

Introduction

Triggered by the EU Water Framework Directive (WFD), MODELKEY aims to provide tools to identify major stressors in European river basins as driving forces of insufficient ecological status, and to assess and forecast their impact on river ecosystems on a basin scale. Exposure, effect and risk models integrated into an end-user friendly decision support system (DSS) as developed in MODELKEY are key instruments in basin scale risk assessment and management support. Close interaction of MODELKEY with potential end-users of MODELKEY approaches is a crucial prerequisite for their successful implementation that will help you as a risk assessor, water manager or policy maker to base your decisions on state-of-the-art science for a maximum improvement of ecological status with limited resources. One of the most

active group of endusers joined together in the Dutch-Flemish End-User Group. We will report on their last meeting in this newsletter. If you want to benefit from MODELKEY and want MODELKEY to address your issues feel free to join our enduser communication board.

The development and integration of modelling tools made substantial progress within the last year. A selection of models we are developing for your work you will find in this newsletter. You will read about different ways to identify toxic stress as a potential cause for insufficient Ecological Status and to establish cause-effect relationships between pollution sources and toxic stress. On the fly, you will witness research activities in our three Case Study Areas: the Elbe, Llobregat and Scheldt River Basins.

Contents

- » Dutch-Flemish End-User Group: MODELKEY identifies new “key pollutants” in the Scheldt River Basin
- » MODELKEY Models: What can they do for you?
- » Diagnostic Effect Model reveals: Sediments impose a higher toxic risk than surface waters
- » Diagnostic Effect Model looks for different factors explaining insufficient Ecological Status
- » Neural network technique demonstrates clear relation between chemical stress and ecological status in the Scheldt River Basin
- » Easy-to-use indicators show relation between chemical stress and ecological status in the Llobregat River Basin
- » Successful first trial application of MODELKEY’s Generic Exposure Model in the Elbe River Basin
- » MODELKEY’s Final Challenge: Predicting the impact of toxic stress on the ecological status
- » MODELKEY events and announcements

Dutch-Flemish End-User Group: MODELKEY identifies new “key pollutants” in the Scheldt River Basin

On the 31st of January 2007, the Second Dutch-Flemish End-User Meeting was organised by the DGW (Ministry of Transport, Public Works and Water Management - Directorate General of Water Affairs, The Netherlands) and Rijkswaterstaat (RIKZ). This meeting brought together Belgian and Dutch policymakers and managers in discussing



the first results of MODELKEY in the Scheldt river basin and the role of the *MODELKEY-DSS*.

Presenting the first results of MODELKEY in the Scheldt river basin provided a glimpse and gave a first indication of the substances that qualify as 'key-pollutants'. Interestingly, this partly concerned substances that do not occur on the list of priority substances and that are also not included on the list of river basin specific substances.

Also the managerial questions in relation to the WFD were covered. It is new that management measures must be linked to the functioning of the water system including all user functions. This yields managerial questions such as: where does the sediment inhibit the healthy functioning of the water system? Which activities and processes contribute to this and to what degree? Is this caused by supply from elsewhere, replenishment and/or dredging activities?

Three tools, which the manager can use in developing the management plans, were presented and discussed; one of them was the *MODELKEY-DSS*. During this discussion, numerous suggestions, wishes and points of concern in using these tools were brought up by the end-users. An example is to ensure that the tools use the same knowledge base



to generate the same answers/solutions based on the same problem.

MODELKEY Models: What can they do for you?

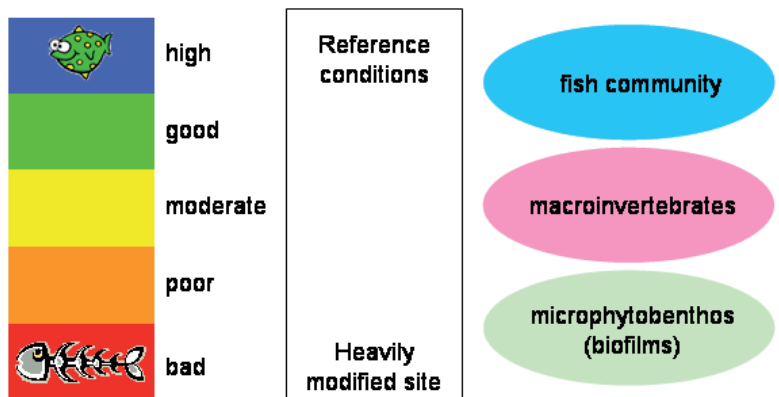
During the implementation process of the Water Framework Directive, different questions arise which can be answered by MODELKEY models. These key questions read:

- » Is the chemical status (partly) responsible for insufficient ecological status?
- » How can the level of toxic stress be quantified?
- » How can the impact of toxic stress on the ecological status be quantified?
- » How do different pollution sources contribute to the toxic stress?

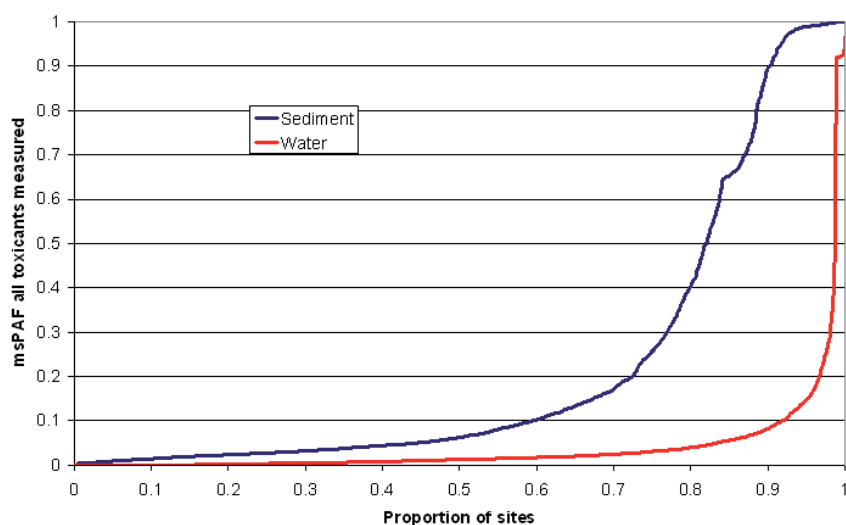
MODELKEY provides different tools to analyse community data, habitat data, chemical data and toxicity data. By means of these tools, you can look for relevant statistical relations which reveal an impact of toxic stress on the communities. Other

tools aim at finding responsible pollution sources for a site with insufficient ecological status, or at quantifying the downstream exposure resulting from specific pollution sources. During the course of MODELKEY, the tools are developed and are being tailored to the WFD Quality Elements (phytoplankton, macrophytes, macrofauna, fish) and to the relevant Ecological Quality Criteria.

Good Ecological Status (WFD) classified by Biological Quality Elements



Diagnostic Effect Model reveals: sediments impose a higher toxic risk than surface waters

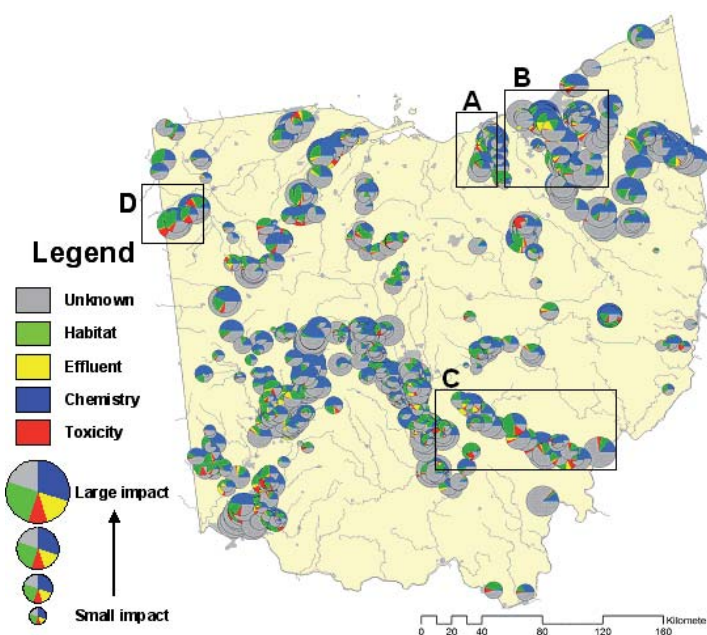


Toxicity indicator “msPAF”, derived from all water and sediment samples included in MODELKEY’s BASIN database. The graph shows that about 10% of all water samples and 40% of all sediment samples show a noticeable risk (an msPAF value > 0.1).

One of the *Diagnostic Effect Models* developed in sub-project EFFECT addresses the potential for adverse ecological effects of mixtures of chemicals. It estimates the joint risk using Species Sensitivity Distributions and mixture principles, taking into account the bio-availability under local conditions. This joint risk is expressed as the “msPAF” or *multi-substance Potentially Affected Fraction (of species)*. As an example, this technique has been used to analyse all samples in MODELKEY’s BASIN database, revealing that a significant toxic risk is much more common for sediment samples than it is for surface water samples.

Diagnostic Effect Model looks for different factors explaining insufficient Ecological Status

The *Diagnostic Effect Model* mentioned above also includes a second step; on a per taxa basis, statistical models are constructed to describe the observed presence and/or abundance as affected by toxic stress and other stress factors. Probabilities of cumulative effects from toxic stress and habitat degradation are expressed in simple pie-diagrams where the pie size corresponds to the loss of species and the slice sizes show the relative importance of the distinguished stress factors as a probable cause of the loss of species (“Effect and Probable Cause” pies (EPC)).

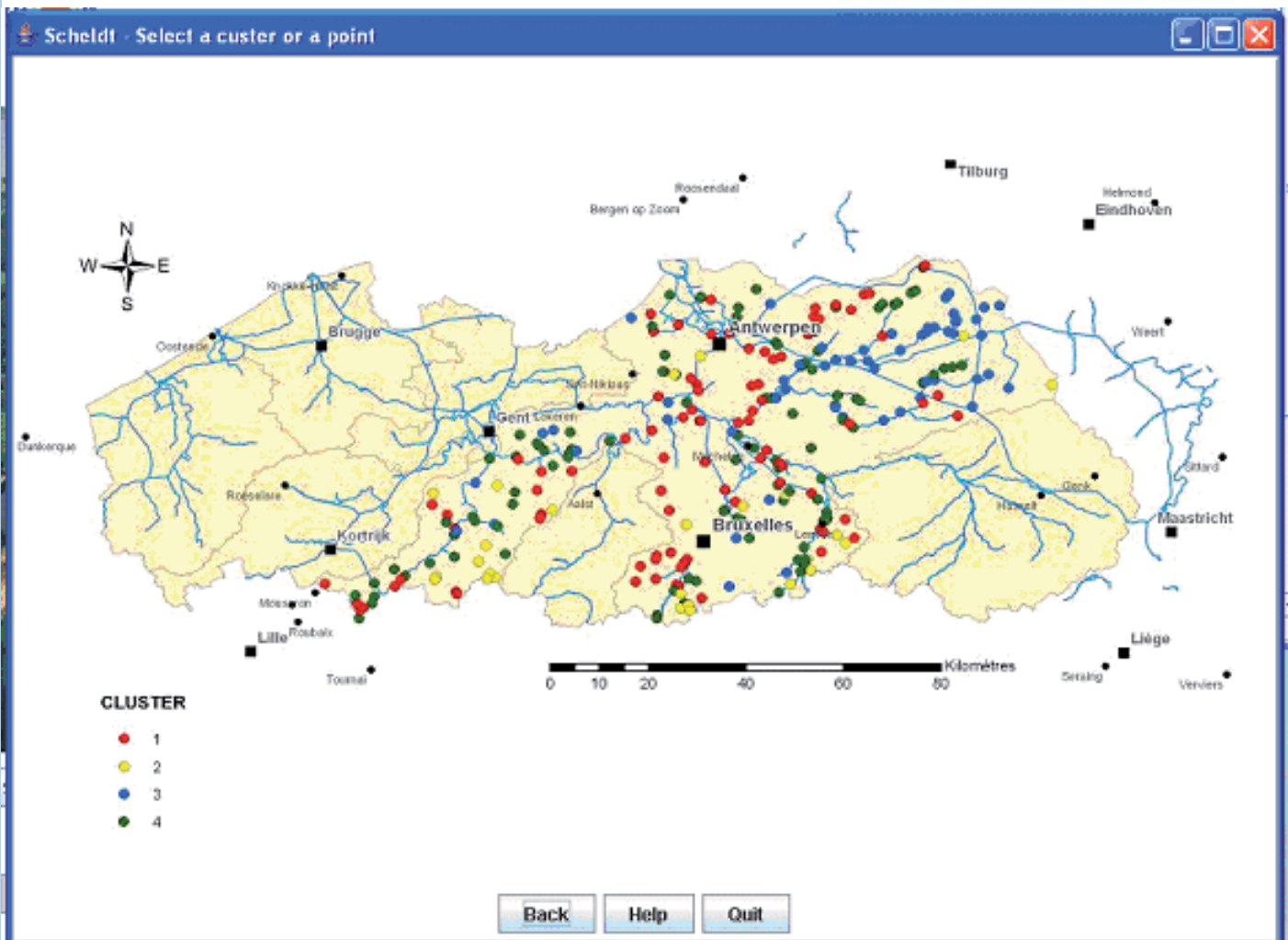


Example results for loss of species (indicated by size of pie chart) and stressors contributing to this loss of species (indicated by pies). Note the share of “unknown” pressure, expressing the degree of uncertainty in the analysis.

Neural network technique demonstrates clear relation between chemical stress and ecological status in the Scheldt River Basin

MODELKEY's sub-project EFFECT also develops some artificial neural network techniques. One of them is an ordination method allowing the classification of sites based on similarities between the biota communities. The community data are linked

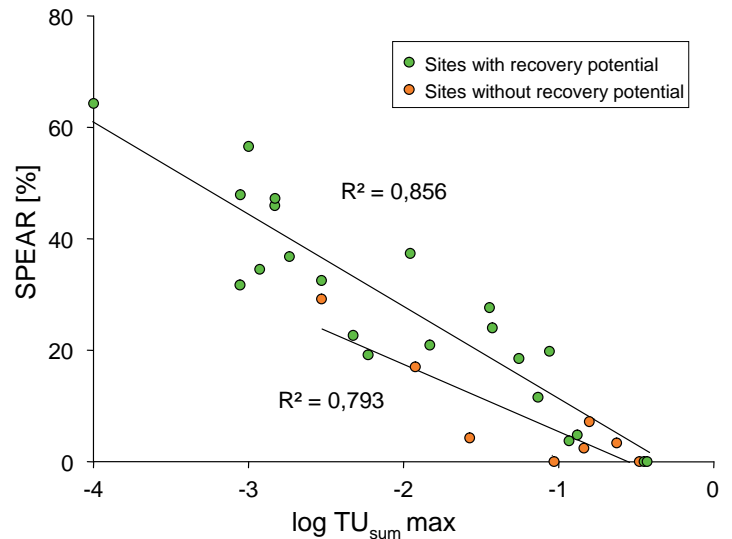
to the abovementioned toxicity index *msPAF*. As an example, in the Scheldt river macro-invertebrate community data are used; the study sites could be clustered to indicate that chemical stress is indeed a factor determining ecological status.



Results frame of the Scheldt Case Study: sampling sites are clustered, according to their community structure (macro-invertebrates assemblages) and the toxic stress indicator *msPAF*.

Easy-to-use indicators show relation between chemical stress and ecological status in the Llobregat River Basin

MODELKEY's sub-project BASIN provides Biological Quality Element (BQE) specific toxicity indicators based on the *Toxic Units* principle as well as biological indicators based on the invertebrate community. In the Llobregat Case Study it was demonstrated that the Toxic Units indicator correlates well with the so-called "species at risk" or *SPEAR* index which measures the relative share of pollution-sensitive species (see also MODELKEY Newsletter 3). A significant decrease in the relative abundance of species classified "at risk" was observed at sites with medium and high Toxic Units.

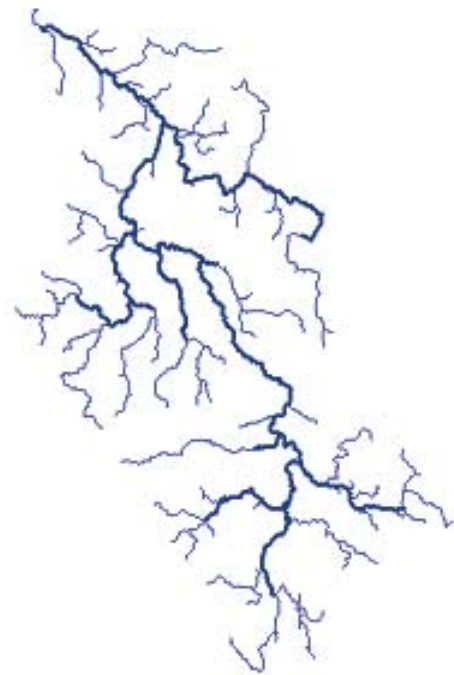
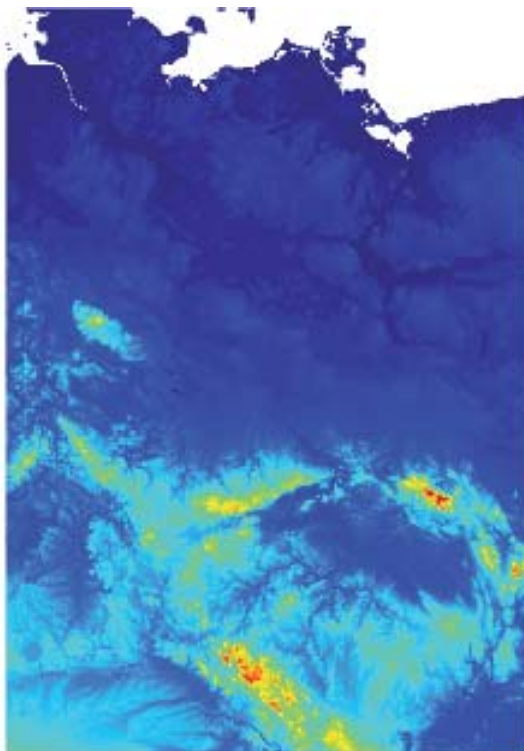


Results frame of the Llobregat Case Study: correlation between toxic stress (represented by Toxic Units indicator) and ecological status (represented by "Species at Risk" index)

Successful first trial application of MODELKEY's Generic Exposure Model in the Elbe River Basin

MODELKEY's sub-project EXPO provides tools to calculate the pollutant concentrations downstream of different types of pollution sources. Thus, it is possible to quantify how different pollution sources contribute to the toxic stress at a given location. It is also possible to rank different pollution sources, with respect to their overall downstream impact.

In particular, the *Generic Exposure Model* aims at assessing and comparing the exposure risks to the environment for each individual pollution source or contaminated site, in every European river basin/estuary with minimal requirements for model steering and use. To this end, MODELKEY makes use of open source GIS maps, which are available at a European scale.



A schematisation of the Elbe River, developed in the Elbe Case Study on the basis of a GIS digital elevation map, which is used by MODELKEY's Generic Exposure Model.

MODELKEY's Final Challenge: Predicting the impact of toxic stress on the ecological status

All methods listed above can be used to represent the present conditions, but also to represent a future situation, where the chemical stress has been changed, for example due to pollution reduction measures. In this way, the MODELKEY tools serve to predict the impact of measures aiming at impro-

ving the chemical status. Only if we succeed in tailoring these tools to the WFD Quality Elements (phytoplankton, macrophytes, macrofauna, fish) and to the relevant Ecological Quality Criteria, we will truly succeed in our mission to support the End Users while implementing the WFD.

MODELKEY events and announcements

European Rivers At Risk

Conference on Risk Assessment in European River Basins - State of the Art and Future Challenges

This conference aims to bring together leading scientists as well as European stakeholder groups involved in the assessment of risks to European river basins. Major developments of the recent European research shall be processed focussing on

- » ecosystem goods and services in risk-based management,
- » water regulation at risk under global change,
- » groundwater ecosystems and drinking water supply at risk,
- » hydromorphological changes and risks to biodiversity,
- » eutrophication risks to biodiversity,
- » risks of environmental pollutants to ecosystem and human health,
- » integrated risk assessment on a basin scale

particularly in terms of practical implementation for river basin management, in order to bridge the gap between science and management practice.

This event is organised by the Integrated Project **MODELKEY** (511237 GOCE, www.modelkey.org) and the Coordination Action **RISKBASE** (036938 GOCE, www.riskbase.info) and will take place from *12th to 14th November 2007* at the Helmholtz Centre for Environmental Research – **UFZ** in Leipzig, Germany.



Please refer to www.ufz.de/europeanriversatrisk for information on the programme, registration, venue etc..