Regional Projection of Water Demand and Nutrient Emissions – The GLOWA-Elbe Approach

V. Hartje[1], A. Klaphake[1], M. Grossmann[1], K. Mutafoglu[1], J. Borgwardt[1], J. Blazejczak[2], M. Gornig[2], T. Ansmann[3], E. Koomen[4], J. Dekkers[4]

[1]Technical University Berlin , hartje@imup.tu-berlin.de, [2]German Institute for Economic Research, juergen.blazejczak@ww.fh-merseburg.de
[3]Centre for Environmental Research Halle – Leipzig, till.ansmann@ufz.de, [4]Vrije Universiteit Amsterdam, ekoomen@feweb.vu.nl

Central questions and overview

The project "Regionalisation" analyses the socio-economic and climatic dimensions of global change on a regional scale. The core task of the project is to identify changes in driving forces and to quantify the resulting environmental pressures.
Two scale transformations are necessary for this approach to succeed: First, the effects of global climatic and economic change on regional development patterns are analysed. Second, the projections for regional, primarily administrative spatial units, are transformed to the spatial dimension of river basins and water users. Central research questions to be answered are:

- How do regional climate patterns change? How do regional settlement and land use patterns change in the course of regional economic, agricultural and demographic development?
- How do changes in climate and land use patterns affect run-off and surface water availability?
- How do water demand and nutrient emissions alter as a result of changes in economic, demographic and land use development?

The innovation of the GLOWA Elbe regionalisation approach is in bringing together established modelling approaches for long term projections of regional socio-economic development and transforming the generated projections consistently to the river basin scale.
Key characteristics of the GLOWA Elbe approach are a combination of (a) primary integration of spatial and temporal resolution (b) a two stage approach: assessment of effects of global change on a regional level with subsequent projection to dimensions of river basin and water users (c) modular concept of modelling, with a loose linkage of modelling approaches.

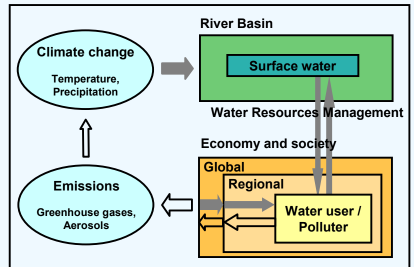


Fig. 1: Dimensions of Global Change and the water cycle

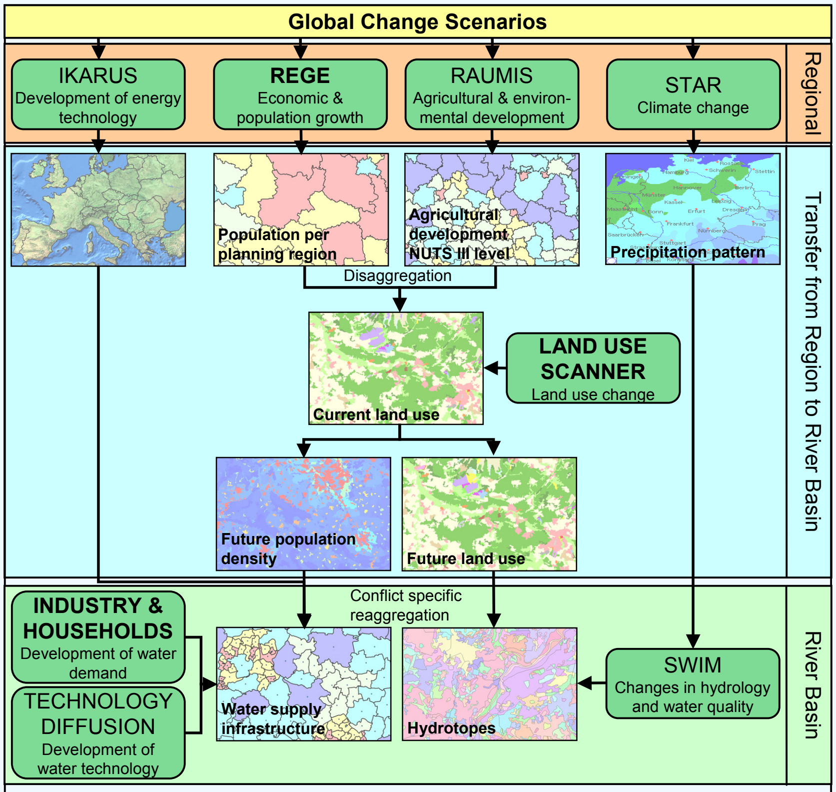


Fig 2: Modelling Framework and performed scale transformations.

Regional economic model REGE (DIW)

The long term regional development of population, employment and gross domestic product is projected by REGE for the Elbe River Basin on the basis of regional planning units for the years 2010 and 2020. Building up on various assumptions about future trends in economic, social and environmental policy, macroeconomic paths of development are derived as a first step.

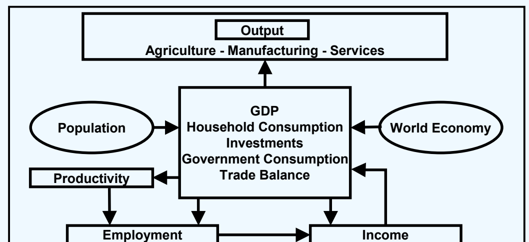


Fig. 3: Macroeconomic and local drivers

In a second step, regional projections are made for Germany. Economic and demographic aspects are analysed in a framework with different sub-models, allowing for structural differences between the western and the eastern part of Germany. The calibration of the sub-models of economic and demographic development is an iterative process via regional labour market balances.

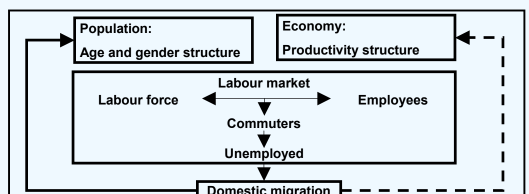
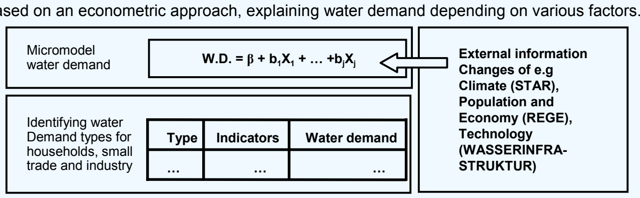


Fig. 4: Iterative calibration of sub-models

Attention has to be paid to the consistency between regional economic models and forecasts on one hand and measures with regard to water availability and water quality on the other hand. These measures may have repercussions on a regional economic level, e.g. in form of additional costs for specific water users.

Water demand models HOUSEHOLD (UFZ) & INDUSTRY (TUB)

The models HOUSEHOLD WATER & INDUSTRY WATER derive the demand for water in households, small trade and manufacturing for the reporting years 2010 and 2020/2025. Both models are based on an econometric approach, explaining water demand depending on various factors.



The econometric models are then used to forecast the regional water demand types. They do also serve as a basis for assessing the vulnerability of various water users.
In spite of the common econometric approach both models do face specific problems. As an example the model HOUSEHOLD has to differentiate between urban and rural areas which are likely to show different patterns of household water demand. For the model INDUSTRY the derivation of shadow prices is crucial since withdrawals of surface water are usually free of charge.

Modelling land use change: LAND USE SCANNER (TUB, VUA)

The LAND USE SCANNER (LUS), developed by the Vrije Universiteit Amsterdam (VUA) integrates and allocates future land use claims from the sectoral models RAUMIS (cf. other poster) and REGE (cf. box above) to model land use change.
It follows the equilibrium principle by using a doubly constrained logit model to allocate future land use to a 250m raster. The two constraints of the model are the overall demand for the land use functions which are given in the initial claims and the total amount of land which is available for each function.
Due to reaggregation to conflict-specific hydrological units the LUS is the central tool to allow scale transformations.

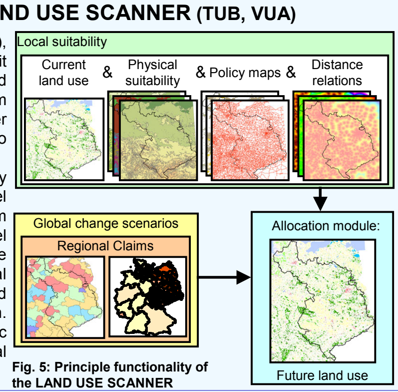


Fig. 5: Principle functionality of the LAND USE SCANNER

References:

Gornig, M. et al. (1999): Perspektiven der Beschäftigungs- und Bevölkerungsentwicklung in Deutschland und in den Bundesländern. *Informationen zur Raumentwicklung*, Heft 11/12.

Hilferink, M. & P. Rietveld (1999): Land Use Scanner: An integrated GIS based model for long term projections of land use in urban and rural areas. *Journal of Geographical Systems*, 1(2): 155-177.

Gömann, H. et al. (2003): Koppelung agrarökonomischer und hydrologischer Modelle. In: *Agrarwirtschaft* 52 (4): 195 – 203.

Wagner, U. & Stein, G. (Eds.) (1999): *Das IKARUS Projekt: Klimaschutz in Deutschland. Strategien für 2000 –2020*. Springer: Berlin.

Renzetti, S. (2002): *The Economics of Water Demands*. Springer, Berlin.

This research work is carried out within the BMBF funded programme GLOWA, project GLOWA-Elbe.