The CatchMod toolbox: easy and guided access to ICT tools for Water Framework Directive implementation

A. van Griensven* and P.A. Vanrolleghem**

*Department of Hydroinformatics and Knowledge Management, UNESCO-IHE Water Education Institute P.O. Box 3015, 2601 DA Delft, The Netherlands (E-mail: *a.vangriensven@unesco-ihe.org*)

**modelEAU - Dépt. Génie Civil, Pavillon Pouliot, Université Laval, Québec, Qc, G1K 7P4, Canada (Email: *Peter@modelEAU.org*)

Abstract Web-based toolboxes are handy tools to inform experienced users of existing software in their disciplines. However, for the implementation of the Water Framework Directive, a much more diverse public (water managers, consultancy firms, scientists, etc.) will ask for a very wide diversity of Information and Communication Technology (ICT) tools. It is obvious that the users of a web-based ICT-toolbox providing all this will not be experts in all of the disciplines and that a toolbox for ICT tools for Water Framework Directive implementation should thus go beyond just making interesting web-links. To deal with this issue, expert knowledge is brought to the users through the incorporation of visitor-geared guidance (materials) in the Harmoni-CA toolbox. Small workshops of expert teams were organized to deliver documents explaining why the tools are important, when they are required and what activity they support/perform, as well as a categorization of the multitude of available tools. An integration of this information in the web-based toolbox helps the users to browse through a toolbox containing tools, reports, guidance documents and interesting links. The Harmoni-CA toolbox thus provides not only a virtual toolbox, but incorporates a virtual expert as well.

Keywords EU legislation; ICT tools; river basin; Water Framework Directive

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Introduction

In the European Union, water management is undergoing changes at the political and legal level. The EU Water Framework Directive (WFD) (EC, 2004a, b) imposes a holistic and iterative approach in order to reach a good status for all waters. Not all member states tend to be familiar with such an approach. An implementation of the WFD is definitely very challenging. To assist the WFD implementation process, the EU provides guidance through the Common Implementation Strategies working groups in the form of guidance documents. In these documents, the importance of public participation, monitoring and modelling and the joint use of them is highlighted, but detailed support on how this should be done is often not provided. On the other hand, there is a large amount of expertise in these issues in the scientific community. A correct design, development and implementation process of the WFD is, at least in part, dependent upon a proper integration of scientific and technological advances (Quevauviller, 2005). This requires that the scientific inputs constantly feed the WFD process. Hence a communication channel between the scientific community and the water policy is needed. To this purpose, the project Harmoni-CA was launched during the 5th framework programme of the European funded research. The objective of Harmoni-CA is to create a forum for unambiguous communication, information exchange and harmonisation of the use and development of methodologies and Information and Communication Technology (ICT) tools supporting the development of integrated river basin management plans (IRBMPs). An important task of Harmoni-CA is the creation of a toolbox to provide easy and guided access to

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approved (benchmarked) ICT-tools necessary for the development of river basin management plans.

The WFD

Purpose of the WFD

The WFD establishes a framework (see Figure 1) for the protection of all waters (including inland surface waters, transitional waters, coastal waters and groundwater) which:

- Prevents further deterioration of, protects and enhances the status of water resources;
- Promotes sustainable water use based on long-term protection of water resources;
- Aims at enhancing protection and improvement of the aquatic environment through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of priority hazardous substances;
- Ensures the progressive reduction of pollution of groundwater and prevents its further pollution;
- Contributes to mitigating the effects of floods and droughts.

Overall, the WFD aims at achieving good water status for all waters by 2015.

Integration: a key concept underlying the WFD

The central concept of the WFD is the concept of integration that is seen as key to the management of water protection within the river basin district:

- Integration of environmental objectives (quality, ecological and quantity objectives);
- Integration of all water resources at the river basin scale;
- Integration of all water uses, functions and values;
- Integration of disciplines, analyses and expertise;
- Integration of water legislation into a common and coherent framework;
- Integration of all significant management and ecological aspects;

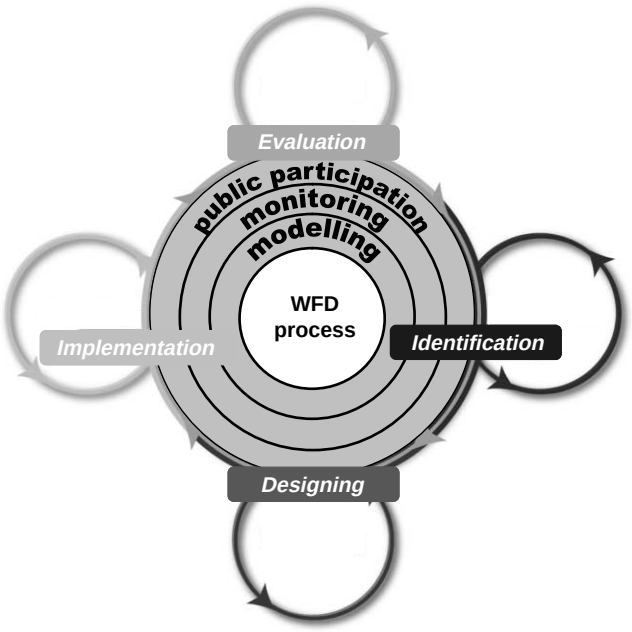

Figure 1 A simplified scheme of the WFD planning process

- Integration of a wide range of measures, including pricing and economic and financial instruments;
- Integration of stakeholders and the civil society in decision making;
- Integration of different decision-making levels that influence water resources and water status;
- Integration of water management among different member states.

The WFD planning process

The WFD planning process basically consists of a sequence of four tasks to be finished by 2015.

- Identification including assessment of present status, analysis of impacts and pressures and establishment of environmental objectives;
- Designing including the set up and analysis of a programme of measures designed to be able to reach the environmental objectives in a cost effective way;
- Implementing the measures;
- Evaluation of the effects of the measures on the environment.

Harmoni-CA: Bridging science and policy

In order to support the implementation of the WFD, the European Commission DG Research has established a cluster on integrated catchment water modelling (CatchMod). The objective of this cluster is the development of common harmonised modelling tools and methodologies for the integrated management of water at river basin or sub-basin scales, including the interface to the coastal zone (see Figure 2).

Within the CatchMod cluster, the project Harmoni-CA has the objective to facilitate communication in between the CatchMod cluster projects and between the cluster and the policy makers. Harmoni-CA is a large-scale concerted action, meaning that it does not carry out a research project, but synthesises available knowledge with the help of

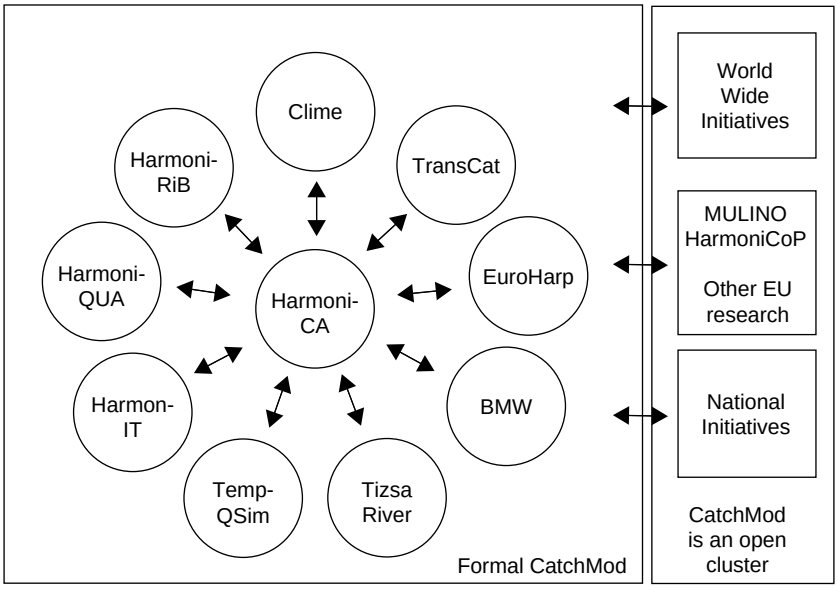

Figure 2 Relation between the Harmoni-CA project and the CatchMod cluster

knowledge providers such as researchers. Typical actions of Harmoni-CA are meetings and workshops, leading to synthesis reports and guidances.

The Harmoni-CA toolbox

The Harmoni-CA toolbox has the challenge to reach out to a diverse public (water managers, consultancy firms, scientists, etc.) with very different needs with regard to ICT tools. Required tools may be modelling codes, model sensitivity analysis tools, calibration tools, model uncertainty tools, tools for the human dimension of river basin management (public participation, socio-economics, decision support), tools for quality assurance of models and modelling, tools for data management and, last but not least, training and case study materials. In addition, the users will not be experts in all of the disciplines. To deal with this issue, the Harmoni-CA toolbox goes beyond just making interesting web-links ICT tools for WFD implementation through the incorporation of user-geared guidance.

The tools

Within the key idea of integration, the toolbox is as broad as possible. Links to tools of all kinds are provided (see Figure 3).

Model codes. For rainfall-runoff modelling, groundwater modelling, groundwater modelling, etc. as well as benchmark reports, model linking tools and web-based applications. Relevant EU funded project product(s) are:

- The River Basin Manager's toolbox with information and tools needed in the implementation of the WFD (http://www.rbm-toolbox.net/). This toolbox has been developed by two different research projects:
  1. Benchmark models for the WFD: BMW;
  2. Relationship between ecological and chemical status of surface waters: REBECCA.
- Harmonised methodologies/tools to quantify nutrient losses from diffuse sources (EUROHARP project, http://euroharp.com);

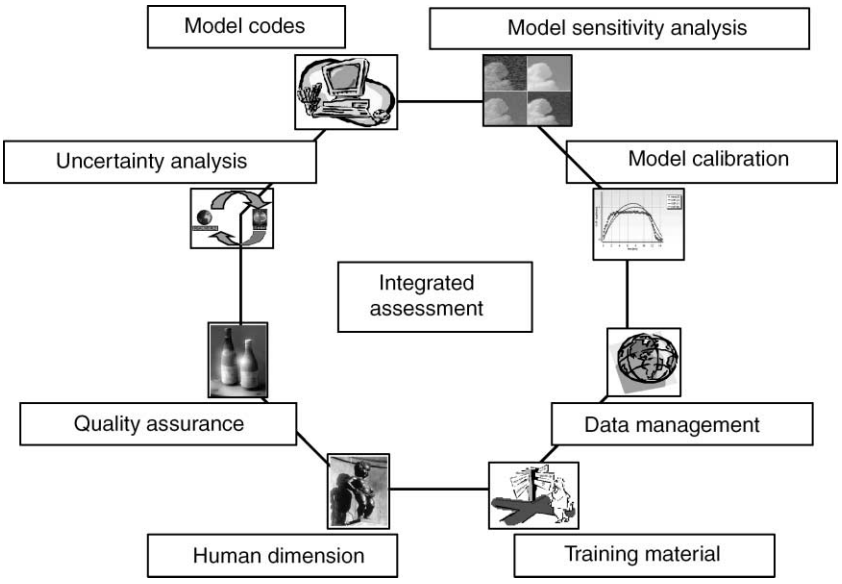

Figure 3 Fields within the Harmoni-CA toolbox

- Evaluation and improvement of water quality models for application to temporary waters in southern European catchments (TempQsim project http://www.tempqsim.net);
- OpenMI (www.openmi.org): Open modelling interface and environment, a standard for model linkage in the water domain (HarmonIT project, http://www.harmoit.org).

Tools for uncertainty analysis. Important EU funded project(s):
- Harmonised techniques and representative river basin data for assessment and use of uncertainty information in integrated water management (HARMONIRIB project, http://www.harmonirib.com);
- Approaches to adaptive water management under uncertainty: (http://www.newater.info/).

Tools for sensitivity analysis and model calibration. Different methodologies as well as linking tools or protocols and web-based applications. EU funded initiatives are:
- Forum for sensitivity analysis (http://sensitivity-analysis.jrc.cec.eu.int/).

Tools for data management. Tools for data bases, optimal experimental design, data assimilation, signal processing and time series analysis as well as links to data sources. Relevant EU funded project product(s) are:
- Harmonised techniques and representative river basin data for assessment and use of uncertainty information in integrated water management (HARMONIRIB project, http://www.harmonirib.com).

Tools for quality assurance. Modelling protocols, guidance for good modelling practices and model quality evaluation. Relevant EU funded project product(s) are:
- The software MoST provides a user-friendly guidance and quality assurance framework that will contribute towards enhancing the credibility of catchment and river basin modelling. It prompts users with the appropriate "next step" in the modelling process and provides an audit trial to check previous decisions (HarmoniQua project http://harmoniqua.wau.nl).

Tools for the human dimension of river basin management. Public participation, socio-economics, decision support and legal aspects. Important EU funded project(s):
- A handbook on public participation (HarmoniCoP, http://www.harmonicop.info).

Training material. Links to training documents, workshops/training courses, web-based courses and test cases. Relevant EU funded project product(s) are:
- Real-life scale integrated catchment models for supporting water- and environmental management decisions (Tisza river project, http://www.tiszariver.com);
- Integrated water management of transboundary catchments (TRANSCAT, http://www.transcat-project.net);
- Pilot river basins: testing of the EU guidance documents (http://viso.ei.jrc.it/wfd_prb):
  - Scaldit (Scheldt) (http://www.scaldit.org);
  - Odense pilot river basin (http://www.odenseprb.fyns-amt.dk/wm124598).
- International river basin commission websites:
  - Rhine basin (http://www.iksr.org);
  - Meuse basin (http://www.meuse-maas.be/);
  - Scheldt basin (http://www.isc-cie.com).
- Climate and lake impacts in Europe: CLIME (http://www.water.hut.fi/clime).

Tools for integrated assessment. Tools for integration of different kinds of information to support policy. Relevant EU funded project product(s) are:

- Multi-sectoral, integrated and operational decision support system for sustainable use of water resources at the catchment scale (MULINO, http://siti.feem.it/mulino/index1.htm);
- Approaches to adaptive water management under uncertainty (Newater project http://www.newater.info).

Guidance

Expert knowledge is brought to the users through the incorporation of guidance (materials) in the Harmoni-CA toolbox. Small workshops of expert teams were organised to deliver Harmoni-CA guidance documents explaining why the tools are important, when they are required and what activity they support/perform, as well as a categorization of the multitude of available tools. The guidance documents aim at being as broad, complete, integrative, multi-disciplinary as possible by choosing authors with different backgrounds and visions. Also important is that the language is generally understandable for people with different backgrounds. External reviewers are sought and the guidance document as well as the peer reviews are presented to the public using the Harmoni-CA/Catchmod workshops and conferences.

For instance, the first Harmoni-CA guidance on uncertainty analysis (Refsgaard et al., 2005) provides general guidance on how to deal with uncertainties during the WFD modelling process. An integration of this information in the web-based toolbox helps the users to browse through toolbox containing tools, reports, guidance documents and interesting links (Figure 4). This Harmoni-CA guidance presents the following methodologies all dealing with uncertainties in one or the other way (Figure 5):

1. Data uncertainty
2. Error propagation equations
3. Expert elicitation
4. Extended peer review (review by stakeholders)
5. Inverse modelling (parameter estimation)

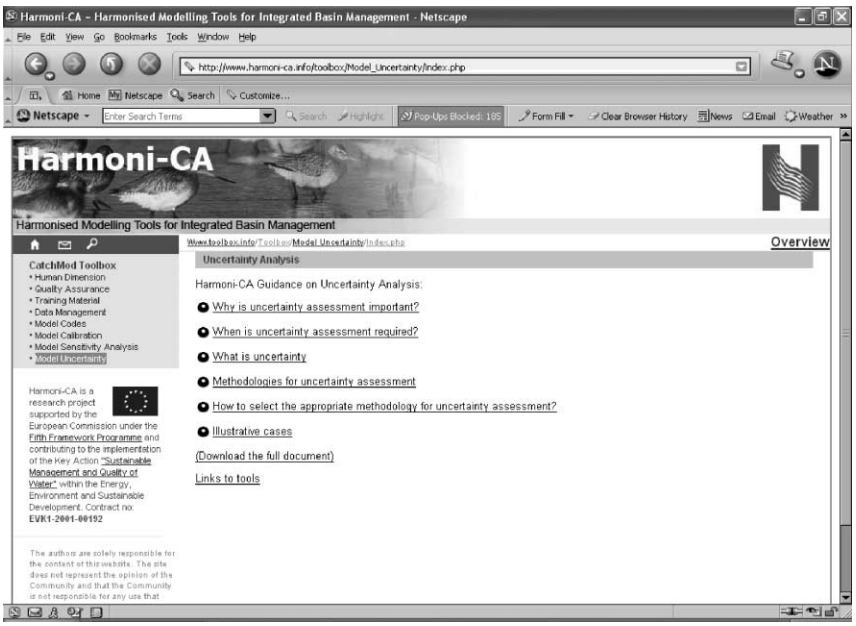

Figure 4 Incorporation of Harmoni-CA guidance on uncertainty analysis into the toolbox

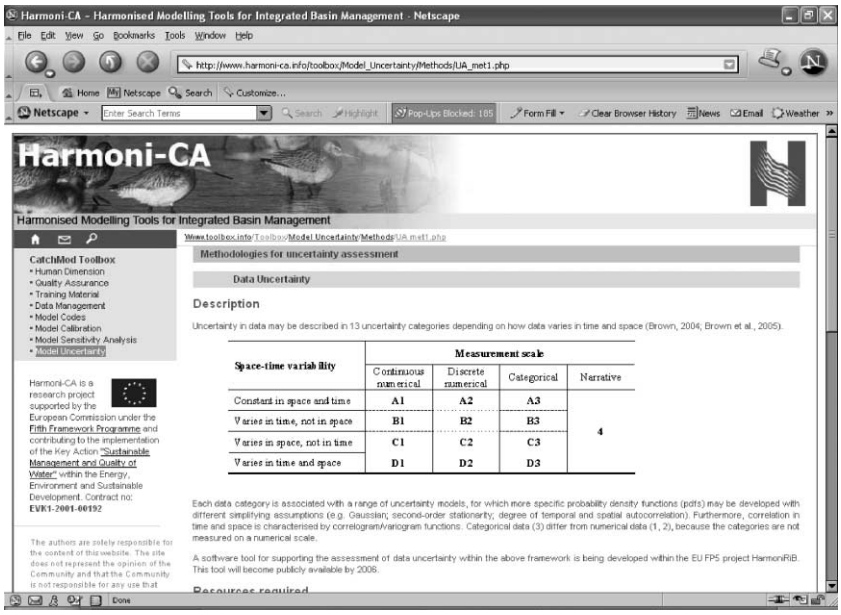

Figure 5 Description of the methodology "data uncertainty" within the field of uncertainty analysis

6. Inverse modelling (predictive uncertainty)
7. Monte Carlo analysis
8. Multiple model simulation
9. NUSAP
10. Quality assurance
11. Scenario analysis
12. Sensitivity analysis
13. Stakeholder involvement
14. Uncertainty matrix

Guidance on how to select the proper uncertainty-related methodology is provided according to the particular modelling process and level of ambition or according to the source and the type of uncertainty one is dealing with. Some illustrative cases also provide help in dealing with uncertainty. The Harmoni-CA toolbox thus provides not only a virtual toolbox, but incorporates a virtual expert as well.

Conclusions

The Harmoni-CA toolbox provides water managers, consultancy firms, scientists, and others access and guidance towards tools that are of use in the implementation of the WFD. In this way, expert knowledge, new developed tools and experience are transferred from the scientific community towards the general public or professionals working in the field of water policy. Such assistance allows better public participation, better use of models, better inter-disciplinary understanding, and will eventually lead to better decision making.

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