

Wolfram Mauser and Sara Stoeber

Department of Geography, Ludwig-Maximilians-University Munich LMU, Luisenstraße 37, 80333 Munich

GLOWA-Danube: Impact of Global Change on the Upper Danube

Global Climate Change will increasingly have regional impacts on the water resources. More frequent floods, low flows and droughts, the retreat of glaciers and snow cover in the Alps as well as changes of the natural and agrarian vegetation particularly in the Upper Danube watershed will be likely consequences of Climate Change.

GLOWA-Danube (www.glowa-danube.de) is a research and development program focusing on the comprehensive analysis of the future of water resources of the Upper Danube. In GLOWA-Danube the impact of Climate Change of a broad range of sectors is investigated. Furthermore the project identifies and simulates strategies for adaptation to and mitigation of the consequences of Climate Change and tests their effectiveness. In GLOWA-Danube a team of researchers from different natural and socio-economic science disciplines work closely together in an interdisciplinary, university-based competence network since 2001.

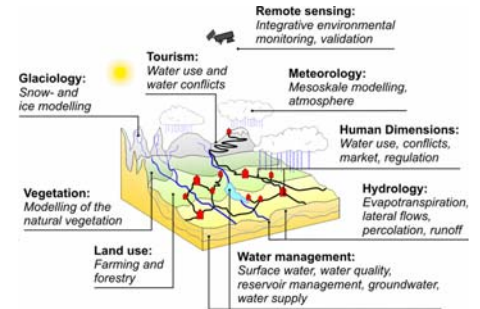


Fig. 1: Aspects of integration in GLOWA-Danube

Aim of GLOWA-Danube

The aim of GLOWA-Danube is to investigate with different scenarios the impact of change in climate, population and land use on the water resources of the Upper Danube and to develop and evaluate regional adaptation strategies. For this purpose the decision support system DANUBIA was successfully set up within the first and second project stage (2001-2006).

DANUBIA – an integrative decision support system

DANUBIA is a coupled simulation model. It includes for the first time model components for natural sciences as well as socio-economic processes and their interactions. With the intention of being predictive DANUBIA uses results of regional climate models for predictions on Climate Change. For the simulation in the included sectors (farming, economy, water supply companies, private households and tourism) DANUBIA uses deep multi-actor models which represent the decisions of the involved actors based on the structure of societies and their framework as well as their interests. All components of DANUBIA run parallel on an inexpensive LINUX-cluster. DANUBIA will be made available as “Open source” at the end of the third project stage in 2010 and will particularly serve decision makers from policy, economy and administration as tool for a foresighted planning of water resources against the background of Global Change.

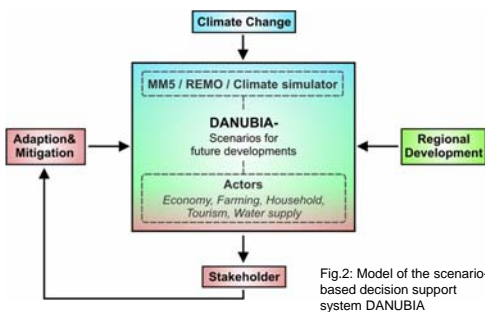


Fig. 2: Model of the scenario-based decision support system DANUBIA



Fig. 3: The catchment area of the Upper Danube

Investigation area: The Upper Danube

DANUBIA is applied to the watershed of the Upper Danube. The Upper Danube with its more than 11 million inhabitants and an area of about 77.000 km² is one of the largest and most important alpine watersheds in Europe. With its strong relief and the altitudinal gradient of up to 3.600 m the Upper Danube is particularly vulnerable to Climate Change. These conditions also lead to a remarkably broad range of influencing factors on the water resources. The watershed includes glaciers as well as temperate lowlands, which are intensively used by agriculture. The Upper Danube in addition is characterised by a complex and intensive use of the water resources for hydropower, farming (possibly future irrigation) and tourism (e.g. snow cannons).



Fig. 4: Confluence of Danube and Inn in Passau

The future of the water at the Upper Danube

Scenario runs with DANUBIA are based on the findings of the IPCC and use results of regional climate models as well as statistical ensemble approaches for the estimation of the future regional Climate Change in the Upper Danube watershed. The analyses show that the average air temperature at the Upper Danube has already increased by approx. 1.5 °C in the last 30 years. First results of scenario ensembles with DANUBIA already show that the droughts in summer will broaden and that the low flow discharge of the Upper Danube will decrease strongly in the future years. Further scenario runs will include changes of glaciers, snow cover and winter tourism, the use of water reservoirs, the consequences for water supply and the use as well as the impacts on farming, tourism, households and industry.

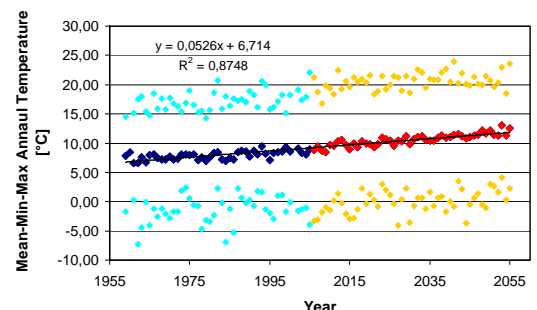


Fig. 5: Temperature increase at the Upper Danube: past and future