Short presentation of GLOWA projects for website of GLOWA Stakeholder Project

Title of the project:

GLOWA-Danube: Groundwater Management and Water Supply
(Grundwasserhaushalt, Grundwasserbewirtschaftung und Wasserversorgung

Project period:

1.3.2004 - 28.2.2007

Institution:

Institute of Hydraulic Engineering (IWS), Young Scientist Workgroup - Groundwater Hydraulics and Groundwater Management, Universität Stuttgart

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Short description:

Objectives

For the German section of the Danube catchment (including the Inn), the groundwater budget and the use of underground and surface water resources is being analysed in light of global climatic and social-economic change. Ecologically sustainable and economically efficient strategies for groundwater management and water supply are being developed in an interdisciplinary, collaborative effort within the GLOWA-Danube project network. To this aim, the following models are being designed for integration in the Decision Support System (DSS) DANUBIA being pursued by the project network: (1) a groundwater model for the spatial balancing of

water and substance transport in the underground and (2) a water supply model which is coupled with an information system covering the water supply structure and infrastructure in the model area.

Methodology

During the first project phase, data was collected, processed and analysed, and model conceptions were developed and implemented for both the groundwater and WaterSupply models. It should be noted that the scientific foundations for the two sub-areas area highly disparate: whereas the theory and practice of groundwater modelling has evolved over decades of work in this subject area, practically no scientific insights can be drawn upon for the modelling of water supply, the regional evolvement of water supply structures and infrastructure and decision-making in water supply. Thus, while the well established and accepted MODFLOW model underlies the groundwater model, the proprietary development of a conceptually completely new model for water supply was inevitable.

The water supply model is based upon the infrastructure database and, at present, mediates between the users with their demands and the available resources by means of a simple spatial allocation. In doing so, this model assumes a key position within DANUBIA as the interface between the hydrological cycle (natural science models) and the anthropogenic requirements and impacts (socio-economic models).

Current results

By the end of the first project phase, two completely functional models were provided:

The results of the groundwater model are very satisfactory. In particular for the short and mid term groundwater turnover in the major quaternary aquifers near the surface, the results are not only plausible, but, at least for some regions, of very convincing quality. Still, expectations must be lowered in those areas (Alps and other lower mountainous regions) in which the geological and morphological conditions render a prognosis difficult. In addition to the stability of the models and the behaviour of the groundwater levels, the exchange of parameters between the groundwater model and the other directly associated project partners in DANUBIA (surface water model “Rivernetwork”, soil water model “Soil”) is of particular interest. Both during the two DANUBIA reference runs and during various test runs, it could be demonstrated that the groundwater model was able to sensibly translate the input percolation from the soil water management model into a delayed and clearly dampened output signal (infiltration, exfiltration) for Rivernetwork.

In the area of transport modelling, the analysis of all available data on nitrate concentration in groundwater and the relationship of these values to such known

variables having a significant influence presents a solid basis for a detailed consideration of substance transport during the 2. phase.

The data basis for water supply was completed for the German section of the catchment towards the end of the first project phase. An initial input-output model was completed which is based upon an allocation of sources to arbitrarily assigned supply units, whereby the capacity of the sources and the population / size of populated area provided the basis for the allocation. The quality of the allocation was analysed by comparing the aggregated groundwater withdrawal per source and year with the yearly extraction from community statistics. The model thus proved well able to represent local systems of water supply, but is less suitable for representing larger group or long-distance water supply schemes or areas with intensive agricultural use. Nevertheless, with both the development of a DANUBIA compatible, stable and plausible model and the conception and implementation of a complex water supply model for a small test area, the goals for the first project phase and important preparatory steps for creating the more substantial model in the second were achieved.

Continuation

In the second project phase, modelling substance transport and improving the present model in the mentioned complex areas will comprise the central tasks for the groundwater group. The aim is to achieve results for these complex areas which are qualitively comparable to the results for the lowlands. Furthermore, new and interesting questions arose from the collaboration with the soil water and surface water groups during the first project phase. These need to be addressed now more in more detail.

The further development of the so-called „flat“ water supply model to a „deep actor“ model is foreseen for the second project phase. Whereby the water supply structures and infrastructure remain static and thus represent only the status quo in the „flat“ model, the „deep“ model should take the inevitable changes of the water supply systems which will occur over the envisioned model time period of up to 100 years into account. Therefore, it is intended to model in minimum the regional consequences of changes in the water supply sector. As it is for obvious reasons not possible to predict the actual decisions of individual water supply companies, it is planned to assign all providers to a limited number of company types using known parameters. The providers then respond in a predefined manner to certain situations (e.g. water scarcity) according to assumptions made for their type. It is not the intention to predict the state of water supply in the coming decades, nor is it desired to identify to “best possible” development. The aim is rather to show the regional consequences of likely responses under known boundary conditions (e.g. the requirements of the European Water Framework Directive) for various scenarios.

Responses to changes in water availability and quality such as alterations, expansion or reduction of present infrastructure appear likely whereas maintaining the present situation over the next 100 years is sheer impossible. In this sense is appears appropriate to attempt to model (but not predict) likely „decisions“ of providers. That this attempt means venturing in to new scientific territory has already been highlighted. Inasmuch, both existing high hopes and apprehensions that such a model could influence (or be misused to influence) political or economical decisions in the water supply field are not justified.

Publications:

2004:

1. **Barthel, R., Rojanschi, V., Wolf, J. und J. Braun:**
   Large-Scale Water Resources Management within the Framework of GLOWA-Danube - Part A: The Groundwater Model
   Physics and Chemistry of the Earth, 2004. - In Review

2. **Mauser, W. und R. Barthel:**
   Integrative Hydrologic Modeling Techniques for Sustainable Water Management regarding Global Environmental Changes in the Upper Danube River Basin
   A.A. Balkema Publishers, Rotterdam, The Netherlands, Brookfield, USA, 2004. - Reviewed

3. **Nickel, D., Barthel, R., Schmid, C. und J. Braun:**
   Large-Scale Water Resources Management within the Framework of GLOWA-Danube - Part B: The Water Supply Model
   Physics and Chemistry of the Earth, 2004. - Reviewed

2003:

1. **Barthel, R., Rojanschi, V., Wolf, J. und J. Braun:**
   Grundwassermodellierung im Einzugsgebiet der oberen Donau: Fortschritte und Probleme im Bereich des Teilprojekts „GLOWA-Danube Grundwasser“
   Forum für Hydrologie und Wasserbewirtschaftung, München, 2003. - Vol.: 2 - Pages: 155-158 - ISBN: 3-924063-59-1 - 04.03

2. **Nickel, D., Schmid, C., Barthel, R. und J. Braun:**
   Ein agenten-basiertes Wasserversorgungsmodell für das Obere Donaueinzugsgebiet
   Forum für Hydrologie und Wasserbewirtschaftung, München, 2003. - Vol.: 1 - Pages: 251-258 - ISBN: 3-924063-59-1 - 04.03

3. **Wolf, J., Rojanschi, V., Barthel, R. und J. Braun:**
   Konzeption eines regionalen Grundwassermodells für das Einzugsgebiet der Oberen Donau im Rahmen des Forschungs-Projektes Glowa-Danube
   Forum für Hydrologie und Wasserbewirtschaftung, München, 2003. - Vol.: 2 - Pages: 159-162 - ISBN: 3-924063-59-1 - 04.03

2002:

1. **Barthel, R., Braun, J., Rojanschi, V., Schmid, C. und J. Wolf:**
   Erstellung eines mesoskaligen Grundwasserströmungs und Transportmodells für das Einzugsgebiet der oberen Donau im Rahmen der Forschungskooperation GLOWA-Danube
   Forum für Hydrologie und Wasserbewirtschaftung, Hennef, 2002. - Nr.: 1 - Pages: 89-94

2. **Barthel, R., Braun, J., Rojanschi, V., Wolf, J., Schmid, C. und D. Nickel:**
   Modelling Groundwater Flow and Nitrogen Transport in the Upper Danube Catchment (Gauge Passau) with regard to Global Change and the Development of Sustainable Water Management Scenarios and Strategies
   GEO 2002, Würzburg Planet Erde: Vergangenheit, Entwicklung, Zukunft, Hannover, 10/2002. - Vol.: 21 - Seiten: 66 - Gemeinschaftstagung von 13 wissenschaftlichen Gesellschaften der Festen Erde. - Schriftenreihe DGG

3. **Rojanschi, V., Barthel, R., Braun, J., Wolf, J., Schmid, C. und D. Nickel:**
   Modelling Groundwater Flow and Nitrogen Transport in the Upper Danube Catchment (Gauge Passau) with Regard to Global Change and the Development of Sustainable Water Management Scenarios and Strategies
   21. Conference Of The Danubian Countries On The Hydrological Forecasting And Hydrological Bases Of Water Management, Bucharest, Romania, 9/2002.

Other public relations work:

02. February 2001: 1. GLOWA-Informations Meeting:

Research Project "GLOWA-Danube" and the development of sustainable water management measures in Baden-Württemberg in light of global and regional change

19. March 2002: 2. GLOWA-Information Meeting

13. May 2003: 3. GLOWA-Information Meeting

Workshops/events

October 2001: MODFLOW-Course, four days, Ingenieurbüro kup, Stuttgart IWS

December 2002: Post Graduate Workshop „Scaling“, two days, Stuttgart IWS