Global Change in the Hydrological Cycle - GLOWA

A German Initiative for Integrative Research on Global Change

GLOWA is sponsored by:

- The German Ministry for Education and Research within its „Research for the Environment“ Programme
- The State of Nordrhein-Westfalen
- The Free State of Bavaria
- The State of Baden-Württemberg

GLOWA

Scientific Aim and Core Themes of GLOWA 2001 - 2010

From the call for proposals 2001:

GLOWA addresses the effects of Global Changes on regional water resources.

The aim of GLOWA is

- to develop integrated strategies
- for sustainable and far-sighted management of water, lakes and rivers
- at the regional level

taking account of ecosystem contexts and the socio-economic framework.

Pilot case studies are carried out in river basins (approx. 100,000 km²) to address core issues of global change in the hydrological cycle and to develop problem solving strategies.

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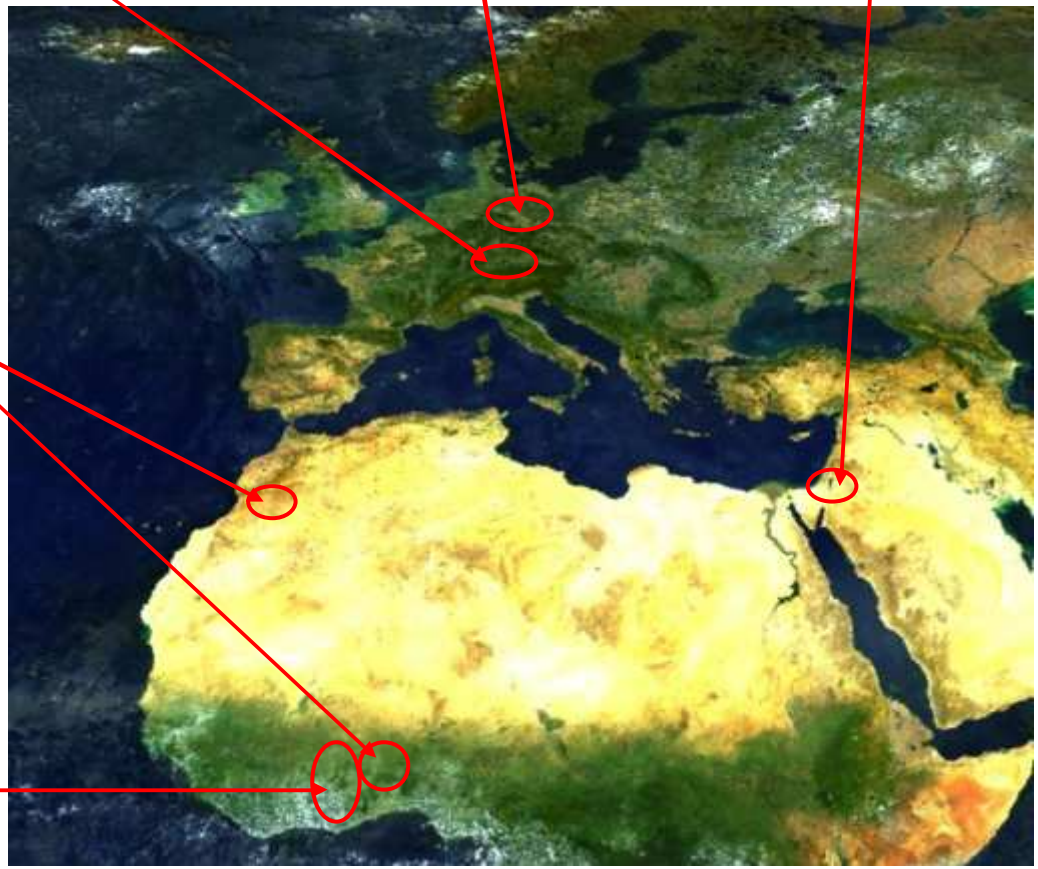
GLOWA - Pilot Projects

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 River
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

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GLOWA – Danube

Integrative Techniques, Scenarios and Strategies for the Future Management of Water in the Upper Danube Basin

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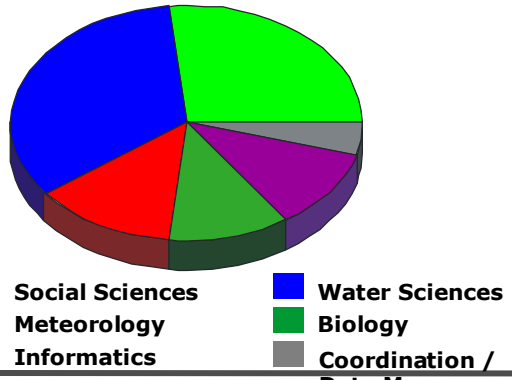
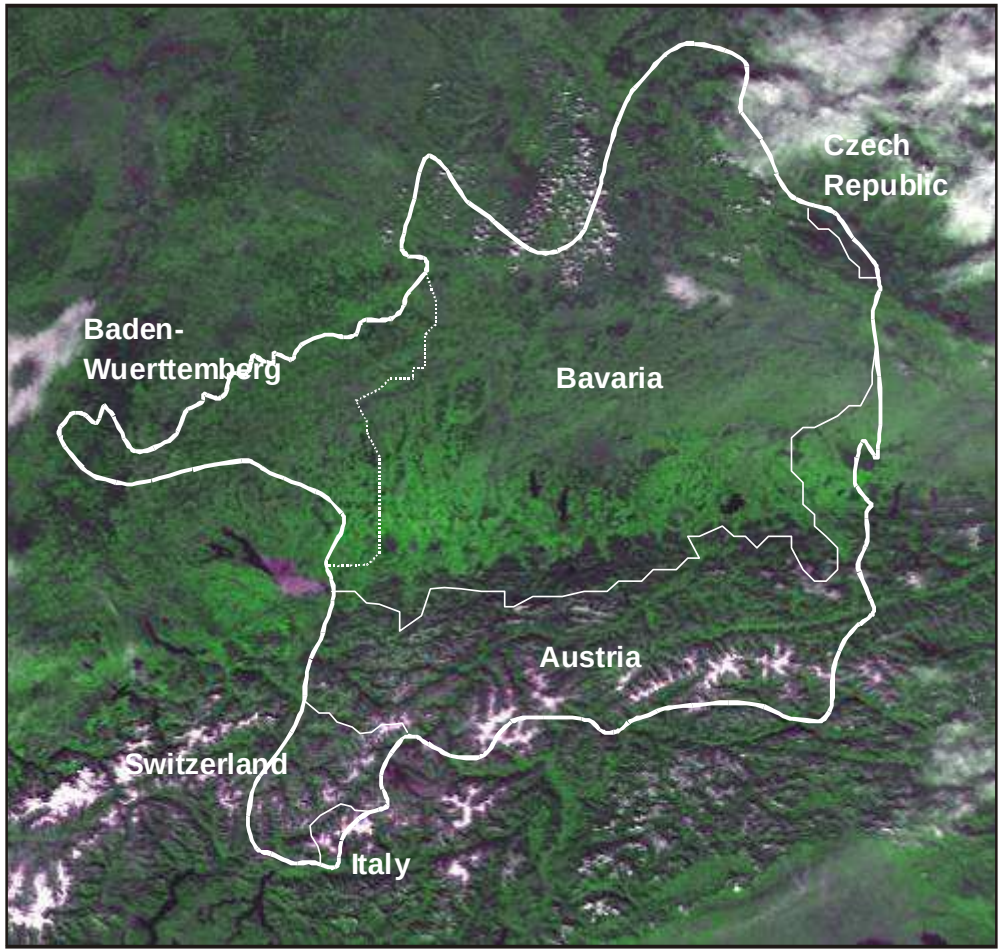
Project-Coordinator:
W. Mauser
University of Munich (LMU)

University Competence Network
consisting of:
13 Partners from
9 Universities and
1 Private Research Company
in South Germany and Austria
40 scientists:





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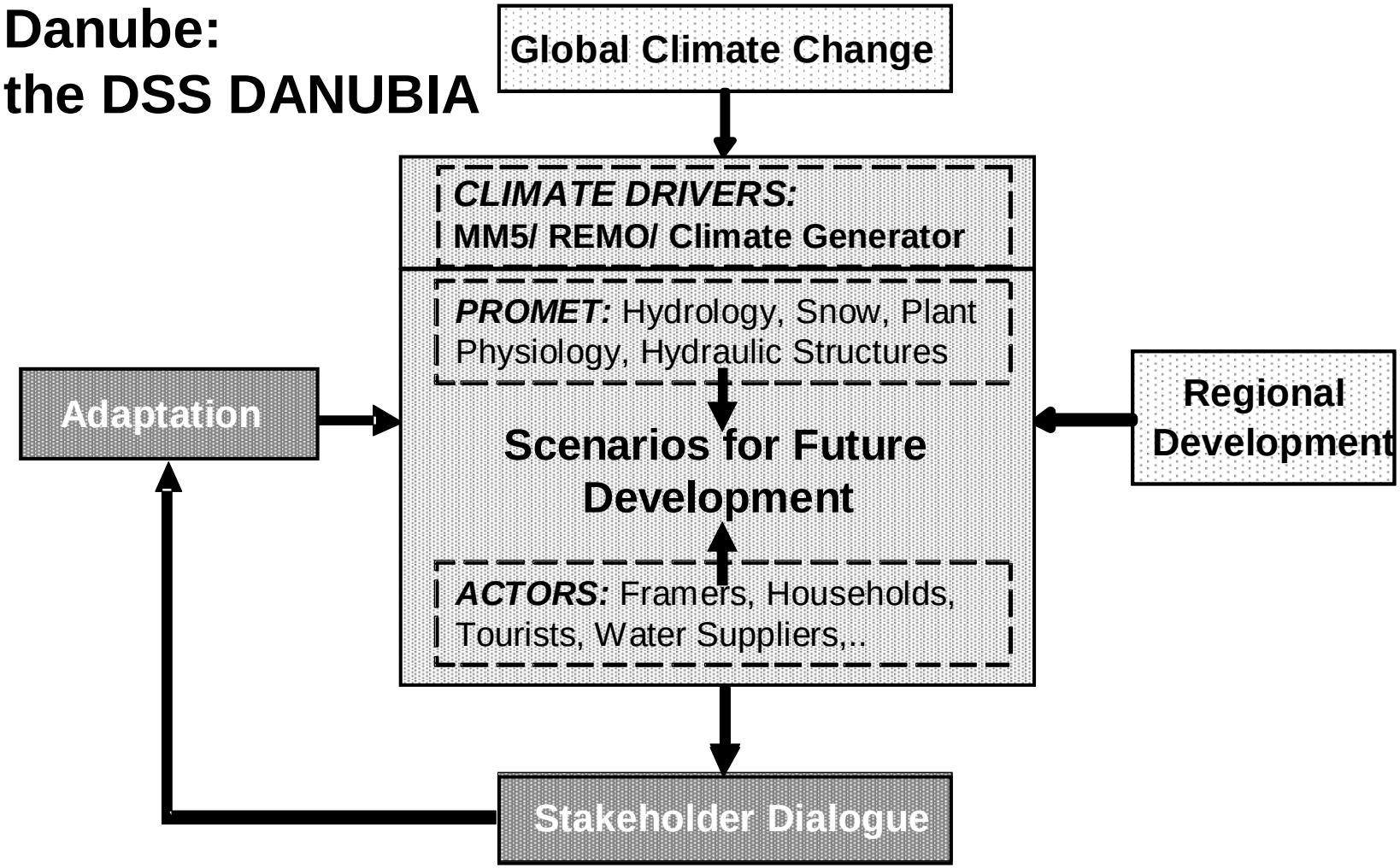
General approach to Integration in GLOWA-Danube: the DSS DANUBIA



Aim and Purpose: build a non-calibrated, fully coupled model system (nature, humans, engineering) to analyse **future scenarios** to develop **adaptation strategies** for **Sustainable Water Ressources Management** under **Global Change Conditions**

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GLOWA-Danube – Rules for Integration

GLOWA – Danube

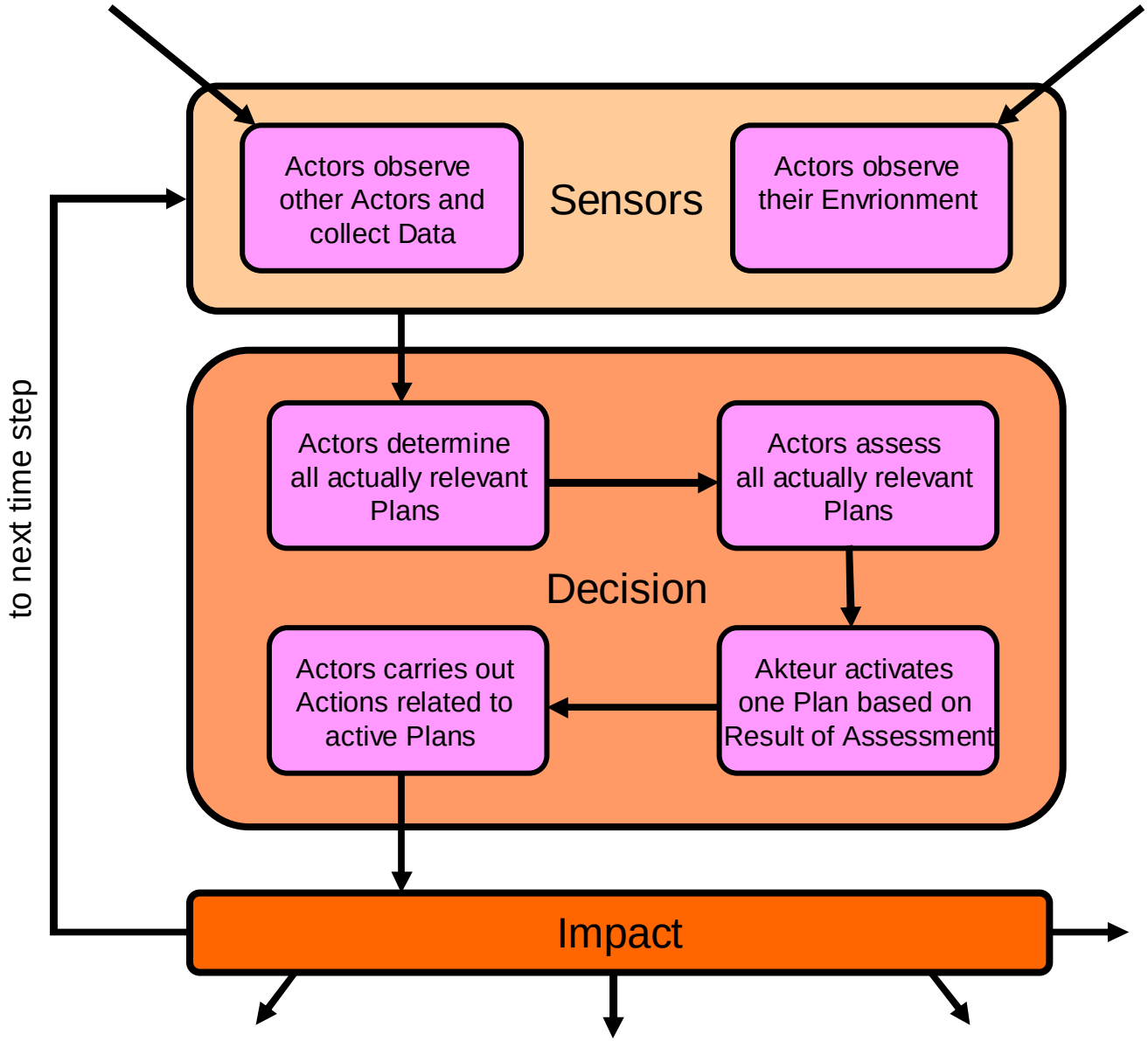
Scientific rules:

- Each research group is accepted as expert in its field! Each group works in the area where it is best!
- There is no single combined model for DANUBIA. DANUBIA is more a market place. Models of different groups run synchronously and exchange variables.
- Each exchanged variable is hosted by a responsible group, which models it. No two groups model the same variable!
- Balances (water balance, energy balance, people, money, etc.) have to be closed across models and groups.

Formal rules:

- All groups describe interactions and interfaces between their disciplines in a common language: the **Unified Modeling Language UML**
- The documentation of the common work is carried out with the Unified Modeling Language
- All interfaces and most models are programmed and implemented in an object-oriented way in **JAVA**.

What is an actor?



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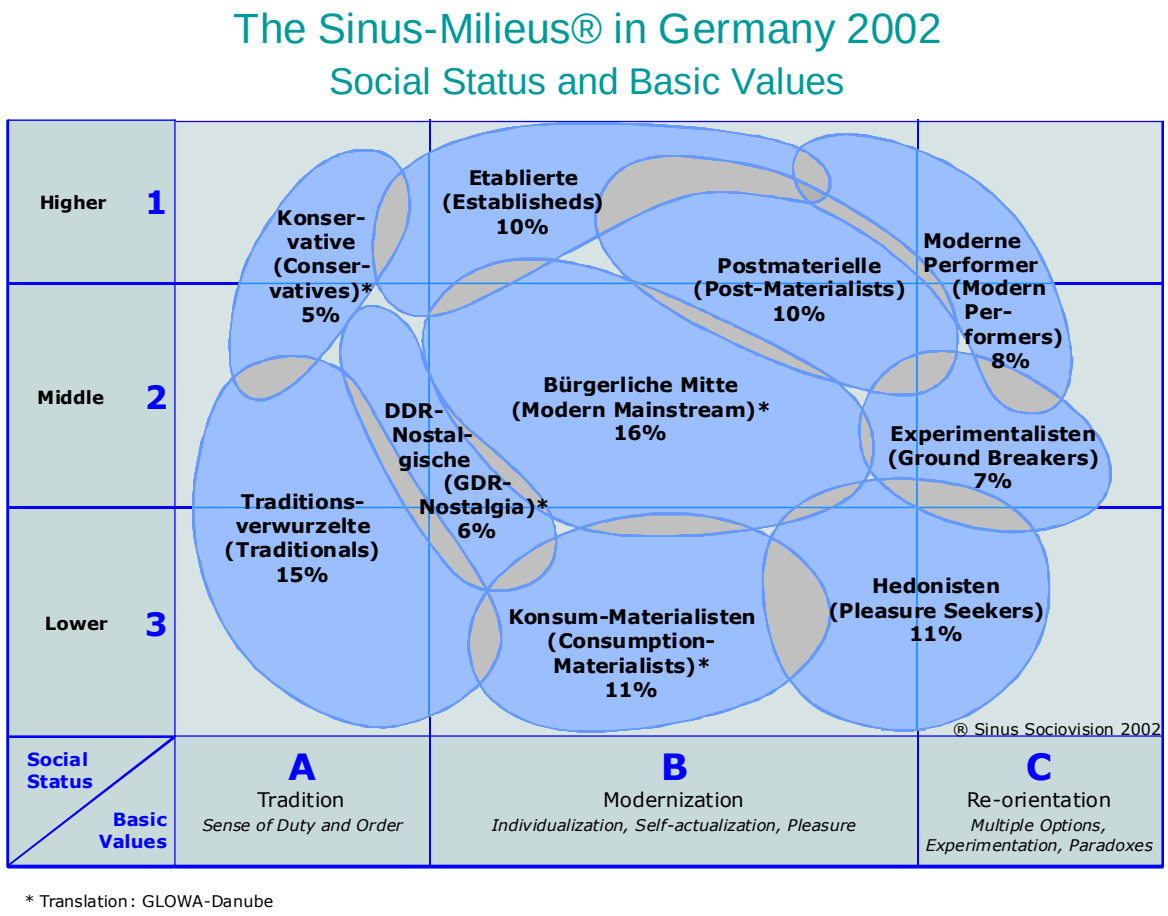
Who are the actors?



* Translation: GLOWA-Danube

Copyright: Sinus Sociovision

Who are the actors?

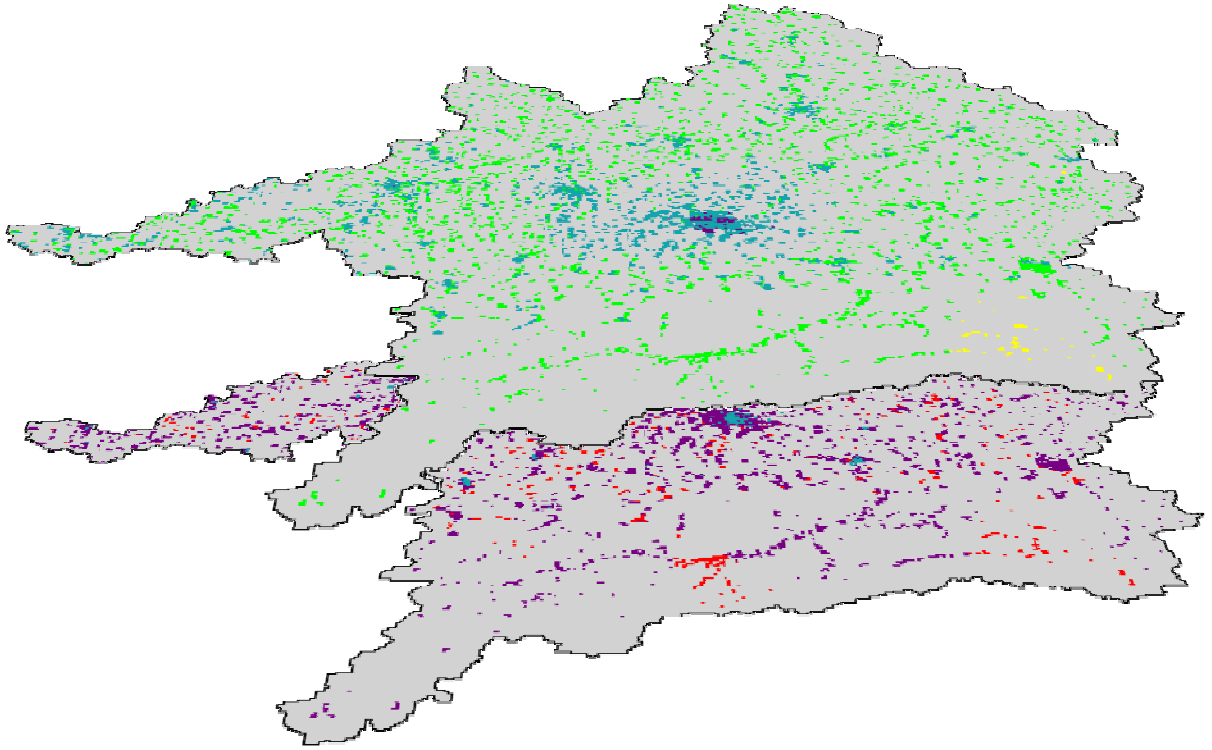
Post-Materialists

Profile:
- age = young families
- income = middle to high
- value “modern” = high
- value “conservative” = low
- importance “price” = low to middle
- importance “environment”= middle to high
- importance “peers” = low

Traditionals

Profile:
- age = older
- income = low
- value “modern” = low
- value “conservative” = high
- importance “price” = middle to high
- importance “environment” = low
- importance “peers” = middle to high

Where are the actors?



Who are the actors?

Relevant water users:

- Farmers (57 000 actors implemented)
- Households (3.3 Million actors implemented)
- Tourists (12 000 actors impelemnted)
- Industry
  - 5 sectors (no actors)
  - *Hydropower Industry*
  - *Power Indurstry*

Relevant water suppliers:

- Communal water suppliers (2100 actors implemented)

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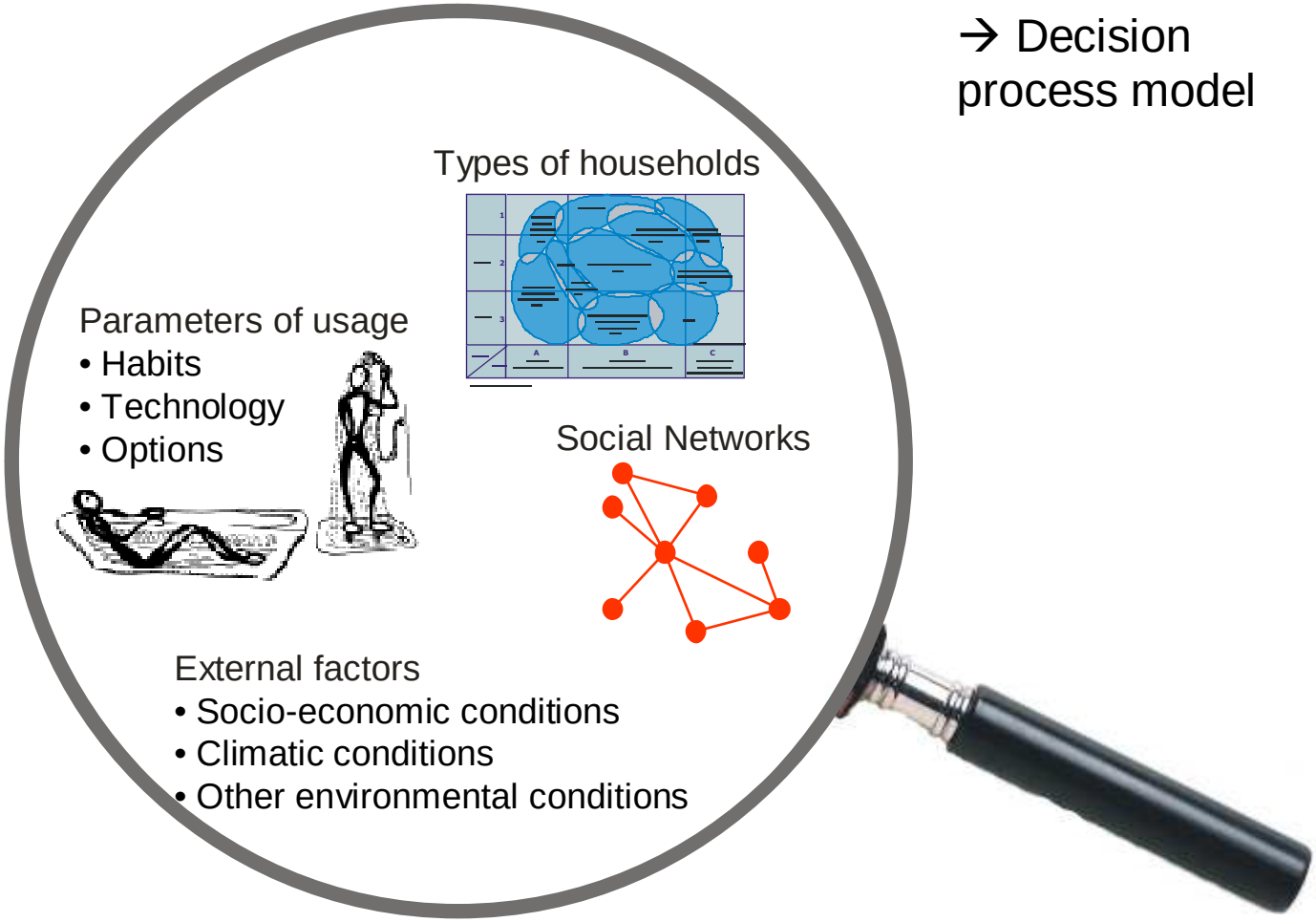
A process model for decision making

Example: households

Actors technology as a magnifying glass

→ Decision process model



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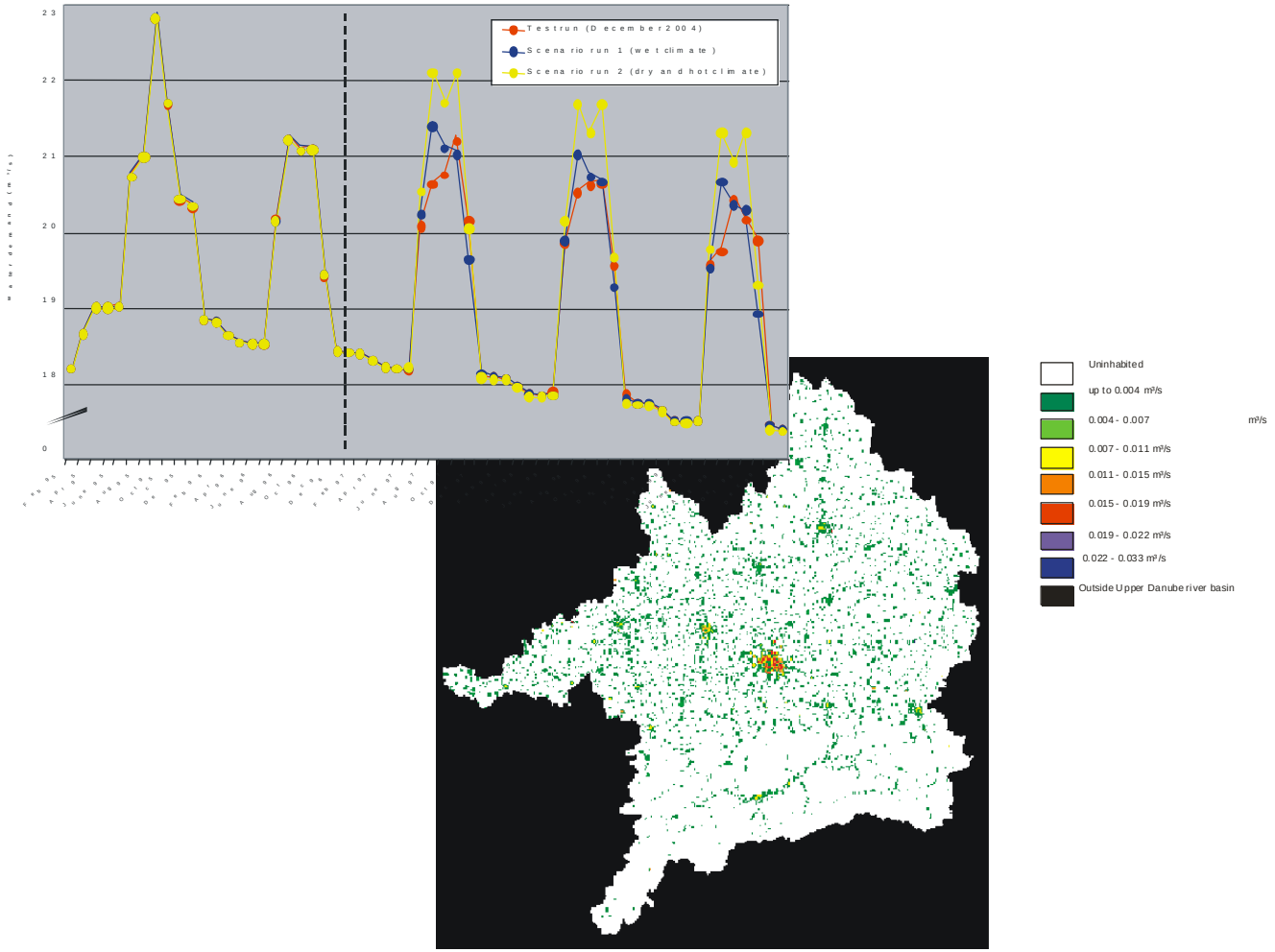
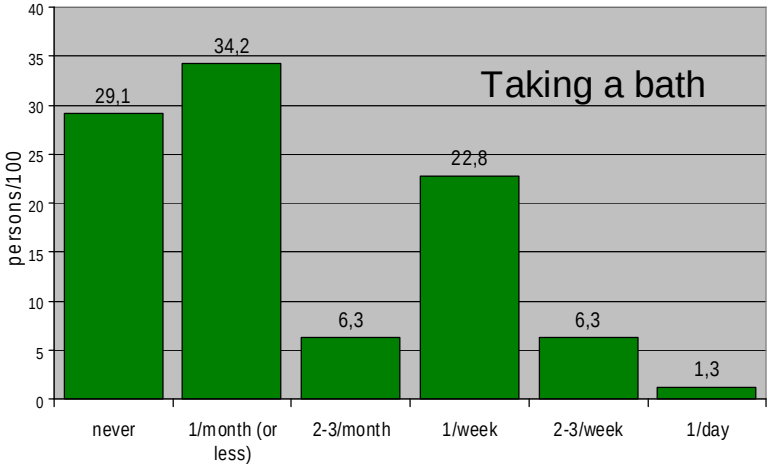
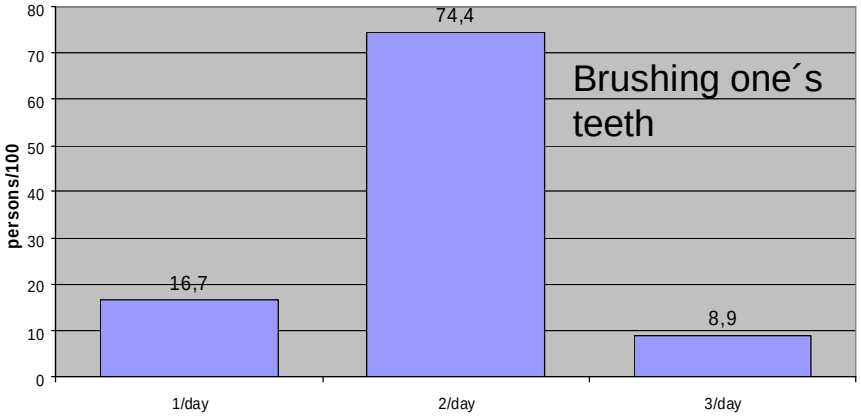
A process model for decision making

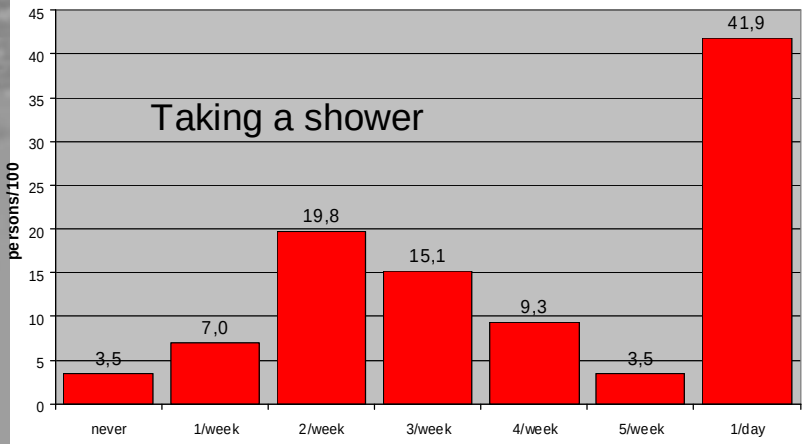


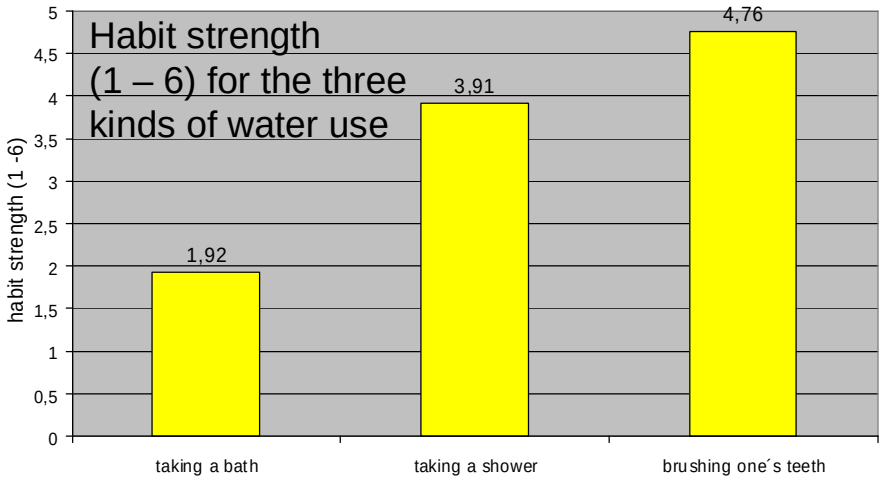
How is Water Use related to Sinus-Millieu

Empirical data – traditionalists:









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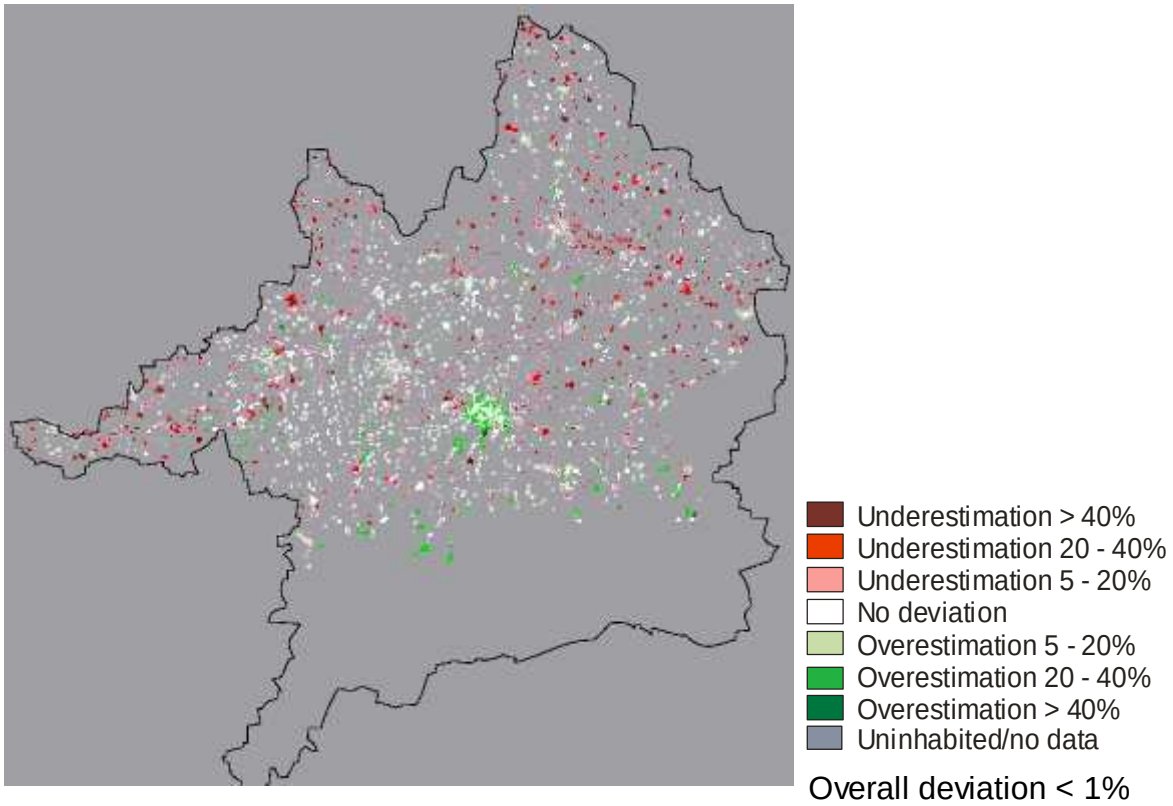
Actor models have to be validated

Spatial validation of domestic water demand

1998:

17.66 m³/s modelled
17.51 m³/s measured



Overall deviation < 1%

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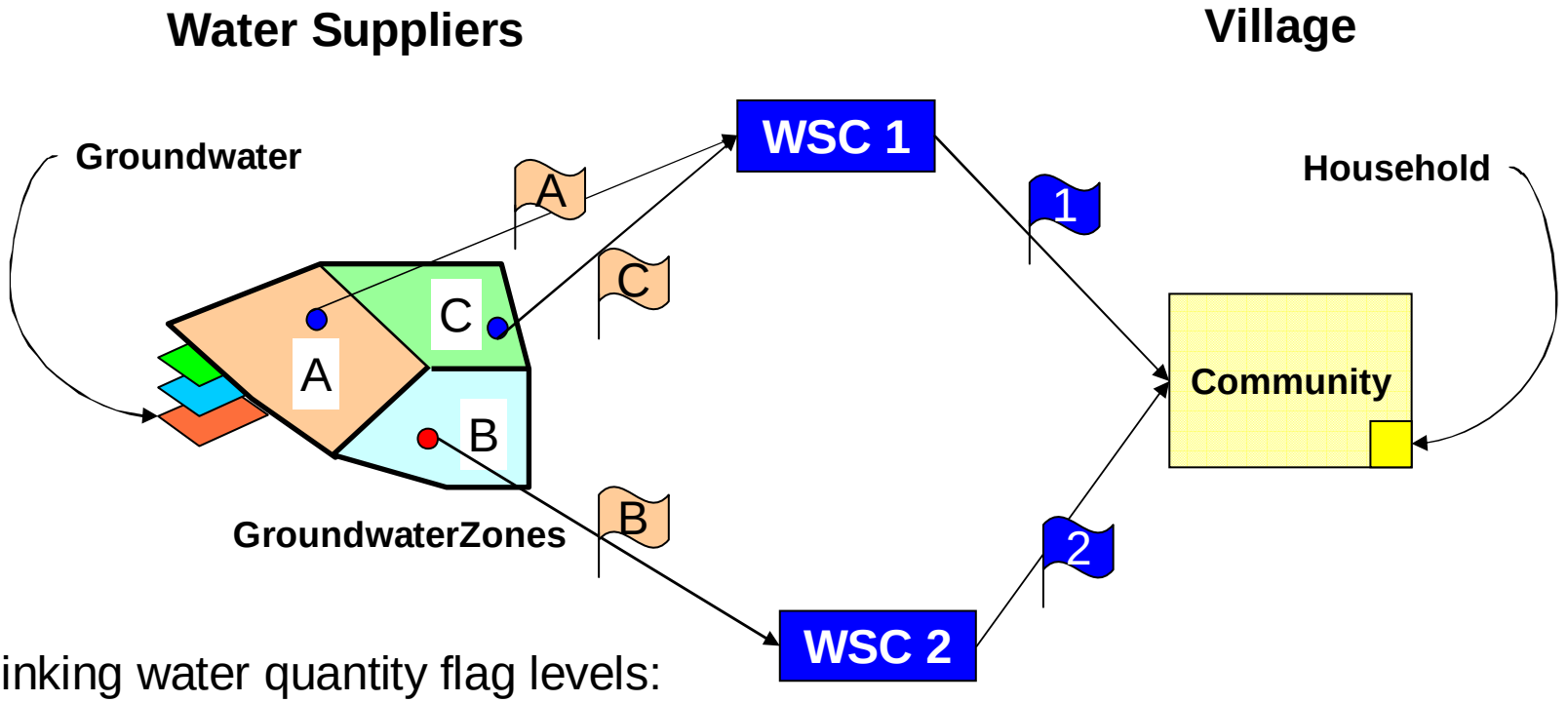
Actors interact with Nature: Water Suppliers and Groundwater



Drinking water quantity flag levels:

(1) No problems

(2) Multiple reports in the local newspaper about water supply problems

(3) First public appeal to save water issued by the mayor

(4) Restrictions for water use

groundwaterQuantityFlags
drinkingWaterQuantityFlags

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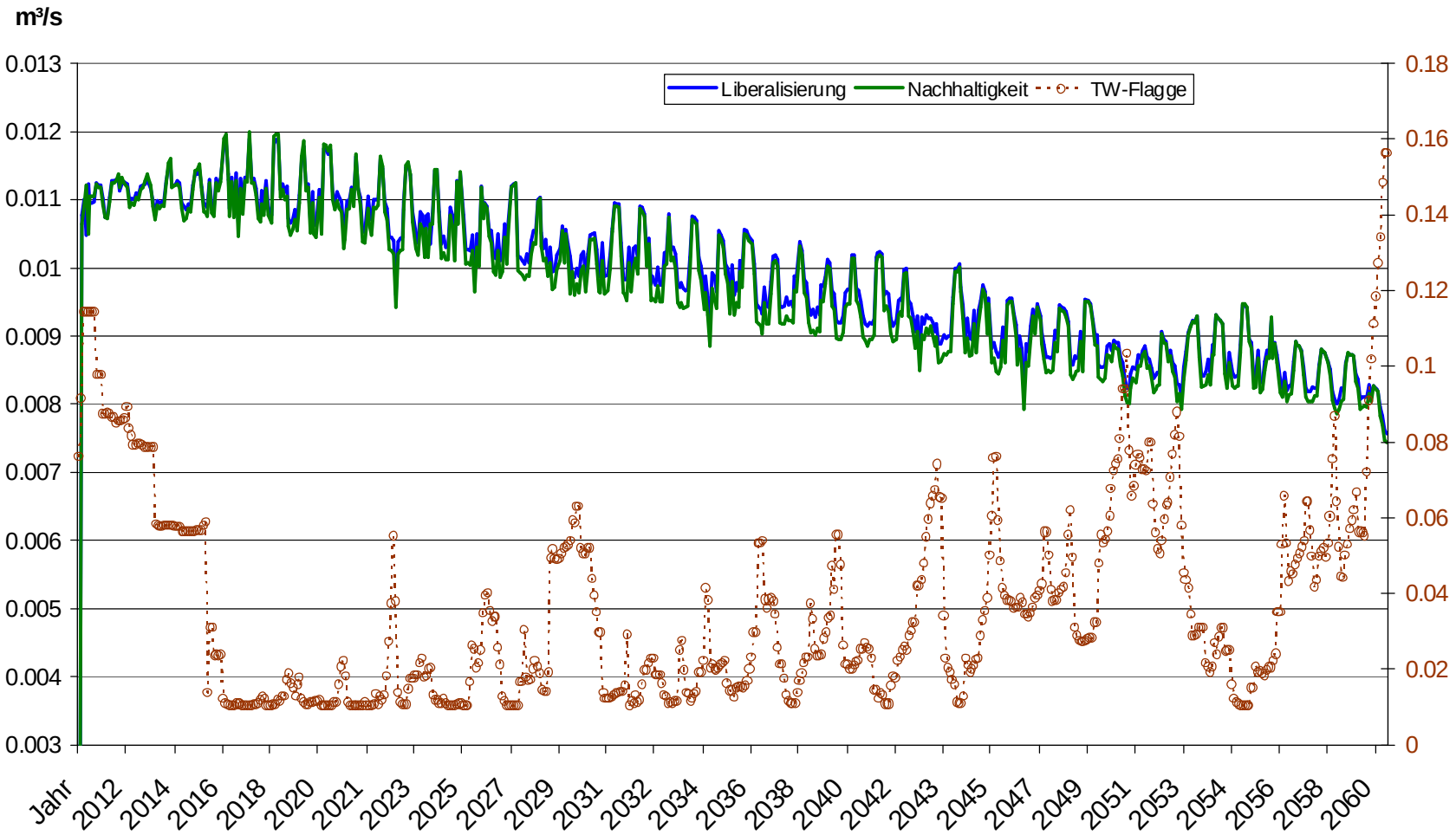
Water Use of Households

Climate Scenario: IPCC A1B



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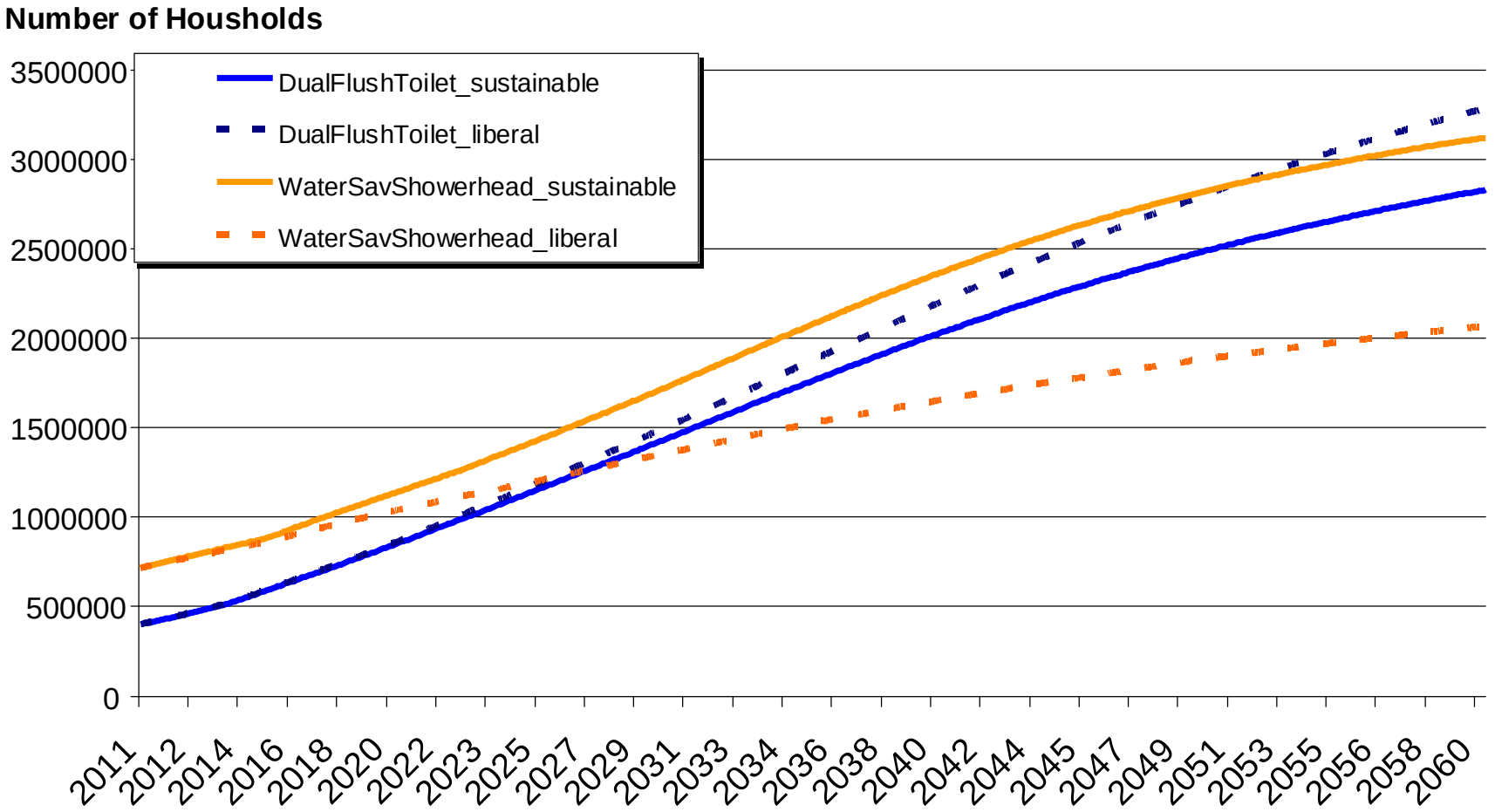
Spread of Water Saving Technology

Climate Scenario: IPCC A1B



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Conclusions - Integration

1. No group by itself would have been able to achieve the level of complexity, realism and sophistication in modeling,
2. Some simple rules for integration seem to be sufficient after agreement on a common structure, e.g. close balances, calculation monopolies for exchanged variables.
3. The consequent use of the Unified Modelling Language (UML) by all groups is very successful, save and efficient to define common structures,
4. Natural and socio-economic sciences start using the same languages for communication (UML and JAVA),
5. Interdisciplinary discussions best start with practical issues and then grow into mutual understanding,
6. The parallel, web based architecture of DANUBIA works very stable, boosts performance, combines models and at the same time preserves sectoral identity,
7. Fully distributed modelling over the net is technologically feasible but not yet efficient due to network security issues,
8. The implementation language JAVA is very safe but very slow,
9. Common progress is often defined by the slowest member in the chain, temporary work-arounds are necessary to make progress in the project predictable.