Geophysical Research Abstracts,
Vol. 11, EGU2009-8103, 2009
EGU General Assembly 2009

Multi-criteria decision support system for Siemianówka reservoir under uncertainties

A. Kiczko (1) and T. Ermolieva (2)

(1) Institute of Geophysics of the Polish Academy of Sciences, Water Resources, Warszawa, Poland (akiczko@igf.edu.pl), (2) International Institute for Applied Systems Analysis, Laxenburg Austria

Extreme events, such as floods or long drought periods, might become the most noticeable effects of climatic change. Variations in a hydrological cycle could have enormous impacts not only on the human economy but also on the ambient ecosystem. Therefore biodiversity protection and the conservation of valuable areas have recently become very important issues in water management politics. In the case of a river system the issue is manifested as a wide range of activities aimed at providing desirable water conditions at protected sites following the demands of existing ecosystems. In many areas freshets that are considered to be a serious threat to the economy and agriculture, has became an essential part of vegetation cycle, significantly increasing the biodiversity of the region. Narew National Park (NNP), Poland, is such an example. Because of the semi-natural character of the region, freshets do not cause losses but are necessary to preserve the environmental value of the region.

This paper presents a Multiple Criteria Decision Support System for the optimal management of the Siemianówka reservoir. The reservoir is localised on the Narew River upstream the NNP. The river system under considerations consists of a storage reservoir and a 100 km long River Narew reach, at which end the NNP is located. The goal of the work is to provide decision makers with a tool that would allow the safety of the NNP environmental requirements within the reservoir management policy to be included. An important issue is the competition between many water-dependent systems and agents, e.g., agriculture, energy, wetlands, for limited water resources. The proposed system allows a trade-off between different reservoir users to be found, including protected wetland ecosystems of the Narew Nation Park. Unobserved inflows play an essential role in the river water balance and are dealt with using rain-runoff modelling techniques. Taking account of weather forecast uncertainties and inherent errors related to the model structure is one of the most challenging tasks, as reservoir management actions have to be performed in advance. Precipitation forecasts are acquired in the form of 7 days-ahead predictions. In this paper we apply a stochastic weather forecast emulator of the European Centre for Medium Range Weather Forecasts ensemble. The resulting inflow predictions consist of a number of possible scenarios. In addition, as the optimisation problem requires numerous realizations of the river model, a numerically efficient Stochastic Linear Transfer Function was applied to flow routing.

To find the optimal solution for all possible scenarios, the reservoir control problem was formulated in a stochastic manner. Optimisation was carried out for several criteria: wetland water requirements, agricultural, energy production, flood protection, fishery and reservoir storage. The goal was to achieve a desirable water management regime within the defined safety levels. These highly non-linear constrains were met through the minimisation of convex functions by solving a linear programming problem within a Multiple Criteria Analysis.