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GLOWA Danube

Actual status of DSS – Developments in central Europe - Neckar and Danube River Basins

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Outline

1. **Research Catchments and Projects :**

   Upper Danube Catchment: **GLOWA-Danube** (BMBF)

   Neckar Catchment: **RIVERTWIN** (EC)

2. **Water Resources Management Tasks in Southern Germany**
   - Decisions that have to be supported → DSS objectives

3. **Integration Approaches and DSS Design**
   - **DANUBIA DSS**: GLOWA-Danube
   - **MOSDEW DSS**: RIVERTWIN

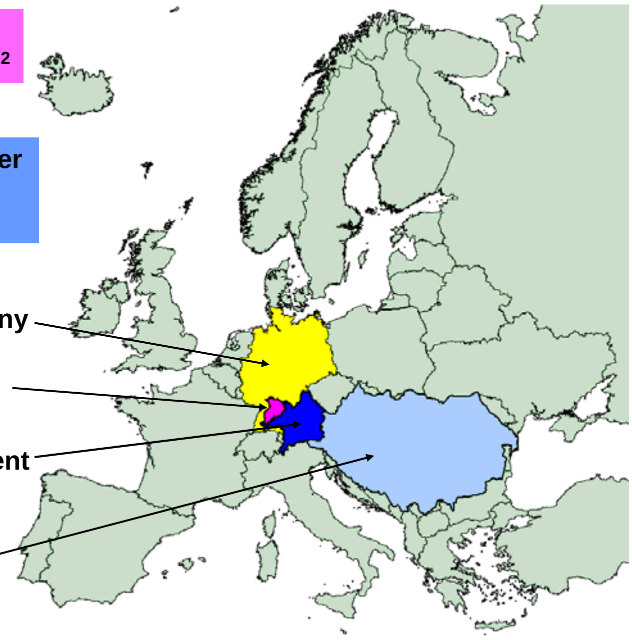
4. **Status and Results**

5. **Lessons Learned and Outlook**

Projects and Catchments

RIVERTWIN: Neckar Catchment, 14,000 km²

GLOWA-Danube: Upper Danube Catchment, 77,000 km²



Germany

Neckar Catchment

Upper Danube Catchment

Danube Catchment (~800,000 km²)

Global Change of the Water Cycle – GLOWA www.glowa.org

German Collaboration in Global Change Research

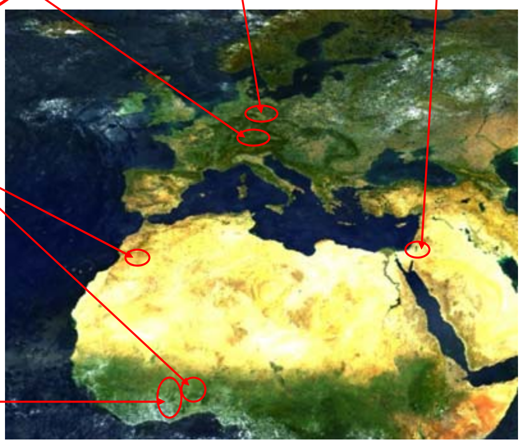
GLOWA-Danube
Integrative Techniques, Scenarios and Strategies for the Water Cycle in the Danube Watershed

GLOWA-Elbe
Global Change Impact on Environment and Society in the Elbe Region

GLOWA-Jordan
Global Change and the Integrative Water Resources Management in Arid Regions

IMPETUS
An Integrated Approach to The Efficient Management of Scarce Water Ressources in West Africa

GLOWA-Volta
Sustainable Water Use, Changing Land Use, Rainfall Reliability and Water Demands In the Volta



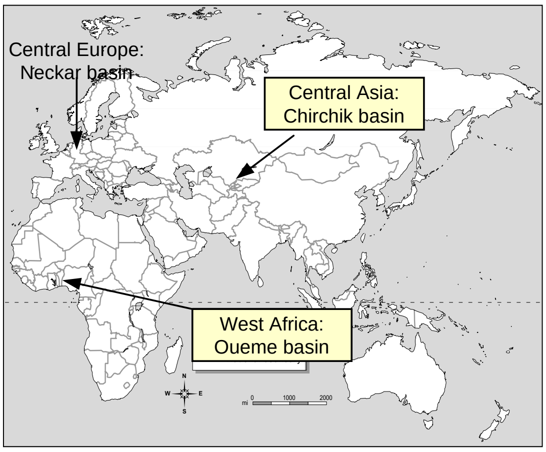
GLOWA-Danube (www.glowa-danube.de): Summary

- **Consequences of Global Change in the Upper Danube Catchment** (Water Supply, Land Use, Agriculture, Economy, Tourism ..)
- **Decision Support System 'DANUBIA'**, comprised of 16 **fully** coupled individual models
- **Integrated / Interdisciplinary Approach:** 12 research groups from different disciplines (Meteorology … Tourism Research)
- **Subproject Groundwater and Watersupply at Stuttgart:**
  - Groundwater flow model plus a module for Nitrogen Transport
  - Watersupply and –distribution model

RIVERTWIN (www.rivertwin.org)

'A Regional Model for Integrated Water Management in Twinned River Basins'

- Apply the principles of the **European Water Framework Directive** (WFD) to other continents.
- Develop the **integrated water and land use management tool** MOSDEW



- **Three research basins:**
  - **Neckar** basin (Germany);
  - **Ouémé** basin (Benin);
  - **Chirchik** basin (Uzbekistan).

11 Partners, 6 Countries

Project Overview

	RIVERTWIN	GLOWA-Danube
Funding	European Commission	German Ministry of Research and Education
Duration	01.03.2004 to 28.02.2007: **3 years**	01.01.2001 to 30.04.2010: **9 years in three phases**
Budget	~ 3 Million Euro	~ 16 Million Euro
Partners	6 (Neckar only)	12
Scientists	~ 15 (Neckar only)	~ 40
Stakeholders / Administration	Included in DSS development from the beginning	Included in DSS development at a later stage (first results)
Overall Objective	Research **and** Development of practical tools	Research mainly: Advanced DSS Technology

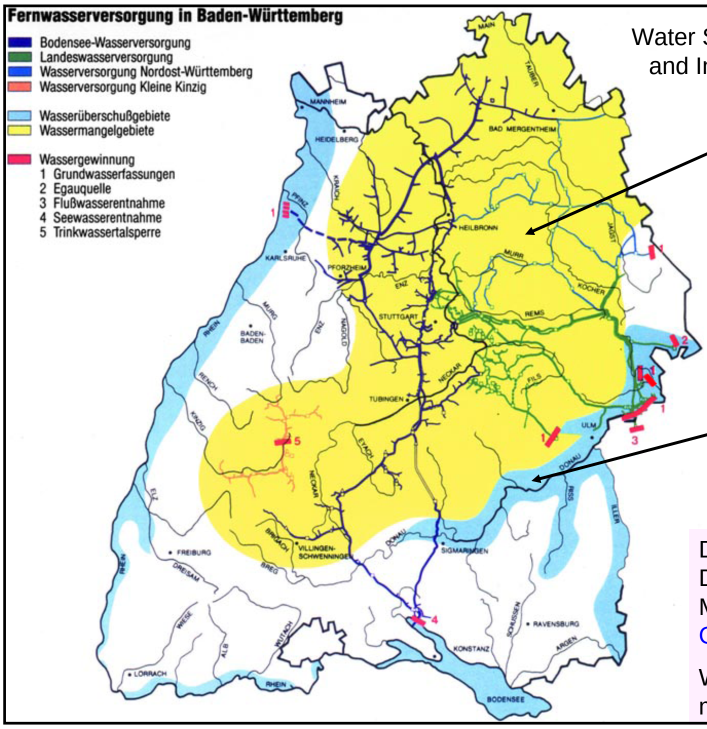
Catchment Overview

	Neckar Catchment	Upper Danube Catchment
Area	**14.000km²**	**77.000km²**
Population	**~ 5 Mio. - 360/km²**	**~ 8.2 Mio. - 100/km²**
Economy	**Highly industrialized and urbanized**	**Less urbanized but still a lot of industrie**
Temperature	**8.7°C**	**~7°C**
Precipitation	**~950 mm/a)**	**~1100mm/a**
GW Recharge	**240 mm/a**	**300 mm/a**
Landuse	Agriculture* 54%, Forestry 36%, Settlement 10%	Agriculture 55%, Forestry 28%, Settlement 12%, Rocks, Glaciers: 5%

*** Agriculture: less than 2% of GDP**

Management Tasks

	Neckar Catchment	Upper Danube Catchment
% of available Water used	**15 to 20 %**	4 to 5 %
Groundwater as source of drinking water	~ 55%	**~90%**
Regions of water scarcity (imports required)	**> 50%**	<10%
Groundwater quality	very good: 10%, good 50%, **poor 40%**	very good: 50%, good 40%, poor 10%
Experienced water related issues	• regional **quality problems** (ground- and surface water) • regional water scarcity • Floods & **draughts** in rivers • Surface water ecology	• Water availability and quality generally good • Local quality problems • floods



Water Supply Infrastructure and Inter Basin Transfer

demand > availability

highly productive aquifers

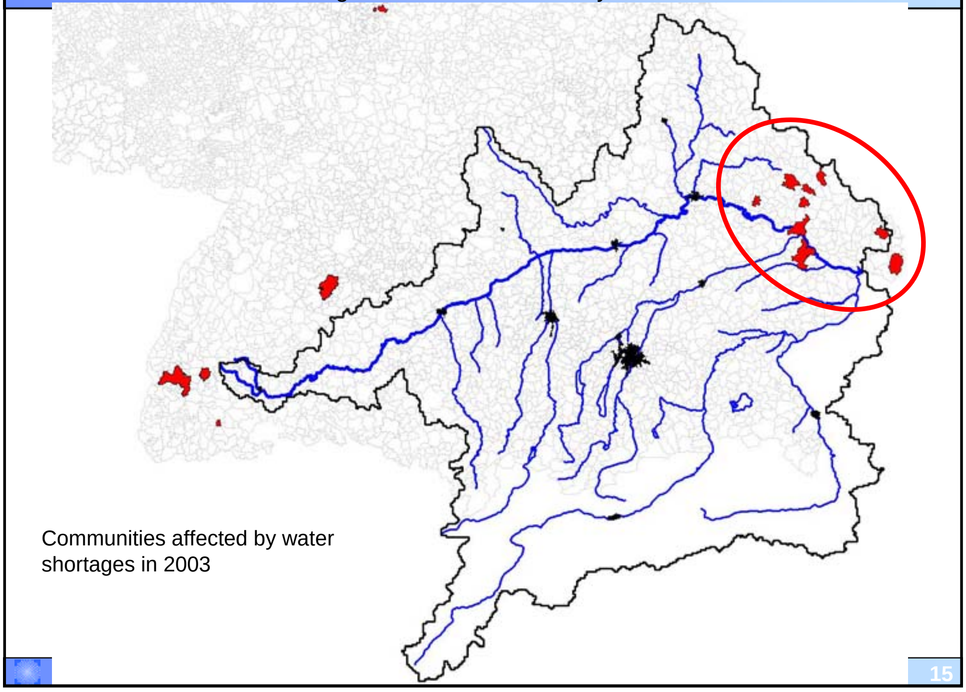
Drinking Water Demand (1998): 700 Mio m³/a (~ 8,5% of GWR) (LfU,2002)

Water Import: ~120 Mio m³/a (Emmert, 1999)

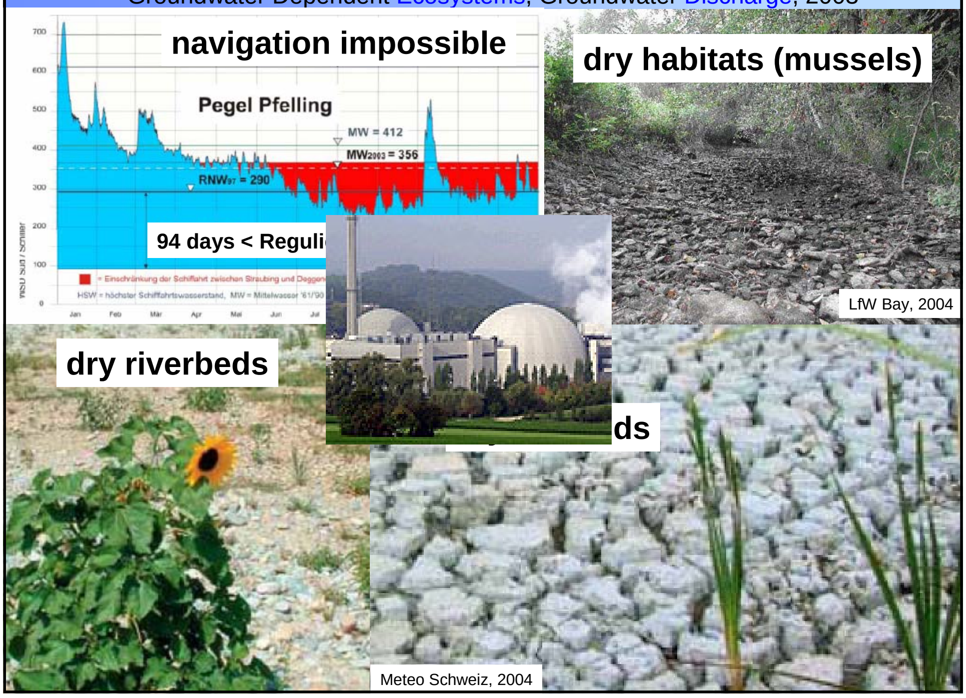
Why DSS and Integrated Water Resources Management in Southern Germany?

- Densely populated Regions
  - All Interventions affect a large number of people and can potentially cause high damages
- How to meet the objectives of the **European Water Framework Directive**?
  - which interventions are necessary and effective?
- Conflicts between different stakeholders (Water Supply, Ecology, Agriculture, Industry)
  - how to solve and avoid them?
- Increasing number of floods experienced in the last decades
  - what will be the impacts of further climate change?
  - how to prevent such events and how to protect people?
- Draughts
  - a relatively new but alarming issue
  - ecology, navigation, energy production: hydropower and **nuclear power plants**,

Water Shortages in Southern Germany in Summer 2003



Groundwater Dependent Ecosystems, Groundwater Discharge, 2003

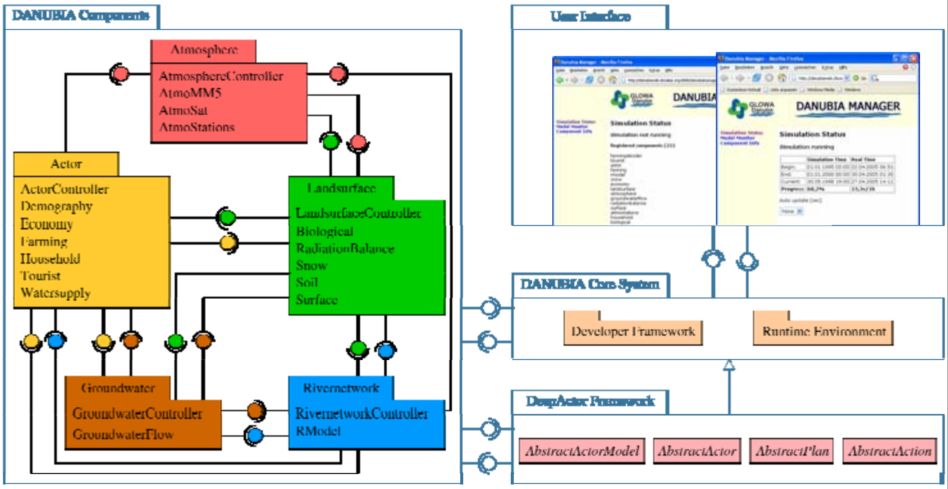


Integration Approaches and DSS Design

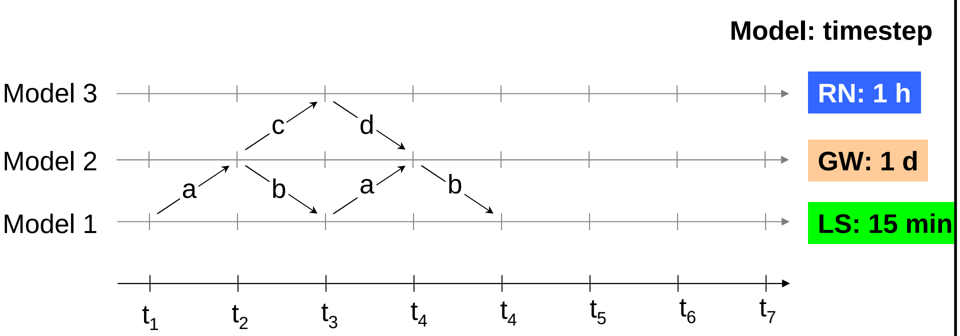
DSS Overview

	RIVERTWIN	GLOWA
Integrated model / DSS	**MOSDEW**	**DANUBIA**
Sectors	Water, Landuse, Economy	Water, Landuse, Economy
Emphasis	Agriculture / Landuse, River Ecology	Hydrology, Water Supply (Tourism)
DSS Type	**GIS based Expert system**	**Model based**
Number models included	**10**, 2-3 socioeconomic	**16**, 6 socioeconomic models
Coupling scheme	**lose coupling** via data sets	**fully coupled** at run-time
Application = Scenario based	Climate, Socioeconomic, Interventions	Climate only (until now)

GLOWA-Danube DANUBIA



Model Coupling: 1) “strong” coupling **(GLOWA-Danube)**



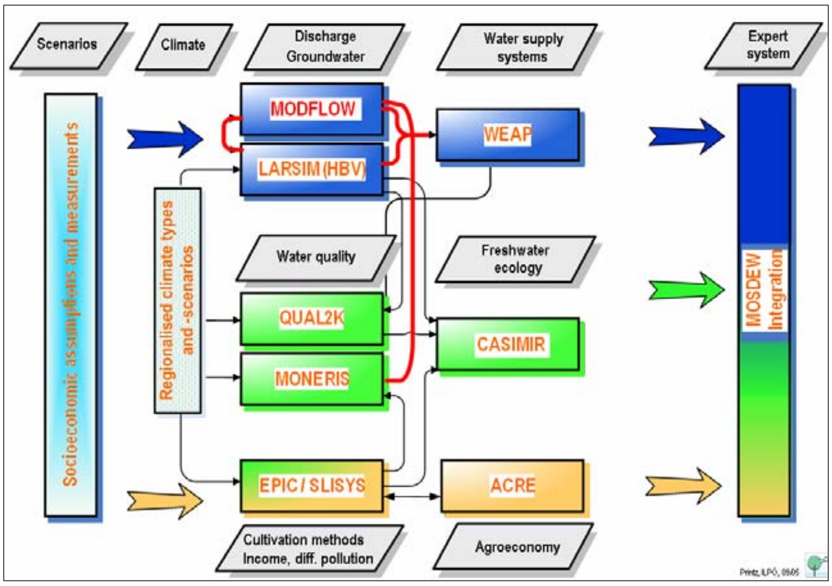
Models

1: LandSurface
2: GroundWater
3: RiverNetwork

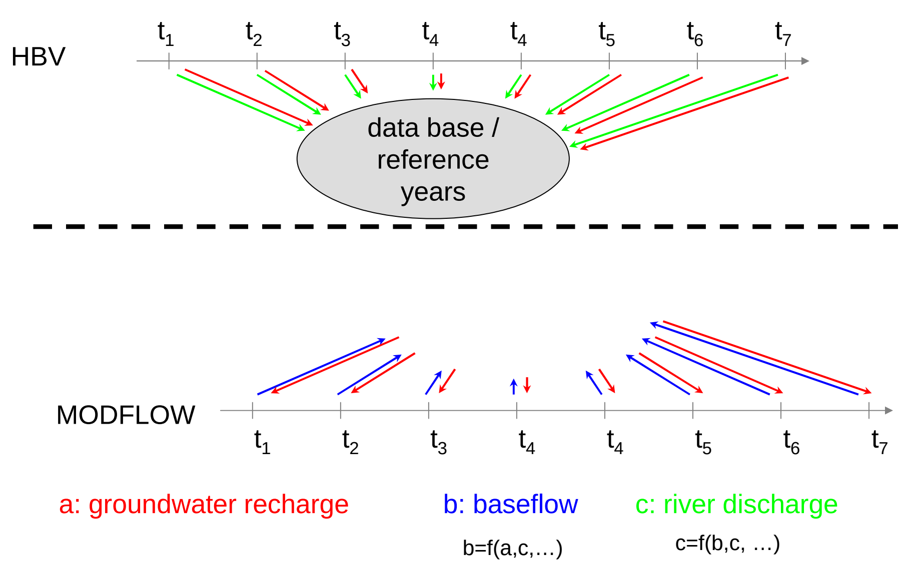
Variables

a: groundwater recharge
b: groundwater level
c: infiltration
d: river level

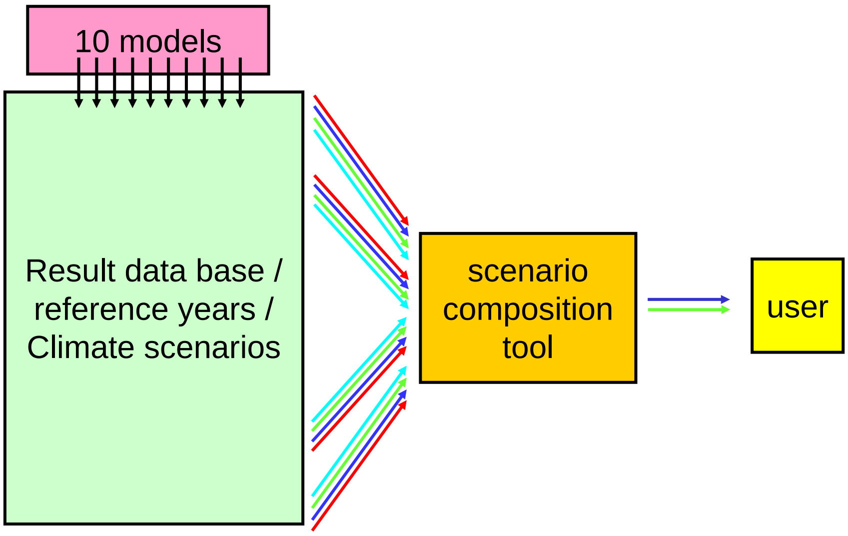
RIVERTWIN – MOSDEW integrated tool: Models and Scenarios



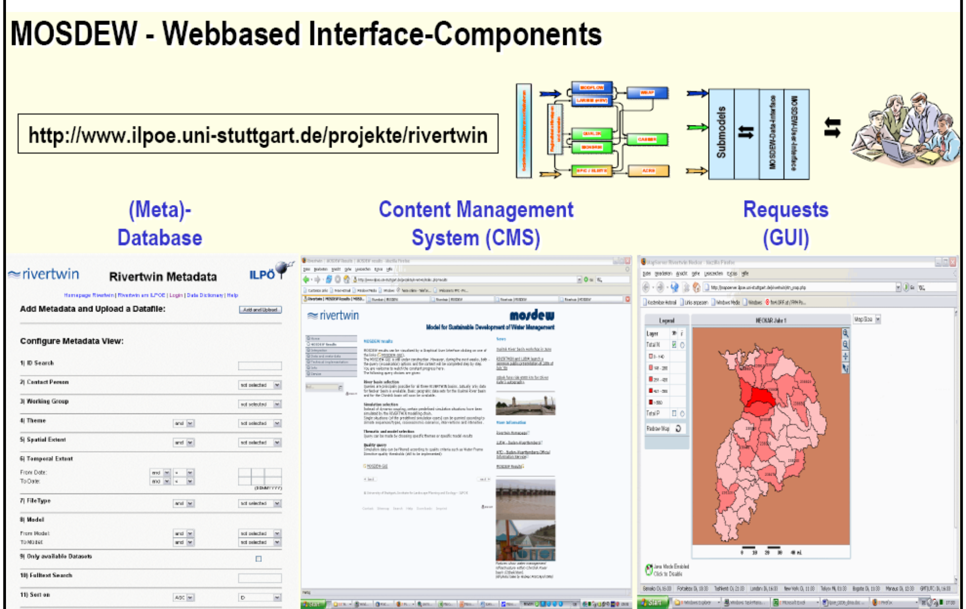
Model Coupling: 2) "weak" coupling RIVERTWIN



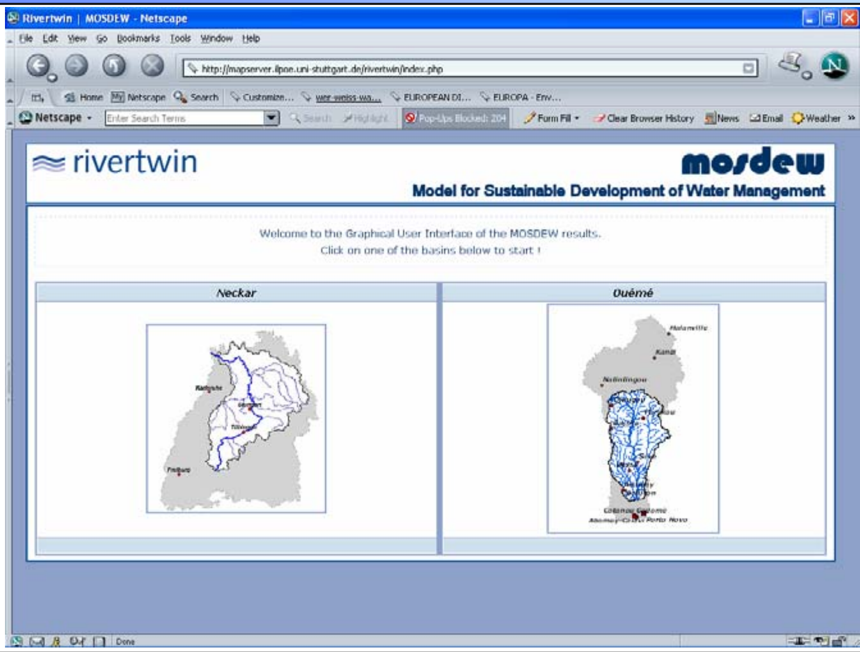
MOSDEW Integration Scheme and Workflow



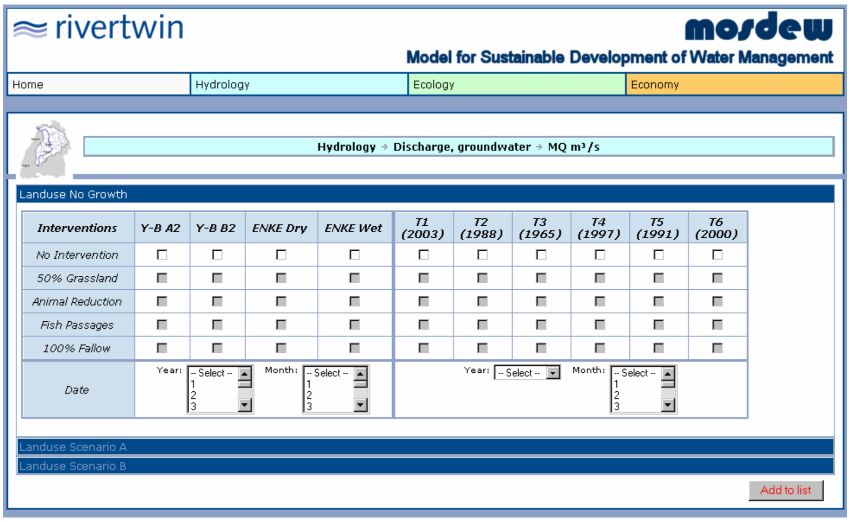
Using MOSDEW



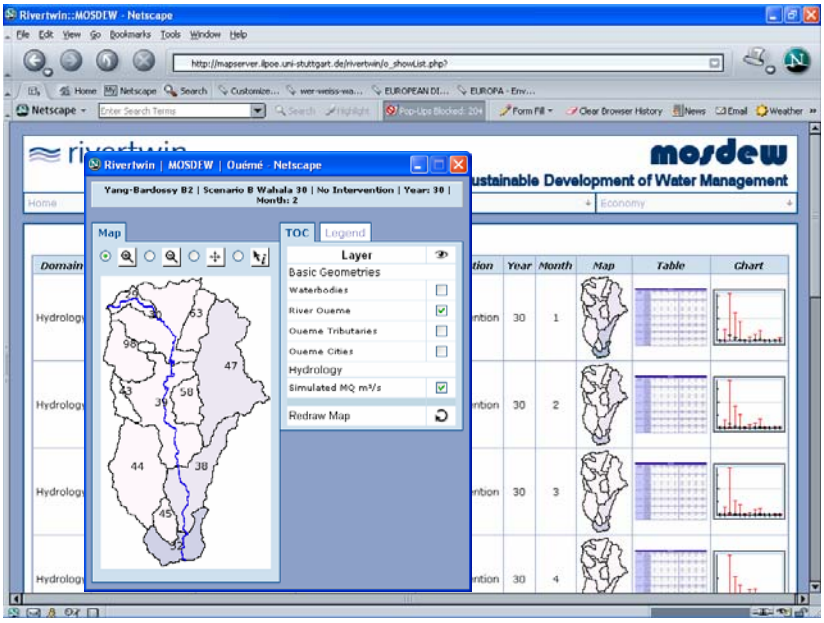
http://mapserver.ilpoe.uni-stuttgart.de/rivertwin/index.php



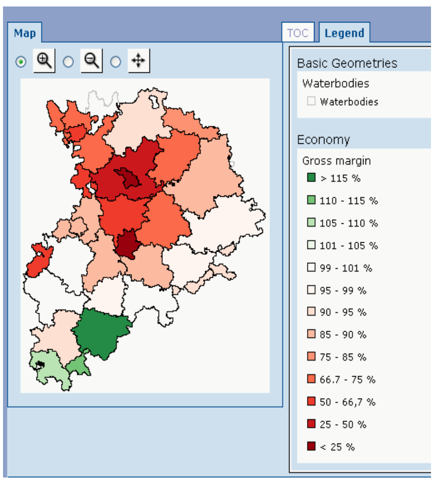
Scenario and Output Definition

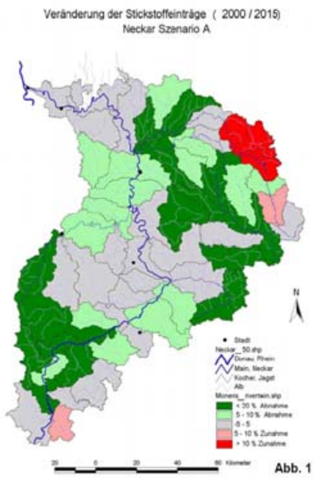


Open access to scenario results



Scenario A - 2015:
Change of total gross margin and diffuse N-pollution (river)





RIVERTWIN Status

- Project almost completed (Feb 2007)
- Web User Interface working online and partly filled with data
  - a huge number of results can be created based on different climatic and socio economic scenarios and interventions
- Open questions
  - many results are not fully validated yet (groundwater model)
  - acceptance of results by stakeholders not clear – are stakeholders really interested?
  - not all results are accurate enough to support decisions (groundwater levels)
  - **practical tests pending**
- Summary
  - in a relatively short time a user-friendly, robust tool was developed
  - whether it is good and useful enough to support decisions is unclear

GLOWA Status

- GLOWA-Danube Summary:
  - an extremely sophisticated modeling framework has been built
  - the system is working, yet it is not applicable in practice yet
  - Scenario definition and simulation has just started
  - Stakeholder involvement was limited until recently
  - three more years to go will hopefully be enough to make the necessary improvements

Conclusions

- Two decision support systems, one relatively simple, one relatively complex - which one is better?
  - The simpler one can provide results faster and it is easier to use
  - The simpler one can be transferred to other basins more easily
  - The more complex one can be used for more specific and more detailed analysis
  - The more complex one can be used to simulate processes more realistically

Conclusions

➔ **The question which is the better one depends on what you want to do with the system, therefore**

- Include stakeholders early to define the management problems and objectives of modeling clear enough
- Analysis your management tasks, data availability and other resources very carefully in order to find out which models to use, how complex the system must be and how simple it can be

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Thank your for your attention!

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Integrated participative communication process