

You are now reading the third Newsletter from the EUROHARP project. We are very much aware of our important role in the information dissemination process. Consequently we allocate considerable project resources to inform about our activities and results (c.f. also the

EUROHARP web-site). The editorial profile is to present samples of the results emerging from the project, as well as information from the ongoing work in the project. This third Newsletter focuses also on how research results become useful for decision-makers.



EUROHARP is a research project supported by the European Commission under the Fifth Framework Programme and contributing to the implementation of the Key Action "Sustainable Management and Quality of Water" within the Energy, Environment and Sustainable Development Programme. Contract no: EVK1-CT-2001-00096.

The primary objectives of EUROHARP are to:

- Provide end-users (national and international European environmental policy-makers) with a thorough scientific evaluation of nine contemporary quantification tools and their ability to estimate diffuse nutrient (N, P) losses to surface freshwater systems and coastal waters, and thereby facilitate the implementation of the EC Water Framework Directive.
- Develop an electronic decision support system (toolbox) for the identification of benchmarking methodologies with respect to both costs and benefits, for the quantification of diffuse nutrient losses under different environmental conditions across Europe.

In this issue:

<i>Bridging the Gap.....</i>	<i>1</i>
<i>Important Project Events.....</i>	<i>2</i>
<i>The EUROHARP Comprehensive Dissemination Overview.....</i>	<i>3</i>
<i>Work on Retention and Testing of Model Applicability.....</i>	<i>4</i>
<i>Two Birds - One Stone; Science into Policy through a Targeted Toolbox</i>	<i>4</i>

<i>Comparison of HBV-N and MONERIS in Sweden and Germany.....</i>	<i>5</i>
<i>Modelling Daily Water Flow in the EUROHARP Catchments.....</i>	<i>7</i>
<i>Invited Article: Water quality modelling in dry streams - European improvement of water management tools for semi arid river basins.....</i>	<i>7</i>
<i>Scientific Conferences.....</i>	<i>10</i>

Bridging the Gap

Two and a half years of the EUROHARP project have come to an end. Now the time has come that all researchers enjoy, the dissemination-publication part of a project. In the forthcoming 18 months 'EUROHARP scientists' will be 'harvesting' from what we have done in terms of:

Developing data requirements for models, Data collection linked to Administrative information, Lakes, Rivers, Soil, Weather, Surface Water Quality and Quantity observations, Land Cover, Land Management, Aquifer, Groundwater, Driftgeology, Agricultural sources, Precipitation pattern, Data organising, Catchment database, The standalone tool-GISViewer, Catchment Information Repository, Management reports, Periodic reports, Progress reports, Newsletters, Literature reviews and Evaluations, Technical

Implementation Plan, Web-site, Retention estimates in rivers and lakes, Trend analysis, Source Apportionment, Model parameterisation, discretisation and calibration, Model application throughout Europe.

However, it is not only topics of purely scientific value that will emanate from the EUROHARP project. I strongly believe that from many of the numerous activities that have been, are and will be carried out within the EUROHARP project framework, *there are many issues that are of interest and use not only for researchers, but also for decision-makers/end-users.*

Today there is an increasingly strong voiced opinion towards/plea for optimisation of research activities, in particular linked to their appropriateness and applicability for facilitating the implementation of national and international policy instruments. The Water Framework Directive is in a

way unifying research and policy making. However, substantial efforts still need to be made, but there is a feeling that something is 'on its way'.

In order to support the implementation of the Water Framework Directive, the European Commission has, *inter alia*, established a cluster on Integrated Catchment Water Modelling (CATCHMOD). The objective of this cluster is the development of common harmonised modelling tools for the integrated management of water at river basin or sub-basin scales, including the interface to the coastal zone. This in order to achieve a selected number of «European Benchmark Models» for the various integrated water management requirements at that scale. It requires a close co-operation and synergy between different ongoing EC projects funded under Key Action that address comparable and complementary issues and research questions.

Many of the projects in the CATCHMOD cluster have clearly the potential of responding to the plea for making the results useful for decision-making. In this process the EC funded concerted action project Harmoni-CA should play an important role. Harmoni-CA is a large-scale concerted action (thus it does not carry out research), but synthesises available knowledge within the various research projects (not only CATCHMOD projects). It organises meetings/workshops, to facilitate information flow and dissemination. Read more about harmoni-CA on <http://www.harmoni-ca.info>.

There are, however, a number of Directives under the umbrella of the WFD. Amongst those is the Nitrates Directive. In 1991, the EC adopted the Nitrates Directive (91/676/EC). It is an environmental measure designed to reduce water pollution by nitrate from agricultural sources and to prevent such pollution occurring in the future. The Directive requires Member States to implement one of the following two options:

1. To apply agricultural Action Programme measures throughout their whole territory or;
2. To apply Action Programme measures within designated Nitrates Vulnerable Zones (NVZs)

The EC web-site

(http://europa.eu.int/comm/environment/water/water-nitrates/index_en.html)

provide further details on the Directive, including the full text of the Directive and a report on how the Directive has been implemented across Europe.

The reason why I am mentioning this Directive in particular is that we believe that one of the main deliverables of the EUROHARP project, the EUROHARP toolbox, could be one important tool for facilitating the implementation of the Nitrates Directive. The EUROHARP Toolbox is intended to provide users with a system for selecting scientifically defensible quantification tools under various types of environments, and give them access to key parameters needed for quantifying diffuse nutrient pollution. Since EUROHARP Newsletter number 2 a number of activities and decisions have been taken towards targeting the Nitrates Directive when developing the EUROHARP Toolbox (see page 4).

However, what this editorial should convey in terms of main message for you as the reader is that the integration of research and policy represents a tremendous challenge both for the research and management communities. I believe the outcome will be successful as long as we talk the same language.

Finally, I would like to draw your attention to the article of our Guest writer Dr Jochen Froebich. The issue of the EC funded project tempQsim that he is co-ordinating is linked to temporary waters in the Mediterranean region. I had the pleasure of attending a tempQsim project meeting this winter in Cagliari and discovered the fascinating world of temporary waters that represent a tremendous scientific and management challenge.

I wish you all some nice summer holidays.

Stig A. Borgvang

EUROHARP Co-ordinator



Steering Committee meeting in Italy, November 2003.

Important Project Events

The Third EUROHARP All Partners Meeting

The Third EUROHARP All Partners meeting took place in Carmona in Spain 9-10 March 2004. It was attended by all EUROHARP project partners. It was hosted by Oficina Técnica del Corredor Verde del Guadiamar (OTCV) and chaired by Stig A. Borgvang, the EUROHARP project co-ordinator. Furthermore Dr Zissimos Vergos from DG Research of the EC attended the first day of meeting. The meeting was opened by Mr Hermelindo Castro, General Director of Network of Protected Natural Areas of Andalusia, who welcomed project partners to Carmona and Andalusia.

During the meeting project partners were able to review project progress, share experiences of data collection and modelling, and discuss work of the forthcoming intersessional period. The importance of maintaining a good

and continuous dialogue between catchment data holders and modellers was highlighted as a critical element in our pan-European project with a large number of participants involved. Furthermore, it was to convey to international and national policy makers and catchment managers project concerns linked to data availability and data organisation. The ongoing work on the implementation of the Nitrates directive with regard to Action Programmes and the forthcoming work linked to River Basin Management Plans require accurate estimates of in particular nutrient losses from agricultural activities. However, the first two years of EUROHARP activities have shown that the data availability for such modelling purposes varies considerably throughout Europe. In that respect there is no 'perfect data catchment' even amongst the carefully selected EUROHARP catchments. Consequently, there is likely to be a number of problems to be solved in this respect in order to successfully implement the relevant policy instruments.

As has been the case since the onset of the EUROHARP project, there was a strong focus in discussions on possible links and synergies between EUROHARP project activities and relevant project outputs for in particular EC relevant policy instruments (a document on the links between the EUROHARP project and the links to the Nitrates and Water Framework Directives has been continuously updated since January 2003). The importance of this issue was emphasised even stronger as a result of the presentation made by Dr Zissimos Vergos. This issue has been and will continue to be on the agenda for the EUROHARP project.



The EUROHARP project group in Carmona, Spain, March 2004.



Presentations of model results. Here Antonio Lo Porto from IRSA-CNR, presenting results from the SWAT modelling.

The EUROHARP Comprehensive Dissemination Overview

On the EUROHARP web-site, all dissemination results and presentations made by partners are made available in the EUROHARP Comprehensive Dissemination Overview- see picture below. It shows the panoply of activities undertaken and the wide range of dissemination routes. Furthermore, it allows you to download any report, presentation or article you would like to know more about.

:: EUROHARP Comprehensive Dissemination Overview

EUROHARP REPORTS
PROCEEDINGS
PUBLICATIONS
POSTERS
PRESENTATIONS
PROGRESS REPORTS TO END-USERS
NEWSLETTERS

LIST ALL:

Type	Date of issue	Reference
Poster/ Proceedings	September 2002	Kronvang, B., Jensen, J.P., Andersen, T., Arheimer, B., Behrendt, H., Hejzlar, J., Boers, P. & Anthony, S. 2002. How can nutrient retention in European catchments be quantified? Poster contribution presented at the 6th Diffuse Pollution Conference Amsterdam, The Netherlands 30 September-4 October 2002, Proceedings p. 606-607.
Presentation	November 2002	Kronvang, B. 2002. EUROHARP. Oral contribution at the 1st Danish Conference on Implementation of the Water Framework Directive. Svendborg, Denmark, 18-19 November, 2002.
Progress Report to End-users	November 2002	Borgvang, S.A. & Selvik, J.S. Progress Report to OSPAR EUC 2002
Presentation	March 2003	Selvik, J.R. 2003. EUROHARP- Towards European Harmonised Procedures for Quantification of Nutrient Losses from Diffuse Sources. Presentation at Harmoni-Catchment

:: EUROHARP Comprehensive Dissemination Overview

EUROHARP REPORTS
< back to menu

Report No	Date of Issue	Reference
EUROHARP Report	December 2003	Schoumans, O.F. & Silgram, M. (eds.), 2003. "Review and literature evaluation of quantification tools for the assessment of nutrient losses at catchment scale. EUROHARP report 3-2003, NIVA report SNV 4739-2003, ISBN 82-597-4411-5, Oslo, Norway, 120 pp.
EUROHARP Report	December 2003	Kronvang, B., Larsen, S.E., Jensen, J.P. & Andersen H.E., 2003. Catchment Report: River Odense, Denmark. Trend Analysis, Retention and Source Apportionment. EUROHARP report 2-2003, NIVA Report SNV 4740-2003, ISBN 82-597-4412-3, Oslo, Norway 20pp.

Work on Retention and Testing of Model Applicability

By Brian Kronvang, NERI, Denmark

The EUROHARP Expert Group on Nutrient Retention has developed an assistant tool (EUROHARP-NUTRET) for catchment managers. It enables managers to calculate nutrient retention in rivers, lakes, reservoirs and wetlands using standardised methods. EUROHARP-NUTRET contains several different Tiers for calculation of nutrient retention; the higher the Tier the higher are the requirements for input data from the catchment manager and (most likely) the better the results. The third version of the EUROHARP-NUTRET will be in a final testing phase during this summer and the fourth version will be downloadable from the EUROHARP web-site as from September 2004.

The EUROHARP Expert Group on Nutrient Retention has also produced a draft of a Nutrient Retention Handbook that includes two parts, viz. Part A that is a Manual for the EUROHARP-NUTRET Software and Part B that is a scientific review on Nutrient Retention in lakes, rivers and wetlands. The final version of the Nutrient Retention Handbook will be published in September 2004 and made available on the EUROHARP web-site.

The EUROHARP catchment data owners and modellers met in Carmona, Spain for the second Work Package meeting in March 2004 for discussion of progress and results of project work. The results of the Source Apportionment application in all 17 catchments, together with trend analysis and nutrient retention calculations are published for all 17 EUROHARP catchments in 3 posters which can be downloaded from the EUROHARP web-site. Half of the seventeen catchment reports, including the results of source apportionment of nutrients, nutrient retention and nutrient trends in the EUROHARP catchments, are now finalised and sent for final comments to the respective catchment data owners. The application of the other 8 EUROHARP Quantification Tools (QTs) are in progress.

The first part of the modelling undertaken within the EUROHARP project, i.e. the intercomparison of the performances and applicability of the nine EUROHARP models (QTs), tested thoroughly on a subset of three core catchments covering a north-south climatic gradient in Europe soon comes to an end. It is followed by the current 'all over Europe' modelling conducted (for each QT) in at least three catchments in Europe. The aim of this part of the project is to analyse the availability of river basin data and validate the applicability of each QT. The final deadline for completing this QT modelling is December 2004. A standardised reporting format for modelling results have been produced and QT-owners will make short catchment reports for submission to catchment data owners on their modelling results.

Two Birds - One Stone; Science into Policy through a Targeted Toolbox

By Nils Vagstad, Stig A. Borgvang, Tor Haakon Bakken, NIVA and Helen French, Jordforsk

The transfer of scientific results into manageable tools for potential end-users and decision makers is vital for the scientific world in order 'to be useful' for the society. The contribution to the process of bridging the gap between research and the policy linked management level has been a key priority issue for the EUROHARP project from the onset (e.g. by the establishment of end-user forum, drafting of progress reports to end-user organisations). The main EUROHARP project deliverables will be integrated into a Toolbox that is aimed at facilitating more efficient and harmonised approaches across Europe in terms of quantifying and managing nutrient losses from diffuse sources in the context of integrated water resource management.

However, such a Toolbox needs to be targeted in its planning and development phases in order to be adequate and useful. This requires a clear understanding of *who* the end-users are, *why*, *how* and *when* the Toolbox is being developed (i.e. for what purposes). Thus, the initial stage of the EUROHARP toolbox development has included a careful analysis of relevant policy instruments, such as the Nitrates Directive (ND) and the Water Framework Directive (WFD) to assess whether potential end-users need and are likely to find the Toolbox useful and actually are likely to make use of it.



Furthermore, it is of utmost importance to analyse and assess how such a EUROHARP Toolbox may provide assistance to and facilitate the work of different end-users involved in the implementation of these directives.

At the current stage of the Toolbox development particular attention is devoted to the Nitrates Directive. This Directive includes two major activities in which the application of modelling tools may be relevant, i.e.

- The quantification of diffuse pressures in the process of designation of Nitrate Vulnerable Zones (NVZ) based on the two main criteria laid down in the Directive (nitrate concentrations and eutrophication)
- The scenario analysis of changed level of pressures in the process of developing an Action Plan addressing relevant measures within the NVZs, in order to reduce the agricultural contribution to

eutrophication and elevated nitrate concentrations in surface- and ground waters.

The ND is under the umbrella of the WFD. Designated NVZs under the ND will be given the status of “protected areas” within the WFD (Article 6 and Annex IV, article 1 (iv)). In this way the Action Plan under the ND will be part of the River Basin Management Plan under the WFD.

The key issue for the further Toolbox development process within the EUROHARP project is to fully understand and assess the possible role of such a Toolbox based on the concrete tasks to be undertaken in the two activities mentioned above. In principle, these tasks may be defined in three stages:

- The preparation of the scientific background material and data in order to support decisions linked to the two activities (researchers and consultants).
- The decisions at local and national levels (NVZs and Action Plans linked to these zones)
- The co-ordination, harmonisation and control at EC level.

The latter stage is of particular importance, because there is a risk that different approaches and lack of harmonisation at national level may impede the successful implementation at European level. The possible role of the EUROHARP Toolbox in linking the three stages in a way that can assure the needed minimum of harmonisation across Europe is therefore a key issue in the further process.

It is important to note that there is no mandate from the EC to develop a Nitrates Directive targeted tool within the EUROHARP project. However, after 2 ½ years of project activities, it appears more and more evident that the strong emphasis on agriculture activities/nutrient losses from diffuse sources within EUROHARP project activities is only ‘matched’ by a similar focus on agriculture stipulated in the Nitrates Directive. Therefore there may be scope for a further dialogue with those responsible for the Nitrates Directive at EC and/or national levels in order to optimise the EUROHARP Toolbox concept for Nitrates Directive implementation purposes. A ‘lucky outcome’ of such a dialogue would ensure that the resources allocated for the development of the Toolbox would bear fruits, outlive the project and benefit the integration of research and policy.

We will keep you updated on the further development of the EUROHARP Toolbox and also about the possible synergies with activities within in particular the BMW project, co-ordinated by the Finnish institute SYKE.



Figure showing screendumps from the preliminary prototype of the EUROHARP Toolbox.

Comparison of HBV-N and MONERIS in Sweden and Germany

By Fogelberg, S.1, Arheimer, B. 1, Venohr, M. 2 and Behrendt, H. 2

¹ Swedish Meteorological and Hydrological Institute (SMHI), SE-601 76 Norrköping, Sweden, e-mail: safia.fogelberg@smhi.se

² Institute of Freshwater Ecology and Inland Fisheries, Department of Lowland Rivers and Shallow Lakes, Müggelseedamm 310, D-12561 Berlin, Germany.

In addition to the work being performed in the EUROHARP project, SMHI and IGB have compared the HBV-N and MONERIS models with regard to nitrogen flow and retention. Differences and similarities in model results were highlighted and evaluated for to models; the dynamic, conceptual, Swedish HBV-N model (Arheimer and Brandt, 1998) and the quasi static, German, MONERIS model (Behrendt et al., 2000). The models were applied, evaluated and compared in two German (Neckar and Warnow) and two Swedish (Rönneå and Motala Ström) catchments of various size and physiography (see Figure 1).

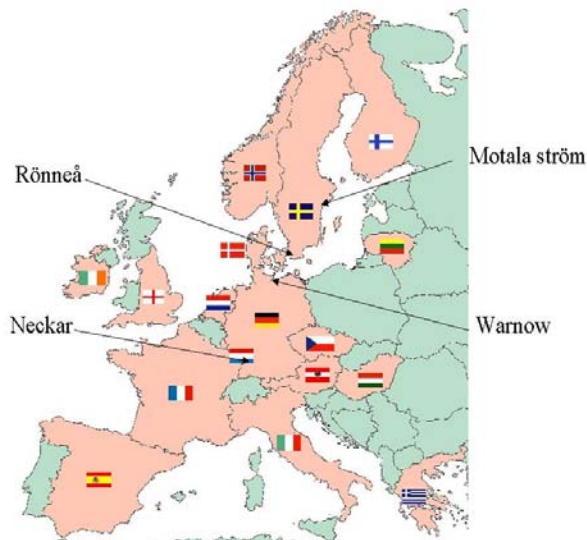


Figure 1. Test catchments: Neckar and Warnow (Germany)-Rönnå and Motala Ström (Sweden).

Model performance

The two models show more or less similar accuracy between measured and calculated load; the deviation is less than 50% in almost all sub-catchments (Table. 1). The poorest agreement between measured and calculated load and concentration for MONERIS is found in the Swedish catchments. The reason for this could partly be the rather coarse nitrogen surplus data used in the calculations. Nitrogen surplus is one of the most sensitive input data for MONERIS and information on nitrogen surplus was only available at county level for the Swedish catchments.

Table 1. Deviation between measured and calculated load and concentration for both MONERIS and HBV-N. In addition, R2 (Nash and Sutcliffe, 1970) and relative volume error for water flow are calculated for HBV-N.

Catchment	MONERIS conc. (%)	HBV-N MONERIS conc. (%)	MONERIS load (%)	HBV-N load (%)	HBV-N R2, water discharge	HBV-N volume error, water flow (%)
Warnow	19.0	36.6	19.0	38.9	0.68	2
Neckar	12.5	20.1	12.5	18.4	0.88	-5
Rönnå	29.6	27.7	29.6	30.5	0.84	1
Motala ström	50.5	32.5	50.5	25.7	0.79	0.2

The poorest agreement between measured and calculated load and concentration for HBV-N occurred in the Warnow catchment. One reason for this may be that the driving data for the hydrology, the precipitation data, were only available in a coarse grid format with one grid cell covering the whole of the Warnow catchment. This means that the same amount of precipitation was applied in all sub-catchments. Coarse resolution precipitation data will strongly affect the calculated water flow (Table 2); this in turns affects the calculated loads and concentrations. Except from the Warnow catchment, HBV-N simulates annual average load

and concentration with a deviation of about 30% or less. MONERIS seems to simulate both load and concentration better in the German catchments than in the Swedish catchments and the deviations are less than 30% in all catchments, except from the Motala ström catchment

Model output of source apportionment and retention

One difference in model output is that with HBV-N source apportionment is done for various pollutants, while for MONERIS it is related to the various pathways. For all catchments, the largest source of nitrogen calculated with HBV-N is from arable land. Other large contributors are forest, atmospheric deposition and urban point sources. MONERIS identifies groundwater and tile drainage to be the dominant pathways. Other large contributors are atmospheric deposition and WWTPs.

Another major difference between the models is the way they define 'gross load'. 'Gross load' for HBV-N means the losses from the root zone together with discharges from point sources. 'Gross load' for MONERIS, on the other hand, means the total inputs from all pathways to the surface water system. The difference is the possible retention in the unsaturated zone of the soil and in groundwater, which is considered explicitly in the HBV-N model together with retention in streams. This difference makes it complicated to compare results from the two models in detail. However, in Swedish applications with HBV-N, the river retention was found to be very low (3%) and is therefore often neglected (Arheimer and Brandt, 1998). Thus, it can be assumed that most of the groundwater/river retention calculated with HBV-N basically refers to groundwater retention.

Based on this assumption it would be possible to compare the lake retention in HBV-N with the surface water retention in MONERIS. The retention calculated by MONERIS in tonnes/yr is then higher in all catchments. The different retention approaches of the models and the difference in calculated inputs into the surface waters are the main reasons for the different retention estimates. In the HBV-N model, lake retention is dependent on the nitrogen concentration and residence time in the lake. In the MONERIS model, on the contrary, the retention rate in rivers and lakes is dependent on the total water surface area and the water flow (Behrendt et al., 2000).

Acknowledgement

Thanks to all who have contributed to the EUROHARP database with catchment information.

References

- Arheimer, B. and Brandt, M. 1998. Modelling Nitrogen Transport and retention in the Catchments of southern Sweden. *Ambio* 27, 471-480.
- Behrendt, H., Huber, P., Kornmilch, M., Opitz, D., Schmoll, O., Scholz, G. and Uebe, R. 2000. Nutrient Emissions into River Basins of Germany. Report UBA-FB, Berlin.
- Nash, J. E., and Sutcliffe, J. V. (1970) River flow forecasting through conceptual models. Part I – A discussion of principles, *J. Hydrol.* 10:282-290.

Modelling Daily Water Flow in the EUROHARP Catchments

By Berit Arheimer and Sofia Fogelberg

Swedish Meteorological and Hydrological Institute (SMHI), SE-601 76 Norrköping, Sweden. e-mail: berit.arheimer@smhi.se

The HBV model (Bergström, 1976; Lindström et al., 1997) is a rainfall-runoff model, which includes conceptual numerical descriptions of hydrological processes at catchment scale. The model is dynamic and normally applied with a daily time-step. It was developed at SMHI during the early 1970's and it has since then been applied in more than 40 countries all over the world. In order to investigate the performance of the HBV model under different hydrological and climate conditions, the model has been applied to 12 of the EUROHARP catchments, and 2 additional German catchments. The aim is to model the rest of the EUROHARP catchments by the end of 2004 (5 more catchments).

The EUROHARP data were used for model set-up in each catchment, except for the German catchments where model input data was available from Fogelberg (2003). However, for some catchments, the database was extended with synoptic meteorological data from ECOMET to receive complete precipitation time-series. Model performance was evaluated by using the explained variance by Nash and Sutcliffe (1970) and the relative volume error.

For most catchments, the HBV model gave reasonable accuracy compared to observed time-series, with R2 above 0.7 and a relative volume error less than 5% (Table 1). The model did not capture the flow dynamics in the southernmost catchments of Greece and Spain, which resulted in low R2 values (0.5 and 0.59, respectively). These catchments have a quick rainfall-runoff response due to absence of lakes, steep topography or sparse vegetation cover, which made it difficult to capture the recessions after peak flows. The precipitation pattern may also be more intense and local, and probably not fully included in the meteorological observations of rainfall data for the whole catchment.

For the German river Warnow it also proved difficult to find representative precipitation data and the present modelling was based on a 1° grid, in such a way that the whole catchment was part of one single grid. Also in the French catchment the low accuracy with observations can be related to poor representativeness of weather data. All the meteorological stations are located along the coast, outside of the catchment. No data were available from stations located inland nearby or inside the catchment, although there is a strong precipitation gradient in this part of western France. For the Lithuanian catchment, on the other hand, the low accuracy with observations is related to limited information of observed water flow as only monthly measurements were available. This means that daily model results are compared to the more smooth dynamics of monthly values.

The results from this study show that the HBV model performance is of good accuracy, especially in northern and middle Europe. Furthermore that it may be difficult to capture the peakiness of the flow in the southernmost countries. Hence, the HBV model could be a useful tool for modelling river discharge throughout Europe provided that

the precipitation data are of good quality and have sufficient spatial resolution.

Table 1. Results from HBV modelling of water flow in 14 European catchments.

Country	R2	Rel. volume error	Country	R2	Rel. volume error
Denmark	0.82	0.03	Spain	0.59	0.15
Sweden	0.84	0.01	Germany, River Neckar	0.88	-0.05
Norway	0.82	0.0001	Germany, River Warnow	0.64	-0.01
Greece*	0.51 0.50	-0.09 -0.08	Lithuania**	0.66	-0.002
England	0.84	0.01	France	0.57	0.001
Czech Republic	0.73	0.02	Luxembourg	0.82	-0.0004
Austria	0.73	-0.0003	Ireland	0.84	0.03

* Two time-periods were modelled for Greece due to a sudden lap in observed time-series.

** Only monthly observations of river discharge available for the Lithuanian catchment.

Acknowledgement

Thanks to all who have contributed to the EUROHARP database with catchment information.

References

- Bergström, S. (1976): Development and application of a conceptual runoff model for Scandinavian catchments. Ph.D. Thesis. SMHI Reports RHO No. 7, Norrköping
- Fogelberg, S. (2003). Modelling Nitrogen Retention at the Catchment scale- Comparison between HBV-N and MONERIS. Master thesis, Uppsala University School of Engineering.
- Lindström, G., Johansson, B., Persson, M., Gardelin, M., and Bergström, S. (1997). Development and test of the distributed HBV-96 hydrological model, J. Hydrol. 201: 272-288.
- Nash, J. E., and Sutcliffe, J. V. (1970) River flow forecasting through conceptual models. Part I – A discussion of principles, J. Hydrol. 10:282-290.

Invited Article: Water quality modelling in dry streams - European improvement of water management tools for semi arid river basins

By Jochen Froebrich

Water quality protection and management section
University of Hannover, Am Kleinen Felde 30,
D-30167 Hannover, Germany, E-mail: jofr@tempQsim.net

Temporary waters are widespread in the Mediterranean, as well as in many other semi-arid regions world wide. Their special hydrology makes them particularly sensitive to anthropogenic pressure. At the same time the availability of safe water resources is critical for a sustainable development.

The main factors which distinguish their behaviour are firstly the no surface water flow during dry seasons, which may last from several months to several years, and secondly the intense run-off associated with heavy storms which often occur shortly after the end of a dry period. In extreme cases, the river system only flows during and immediately after exceptional storms.

Up to now, water quality models for water management have been predominantly developed for streams with permanent flow. Nevertheless increasing water scarcity, which is reflected also in the EU Water Directive, requires a closer consideration of temporary rivers.

The tempQsim project aims for the first time to make specific improvements to water quality models for application to temporary streams. TempQsim is, as EUROHARP, part of the Catchmod Cluster which will improve forecasts of pollution dynamics and help to plan efficient protection for scarce surface water resources. Some Research Institutes (JRC, IRSA) are involved as partners in both projects, strengthening synergies and co-operation between the projects.

After installation of a number of automatic sampling stations in eight study catchments in Portugal, Spain, Italy, South-France, Greece and Bulgaria to supplement existing data, the first new measurements of water quality parameters have been achieved during the floods in the autumn and winter of 2003/2004. New model developments are based on selected water quality models, which have been applied and evaluated in the eight catchments of the project.



Figure 1. Characteristic appearance of temporary streams during the dry period (Rambla Murta, South Spain).

Some of the main features of this conceptual development have already been identified and first results have been compared during the Mid-term review in Sardinia, March 2004.

Hydrology

The application of standard water quality models to semi-arid areas runs into two main problems:

- When and where does the runoff occur?
- What is the origin of the run-off?

The occurrence of run-off is directly associated with the water quality. Even in case of precipitation, there are events which do not lead to run-off either in the entire basin or in parts of it. Without through run-off there is little transportation and the period between runoff events is characterised by accumulation of deposits as 'slugs' of material both in the land phase and within the channelway. If run-off occurs only in restricted parts of the basin, accumulated mass transport may be translated within the stream channel, but will not reach the outlet. This means that the accumulation period will be extended and lead to an increase in readily mobilised sediment, leading to elevated suspended matter concentration in the subsequent flood event.

Another important consideration is whether run-off is created by overland or by subsurface flow. Francesc Gallart, one of the leading hydrologist in the project, has presented results showing that in which same model calibration quality could be achieved by very different choices of the subsurface flow component. This uncertainty can be partially resolved by using groundwater data in combination with outflow discharge, and has a dramatic impact on the simulation of nitrate leaching versus the more erosive transport of particulate organic matter and phosphorus.

Suspended sediment

Improvements in understanding the role of particulate matter form an important part of the tempQsim. Output of sediment-bound pollutants is strongly linked to detachment of sediment, particularly from agricultural areas within the catchment. In semi-arid areas, there is an additional major contribution from re-entrainment of channel bed material, particularly in 'first flush' events. Our initial data from the floods of autumn 2003 reveal considerable diversity in both dynamics and measured concentrations. Mike Kirkby and colleagues from University of Leeds are providing a link to previous EU-funded work in the Medalus and other projects, focusing on large scale estimation of erosion loss from catchment areas.



Figure 2. Erosion from irrigation areas, Rambla Albujo, (Spain), Photo: S. Kretschmer.

A number of Mediterranean catchments, including two of our test catchments (Vène and Albujo), deliver water and sediment to coastal lagoons, which retain pollutants from feeder catchments more than the open sea. The input of organic matter and its resulting oxygen consumption is,

therefore, of high interest for the project. First results for the Vène catchment obtained by the HSM-team in Montpellier demonstrate the enormous amount of organic matter carried to the Thau lagoon downstream during the flush events in autumn 2003.

Dedicated campaigns have focused on phosphorus concentrations in the dry channel beds, indicating potential P-sources and loads during the flush events. Difficulties remain in identifying the inter-connections with flood magnitude, flood timing and bed concentrations. Further detailed fieldwork is focusing mainly on the reach scale.

Impact of channel-bed moisture on microbiological processes affecting water quality

One important issue for tempQsim is the question of how much pollution potential is reduced or increased by in situ biological transformations between significant run-off events. Although we do not expect that tempQsim will observe novel biological reactions, the current state of scientific knowledge on the impact of contraction and expansion dynamics and associated sediment moisture conditions is extremely limited. Under the leadership of Klement Tockner and Urs Uehlinger (EAWAG) the project is studying the impact of moisture on respiration and organic matter decomposition on bed sediments.



Figure 3. Deposition areas at Iskar-river (Bulgaria), Photo: I. Ribarova.

Data scarcity

“Data scarcity is unfortunately strongly correlated to water scarcity”, a statement that was to be confirmed during the first project months. Even with the limited resources available, the project’s basic field work will help to extend the understanding of water quality dynamics, especially for smaller and medium size rivers in the Mediterranean. This is of particular relevance as Nikolaos Nikolaidis (TU Crete) estimated that 40% of the Greek land area drains to the sea through such river types.

Lab experiments

As it is difficult to estimate process rates in situ under comparable conditions, the tempQsim project is performing a number of laboratory experiments. Sediment samples taken from several study sites are being used to compare, within a single laboratory, respiration rates, decomposition rates and

comparable dynamics under standardised conditions. The first results of these experiments are expected at the end of summer 2004.

Model testing and improvement

As part of the Catchmod Cluster, modelling is clearly one main focus of projects associated. The work programme of the tempQsim project contains first a phase of testing the unmodified models (under the co-ordination by A. Lo Porto, IRSA) and afterwards the modification of selected models (coordinated by R. Neves, IMAR). During the testing phase, the following models have already been applied for appropriate test catchments: Cascade, SWAT, HSPF, PESERA, Athys-Pol, Topmodel and Eurosem. Considering different modelling tools for different concepts, the model improvement phase will address mainly two classes of approaches

- a) event based models
- b) deterministic, continuous models

Concerning event-based models, the University of Leeds is co-ordinating the development of the PESCAS model, which will include the combination of the PESERA model with specific event-based approaches for pollution leaching and transport. This concept will allow the inclusion of coarse scale erosion predictions and thus show the explicit effect of land use management on mass transport to the outlet points.

The family of deterministic continuous models have major differences both in their hydrological routines and in the concepts used to forecast sediment water interactions. Hence the tempQsim project will make a significant contribution by providing a more comprehensive theoretical description and comparison of approaches which are implemented in selected models. These approaches may then be applied as a simple model or embedded in a more complex model.

The strengths and weaknesses revealed in the tested models have been discussed within the project. A first conclusion of this work is that run-off (and erosion as well) generation and routing must be based on a sub-daily (probably hourly) time step. Intermittent rivers catchments in water scarce areas often feature rather sparse monitoring/gage stations where often only basic daily data are recorded. A compromise should then be found between the optimal desired time step in modelling and the common time/spatial density of available data.

A second conclusion is that accumulation of readily mobilised suspended matter during the dry period is not currently included in available models. This leads to difficulties in forecasting re-suspension in first flush events. This is part of a more general need to give increased consideration in models to the reactions occurring at the channel bed. To meet these needs in the current project phase, the models will first be improved to meet the specific needs of each study site, as far as the capabilities of each model allow.

Critical components, which have been identified as necessary for models to perform well for temporary waters, include realistic representations for the deposition at the beginning of the dry season, the re-suspension of sediment and associated nutrients/ pollutants from the channel bed, together with

erosion and nutrient leaching from the land during the first flush events in the autumn, and the in situ transformation and eventual leaching of nutrients and pollutants within the bed sediment.

End user aspects

In initial discussions with end users, a number of requirements are considered as important for the project. Firstly, the model user interfaces should be more closely linked to the practical demands of designing alternative technical or management solutions. In this context, it seems important that models fit into existing management systems and are tailored to the needs of specific operating authorities.

In summary, the needs are mainly associated to increase the authorities competence and capacity, to support the ongoing and future monitoring, and to enable a smooth integration to existing databases / web portals already maintained by the authorities.

Scientific Conferences

The XXIII Nordic Hydrological Conference "Fresh Water Resources Management" and UNESCO IHP joint session "Climate change and hydrological processes" in Tallinn, Estonia, 8-12 August 2004. EUROHARP related work will be presented by SMHI, Sweden and FV-IGB, Germany (see articles in this newsletter). Their contributions are available at the EUROHARP web-site under Dissemination Overview.

Next Issue of the EUROHARP Newsletter:

January 2005

Please send suggestions for contributions and comments to euroharp@niva.no

Editors: Stig A. Borgvang and Line J. Barkved, NIVA.