Chapter XI
Modelling of Water Use Decisions in a Large, Spacially Explicit, Coupled Simulation System

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ABSTRACT

This chapter presents the purpose, the basic concepts, the implementation, and a scenario run of the agent-based part of a large decision support system for the water resources management of the Upper Danube basin, Western Europe. Sixteen process models from 11 disciplines in the natural and social sciences are integrated in the system. They use common spatial and temporal concepts to communicate with each other at run time. A variety of agents based on large scale empirical evidence serves to model the drinking water use of households. An example scenario run under global warming conditions shows the interplay between modelled water supply companies, households, climate, and groundwater resources.
INTRODUCTION

A Comprehensive Model of Social and Natural Aspects of a River Basin: The DANUBIA System

One of the problems of environmental decision making is the lack of a sound, coherent, and dynamic representation of social and environmental processes and the integrated projection of possible developments into the future. It is widely accepted that computer based decision support systems (DSS) can provide a useful basis to advance environmental decision making. However, such a DSS does rely heavily on a valid “core engine” which integrates the implementations of domain-relevant processes from the different fields and disciplines and their interactions. The GLOWA-Danube project, sponsored by the German Ministry of Education and Research since the year 2000, aims at providing such an integrated, spatially explicit DSS to enhance water-related decision making in the Upper Danube river basin under conditions of global environmental change (Mauser & the GLOWA-DANUBE project group, 2000, 2002; Ernst, 2002).

The river basin considered here has an extension of approx. 75,000 km², ranging from the Alps to the Bavarian lower plains, and includes parts of southern Germany, Austria, and Switzerland. About 10 million people are living there, and the basin includes high mountains, agricultural regions, as well as big cities such as Munich.

The DANUBIA system acts as the DSS’s core engine and integrates 16 fully coupled process models from 11 scientific disciplines, ranging from hydrology to environmental psychology and from meteorology to tourism research (for a description of DANUBIA from a computer science perspective, see Barth, Hennicker, Kraus, & Ludwig, 2004). The system structure follows the structure of the domain: There are five components (Landsurface, Atmosphere, Groundwater, Rivernetwork, and Actor) as represented in Figure 1. Each component encompasses up to six models. For example, the actor component,

Figure 1. The five DANUBIA components as a UML diagram. The components Landsurface, Atmosphere, and Actor each encompass multiple models which are coupled among each other analogously to DANUBIA main components.
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