PMA - IT TOOL FOR ADAPTIVE WATER MANAGEMENT

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The paper identifies some major challenges for research and practice needed to improve the common understanding of the transition from the current water management regimes to adaptive water management. The authors developed a web platform in which new scientific methods and practical tools are promoted for the participatory assessment and implementation of adaptive water management at local, and basin scale. The platform for integrated water management - PMA is a fully functional web site developed by the researchers from the Environmental Informatics Laboratory within University "Politehnica" of Bucharest, in the frame of a national excellence research program.

Keywords: adaptive water management, quality water, case study.

1. Introduction

Adaptive management is a general expression for adaptive resource management. It is a structured and iterative process for making optimal decision in the face of uncertainty that insists on system monitoring in order to reduce the uncertainty over long periods of time. Therefore the decision making simultaneously maximizes one or more resource objectives and, either passively or actively, accrues information needed to improve future management. Adaptive management is often characterized as "learning by doing" process.

2. Adaptive management

Adaptive management can be considered either passive or active. Passive adaptive management begins by using predictive modeling based on present knowledge to inform management decisions. As new knowledge is gained, the models are updated and the management decisions are accordingly adapted.

Active adaptive management, on the other hand, involves changing management strategies altogether in order to test completely new hypotheses. So while the goal of passive adaptive management is to *improve* existing

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management approaches, the goal of the active adaptive management is to *learn* by experimentation in order to determine the best management strategy.

Key features of both passive and active adaptive management are:
- iterative decision-making (evaluating results and adjusting actions on the basis of what has been learned);
- feedback between monitoring and decisions (learning);
- explicit characterization of system uncertainty through multi-model inference;
- bayesian inference;
- embracing risk and uncertainty as a way of building understanding.

Adaptive management is particularly applicable for systems in which learning via experimentation is impractical. However, any one of five process failures can seriously compromise effective adaptive management decision making:
- The monitoring is never completed.
- The monitoring data are not analyzed.
- The analyzed results are not conclusive.
- The analyzed results are interesting but never reach decision makers.
- The decision makers do not use the results because of internal or external factors.

Because adaptive management is used to make decisions regarding the management of valuable natural resources, it directly affects (and is affected by) public policy and politics.

3. PMA – IT Tool

Adaptive management is not simply a matter of acting and waiting to see what happens; instead, it requires that activities be generated, purposefully monitored, and scientifically evaluated so that management, policy, and actions are more effective regarding water domain. In this manner our understanding of what works and what doesn't is increased (fig.1).

Monitoring is a critical component of adaptive management because it involves deliberate and systematic observation, detection, and recording of conditions, resources, and environmental effects of human and management programs and actions.

Monitoring is currently performed by agencies and other entities, but it is typically not well coordinated and integrated among involved parties. Examples of common obstacles include inadequate communication and coordination, conflicting or non-complementary agency interests or mandates, underlying technical issues, inconsistent data integration and sharing, and inadequate funding. Develop and implement a decision-making system that is guided by the best

available science and that uses new information generated from the monitoring of conservation actions remains a general goal in many countries.
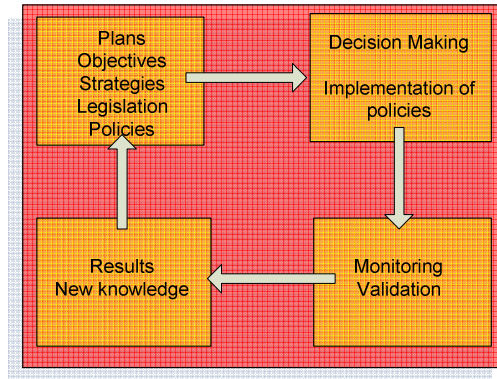

Fig. 1 – The principle of adaptive management

The adaptive web platform for integrated water management - PMA is a fully functional web site developed by the researchers from the Environmental Informatics Laboratory within University Politehnica of Bucharest, in the frame of the CEEX Project no. 203 (fig.2).

The web-site is in the process of completion; it is permanently updated and tested, it's continuously development being the team's top priority.

Fig. 2 – PMA – Home Page

Building an adaptive water management system requires the access to the updated legislation and policy in this domain. Therefore the PMA has implemented on one of its section the transposing of the European policies in water domain, the laws for public utilities and services, the laws for hydrographic river basin and horizontal legislation.

Through the PMA platform everyone who is registered has access to all the management systems needed for water companies, service utilities, researchers that work in this domain, private companies and research institutes: the Quality Management System (SR EN ISO 9001:2001), the Environmental Management System (SR EN ISO 14001:2005), the Occupational Health and Security Management System (OHSAS 18001:2007) and the Integrated Management System which includes a multi–correlation between the standard management systems prior mentioned (fig.3).

Fig. 3 – Available Management Systems

The developers of the web-site presented the integrated water management by defining the concept, making an analysis of the system, identifying structural elements of the management, specifying method of approach of management and presenting the integrated management of river basin and urban water system.

There were also published three case studies developed by the powerful tool for modeling and simulation InfoWorks produced by Wallingford Software Ltd, for river systems, water supply systems and used water collection systems (fig.4 and 5).
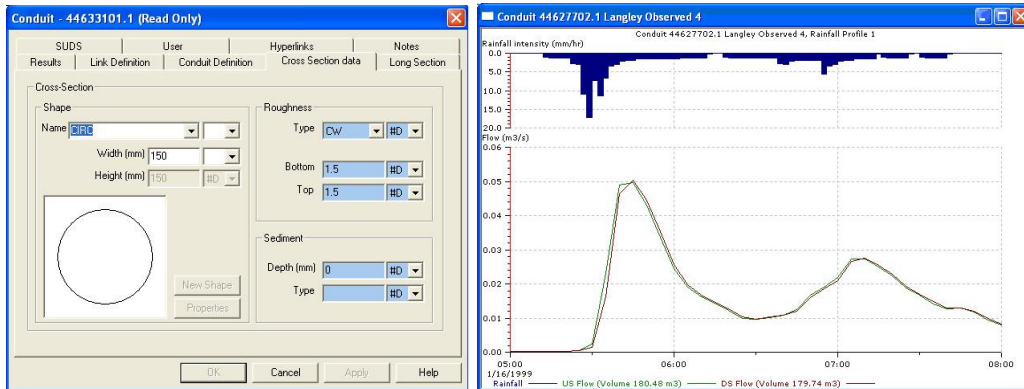

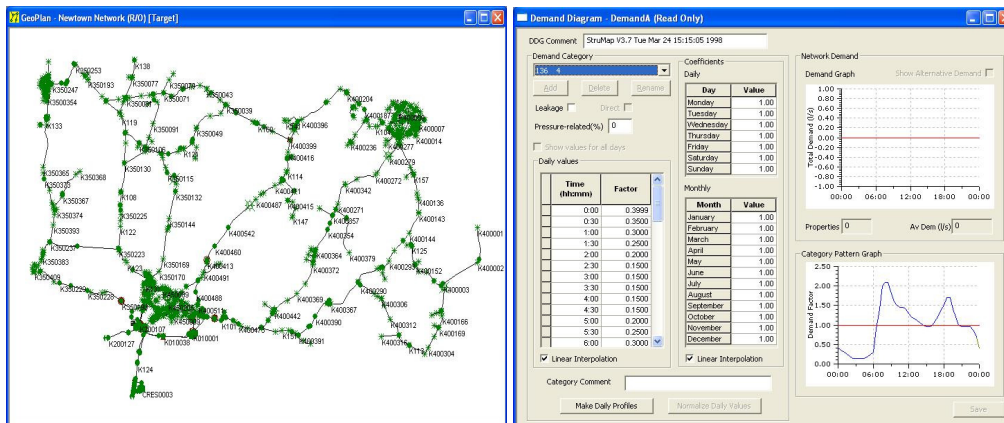Fig. 4 – Views from InfoWorks CS (Collection Systems)

Fig. 5 – Views from InfoWorks WS (Water Supply)

4. Case study for OLT River

One of the significant case studies included in the PMA web platform is devoted to the River Olt. This is a comprehensive example of a very complex system of water utility which needs the integrated water management on the whole basin. The hydrographic basin of River Olt is one of the most important ones in Romania. It has a surface of over 24050 km^2, a total length of 615 km, includes 17 dams for non-power usage and over 25 hydroelectric power plants.

The case study includes the modeling and simulation of the management of the water within the basin for energy production as well as for non-power purposes (water supply, irrigation, industrial usage etc.). The model and the results for the upstream section containing the lake of the Călimăneşti Hydro Power Plant are presented in fig. 6, 7 and 8. The simulation was performed in order to predict the water level evolution generated by a typical rain.
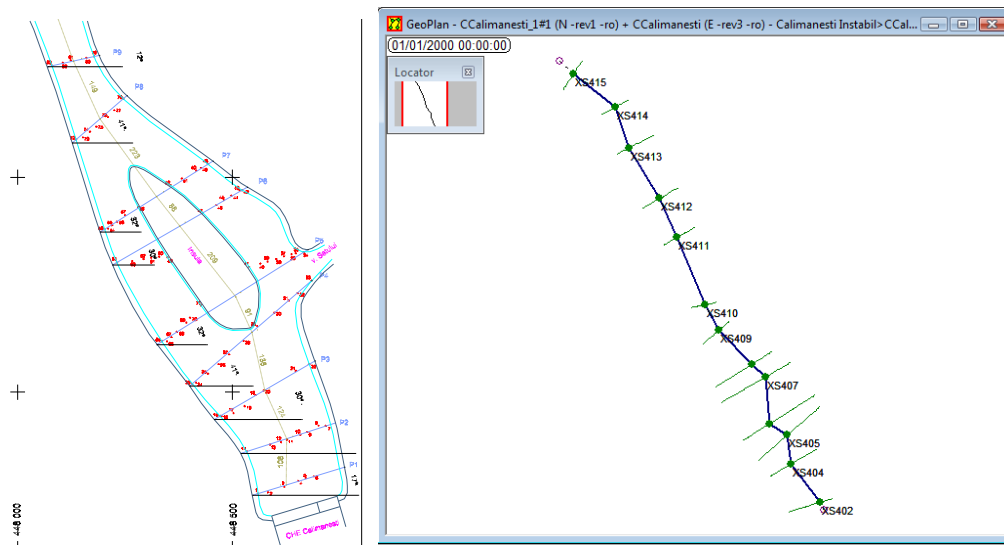

Fig. 6 – Situation plan and model in InfoWorks RS for Călimăneşti Hydropower Station
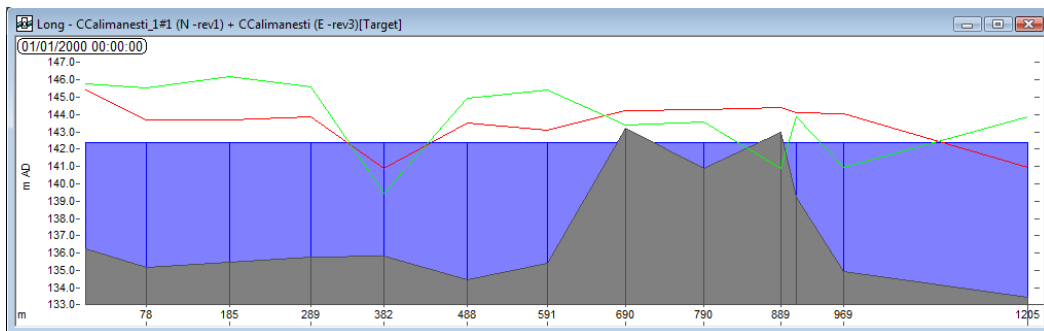

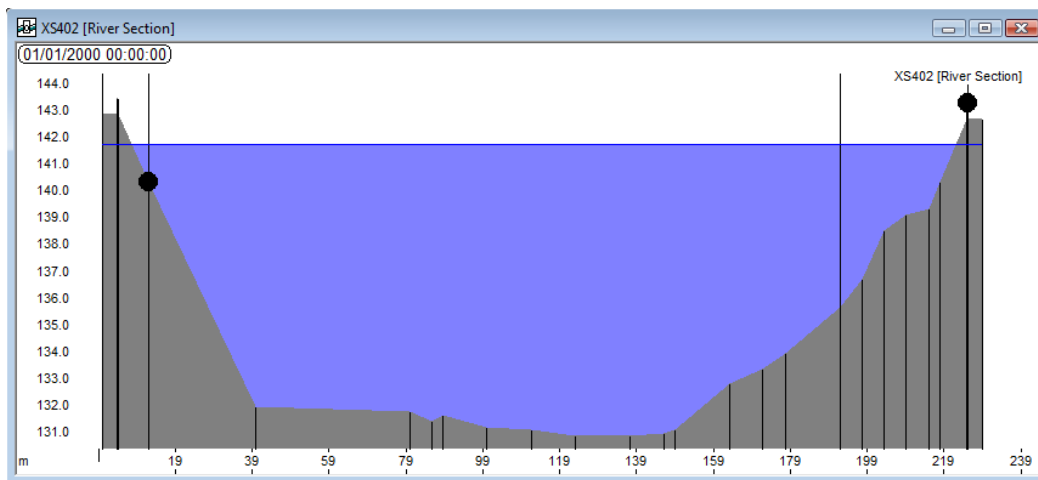Fig. 7 – Water level evolution generated by a typical rain

Fig. 8 – Cross section near the dam

5. Development directions for the PMA

The water management has a huge importance for the population of a country. Water companies have a great responsibility in the communities to provide consumers with high quality water, to meet all environmental requirements and to ensure the safety of their contractors and users. In order to accomplish that, the people involved in this process needs to stay up-to-date to the latest legal framework, newest management instruments, the latest state-of-the art software programs and monitoring techniques in order to improve the iterative process of the adaptive water management. Therefore the current activities and direction of development for the PMA are as follows:

- actualization of the legislation, management systems and crisis situations procedures;
- integration to the web page of a modern WEB – SCADA system to incorporate the aspect of monitoring water parameters, a key factor in adaptive management procedures;
- publication of the results of some case studies that are currently in progress, such as the modeling and simulation of the Middle River Olt, in the context of power generation in order to create a DSS for water management; modeling and simulation of the water supply system for medium size cities like Târgovişte for the development of a DSS for urban water management;
- modeling and simulation of small rivers like Olăneşti for both energy purposes and water supply;
- implementation of a GIS system for water management for the hydrographic basin of River Olt;

- development of the platform facilities in order to give controlled access to the registered users to certain modeling and simulation software managed by Environmental Informatics Laboratory.

6. Conclusions

The high-sped development of the web-based technology and the continuous improvement of the integrated management systems will bring considerable benefits to the water organizations as they will manage better the environment, water quality and occupational health and safety requirements.

The potential users of the WEB platform for adaptive water management are: water domain authorities, commercial societies which act in the field of the integrated water management, the scientific community inside the country and abroad, academic institutions (professors and students), and water consumers.

R E F E R E N C E S

[1]. *C.L.Elzinga, D.W.Salzer, and J. W. Willoughby,* "Measuring & monitoring plant populations". BLM Technical Reference 1730-1. BLM Denver, Colorado, x1 477 pp., 1998.
[2]. *C.S.Holling (ed.),* "Adaptive Environmental Assessment and Management". Chichester: Wiley. ISBN 0-471-99632-7, 1978.
[3]. *N.Lee Kai,* "Compass and Gyroscope: Integrating Science and Politics for the Environment". Washington, D.C.: Island Press. ISBN 1-55963-197-X, 1993.
[4]. *C.Walters,* "Adaptive Management of Renewable Resources". New York: Macmillan. ISBN 0-02-947970-3, 1986.
[5]. *B.K.Williams, R.C. Szaro, C.D. Shapiro,* "Adaptive Management: The U.S. Department of the Interior Technical Guide". US Department of the Interior. ISBN 1-411-31760-2, 2007.
[6]. *Daniela Vasiliu,* "Environmental Informatics". Technical Press House, Bucharest, 2007 (in Romanian)
[7]. *Wallingford Software*, InfoWorks, 2007.
[8]. Washington's Statewide Strategy to Recover Salmon, Section VI. 303 – "Adaptive Management and Monitoring", 2006.