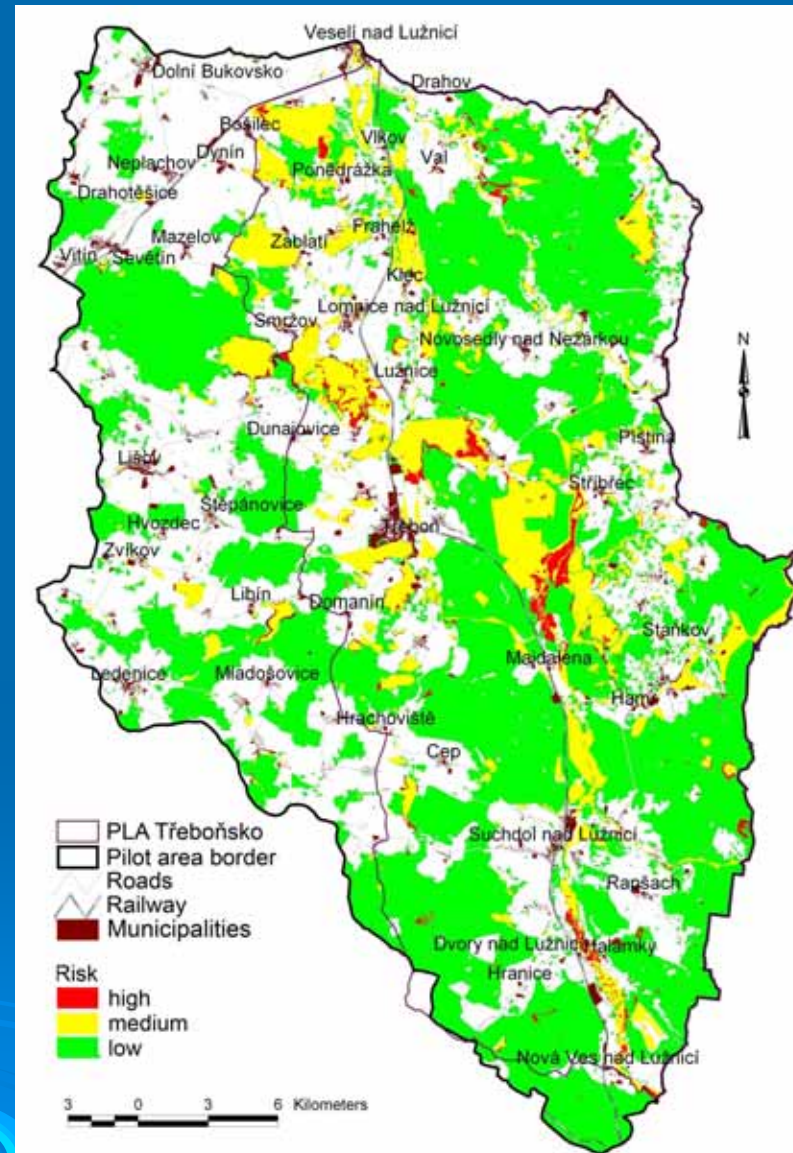
Moldawa River pilot area

Results of risk analysis

- Ecological risk

Approach

- Hazard analysis
- Analysis of ecological vulnerability
- Risk analysis by overlay





Partner involvement

- ▶ Dresden Flood Research Center (D-FRC)
 - Leibniz Institute of Ecological and Regional Development (IOER)
 - Dresden University of Technology (TU Dres)
 - UFZ Environmental Research Centre Leipzig-Halle (UFZ)
- ▶ University of Potsdam (UniPdam)
- ▶ GEO Group (Geo)
- ▶ University of Prag (LERMO)
- ▶ Other partners of FLOODsite (e.g. exchange of models)



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rimax Research Project

Change and Management of Risks due to Extreme Flood Events in Large River Basins – the Example of the Elbe River (VERIS-Elbe)

Duration 7/2005 – 08/2008

Coordination: Dr. Jochen Schanze, IOER

Consortium:

Leibniz Institute of Ecological and Regional Development (IOER)

Technische Universität Dresden (TUD)

Bundesanstalt für Gewässerkunde (BfG)

in cooperation with

European Commission, DG Joint Research Center (JRC),
D-FRC, PlanEVAL and Plan+Risk Consult



Research Questions

1. How may risks of extreme floods be **holistically simulated with a high spatio-temporal resolution** on the scale of large river basins? (Methodology)
2. How do flood risks, flood vulnerability, and damage expectancy values alter through **changing natural and societal conditions** as well as through strategic alternatives of **mitigation measures**? (Cause-effect analyses)
3. Which **socio-economic and ecological effectiveness** and comparable cost-efficiency do the strategic alternatives of mitigation measures show and which **instruments** can support their implementation? (Evaluation, implementation instruments)



Spatial reference

Whole catchment

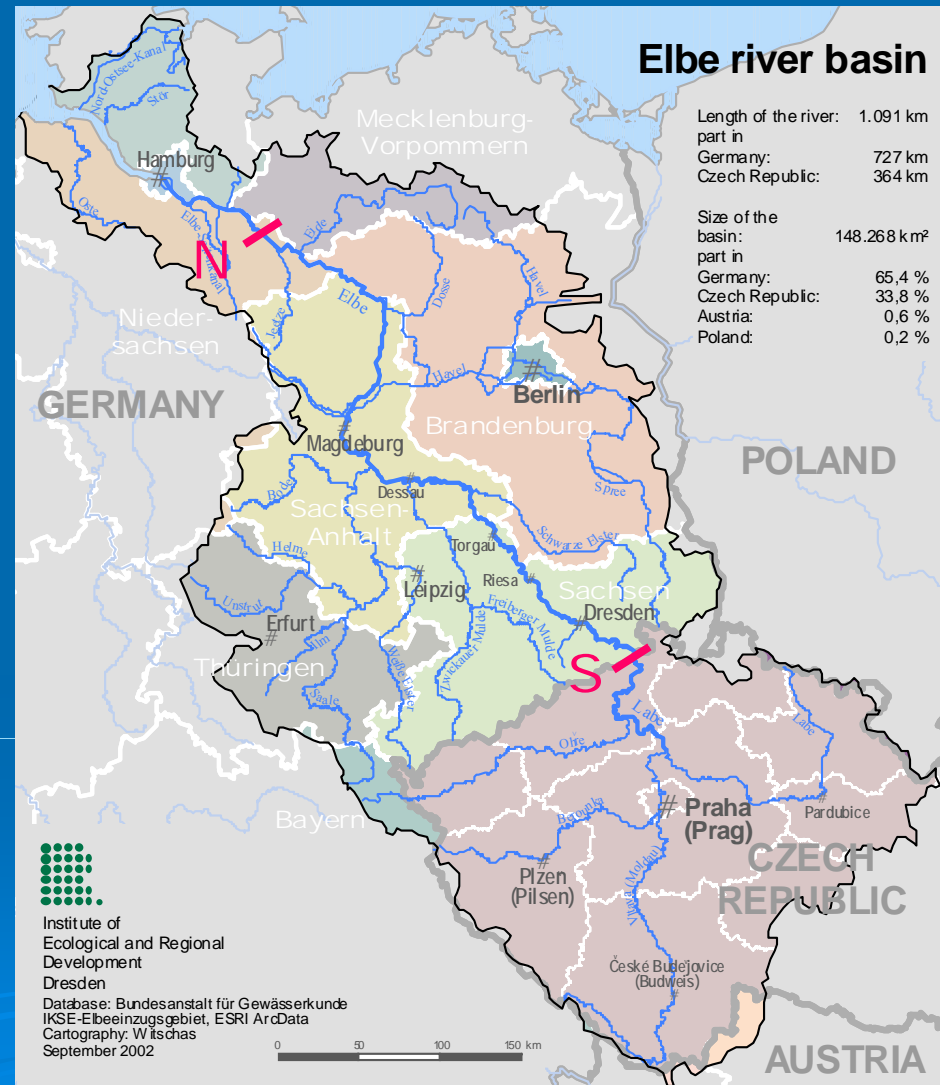
- ▶ Climate change projections (MPI M, GLOWA-Elbe II, Enke)
- ▶ LISFLOOD

German Elbe river floodplain

- ▶ all models
- ▶ all projections

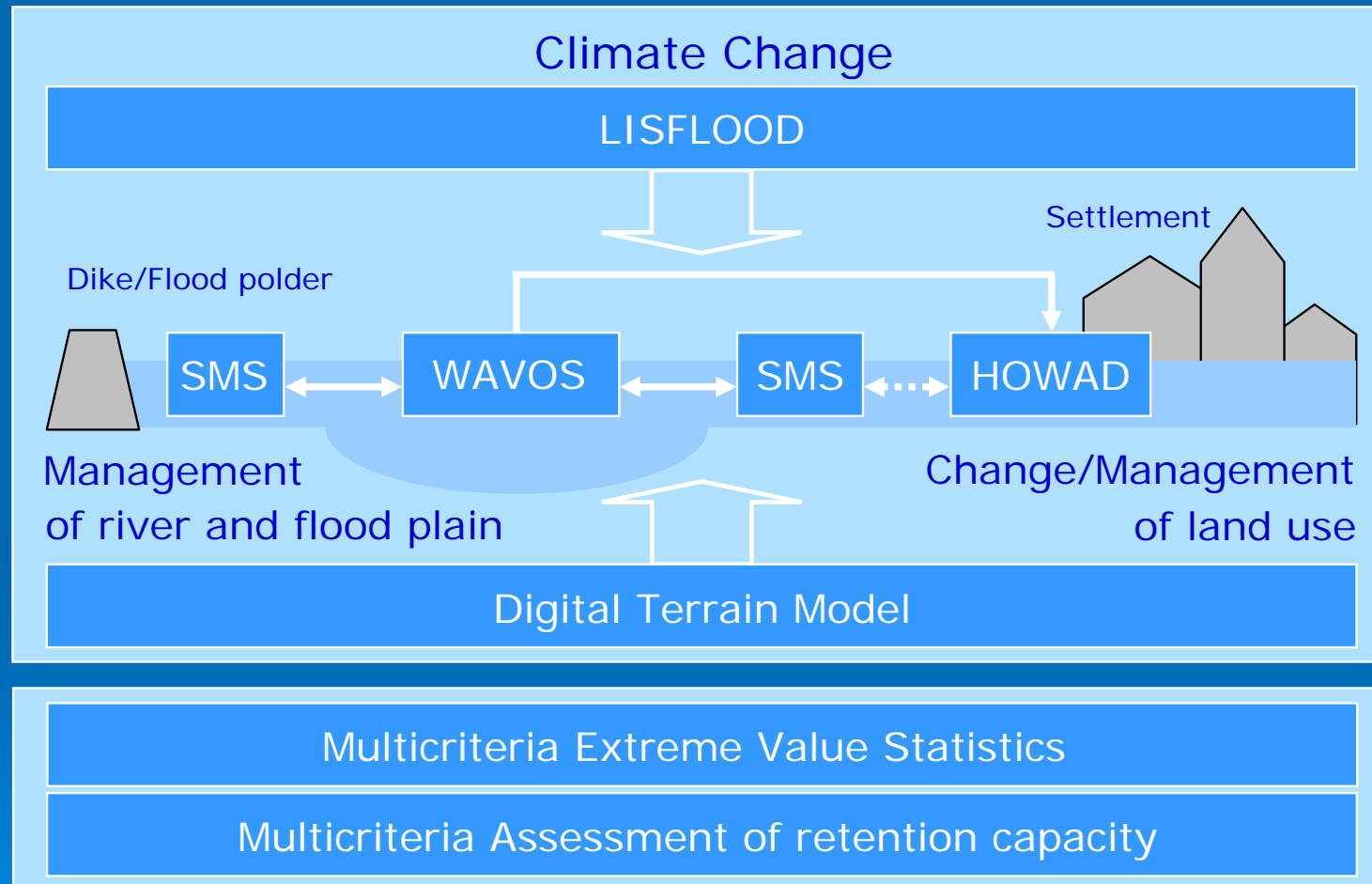
River section

- Gauge **S**chöna till
- Gauge **N**eu Darchau





Model system to simulate the flood risk system



Explanation: HOWAD – Flood Damage Simulation Model, LISFLOOD – Rainfall-Runoff Model, SMS – 2D-hydrodynamic-numerical Surface Water Modelling System, WAVOS – Water Level Prediction System

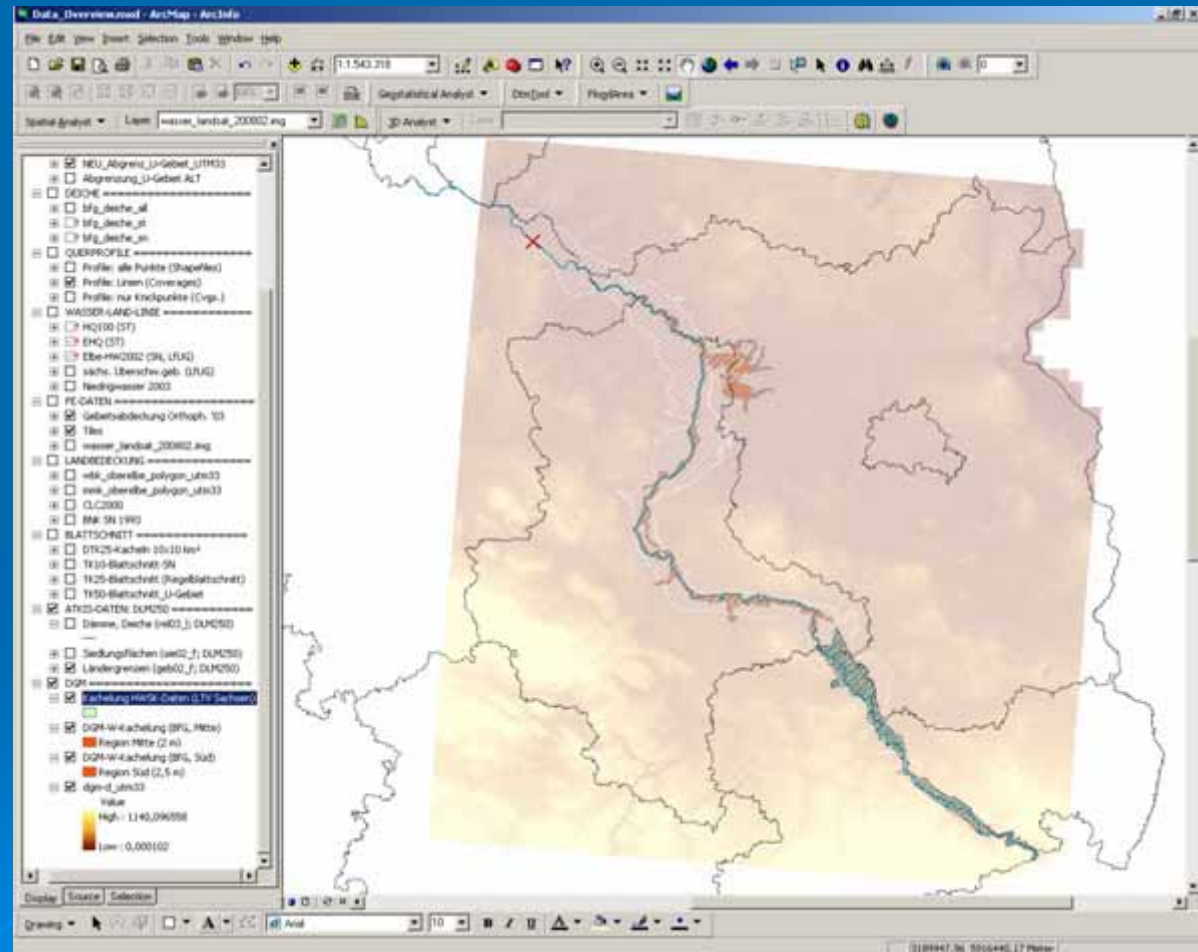


VERIS-Elbe – DTM availability

DTM coverage of study area

- DGM-D
(ATKIS:
25 m Raster)
- DGM-W
(BfG: Laser Scan
2 m (middle)
2.5 m (south))
- HWSK data
(LTV: Laser Scan
2 m Raster)

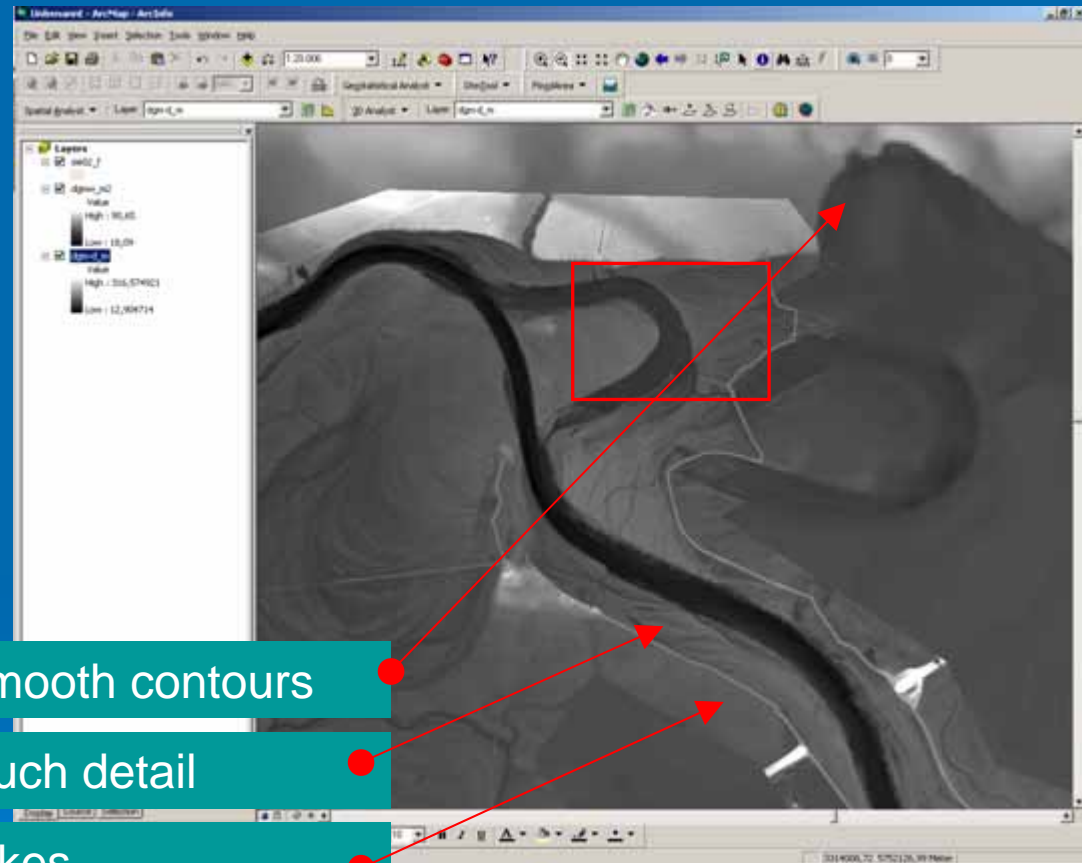
Krüger (2006)





DTM comparison

- ▶ DGM-D (ATKIS)
25 m Raster
- ▶ DGM-W (BfG)
2-2.5 m Raster
- ▶ HWSK (LTV)
2 m Raster



DGM-D: Smooth contours

DGM-W: Much detail

DGM-W: Dikes

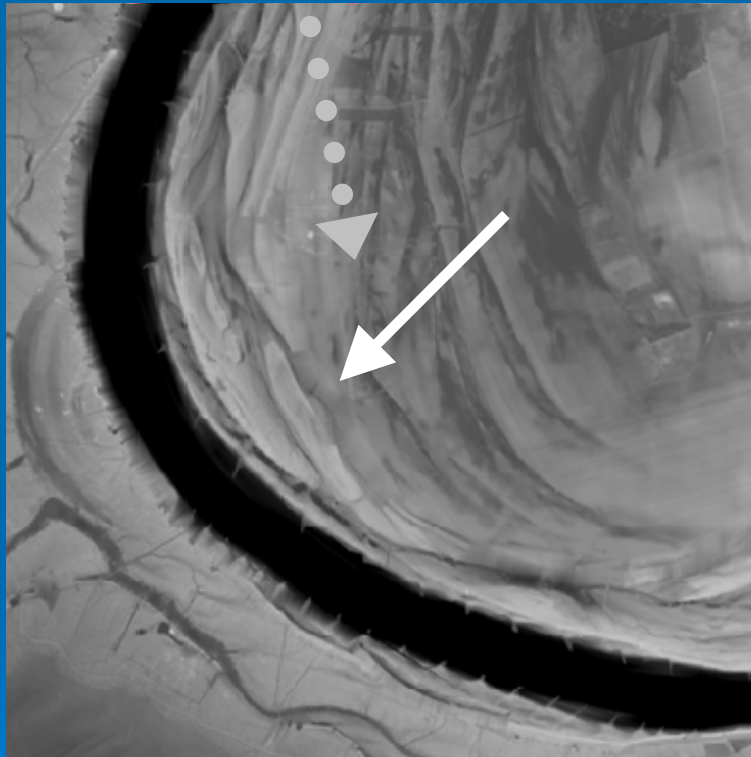
Krüger (2006)



Dike detection and extraction

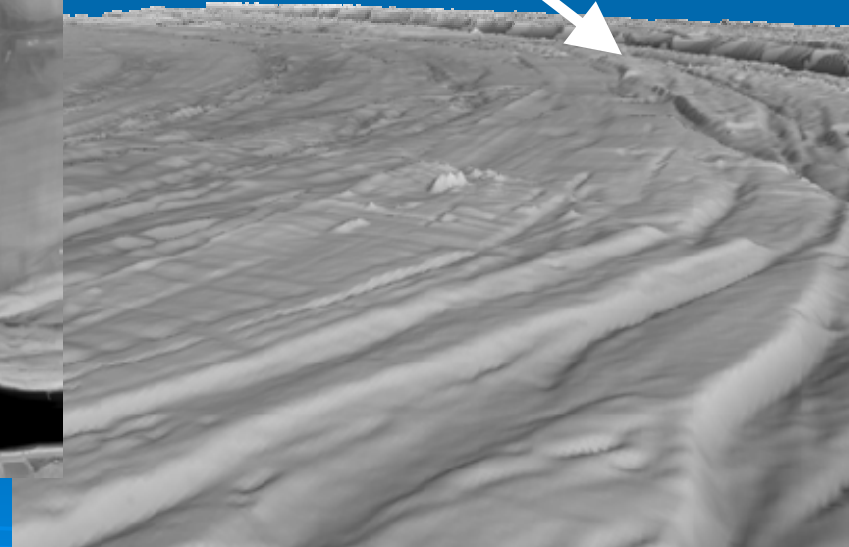
Software module for analysing / editing DTM

- Dike detection, dike extraction, dike raising / dike moving
- DTM intersection of water levels
- Identification of potential retention areas



DTM cutout

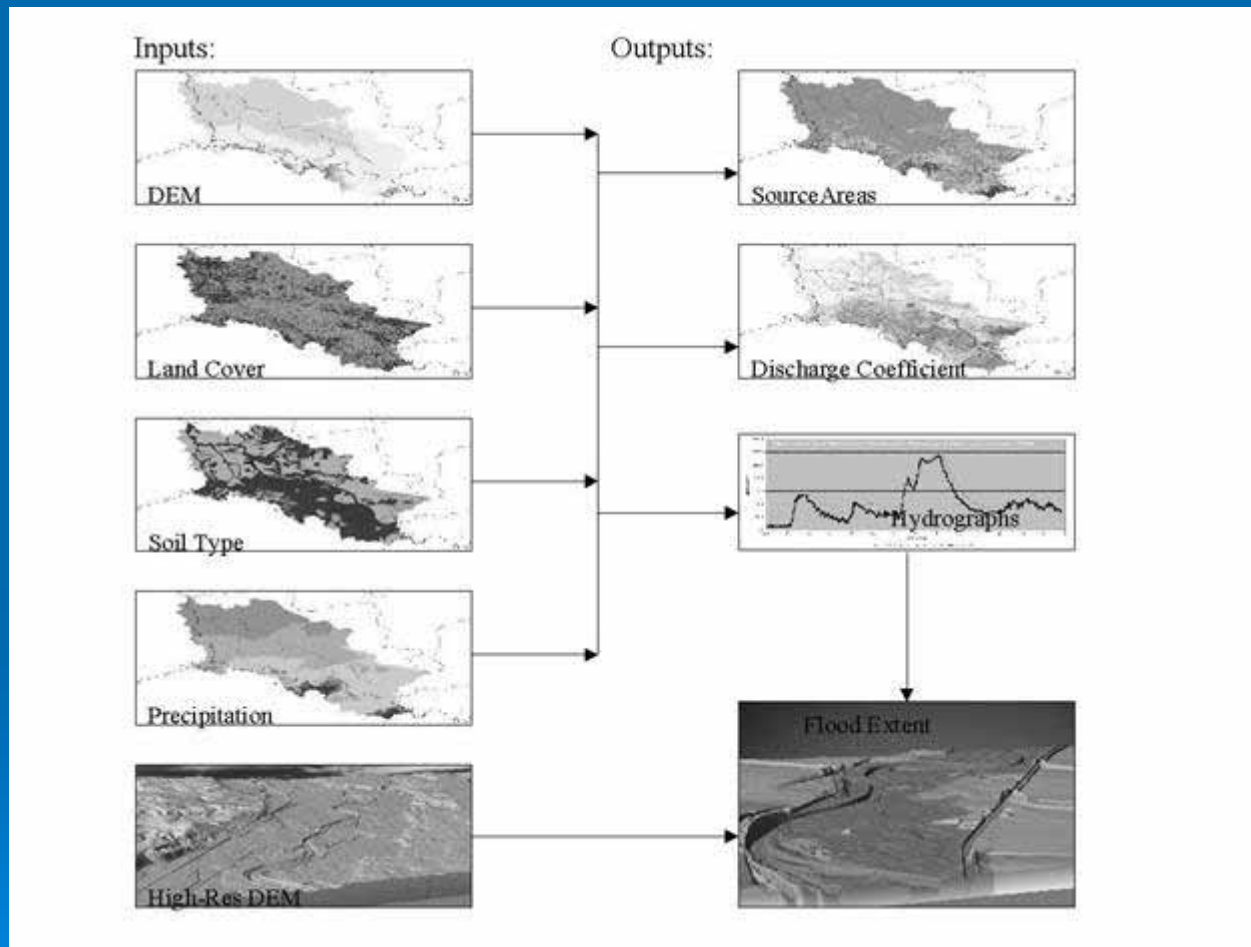
Krüger (2006)



Perspective view
heights by factor 10



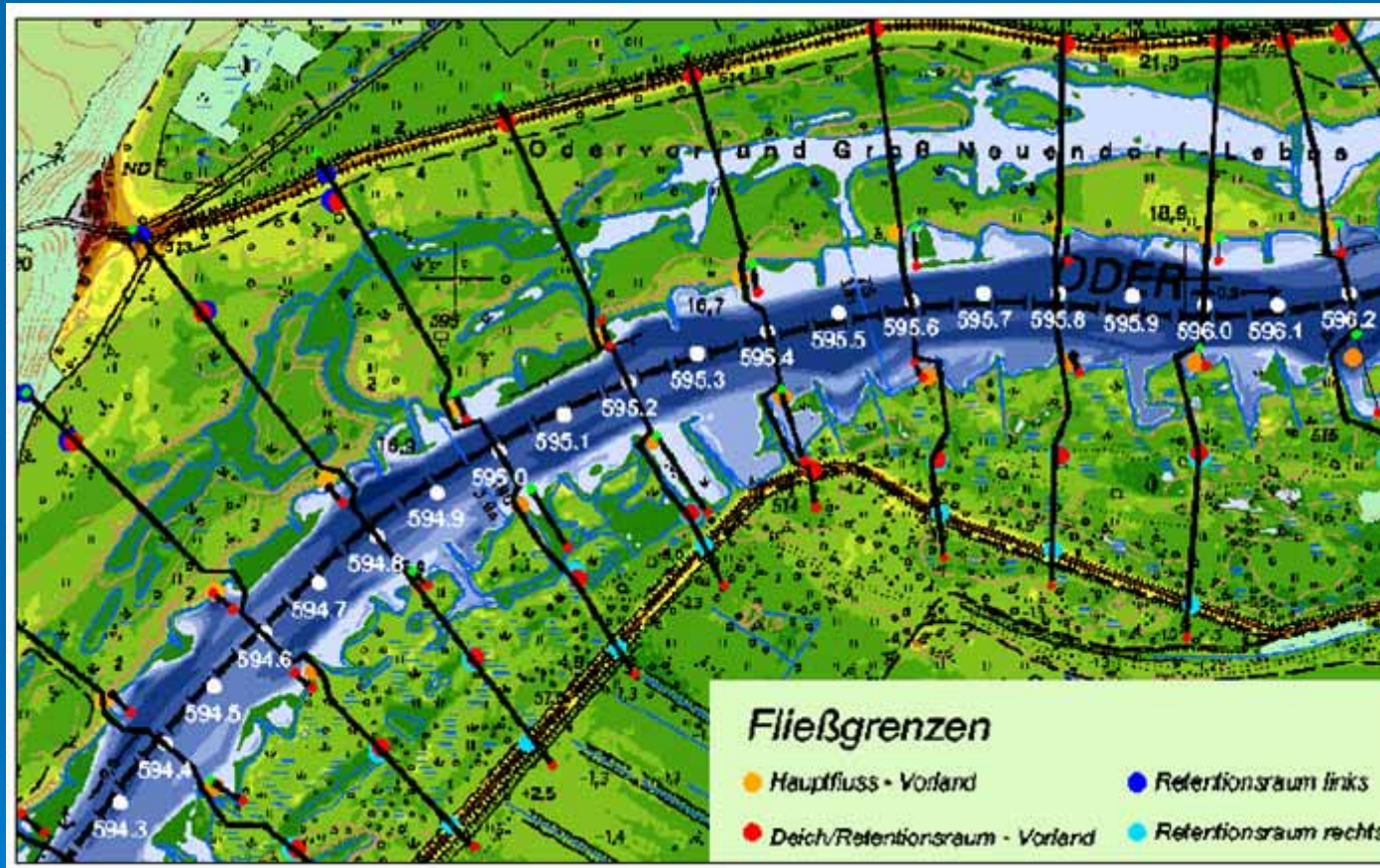
Transnationale flood simulation model LISFLOOD (JRC)



De Roo (2003)



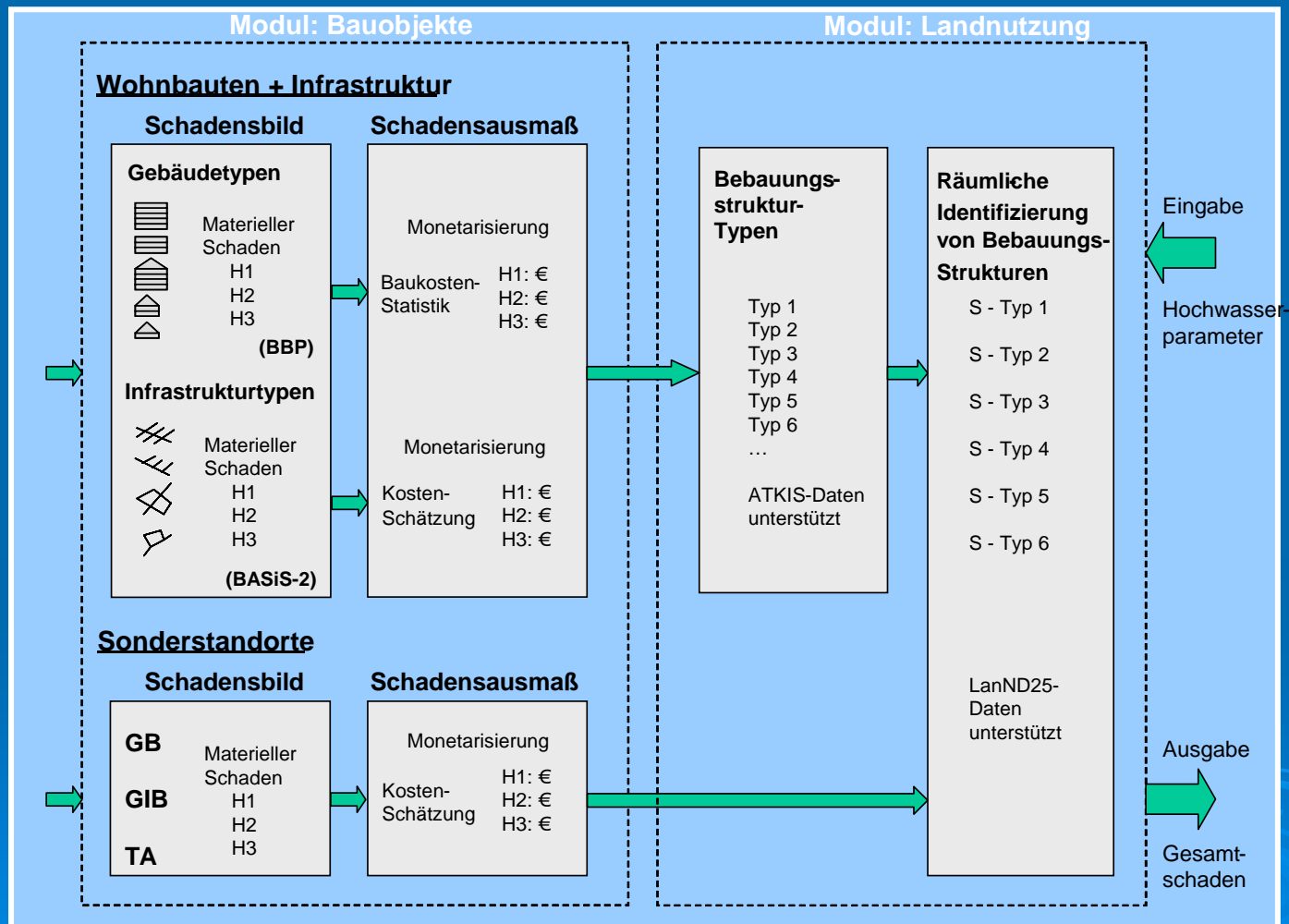
Wasser level forecasting model WAVOS (BfG)



Quelle: Rademacher (2002)



Flood damage model HOWAD (IOER)

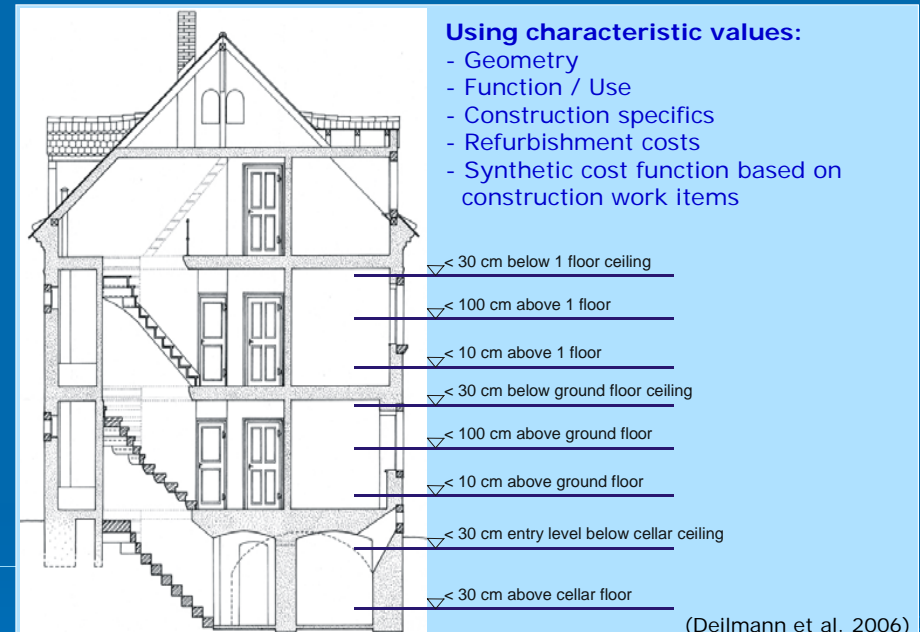




High resolved vulnerability modelling (HOWAD)



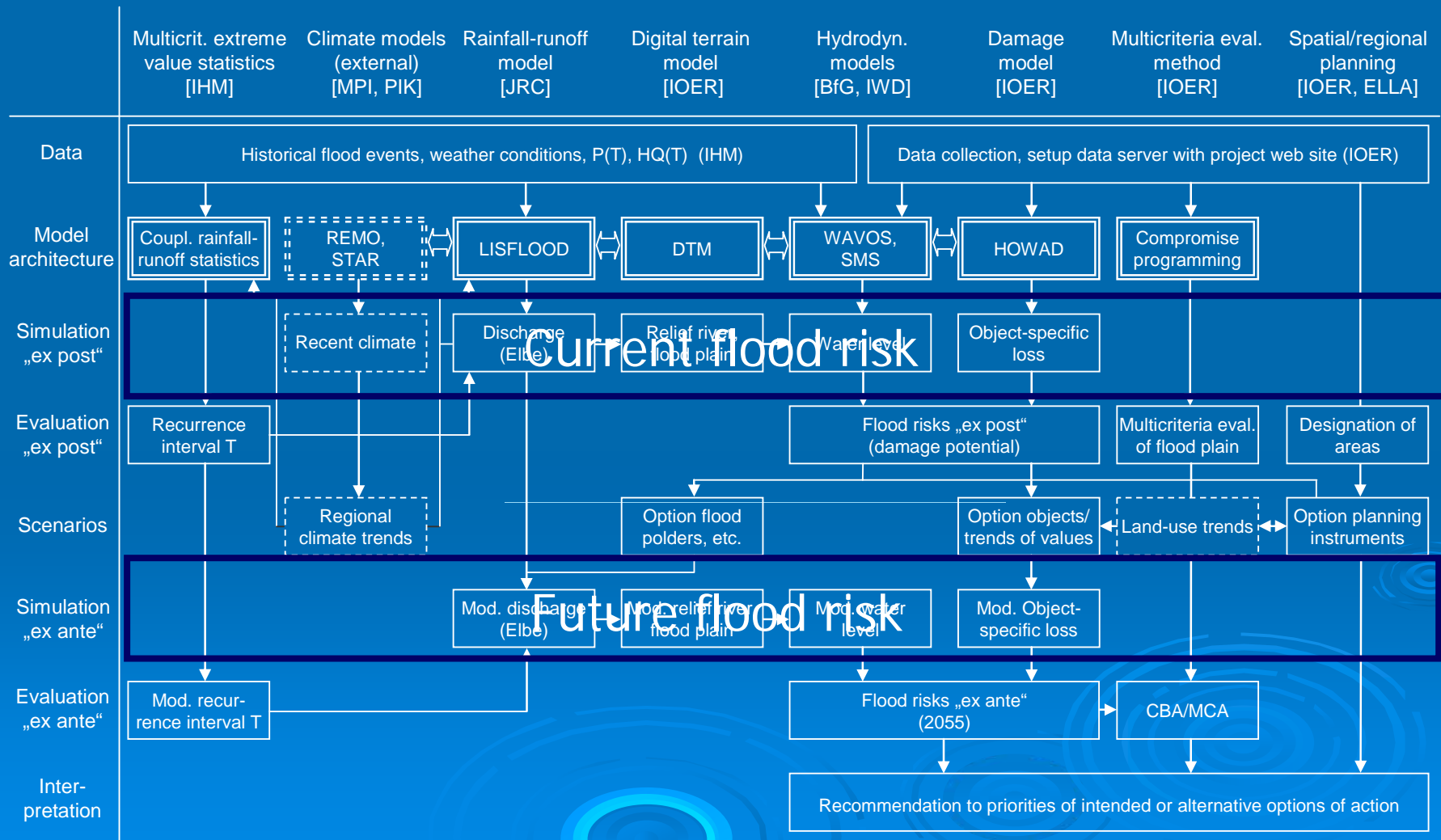
(Deilmann & Hennersdorf 2006)



(Naumann & Deilmann 2006)



Overview of the methodological approach to simulate the current and future flood risk system (VERIS-Elbe)





Areas of exploration of futures for the Elbe River Basin

Trends (selection):

- ▶ Climate change based on various downscaling methods (REMO, STAR, Method Enke).
- ▶ Land-use change due to EU- and national policy, demographic trends etc
- ▶ Economic development

Risk reduction options (selection)

- ▶ Flood polders, dike relocation etc (flood prevention and defence)
- ▶ Planning restriction for land-use development (risk mitigation)
- ▶ Adaptive building construction (resilience)



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Probable interfaces with the International Commission for the Protection of the Elbe River

- ▶ FLOODsite could show how a methodology for an integrated flood risk management looks like
- ▶ FLOODsite moreover elaborates some examples of the applicability of the methodology with concrete results
- ▶ VERIS-Elbe is further detailing the FLOODsite approach and is testing it for the German Elbe River floodplain
- ▶ VERIS-Elbe provides a lot of direct applicable results (e.g. DTM)
- ▶ VERIS-Elbe uses a model system for simulation and applies it for the ex-ante analysis of long-term scenarios
- ▶ Especially VERIS-Elbe but also FLOODsite would appreciate a intensive exchange with the ICPE (e.g. scenarios formulation)
- ▶ Maybe there could be a joint way of enhancing the VERIS-Elbe approach to the whole transnational Elbe river basin



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Outlook and Conclusions

- ▶ FLOODsite Elbe river pilot currently realized **50 % of the overall work**
- ▶ VERIS-Elbe has recently passed **year one of the 3 years programme**
- ▶ Both projects will provide 2 international examples for a **holistic and continuous flood risk management**
- ▶ They also provide the basics for the **implementation of the upcoming Flood-Directive**
- ▶ Especially VERIS-Elbe may be used by the ICPE **to estimate future flood risks and to ex-post evaluate the effectiveness of the previous action programme** at the Elbe river



Acknowledgement

- ▶ The IP FLOODsite are funded by the European Commission under the 6th EU Framework Programme (EC Contract-No. GOCE-CT-2004-505420).

www.FLOODsite.net

- ▶ The VERIS-Elbe research project of the German RIMAX Programme funded by the BMBF.

www.VERIS-Elbe.ioer.de





Announcement

European Symposium on Flood Risk Management Research

International Congress Centre Dresden
6 – 7th February 2007 in Dresden, Germany



Thank you for your Attention.



Dresden Flood Research Center