

Integrated Modeling and Assessment and Decision Support Systems for Improving Sustainability Outcomes in River Basins

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Abstract. Implementation of the concept of sustainability is very uncertain and subjective, but modellers and modelling can play a vital role in managing our environment sustainably. The shortcomings of environmental models are plain, but such models can, as a minimum, clarify possible consequences of decisions. At best they may also indicate relative likelihoods and extents of outcomes well enough to support decisions that yield much more sustainable outcomes than at present.

One can communicate the need for integration in different ways. From a management perspective, integrated river basin management requires integration of: (i) different objectives and their related outcomes, like economic efficiency, social equity and ecological integrity; (ii) all water resources (surface water, groundwater, estuaries); (iii) water- and land-related issues; (iv) different types of water use (agricultural, ecological, domestic, industrial, recreational); (v) all water users and everyone affected by water uses.

It is clear that the integrated modelling of problems in river basins poses considerable difficulties. These systems are complex, distributed in space, dynamical (with time-spread responses to change), and heterogeneous. Their models must cover a range of sciences (e.g. hydrology, ecology, agriculture, forestry, economics, psychology, even demography, sociology and politics) and a range of categories of people affected. The evolving discipline of Integrated Assessment (IA), which will be discussed, aims to deal with such systems, including the human component.

Integrated Scenario Modelling (ISM) is a core activity of many IA exercises. It involves a model as an approximation of the system under study. The model allows the simulation of how input drivers (scenarios) such as climate and human activities yield outputs (indicators) representing the states of the system. In IA, the system is extended so that policy and management link to the controllable human activity inputs. A sustainability target or indicator is some function of the outputs, usually a

simple function such as an average, maximum or minimum level. Thus ISM is at the centre of IA, connecting policy and institutional drivers to sustainability indicators. ISM outputs also play an essential part in multicriteria analysis, formal or informal. Integrated Scenario Modelling, when encapsulated in a decision support system, has many benefits. It provides: a way of investigating and explaining tradeoffs; a readily accessible collection of models, methods and visualisation tools; a focus for integration across researchers and stakeholders; a training and education function; an exploratory aid capable of adoption and further development by stakeholders; a permanent summary of the project methods; and a means of making the management analysis transparent.

The talk will characterise the different types of integrated modelling that are available and illustrate how some of these have been used in several case studies. It will also summarise the lessons that we have learnt, especially from the point of view of software and decision support system development.