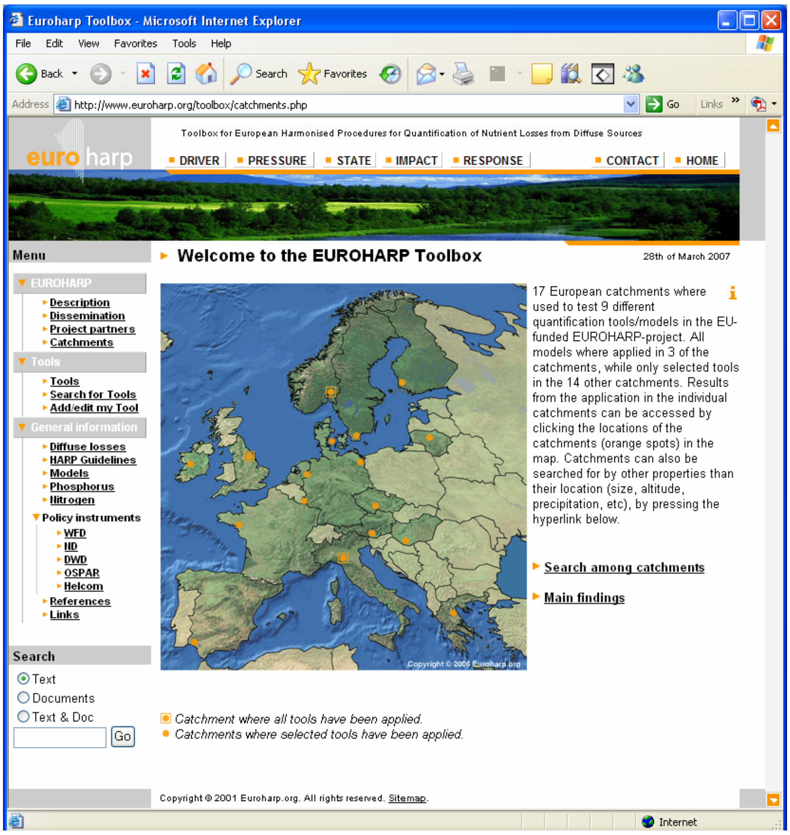
REPORT SNO 5363-2007

# Extension of the EUROHARP Toolbox

## Functional specification and an inventory of tools for quantification of nutrient losses from diffuse sources



Norwegian Institute for Water Research
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# REPORT

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Abstract

This report provides a detailed description of the extension of the EUROHARP Toolbox, and an inventory of tools capable of simulating runoff of nutrients from diffuse sources. The original version of the EUROHARP Toolbox was one of the key deliverables of the EU-funded EUROHARP-project, which was designed to model runoff from diffuse sources. The aim of this extension has been to design and program the Toolbox for further inclusion of models not tested in the EUROHARP-project. To support the registration of new tools, an on-line registration module has been developed, including a system to handle user control to information in the Toolbox database, the database has been extended and additional text and explanations provided. Furthermore, new dialogues for search (basic search and advanced search) and comparison of tools have been developed, in order to improve the possibilities to compare tools by their intrinsic properties.

Based on a comprehensive search in literature, other toolboxes and databases and via the authors' network of scientists, an inventory of models not part of the EUROHARP-project has been compiled. The compilation of models has been divided into those tools considered highly relevant (table 3.1) for the topic, and a second group of models (Appendix B) less dedicated for the simulation of nutrient runoff from diffuse sources. The 'owners' of the tools in the first category will be invited to register their tool in the extended EUROHARP Toolbox.

| 4 keywords, Norwegian | 4 keywords, English |
|---|---|
| 1. Modellering av diffuse kilder | 1. Diffuse sources models |
| 2. Avrenning fra landbruket | 2. Agricultural pollution |
| 3. Modellering | 3. Modelling |
| 4. Verktøykasse | 4. Toolbox |

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# Ackowledgements

The extension of the EUROHARP Toolbox is a continuation and further development of the work that was carried out as part of the EUROHARP-project, which was designed to model runoff from diffuse sources, and the Toolbox was one of the key deliverables in that project. The extension of the EUROHARP-project, which is specified in this report, aims at opening up the Toolbox to include also tools that were not part of the EUROHARP-project. The efforts made to extend the Toolbox have been funded by HARMONI-CA via the Institute of Inland Water Management and Waste Water Treatment (RIZA) in The Netherlands.

I would like thank the clients' project manager Michiel Blind (RIZA) for his firm, but still flexible way of managing the project, and his very valuable input during the specifications of the extended Toolbox.

I would also like to thank Paul Boers (RIZA), Piet Groenendijk (Alterra Green World Research) and Wim De Lange (RIZA) for taking part in the workshop in Lelystad late January along with Michiel Blind and for providing very useful and constructive comments.

Line J. Barkved has been responsible for the compilation of the extensive list of models in this report, and Andreas Hem has been responsible for the programming of the extended Toolbox. They have both performed work of excellent quality in a project with tight deadlines.

Finally, I would like to thank the leader of EUROHARP, Stig A. Borgvang, for his ever-lasting inspiration and insight in the field for water resources management and for addressing his international network.

Oslo, March 2007

*Tor Haakon Bakken*

# Contents

# Abstract

This report provides a detailed description of the extension of the EUROHARP Toolbox, and an inventory of tools capable of simulating runoff of nutrients from diffuse sources. The original version of the EUROHARP Toolbox was developed as one of the key deliverables of the EU-funded EUROHARP-project. The aim of this extension has been to design and program the Toolbox for inclusion of models not tested in the EUROHARP-project. To support the registration of new tools, an on-line registration module has been developed, including a system to handle user control to information in the Toolbox database, the database has been extended and additional text and explanations provided. Furthermore, new dialogues for search (basic search and advanced search) and comparison of tools have been developed, in order to improve the possibilities to compare tools by their intrinsic properties.

Based on a comprehensive search in literature, other toolboxes and databases, and via the authors' network of scientists, an inventory of models not part of the EUROHARP-project has been compiled. The compilation of models has been divided into those tools considered highly relevant (table 3.1) for the topic, and a second group of models (Appendix B) less dedicated for the simulation of nutrient runoff from diffuse sources. The 'owners' of the tools in the first category will be invited to register their tool in the extended EUROHARP Toolbox.

# 1. Introduction

## 1.1 The purpose of the report

The aim of this document is to describe in detail the extension of the EUROHARP Toolbox. The document will act as a detailed description of all major changes to the existing Toolbox and aims at creating a common understanding between NIVA as developers and future users and the RIZA as the client. The document will be used to:

- Illustrate the functionality to be developed in order to ensure that there is a common understanding between NIVA and RIZA of the final product/outcome of the project
- Guide the programmers during the development of the system
- Act as a guideline during bug testing of the Toolbox
- Provide input to Help-functions (Tooltips, Info-buttons, etc) embedded in the Toolbox

This document has been updated based on discussions with the client, invited experts and NIVA.

## 1.2 Description of work and deliverables

The new and extended version of the EUROHARP Toolbox is developed based on the information in the original version of the Toolbox, which was developed as one of the key deliverables of the EU-funded EUROHARP-project. As the type of information to be collected was selected by a group of the most experienced diffuse sources modellers in Europe, it is assumed that the information present in the database is both relevant and of high quality. However, to open up the Toolbox for inclusion of models not tested in the EUROHARP-project, an evaluation of information in the old Toolbox has been made. This evaluation has shown some over-lap between information in the different database fields, and necessary re-arrangements of information have been carried out. An update of the Toolbox and related changes in database structure has then reduced the amount of repeated information.

According to the contract between RIZA and NIVA, the project should produce the following deliverables:

- An extended version of the EUROHARP Toolbox
- A short description of the extensions (this report)
- An inventory of diffuse sources models (included this report, section 3 and Appendix B)
- A digital version of a flyer describing the extended Toolbox

It should be noted that:

- The project has not carried out any testing of models.
- Data from the EUROHARP-project is generally not directly available from the Toolbox, as the EUROHARP-project was confined by restriction from data owners as the project was finished.

- Quality assurance of the information entered by "external model owners" has to a very little extent been done by the EUROHARP Toolbox Administrators.

**URL to the Toolbox:**

The updated/extended version of the Toolbox is found on the following address: www.euroharp.org/toolbox

This address is the same as the address that was established during the EUROHARP-project. The extended Toolbox is developed based on the EUROHARP, but less dependent on the results of that project. It was, however, recommended to keep the same web address as this is now considered a well-known Web site within the community of modellers of diffuse sources pollution.

# 2. User requirements of the extended EH Toolbox

## 2.1 Nomenclature

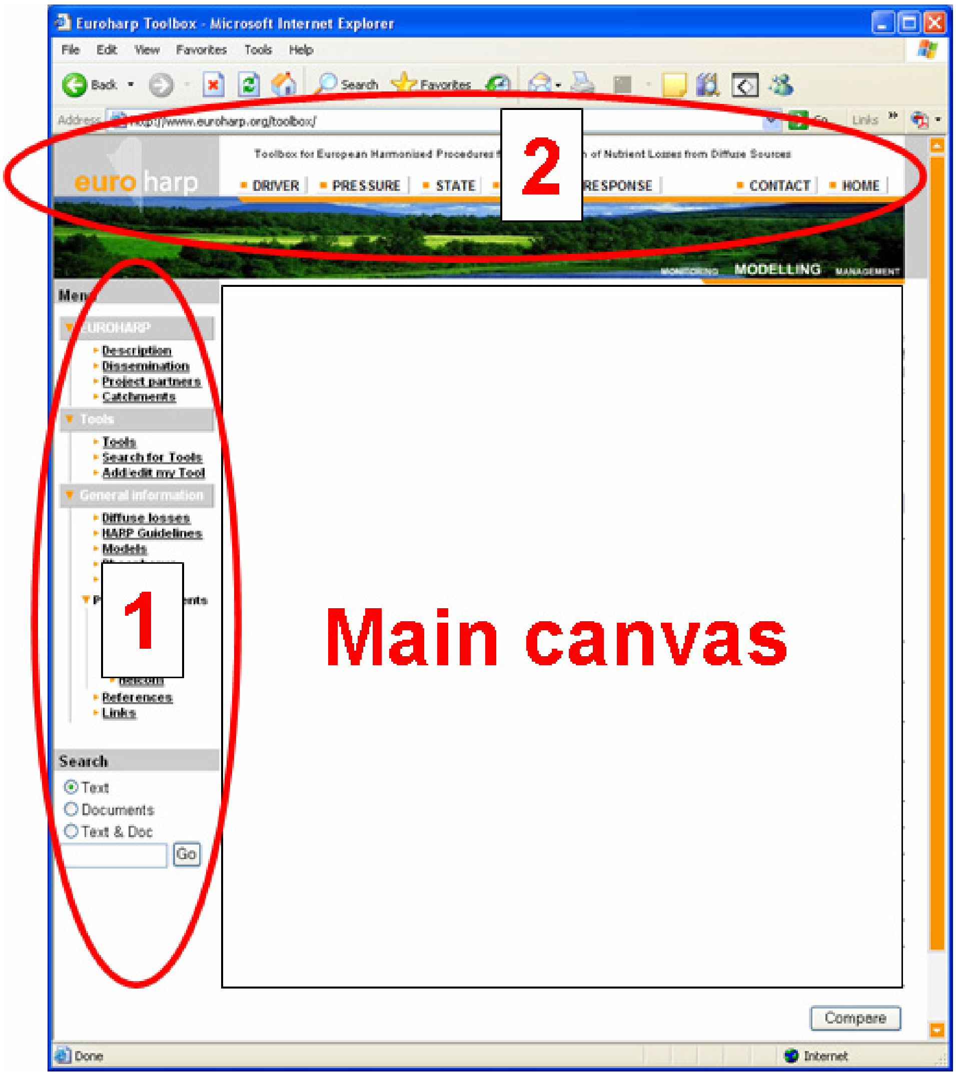



*Figure 2.1. This figure illustrates the main elements of a dialogue.*

Dialogue: This is a general term used to denote the graphical user interface (GUI) of a web page or pop-up.

Vertical menu: The vertical menu is the menu on the left side of the dialogue, given by number 1 in figure 2.1. This part of the dialogue is always shown (except for in pop-ups) and is never changed or replaced as the user navigates within the Toolbox.

Horisontal menu: The horizontal menu is located on the very top of the dialogue, given by number 2 in figure 2.1. This part of the dialogue is always shown (except for in pop-ups) and is never changed or replaced as the user navigates within the Toolbox.

Main canvas: This is the main part of the dialogue and is located in the centre (see figure 2.1). This part of the dialogue is changed/updated as the user navigates within the Toolbox, searches for tools, presents tools, etc.

Tooltips: These are yellow flags or stickers that appear to the user as he or she moves the cursor above a certain item or element in the user interface, providing explanatory text. This is similar to what is implemented in most Windows applications.

## 2.2 Organisation of the introduction dialogue

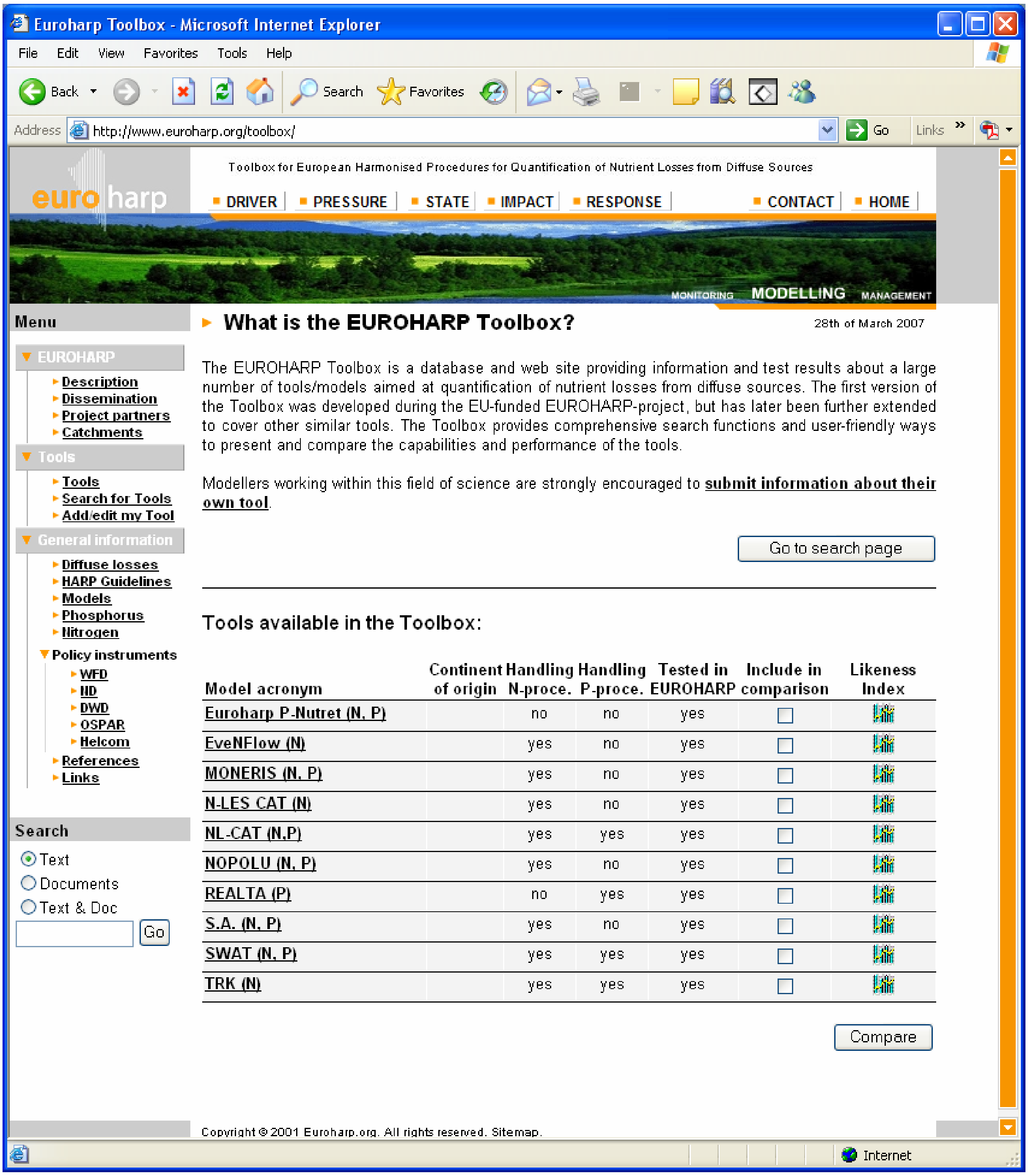



*Figure 2.2. The figure shows the proposed new intro-page to the EH Toolbox. The upper image is a Flash animating Monitoring, Management and Modelling.*

An extension of the EUROHARP Toolbox represents a change in focus of the Toolbox, from a project specific deliverable to a generic toolbox holding information about a number of diffuse source models. This requires an update of the main dialogue of the Toolbox, changing the focus from a catchment approach to a more generic model approach, covering also those models not tested in the EUROHARP-project. The new entrance page include the following changes/extensions:

**Vertical menu**
EUROHARP: "Catchments" is added as a new hyperlink under the EUROHARP menu. When the user presses the "Catchments"-link, the old main page/dialogue will be opened, providing a map interface to the study catchments of the EUROHARP-project. The text on the old opening page is replaced by an updated text.

Tools: The menu option Tools is kept. When the user clicks this link, the introduction page (dialogue) is opened.

Search for Tools: The menu option "Search for Tools" is added under the "Tools" menu. When the user clicks this link, the Basic Search for Tools-dialogue appears (see chapter 2.6), taking the user into the part of the system where he/she can search among all tools registered in the Toolbox database.

Add/Edit my tool: The menu option "Add/Edit my tool" is added under the "Tools" menu. When the user clicks this link, the login dialogue appears (see chapter 2.3), taking the user into the part of the system where he/she can login to the database, and then register a new tool in the Toolbox database, or edit/add information about a tool that is already present in the Toolbox database.

**Horisontal menu**
The horizontal menu (Driver, Pressure, State, Impact Response, Home, Contact) is basically kept with no major changes, except for a necessary update of text behind some of the buttons.

**Main canvas**
Tools are the main focus on the introduction dialogue in the new/extended Toolbox, and not catchments as in the old version.

Major updates of the main canvas of the intro-dialogue have been implemented. The upper part of the main canvas is an animated Flash stating "Monitoring, Management, Modelling", launched the first time the URL is launched. The flash lasts for maximum 5 seconds.

As the user enters the Toolbox, the lower part of the main canvas lists all tools stored (no search filter applied) in the Toolbox. The following information is listed:

- Model acronym
- Country/continent of origin
- Handling N-processes (Yes/No)
- Handling P-processes (Yes/No)
- Tested in EUROHARP (Yes/No)
- Check box indicating if the tools is part of a comparison
- Likeness Index

By clicking/selecting one model (hyperlink directly on each model) a detailed description of this model will be launched (see section 2.8). By checking two or more models and clicking the Comparison-button, a similar detailed description of the models, presented beside each other, appears (see details in section 2.9).
Sort function is implemented in top of all columns (model name, model acronym, etc.).

**Buttons**
Go to search page: Pressing this button launches the search page with the basic search filter (see section 2.6). This selection is identical to pressing the "Search for Tools" hyperlink in the vertical menu.

Compare: Pressing this button launches the description of the selected models (those checked) for comparison of information/properties (see details section 2.9).

Likeness Index: A pop-up showing the likeness between the selected tool and the other tools in the list is launched as the user presses the Likeness index icon. A further specification of the calculation and appearance of the index is given in section 2.12.

## 2.3 Registration of new user/login existing user

This dialogue is used to register users that aim to include their own tool to the Toolbox, and to enable the users of models already present in the Toolbox database to edit/add information about their model. The dialogue is also a way to avoid that information is added by unknown users or changed by someone that is not the owner of a specific tool.

The user enter this dialogue by clicking "Add/Edit my Tool" from the vertical menu.

It should be noted all other parts of the Toolbox are public, i.e. open to everyone.

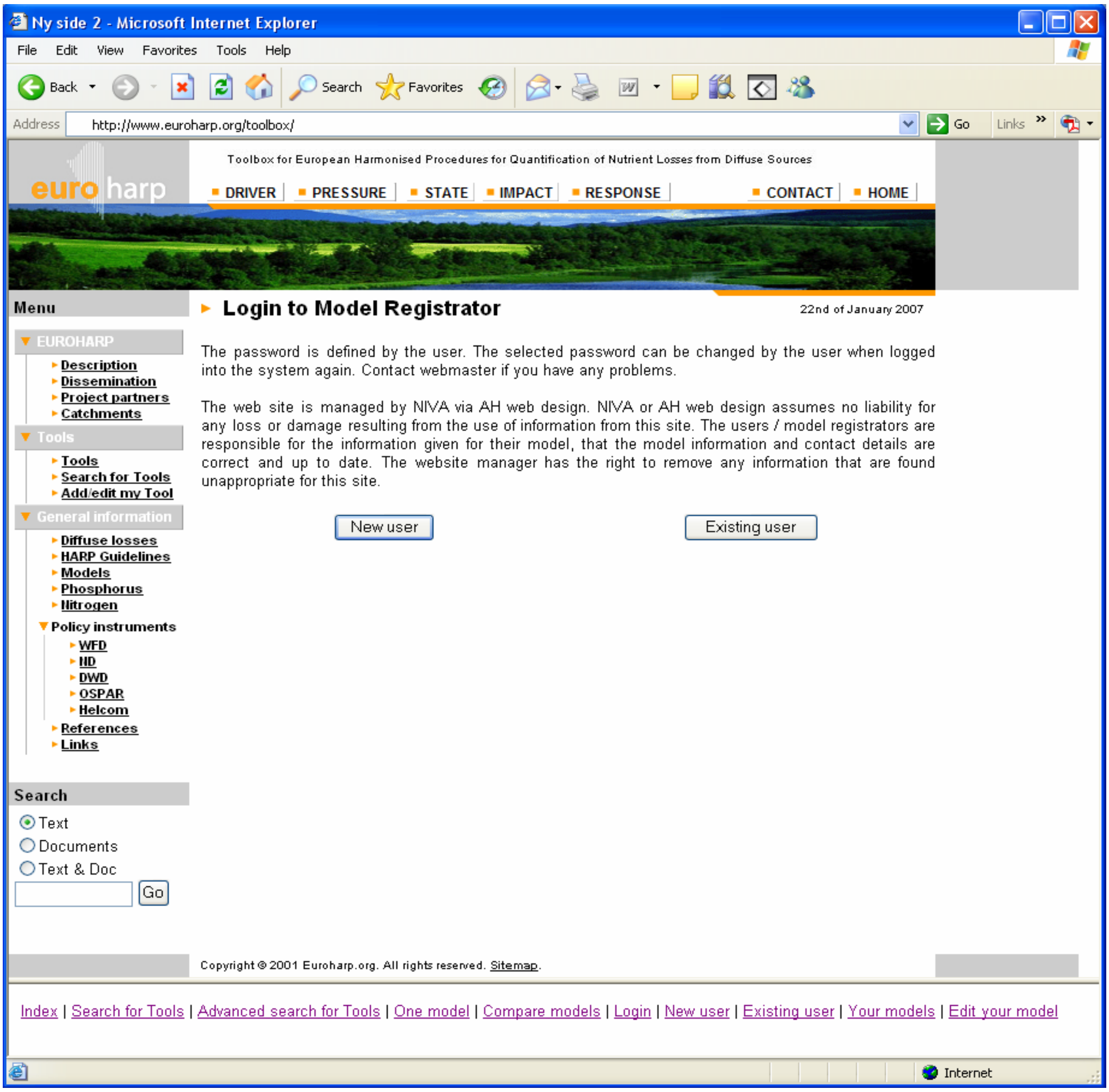



*Figure 2.3. The figure illustrates the login/user registration of the Toolbox. New users should select "New user", while existing users should press the "Existing user"-button.*

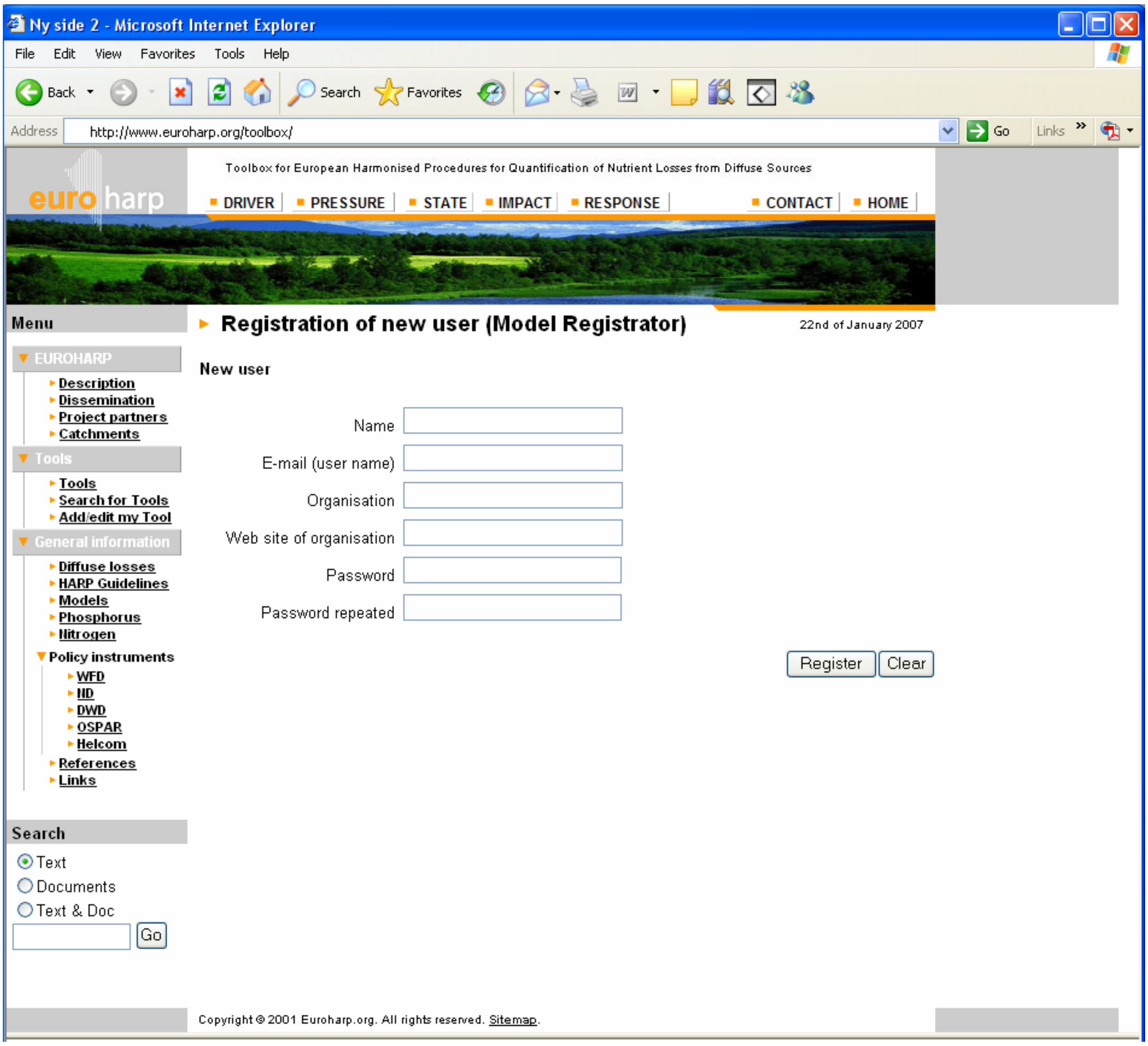



*Figure 2.4. The figure illustrates the registration of new users of the Toolbox ("users" in terms of a person that wants to register a new tool).*

From the login-dialogue (figure 2.3) the user that selects "New user" is prompted with the dialogue shown in figure 2.4.

**Description of the main canvas**

Name: Full name of the user that wants to register to the Toolbox in order to submit information about a tool.

E-mail (user name): E-mail address should be entered, which is the user name when the users logs in to the system later.

Organisation: Name of the organisation the user is affiliated with. It is considered that this will increase the seriousness of the registration.

Web site of organisation: Web site to the organisation the user is affiliated with. It is considered that this will increase the seriousness of the registration.

Password/Repeated password: Password freely defined by the user.

When all the information is provided, the user can go directly into the registration dialogue (see section 2.5) and start the registration of his/her tool.

Register-button: When the user has entered all the information, he/she is registered as a user as soon as the Register-button is pressed. The dialogue for registration of tools (see section 2.5) is then launched. The information provided by the new user (name, user name, password, etc) is also automatically sent to the given e-mail address.

Clear: Clicking this button removes the entered information from the text fields. Clicking the button will not remove any information that is already stored in the Toolbox database.

Check box: A check box with the lable "Send me monthly notification of updates in the EUROHARP Toolbox" is implemented. The notification shall contain information about new tools that are added to the Toolbox, and which tools that has been updated. It shall be possible to later "un-check" this if the user does not want to receive monthly notification from the Toolbox administrator.

To un-register as a user (model owner): It is not possible to automatically unregister as a user as model descriptions are linked to the users. If someone still wants to unregister, this is handled by contacting the Toolbox Administrator.

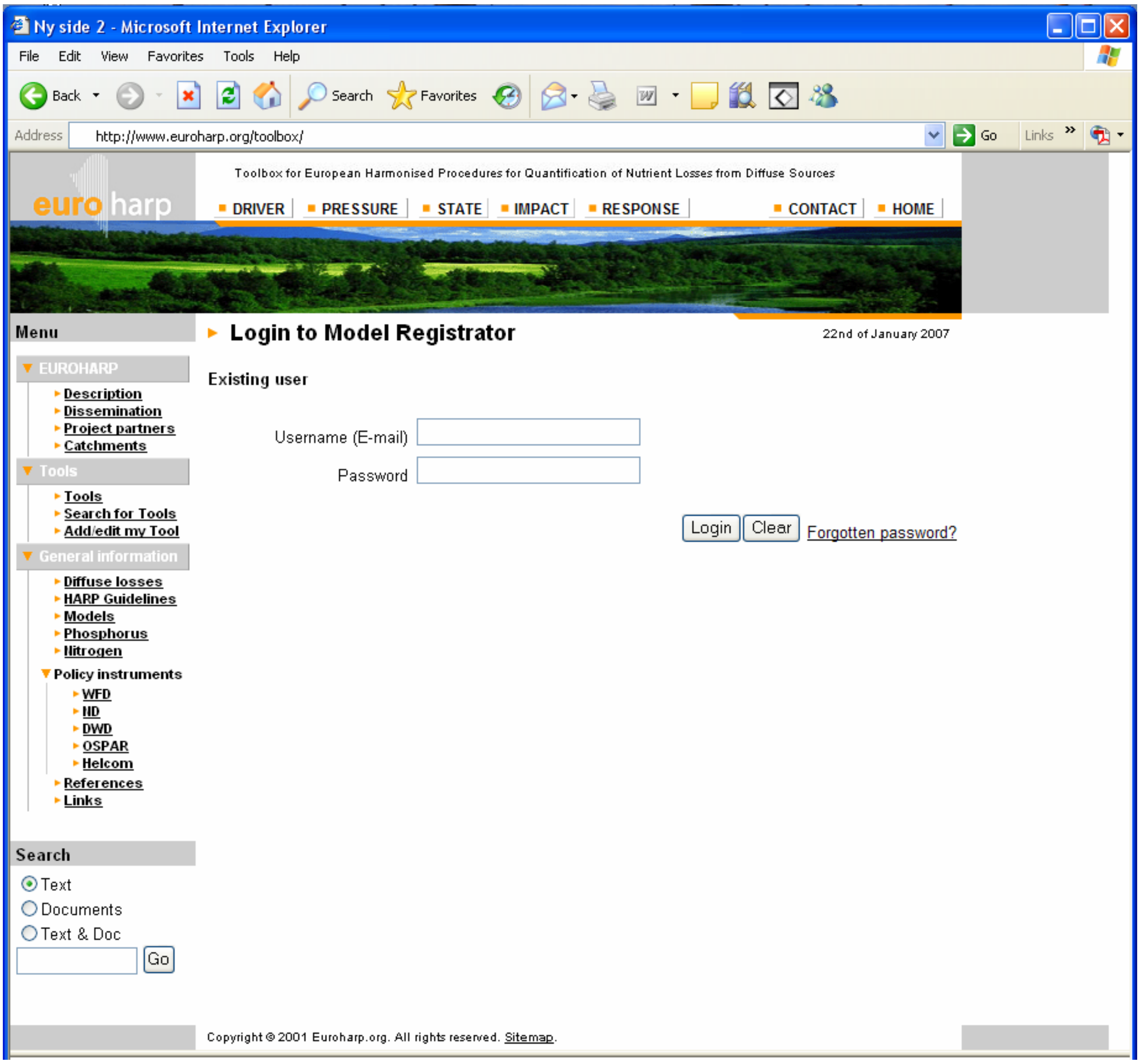



*Figure 2.5. The figure illustrates login for registered users ("users" in terms of a person that can register a new or edit an existing tool in the database).*

From the login-dialogue (figure 2.3) the user that selects "Existing user" is prompted with the dialogue shown in figure 2.5.

**Main canvas**
E-mail (user name): E-mail address should be entered, which is the user name when the users logs into the system.

Password: Password should be entered before the user is enabled to login to the system.

Login: When the user presses this button, the dialogue where the user can select which tool to edit, delete, make public, etc is launched (see section 2.4).

Clear: Clicking this button removes the entered information from the text fields. Clicking the button does not remove any information that is already stored in the Toolbox database.

Forgotten password: A new password can be obtained directly from the Toolbox Administrator. The user has to enter e-mail address and a new password is sent automatically to the given mail-address.

## 2.4 Administration of registered tools

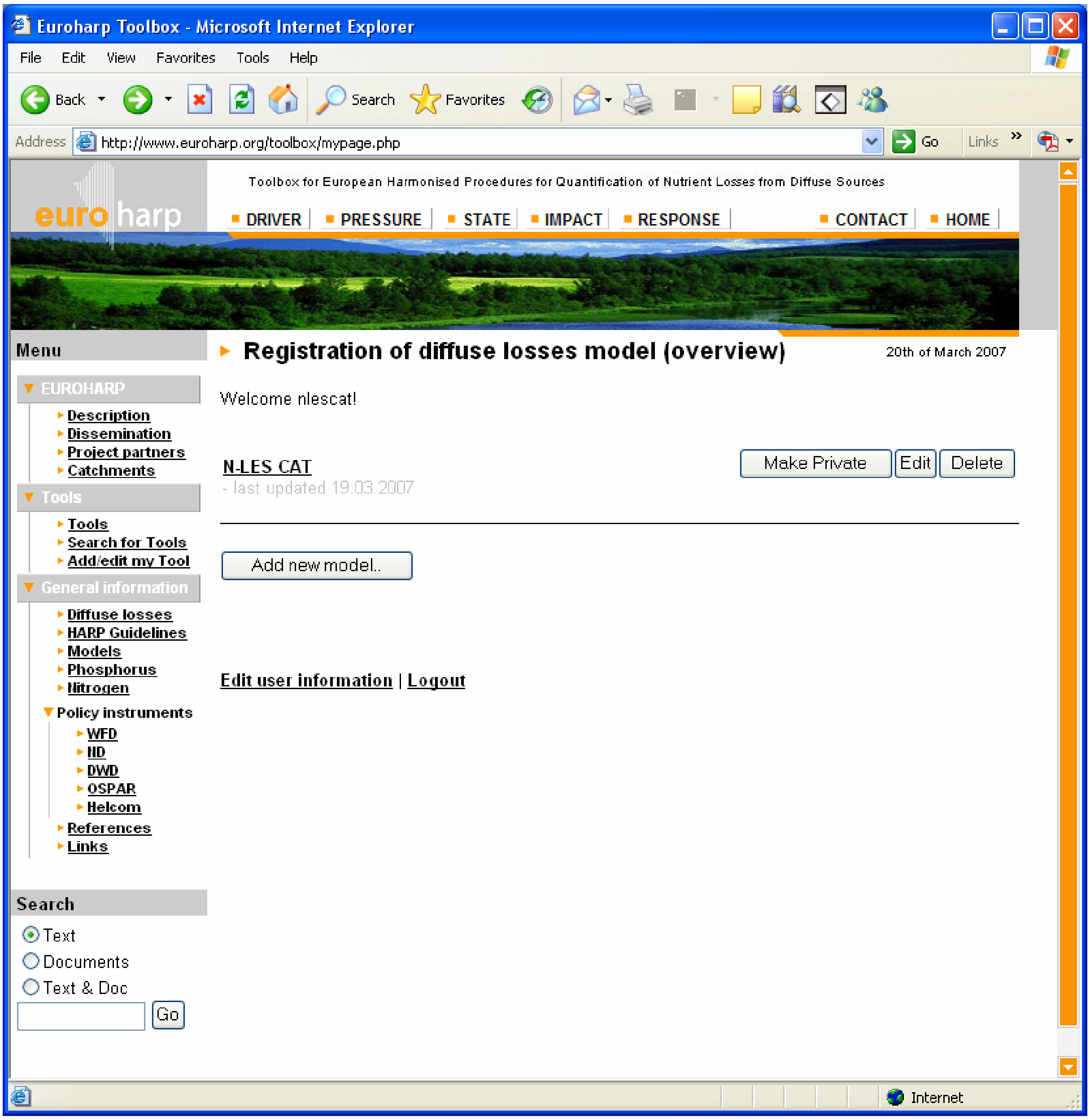



*Figure 2.6. The figure illustrates the dialogue for the administration of already registered tools.*

This dialogue is used for the administration of tools registered in the database.

**Main canvas**

Your model: This is the name of the models in the database that are linked to the logged in user.

Preview: In order to see how the description of the model appears within the Toolbox, the users are enabled to have a preview of the registered models.

Make public: Pressing this button makes all the information about the selected model available via the (external) EUROHARP Toolbox. Implementing such a function enables the user to enter information to the Toolbox without making it immediately available on the Internet. This can be very useful if the user needs to check some of the information, has not completed all registration forms, or if the Toolbox administrator wants to “hide” some information without deleting it from the database. As the model is made public, this button shifts its lable to “Remove from public”.

Edit: Pressing this button enables the user to start editing information about the selected tool that is already present in the Toolbox database (see section 2.5).

Delete: Pressing this button will enable the user to delete a full model description that is present in the Toolbox database. The deletion is not completed before such an operation is confirmed by the user (Warning to be inserted).

Add new model: This allows the user to start entering information about a new tool into the Toolbox (see section 2.5).

Edit user information: The user can edit the given user information (see figure 2.4) by clicking this hyperlink.

Logout: Pressing this logs the user out of the Toolbox.

Reminder to model owners: If the model has not been updated for one year, the Toolbox Administrator will send an e-mail to the model owner requesting him/her to validate the information about the model in the Toolbox.

## 2.5 Adding a new/editing an existing model

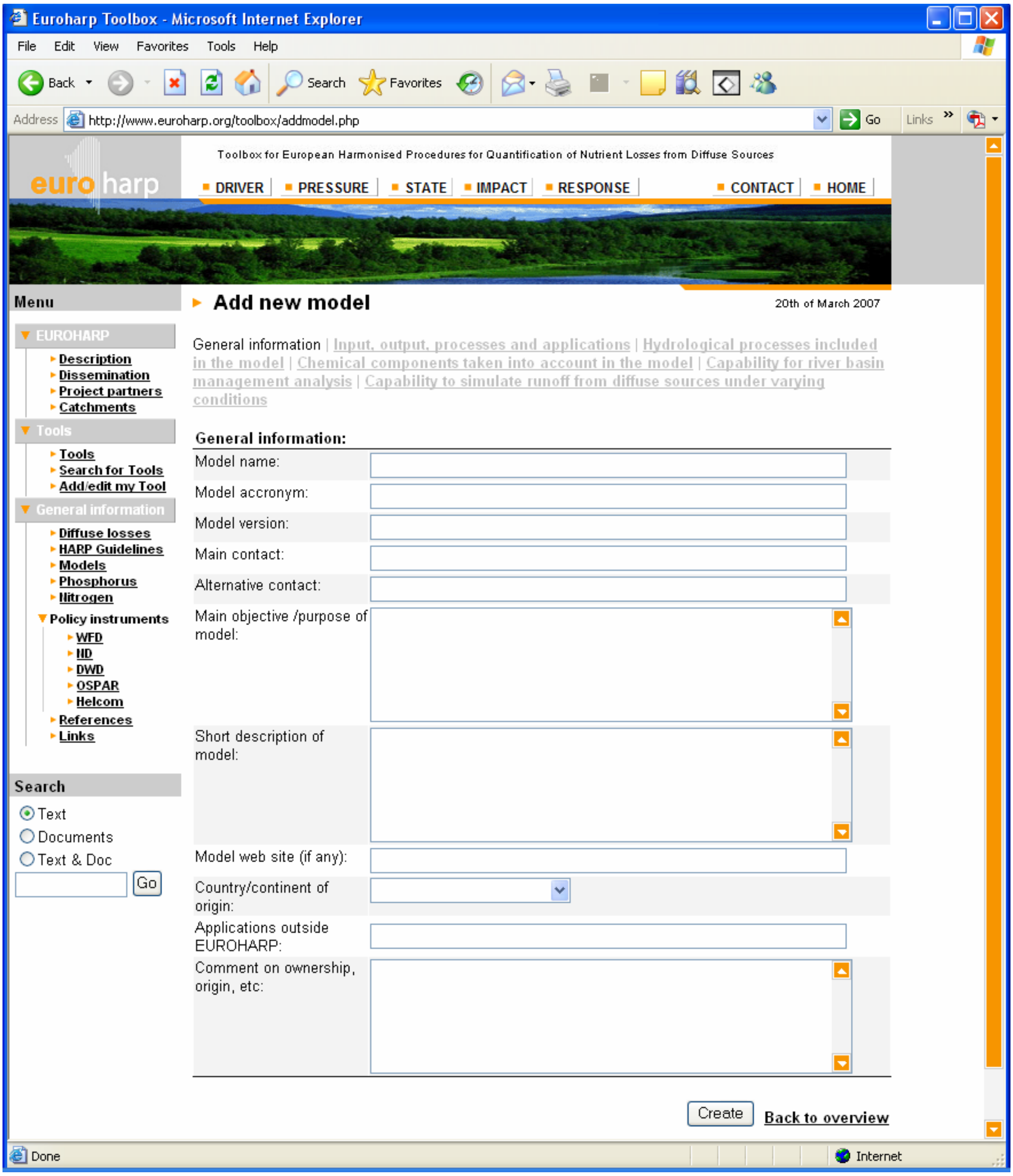



*Figure 2.7. The figure illustrates the dialogue where the user can start enter/edit information about a given tool. If the user has selected Edit to enter this dialogue, the fields are populated with data already present in the database.*

This is the dialogue for registration of information about the individual tools.

**Description of the main canvas**
This dialogue is opened as soon as the user is logged into the database and has selected if he/she wants to register a new model or edit an existing model linked to the given user. The only way to enter this dialogue is via the “Add/Edit my tool” link in the left, vertical menu.

The dialogue is organised in the following way:

On the very top is the name of the model shown (if already registered).

Below the model name a set of hyperlinks (General information | Input, output, processes and applications | Hydrological processes included in model, etc) are provided. These can be considered as tabs for groups of information to be entered. A complete description of each group of information to be entered is given in Appendix A.

The first tab (Group of information), called “General information” is shown in the centre and the lower part of the main canvas. As the user presses another hyperlink, this is shown on top of the fields the information is entered into.

Description of fields (Model name, Model acronym, Model version, Main contact, etc): These are the fields that the user should populate with information. The fields can be populated with more data than shown in the dialogue, as the size of the fields is determined by the database and not the GUI. In the other tabs, also other types of controls like drop-down lists, check buttons, etc are available, depending on the actual information to be provided. Copy and Paste-functionality is supported by the text fields in order to ease the registration of information.

**Description of the buttons:**
Create: Pressing this button saves the information entered in the text fields to the Toolbox database. This button should be pressed before the user shifts to the next tab. If the user tries to shift to another tab without saving the new/changed information, he/she is prompted with a warning/question to save the information.

Clear: Pressing this button removes the information shown in the user interface. Removing information from the database requires that the user removes the text/selections (ie. via the Clear-button), and presses Save.

Yellow tool tips: As the user moves the cursor above items in the dialogues, a yellow tool tip should appear explaining and securing a correct interpretation of the terms.

## 2.6 Basic search for tools/models

As the user presses "Search for tools", either in the vertical menu or from the Search button that appears in the main canvas of the Intro-dialogue, the "Basic search"-dialogue appears. This dialogue is very similar to the Intro-dialogue, except for the fact that the Flash is not played, and the description of the Toolbox is replaced by search options. The following search options are available from this dialogue:

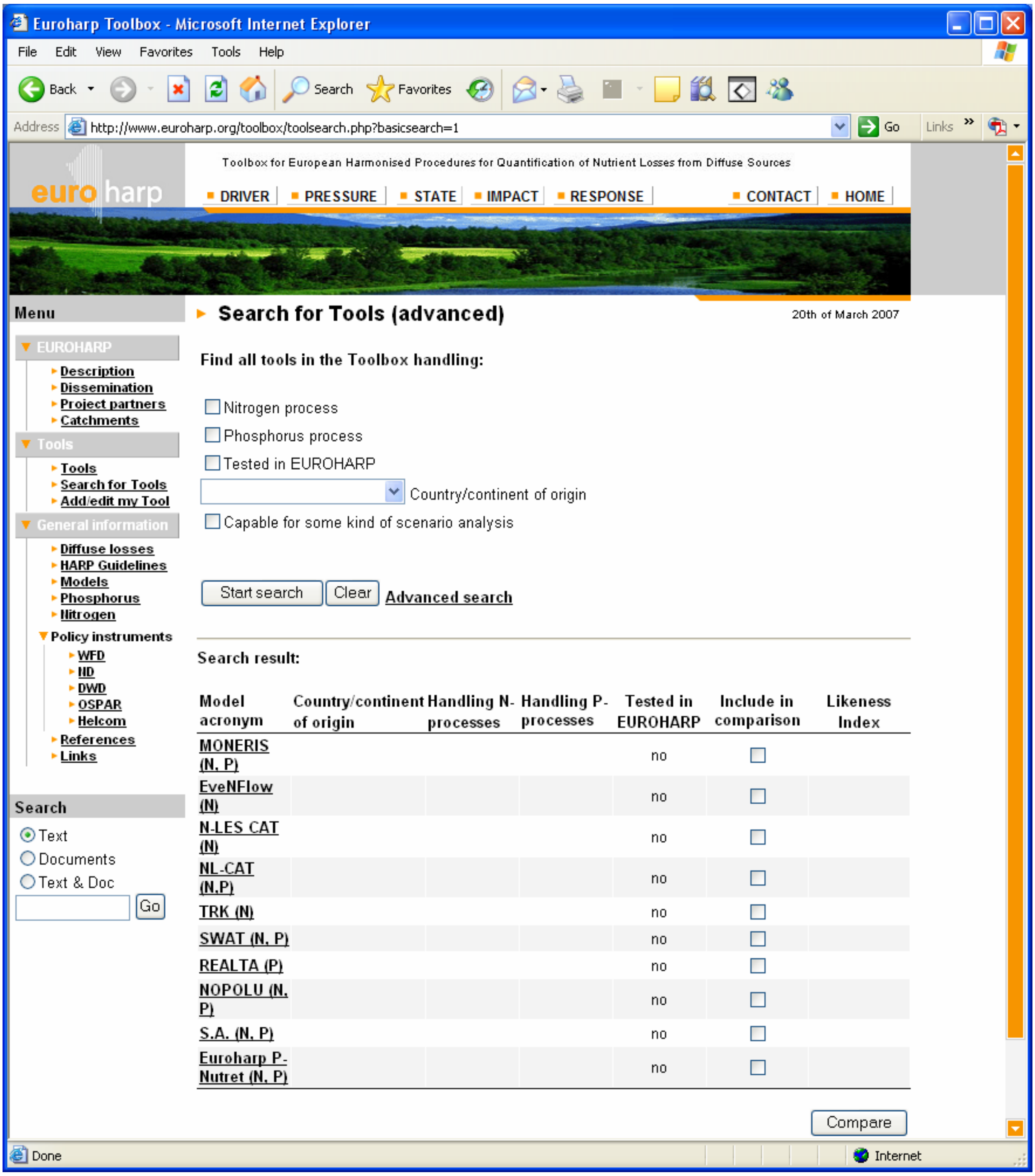


*Figure 2.8. The figure illustrates the dialogue where the basic search filters can be set and search performed.*

This is the dialogue very the basic (most commonly used) search filters can be set.

**Description of the upper part of the main canvas**

The following search filters shall be available in the Basic search dialogue:
- Nitrogen processes
- Phosphorus processes
- Tested in EUROHARP. This limits the list of tools to only those tools part of the EUROHARP-project and those tools not part of the EUROHARP-project.
- Country/continent of origin (drop-down list containing European countries and other selected countries/continents).
- Capable for some kind of scenario analysis

It should be noted that there are AND-statement between the search filters, i.e. if the user checks two or more search criterias, all must be fulfilled for the found/listed tools.

It is included yellow tooltips that appear when the user moves the cursor above the different search filters that explain briefly the meaning of each filter.

Start search button: Pressing this button starts the database search and populates/fills a list of found tools in the lower part of the dialogue.

Clear: Pressing this button removes the defined search filters.

Advanced search: Clicking on this link takes the user to a new dialogue where more advanced/comprehensive search filters can be set. Details about this dialogue are given in section 2.7.

**Description of the search result**
As the user has performed a search for tools, the lower part of the main canvas is filled with all tools stored in the Toolbox fulfilling the defined search critieria. The following information is listed about each tool:

- Model acronym
- Country/continent of origin
- Handling N-processes (Yes/No)
- Handling P-processes (Yes/No)
- Tested in EUROHARP (Yes/No)
- Check box indicating if the tools is part of a comparison
- Likeness Index

By clicking/selecting one model for inspection or several for comparison, detailed descriptions of the tools are launched (see details in section 2.8 and 2.9). The models that are checked in the list are launched for comparison. There are hyperlinks on every model allowing the user to click directly on one model to view the description of the selected model. The comparison sheet/dialogue is launched when two or more models are checked and the “Compare”-button pressed.

All columns have sort functions when the user clicks on top of them.

Please note, that the heading text is changed according to how the list is populated. When the user enters the dialogue as the opening page (no search filters defined), the provided text is “Tools available in the Toolbox”. If the list of tools is limited by a search filter, the heading is; “Tools in the Toolbox fulfilling the given criteria”.

The search filter applied is shown behind or under the heading of the search result.

Likeness Index: A pop-up showing the likeness between the selected tool and the other tools in the list (only those listed) is launched as the user presses the Likeness index icon. A further specification of the calculation and appearance of the index is given in section 2.12.

## 2.7 Advanced search for models/tools

This dialogue is available as the user presses the "Advanced search"-button from the Basic search-dialogue (see section 2.6).

The advanced search criteria are grouped into 3 tabs.
- Tab 1: Search on model output and represented processes + text search
- Tab 2: Capability for a particular catchment
- Tab 3: Potential capability for scenario analysis

It is also a "Start search"-button available, and a link to go back to the Basic search criteria. Details for the different tabs are presented in the sections 2.7.1 – 2.7.3.

### 2.7.1 Tab 1: Search on model output represented processes + text

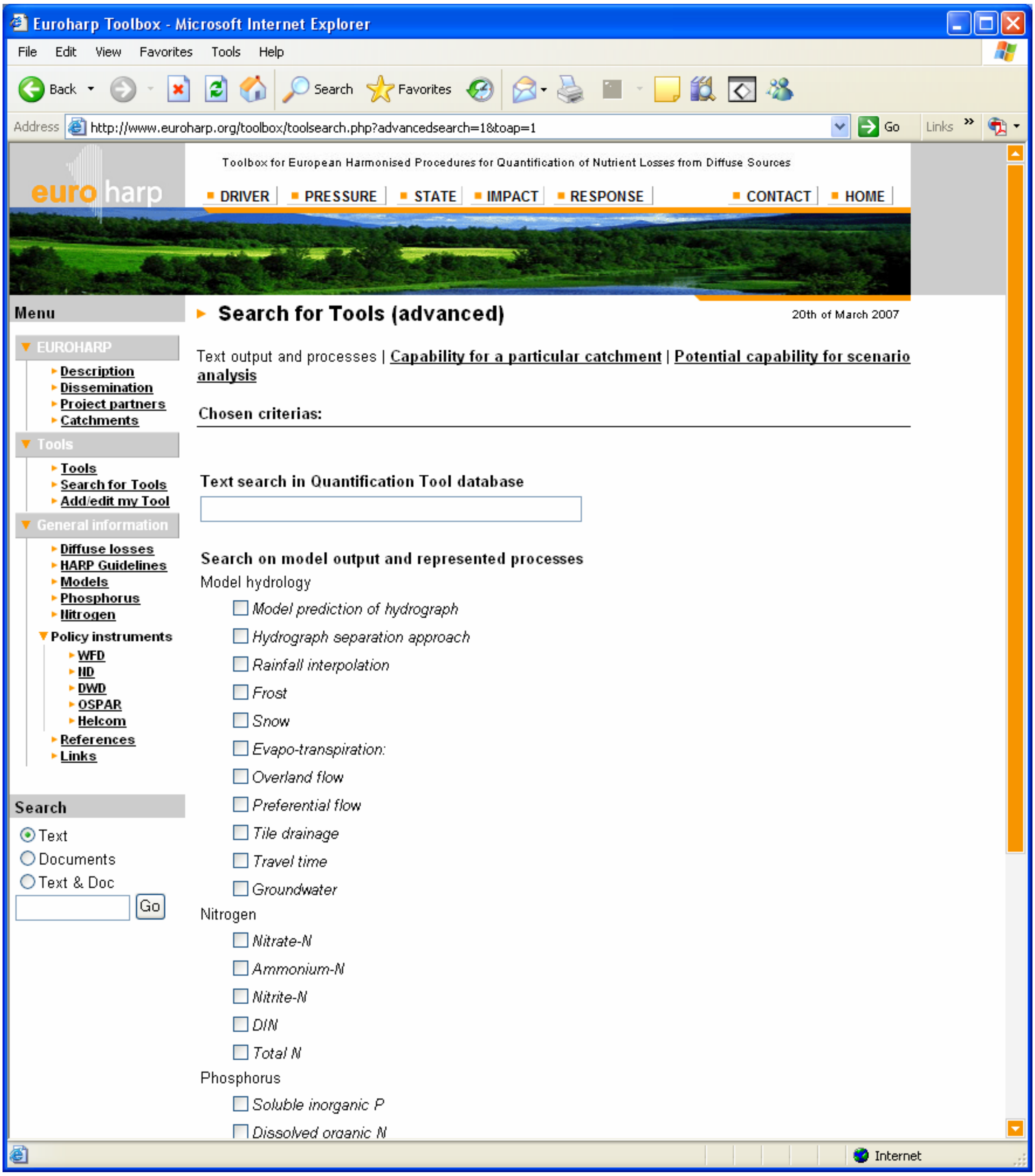



*Figure 2.9a. The figure illustrates Tab 1 in the advanced search dialogue. The search function also covers fields in the database added as part of the extension of the Toolbox (part 1).*

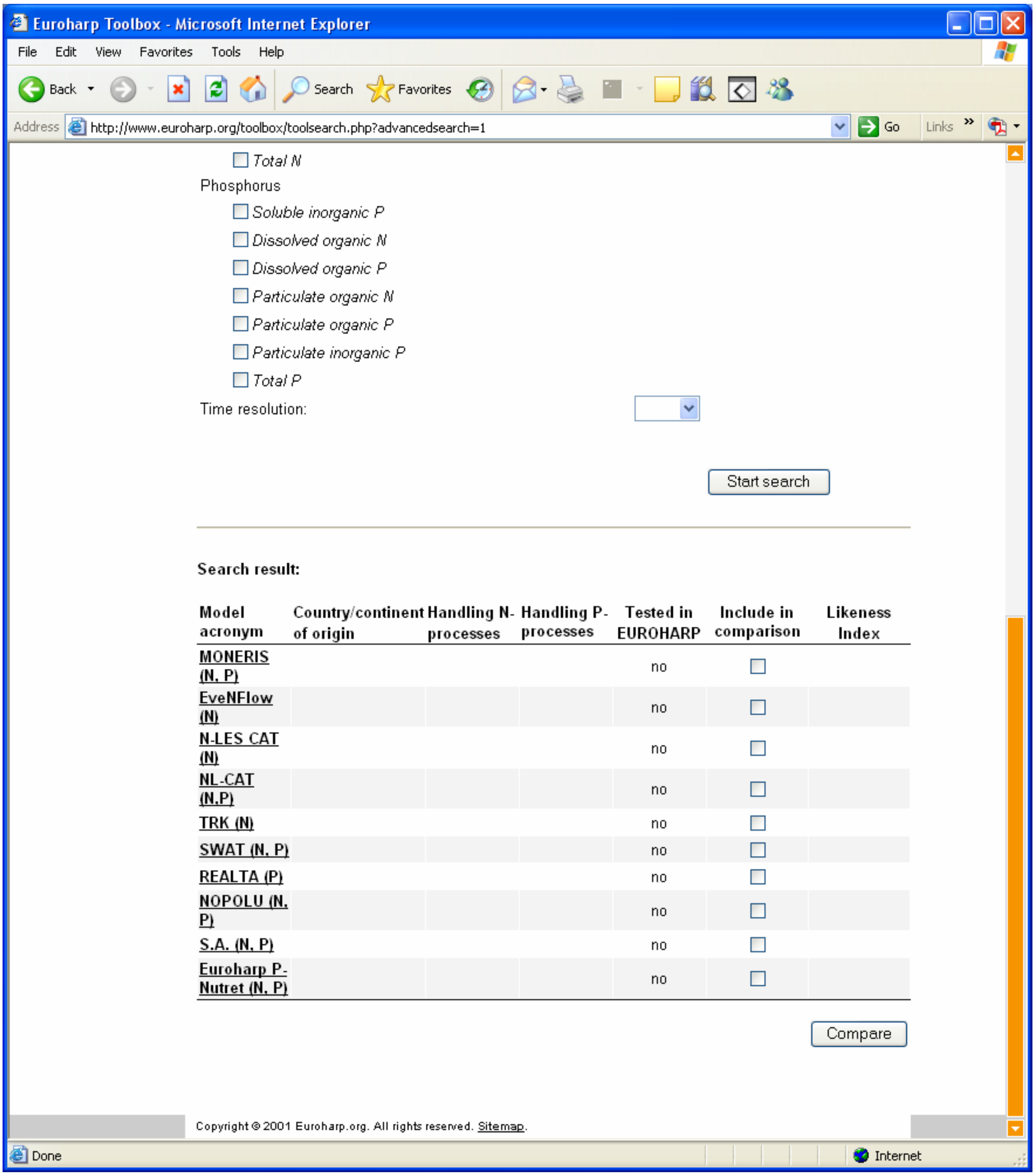



*Figure 2.9b. The figure illustrates Tab 1 in the advanced search dialogue. The search function also covers fields in the database added as part of the extension of the Toolbox (part 2).*

### 2.7.2 Tab 2: Capability for a particular catchment

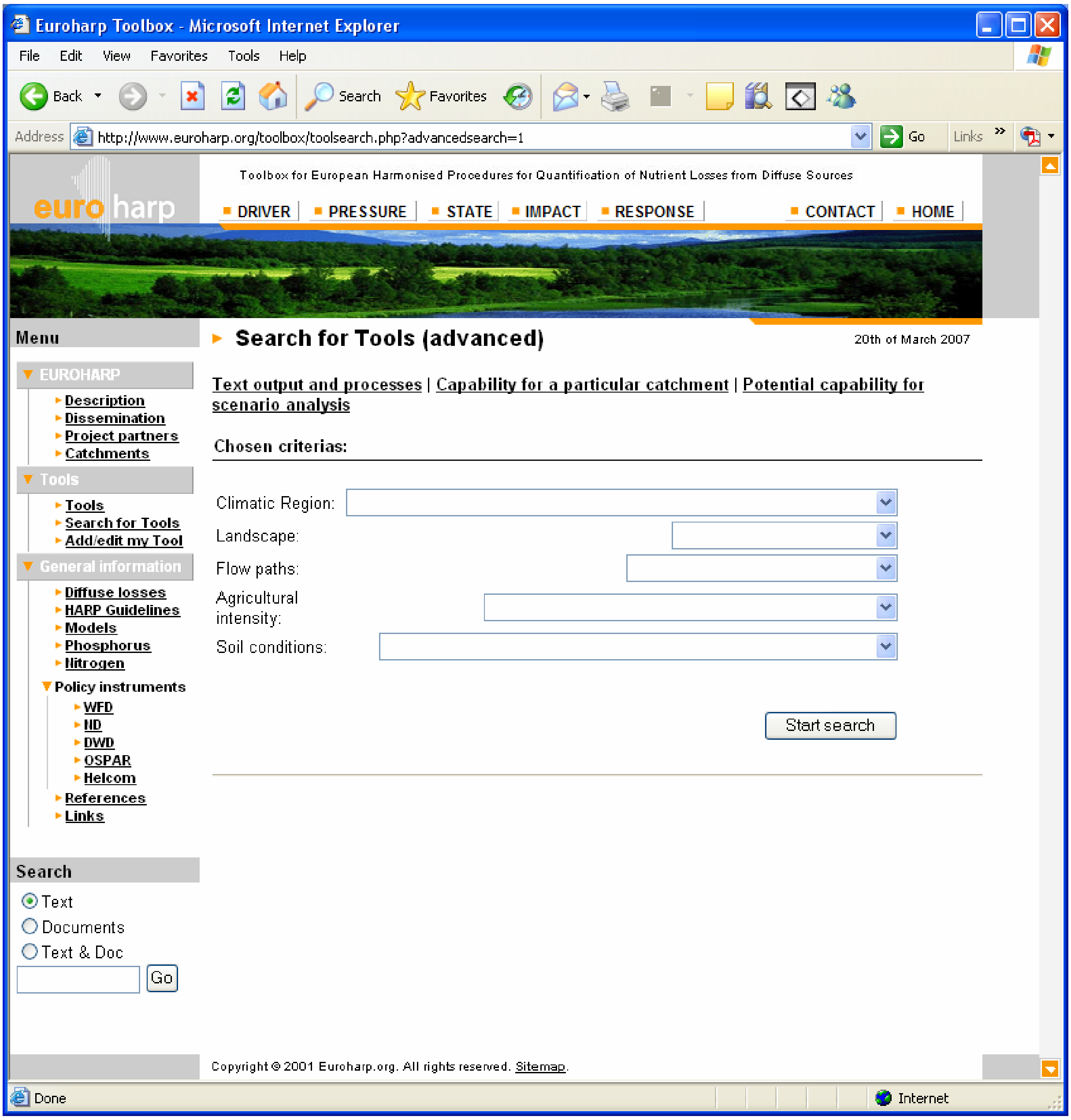



*Figure 2.10. The figure illustrates Tab 2 in the advanced search dialogue. The drop-down menus contains categories of information defined by the EUROHARP-project (Schoumans, O.F. & M. Silgram, 2003).*

### 2.7.3 Tab 3: Potential capability for scenario analysis

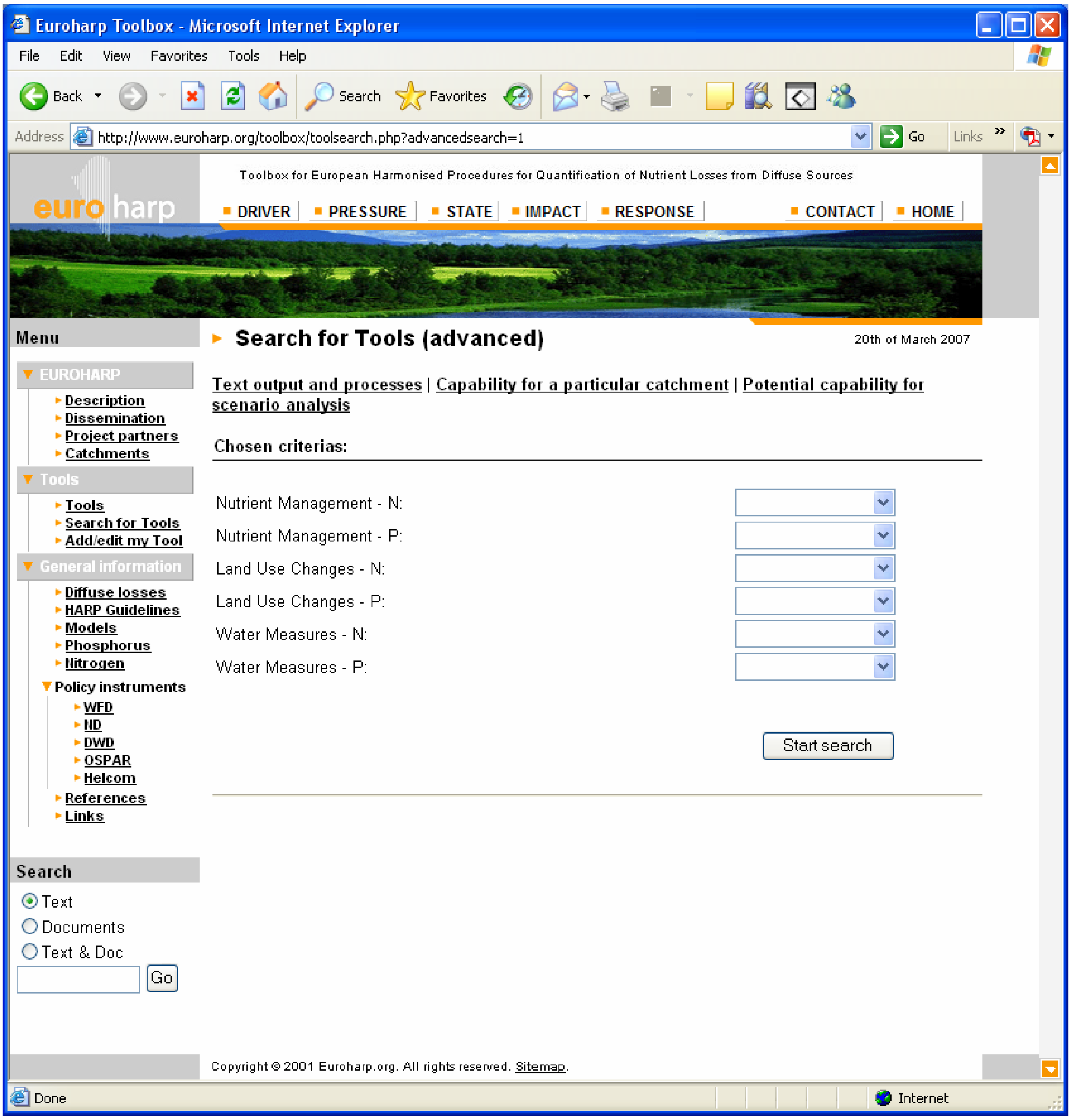



*Figure 2.11. The figure illustrates Tab 3 in the advanced search dialogue. The drop-down menus contains categories of information defined by the EUROHARP-project (Schoumans, O.F. & M. Silgram, 2003).*

## 2.8 Inspection of one model

This is the dialogue that is launched when the user wants to present/inspect one model/tool. Due to the fact that there is a long list of information about each individual tool to be presented, the screendumps shown in this document are split into 5 figures (figure 2.12a-2.12e).

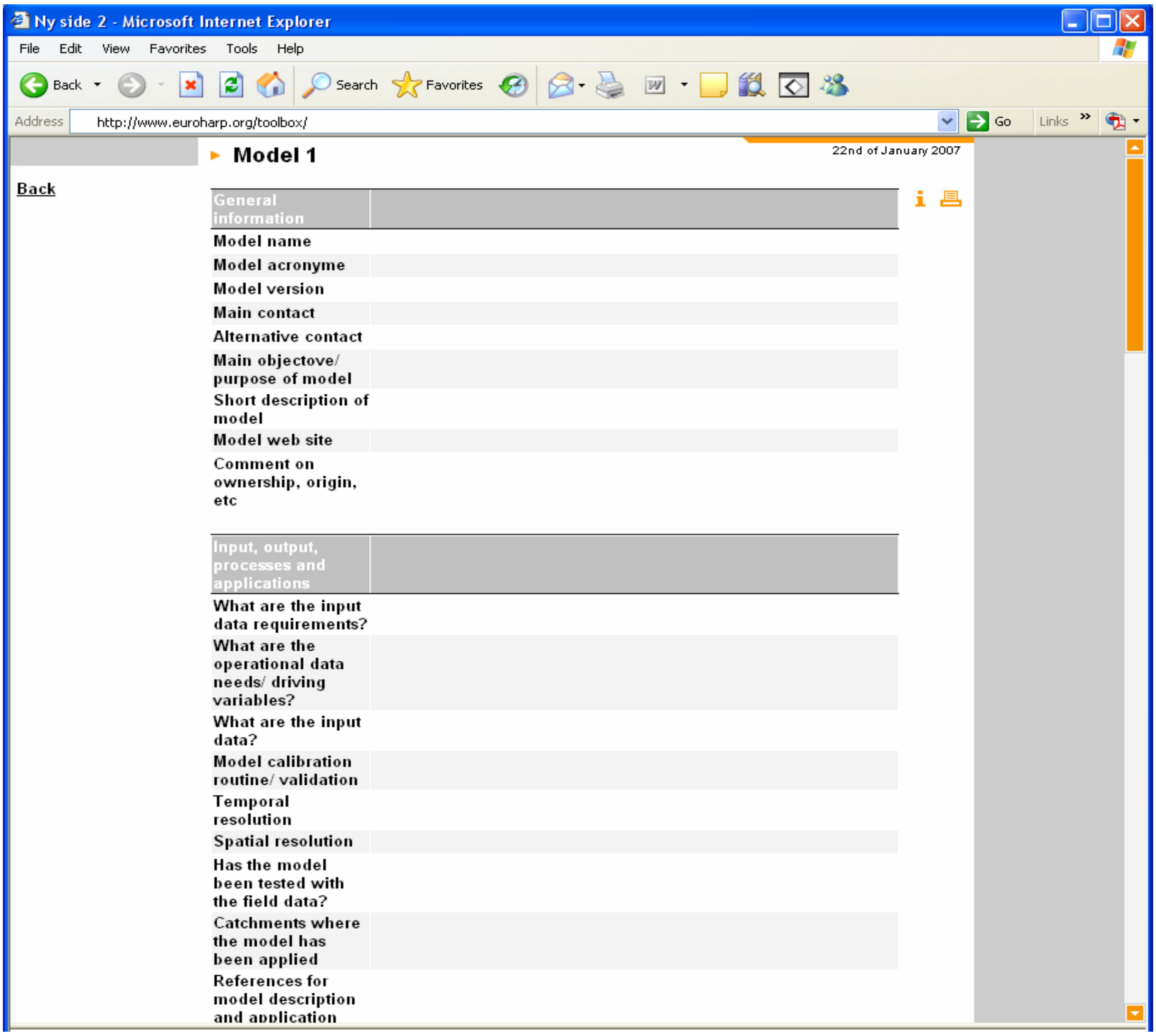



*Figure 2.12a. The figure illustrates the presentation of one model in the Toolbox (part 1).*

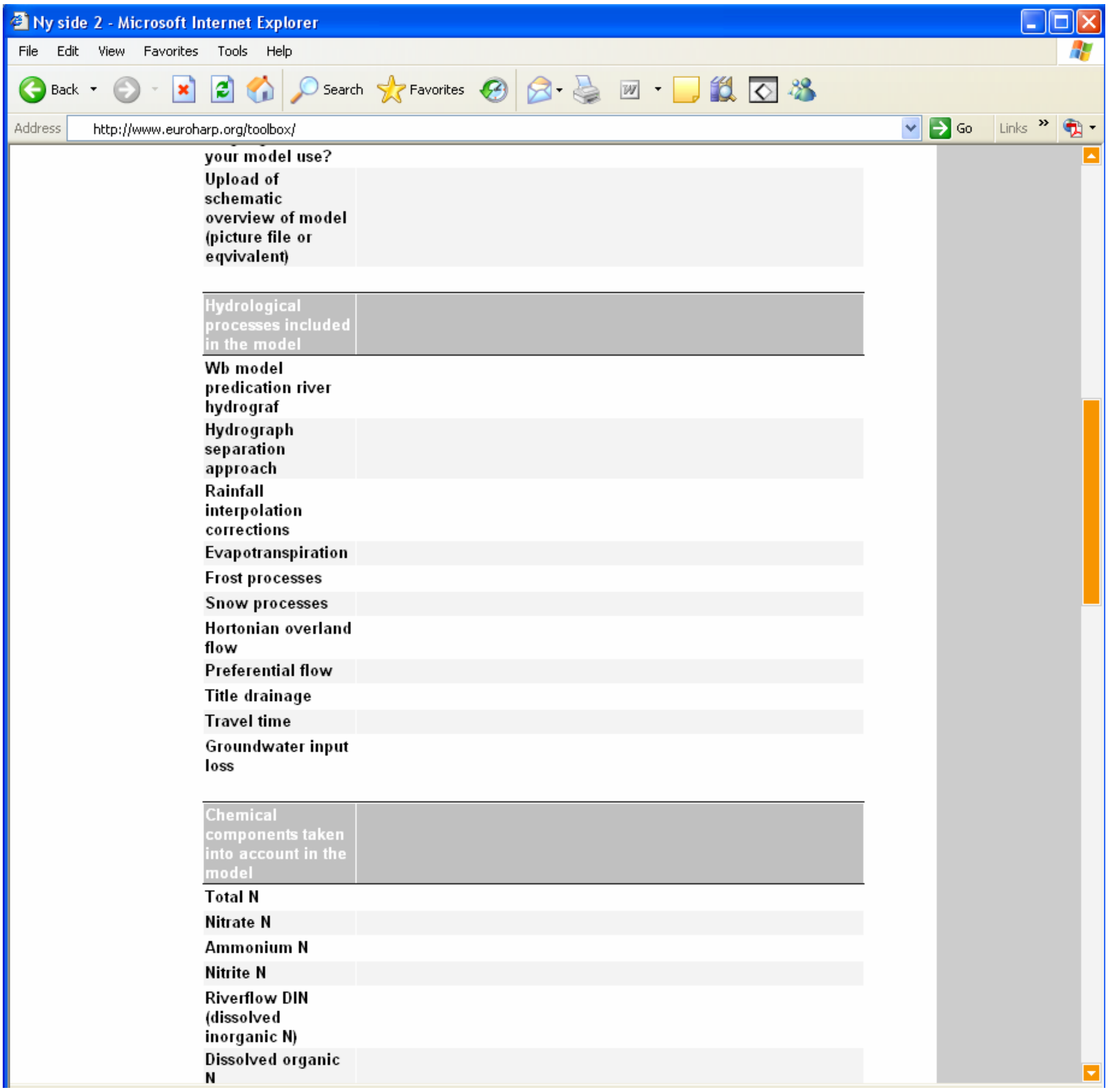



*Figure 2.12b. The figure illustrates the presentation of one model in the Toolbox (part 2).*

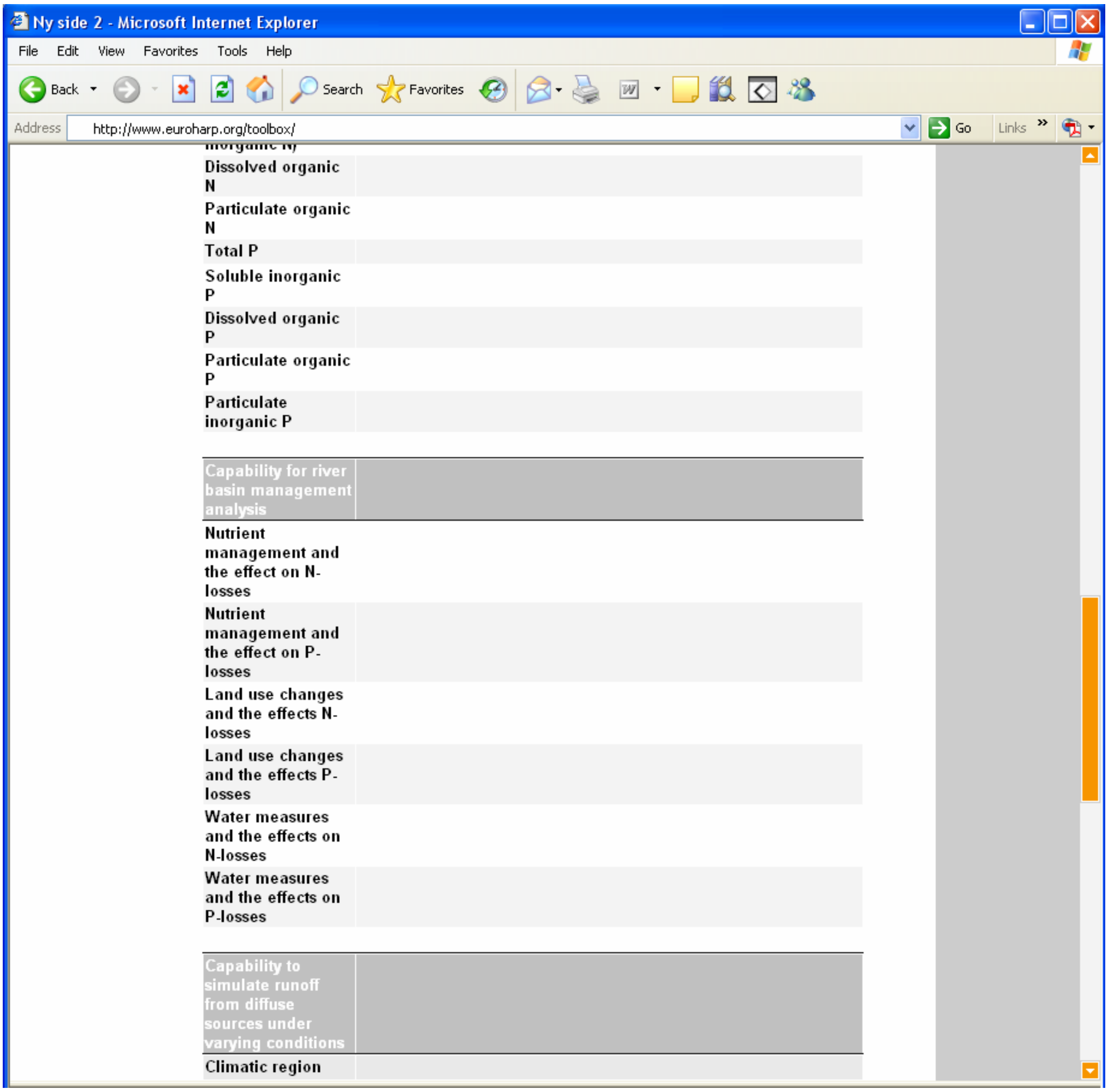



*Figure 2.12c. The figure illustrates the presentation of one model in the Toolbox (part 3).*

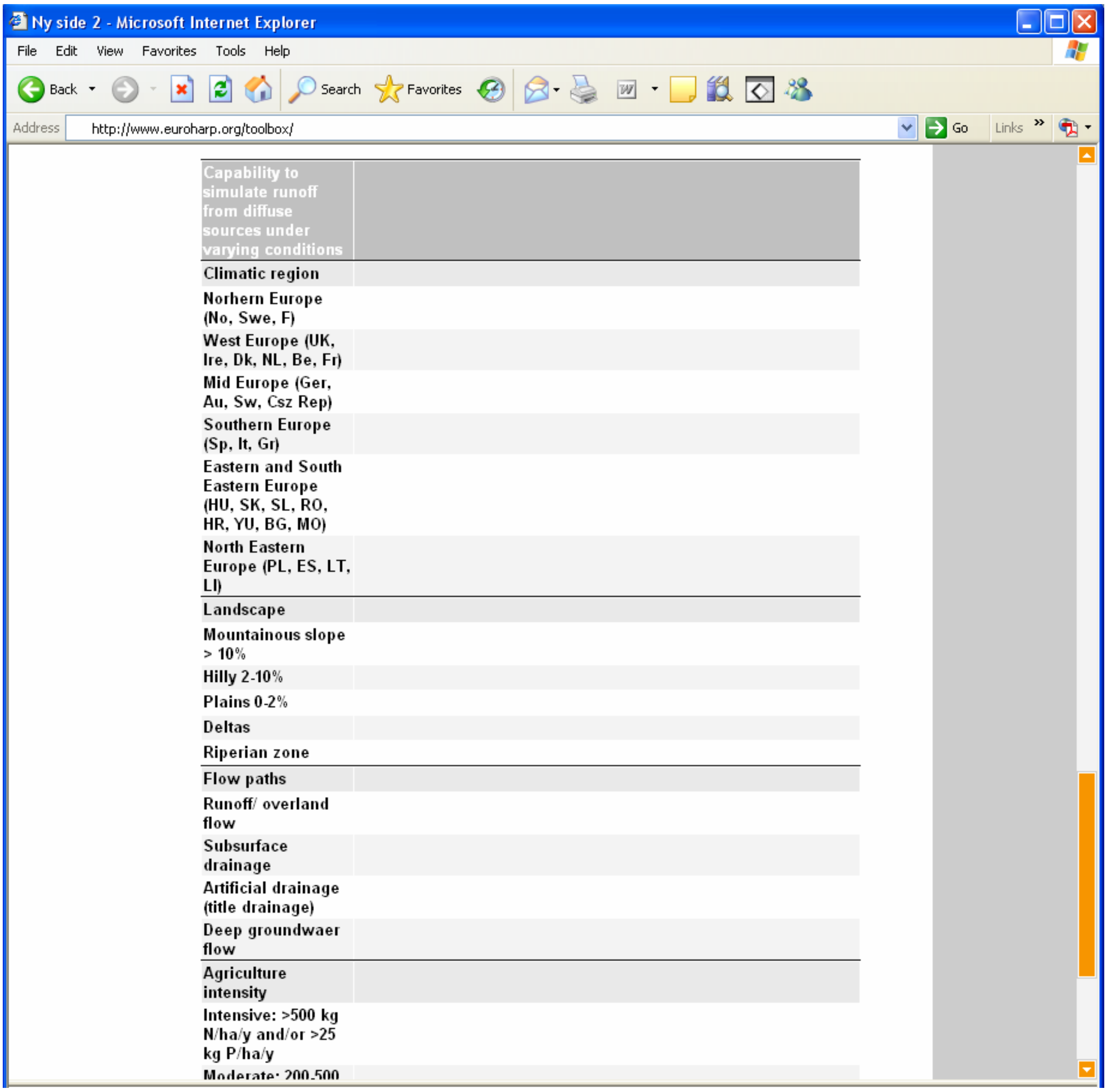



*Figure 2.12d. The figure illustrates the presentation of one model in the Toolbox (part 4).*

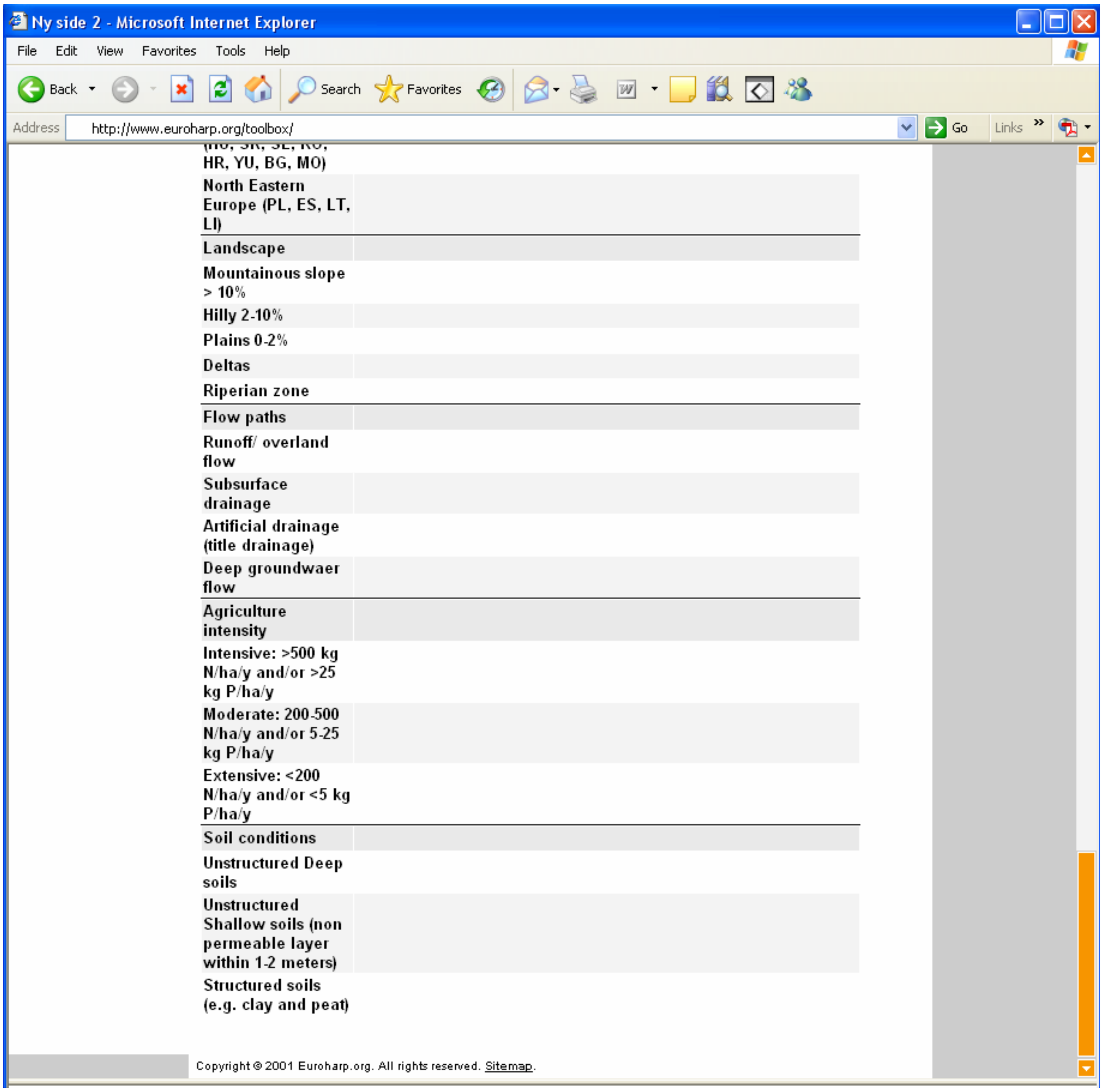



*Figure 2.12e. The figure illustrates the presentation of one model in the Toolbox (part 5).*

**Comments to the presentation**

The way of inspecting a model description follows more or less the same structure and format as in the old version of the Toolbox. However, some changes are introduced:

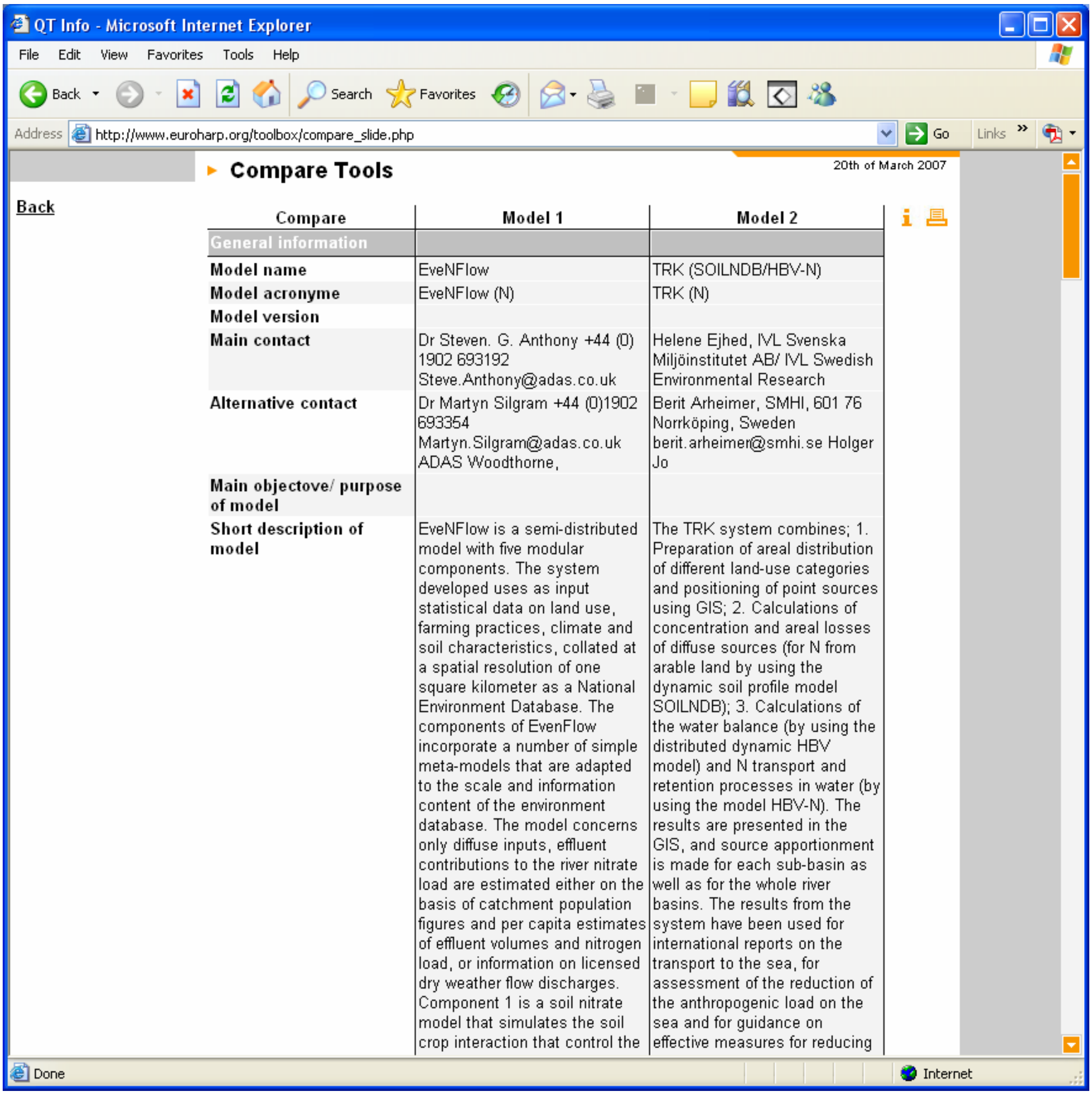
- The order of the information basically follows the order shown in Appendix A
- The headings are as shown in Appendix A
- Link to EUROHARP-specific information (catchments applied in, results, etc) are located above “Input, output, processes and applications”, are given a different colour and/or font than the rest of the information, and have its own “Show”-link. The link to the EUROHARP-results is not shown in the screendumps 2.12a-2.12e.
- Text fields (eg. Description and details) with more than 5 lines have a “Show”-function. By default, only the first 5 lines are shown.

- Each property/field/row is separated by introducing a very mild background colour. For instance, row number 1, 3, 5, 7, etc have very mild blue background, while the even numbers have standard white (as in present version).
- Copy and Paste-functionality is supported.
- Criteria/properties that have been used during a search are marked with a different colour in the dialogue presenting one model.
- Likeness Index is shown by a clickable icon in the list of properties. Clicking the icon launches a pop-up, as described in detail in section 2.12. The Likeness Index is inserted above the EUROHARP-specific information.

## 2.9 Comparison of two or more found models

The comparison of two or more tools follows more or less the same structure as the presentation of one tool (section 2.8). Some more functionality is, however, supported:

- As the user selects/activates one row/field in one model description, the same fields in the other tools/models should is also highlighted.
- The same rows/fields are presented beside each other in order to provide a user-firiendly way to compare fields/properties.
- Copy, paste information about all selected models/tools into MS Excel or Excel-compliant format is supported.
- When search is based on specific criteria, the criteria matching the defined filter are highlighted to show the user which criteria actually made the tool to be found/listed.
- Likeness Index is included (similar to specified in section 2.8).




| Compare | Model 1 | Model 2 |
|---|---|---|
| **General information** | | |
| **Model name** | EveNFlow | TRK (SOILNDB/HBV-N) |
| **Model acronyme** | EveNFlow (N) | TRK (N) |
| **Model version** | | |
| **Main contact** | Dr Steven. G. Anthony +44 (0) 1902 693192 Steve.Anthony@adas.co.uk | Helene Ejhed, IVL Svenska Miljöinstitutet AB/ IVL Swedish Environmental Research |
| **Alternative contact** | Dr Martyn Silgram +44 (0)1902 693354 Martyn.Silgram@adas.co.uk ADAS Woodthorne, | Berit Arheimer, SMHI, 601 76 Norrköping, Sweden berit.arheimer@smhi.se Holger Jo |
| **Main objectove/ purpose of model** | | |
| **Short description of model** | EveNFlow is a semi-distributed model with five modular components. The system developed uses as input statistical data on land use, farming practices, climate and soil characteristics, collated at a spatial resolution of one square kilometer as a National Environment Database. The components of EvenFlow incorporate a number of simple meta-models that are adapted to the scale and information content of the environment database. The model concerns only diffuse inputs, effluent contributions to the river nitrate load are estimated either on the basis of catchment population figures and per capita estimates of effluent volumes and nitrogen load, or information on licensed dry weather flow discharges. Component 1 is a soil nitrate model that simulates the soil crop interaction that control the | The TRK system combines; 1. Preparation of areal distribution of different land-use categories and positioning of point sources using GIS; 2. Calculations of concentration and areal losses of diffuse sources (for N from arable land by using the dynamic soil profile model SOILNDB); 3. Calculations of the water balance (by using the distributed dynamic HBV model) and N transport and retention processes in water (by using the model HBV-N). The results are presented in the GIS, and source apportionment is made for each sub-basin as well as for the whole river basins. The results from the system have been used for international reports on the transport to the sea, for assessment of the reduction of the anthropogenic load on the sea and for guidance on effective measures for reducing |

*Figure 2.13. The figure illustrates the presentation/comparison of three models in the Toolbox. All other properties available in the Toolbox database are also presented/ compared. They are not shown in this figure as there are identical to the properties shown in the figures 2.12a-e and also presented in appendix A.*

## 2.10 Update of text information in the Toolbox

Many of the text strings in the existing Toolbox had to be updated as the Toolbox was updated from being a project specific deliverable to a more generic Toolbox. Text is available directly on the HTML-pages (dialogues), in the database and hence generic text that appears as a function of user selection, and in the Info-boxes (behind i-buttons, usually located in the upper right side of the dialogues).

Updates of text is not included in this document, but is updated and inserted directly in the Toolbox.

## 2.11 Likeness Index

The idea of the likeness index is to present a very brief and rough comparison of the models in the Toolbox based on the models' properties, included processes and capabilities. The likeness index is a value between 0 and 1, where 0 represent or indicate no similarities between two models and 1 represent a 100 % match between the properties of the models compared.

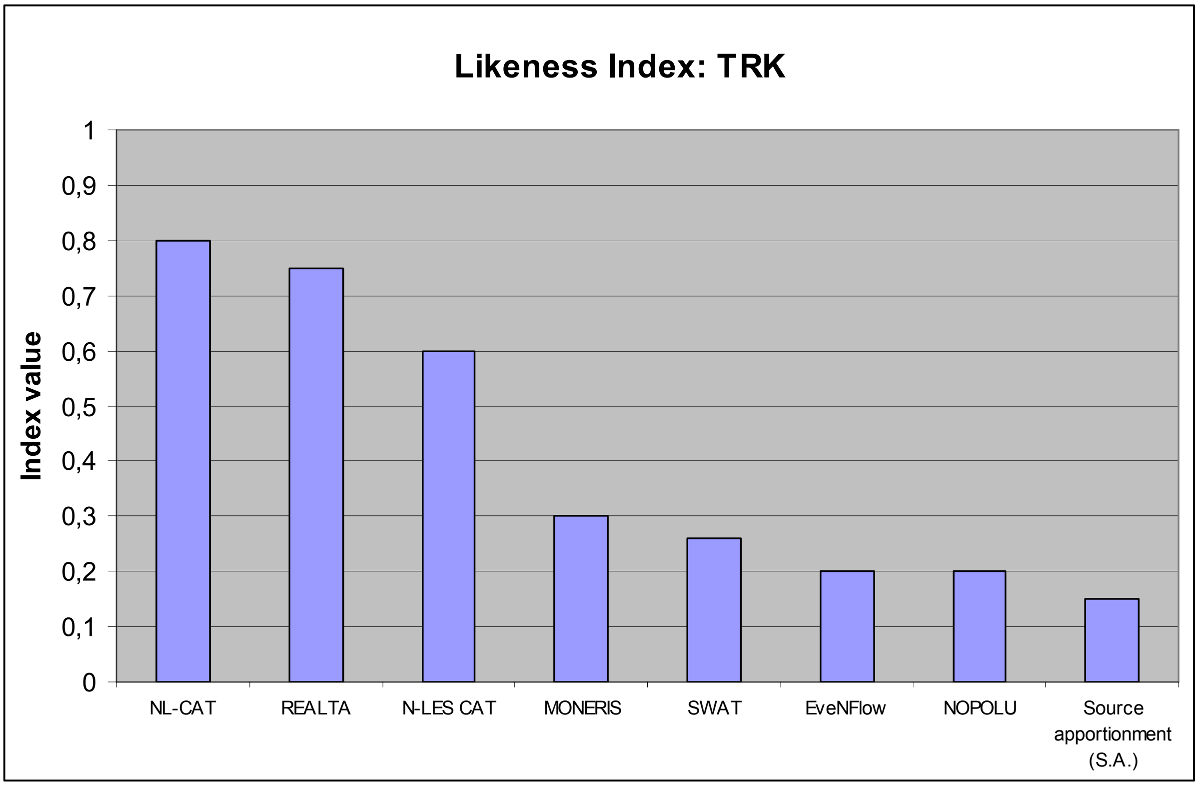



*Figure 2.14. The figure illustrates the presentation/comparison of TRK with all models in the Toolbox. The models (along the x-axis) are organised as the models with the highest likeness index to the left and the models with the lowest likeness index to the right.*

**Calculation of the Likeness Index**

The Index is calculated based on information registered in the Toolbox database. The index can, of course, not be calculated based on text information, and only the properties within the following categories:

- Hydrological processes included in the model
- Chemical components taken into account in the model
- Capability for river basin management analysis
- Capability to simulate runoff from diffuse sources under varying conditions

In addition, the following properties under the information category "Input, output, processes and applications" should be included:

- What are the output data?
- Output on nutrient fluxes/concentrations
- Spatial resolution - lumped or distributed?
- Spatial resolution - details on distributed

Information provided within these categories is all defined from drop-down lists.

The index is always calculated with respect to one selected tool, and the likeness of the other tools with respect to this tool. The procedure to calculate the index is that the system finds all the defined values of the selected tool, and compares these with the properties of all the other tools. The properties of the selected tool that match the properties of each of the other tools are counted and the sum of the "matches" is divided on the total number of properties. Properties that are set to "unknown", "not set" or similar, are excluded from the calculation, no matter if these undefined properties are for the selected tool or any of the tools it is compared with.

The number of properties used in the comparison is given along the x-axis of the graph (n = number of properties included in the calculation).

## 2.12 Required/Not required and use of default values

The use of required fields is defined in the Excel-file that follows this report, also given in Appendix A. Required fileds are indicated in the user interface by an asterix (*).

To encourage the model owners to carefully define the processes handled and the capabilities of their tool, all fields (drop-downs) among the categories given below are by default set to "Unknown/Not set".

- Hydrological processes included in the model
- Chemical components taken into account in the model
- Capability for river basin management analysis
- Capability to simulate runoff from diffuse sources under varying conditions

## 2.13 Administrative logging of user behaviour

A logging system to get an overview of the actual use of the EUROHARP Toolbox is implemented. From this it is possible to extract information about which pages that are most commonly accessed. This information is not to be available to ordinary users, but only administrators of the system.

# 3. Inventory of diffuse sources models

One of the objectives with the extension of the EUROHARP Toolbox is to include more diffuse source models in addition to the EUROHARP models already present in the Toolbox. A search for potential models to be included was conducted by search in other existing toolboxes and general literature and internet searches (see details below). The outcome of these searches were compiled in table 3.1 and Appendix B. Models included in table 3.1 are, as far as the authors of this report knows, models quantifying nutrient runoff from diffuse sources that can be run as stand-alone systems. This means that they do not need to be connected to other external models or modules in order to simulate nutrient concentrations/load on a river basin scale.

In addition those models listed in table 3.1 that have simulation of nutrient runoff from diffuse sources on a catchment-scale as their main focus, a number of other models, or sub-modules of larger modelling systems, might also be of relevance. These models that do not simulate diffuse losses and nutrient concentrations/loads on catchment-scale as their primary purpose are included in Appendix B.

We would like to underline that these lists probably do not cover all relevant tools ever developed, as it might be several tools that are not published in searchable literature or databases.

The reports of Arheimer & Olsson (2003), Ward et al. (1999), Parsons et al. (2004), French & Delstraa (2003) all give comprehensive overview of models and have been useful in compiling the information in table 3.1 and Appendix B and represent interesting sources of information for further reading on diffuse source and water quality modelling.

**Sources of information:**

- The BMW - Benchmark Models for the Water Framework Directive Toolbox: http://www.rbm-toolbox.net/bmw/index.php
- The Register of Ecological Models (REM) a meta-database for existing mathematical models in ecology. REM is a cooperative service of the University of Kassel (www.uni-kassel.de/uk/) and the GSF (www.gsf.de) - National research center for Environment and Health http://eco.wiz.uni-kassel.de/ecobas.html
- EPA - Water Quality Models and Tools: http://www.epa.gov/waterscience/models/
- Arheimer, B. & Olsson, J. 2003. Integration and Coupling of Hydrological Models with Water Quality Models: Applications in Europe. Swedish Meteorological and Hydrological Institute (SMHI). www.wmo.ch/web/homs/projects/Components/English/k55102.pdf

- Ward, Jr., George H. & Benaman, J. 1999. A survey and review of modeling for TMDL Application in Texas water courses. Online Report CRWR-99-8. Center for Research in Water Resources. The University of Texas at Austin Austin, Texas 78712 December 1999. www.crwr.utexas.edu/reports/pdf/1999/rpt99-8.pdf
- Parsons, J.E, Thomas, D. L., Huffmann, R. L. (eds.) 2004. Agricultural Non-point Source Water Quality models. Their use & Application. A co-operative publication associated with CSREES and EWRI. Southern Cooperative Series Bulletin # 398, 204 pp. ISBN: 1-58161-398-9. *Updated version of original document from 2001.* http://www3.bae.ncsu.edu/Regional-Bulletins/Modeling- Bulletin/modeling-bulletin.pdf
- French, H. & Deelstra, J.2003. Modelling at Jordforsk: Objectives and overview of present and potential models. Jordforsk report no 70/2003. http://gammel.jordforsk.no/modeller/jfmodelreport.pdf


*Table 3.1.The table provides an overview of models handling diffuse sources of nutrients. The models presented in this table are the models considered most relevant and similar to those models tested as part of the EUROHARP-project that were found during the literature and Internet search. A number of other models that to some extent also cover the same modelling domain (runoff nutrient from diffuse sources), but where most models have their primary focus on other processes, are given in Appendix B.*

| Acronym | Name | Contact name/Institute | Contact e-mail | Web | Description | Model Reference |
|---|---|---|---|---|---|---|
| AGNPS | Agricultural Non-Point Source pollution model | Dr Jaewan Yoon Dep. of Civil and Environ-mental Engineering. Old Dominion University, UK | yoon@cee.odu.edu | http://dino.wiz.uni-kassel.de/model_db/mdb/agnps.html | AGricultural Non-Point Source Pollution Model (AGNPS) is a joint USDA-Agricultural Research Service and -Natural Resources Conservation Service system of computer models developed to predict non-point source pollutant loadings within agricultural watersheds. It contains a continuous simulation, surface runoff model designed to assist with determining basin management plans (BMPs), the setting of total maximum daily loads (TMDLs) and for risk & cost/benefit analyses. | Young, R.A., Onstad, C.A. Borsch, D.D. and Anderson, W. P., 1989. AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds. *Journal of Soil and Water Conservation* Vol. 44, No. 2, 168-173 pp. |
| CAMEL | Chemicals from Agricultural Management and Erosion Losses | B. K. Koo The Macaulay Institute, Aberdeen, UK | b.koo@macaulay.ac.uk | http://www.copernicus.org/EGU/hess/hessd/2/1359/hessd-2-1359.pdf | A spatially-distributed conceptual model for simulating reactive transport of Phosphorus from diffuse sources at the catchment scale. A catchment is represented in the model using a network of grid cells and each grid cell is | Koo, B.K., Dunn, S. M. and Ferrier, R. C., 2005. A distributed continuous simulation model to identify critical source areas of phosphorus at the |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | comprised of various conceptual storages of water, sediment and Phosphorus. | catchment scale: model description. *Hydrol. Earth Sys. Sci. Discuss*. 2, 1359–1404 pp. |
| ECM | Export Coefficient Model | Prof. Kenneth H. Reckhow, Nicholas School of the Environment and Earth Sciences, Duke University, UK | reckhow@duke.edu | | Distributed model constructed to predict annual loss of N and P from river basins at various points throughout a drainage system. The annual load delivered to a water body is calculated as the sum of the individual loads exported from each nutrient source within a catchment. Export coeffiecients for different land uses (and locations) can be derived from literature. | Reckhow, K.H. and Simpson. J., 1980. A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorous Concentration form Land Use Information. *Canadian Journal of Fisheries and Aquatic Sciences*, 37(9), 1439-1448 pp. |
| EUTROMOD | EUTROMOD | Carol Winge North American lake Management Society, USA | winge@nalms.org info@nalms.org | http://www.nalms.org | EUTROMOD is watershed-scale nutrient loading and lake response model developed by North American Lake Management Society (NALMS). The model provides information concerning the appropriate mix of point source discharges, land use, and land management controls that result in acceptable lake water quality. EUTROMOD is intended for predicting lake-wide average conditions for the growing seasons as a function of annual loadings. Annual runoff, erosion, and nutrient (nitrogen and phosphorus) loadings are simulated with a simple, lumped watershed modeling procedure. Lake response is predicted by a set of nonlinear regression equations. | |
| INCA | Integrated Nitrogen in CAtchments | Dr Andrew J. Wade, Reading University, UK | A.J.Wade@reading.ac.uk | http://www.rdg.ac.uk/INCA/ | The Integrated Nitrogen in CAtchments (INCA) model is a semi-distributed, deterministic model which simulates and predicts nitrogen transport and processes | Whitehead, P. G., Wilson, E. J. and Butterfield, D. 1988. A semi-distributed Integrated Nitrogen |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | on a daily basis within catchments. Sources of nitrogen can be from atmospheric deposition, from the terrestrial environment or from direct discharges. There are three components included (for INCA-N); the hydrological model, the catchment N process model and the river N process model. . The INCA model is currently being further developed on the basis of the earlier work by Whitehead et al. (1998) and INCA-P and INCA-C versions are also available in addition to an updated version of INCA-N. | model for multiple source assessment in Catchments (INCA): Part I-model structure and process equations, *The Science of the Total Environment,* 210/211, 547-558 pp.<br><br>Wade, A.J., P. Durand, V. Beaujouan, W. Wessels, K. Raat, P.G. Whitehead, D. Butterfield, K. Rankinen and A. Lepistö, Towards a generic nitrogen model of European ecosystems: New model structure and equations. *Hydrol. Earth Syst. Sci.* 6 (3), 559–582 pp. |
| MERLIN | Model of Ecosystem Retention and Loss of Inorganic Nitrogen | Richard F. Wright, NIVA Norway | wri@niva.no | http://www.macaulay.ac.uk/dynamo/merlin.htm | MERLIN is a simple process oriented catchment scale model of linked C and N cycling in ecosystems. The model can be used for simulation and prediction of concentration of inorganic nitrogen in soil leachate and runoff in terrestrial ecosystems. Fluxes in and out of the ecosystem as well as between compartments are taken into account. The rates of fluxes are controlled by the C/N ratios of organic compartments as well as the inorganic N concentrations in the soil solutions. MERLIN emphasises the coupling and interaction of hydrological and abiotic processes affecting N, with the biotic cycling of N within the ecosystem. | Cosby, B.J., Ferrier R.C., Jenkins, A., Emmett, B.A., Wright, R.F. and Tietema A., 1997.Modelling the ecosystem effects of nitrogen deposition at the catchment scale: model of ecosystem retention and loss of inorganic nitrogen (MERLIN). *Hydrol. Earth System Sci.* 1, 137-158 pp. |

| | | | | | | |
|---|---|---|---|---|---|---|
| MESAW | Matrix Equations for Source Apportionment of Water pollutants | Dr Per Stålnacke, BIOFORSK, Norway | per.stalnacke@bioforsk.no | http://mantraeast.webmedia.ee/ | The MESAW model uses nutrient loads for a fixed time interval at each monitoring site as the response variable and the characteristics of subbasins as explanatory variables to estimate diffuse nutrient emissions through non-linear regression analysis. Recommended for estimation of nutrient loss coefficients and retention coefficients. | Grimvall, A. and Stålnacke, P., 1996. Statistical methods for source apportionment of riverine loads of pollutants. *Environmetrics* 7, 201-213 pp. |
| PolFlow | | Dr. Marcel de Wit, RWS RIZA, the Neterlands | m.dwit@riza.rws.minvenw.nl | | PolFlow is a GIS-based model, which simulates the transport of nutrients from soil to surface water as a function of soil, lithology, and runoff characteristics. PolFlow consists of a hydrological module and a nutrient module. Dynamic functions are used to account for the delay of nutrient transport in the soil and the groundwater. Nutrients are routed through the river network with digital drain direction maps. The nutrient loss in each river segment is described as a function of discharge, the occurrence of lakes, and river gradients. | De Wit, M. J. M., 2001. Nutrient fluxes at the river basin scale. I: the PolFlow Model. *Hydrol. Proc*. vol. 15 (5), 743-759 pp. |
| SHETRAN/ GOPC | Système Hydrologique Européen TRAnsport/ Grid Oriented Phosphorus Component | Prof. P.E. O'Connell, Newcastle University, UK | p.e.o'connell@ncl.ac.uk | http://www.epa.ie/EnvironmentalResearch/EPA-FundedResearchProjects/ReportsOutputs/FileUpload,11169,en.pdf<br><br>http://www.ucd.ie/dipcon/docs/theme03/theme03_34.PDF | SHETRAN is a 3D, coupled surface/subsurface, physically-based, spatially-distributed, finite-difference model for coupled water flow, multi-fraction sediment transport and multiple, reactive solute transport in river basins. It gives a detailed description in time and space of the flow and transport in the basin, which can be visualised using animated graphical computer displays. SHETRAN/ GOPC has a generic phosphorus modelling component combined with the SHETRAN model to model the phosphorus detachment and | Ewen, J., Parkin, G. and O'Connell, E., 2000. "SHETRAN: Distributed basin flow and transport modelling system". Journal of Hydrologic Engineering, vol. 5, No. 3, 250-258 pp. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | transport. The GOPC component takes as inputs the hydrological fields produced by the catchment model SHETRAN. | |
| TOPCAT-N/P | TOPCAT | Prof. P.E. O'Connell, Newcastle University, UK | p.e.o'connell@ncl.ac.uk | http://www.ncl.ac.uk/wrgi/TOPCAT/<br><br>http://www.ncl.ac.uk/wrgi/wrsrl/models.html | TOPCAT-N is a catchment scale model for simulating flow and nitrate. TOPCAT-P a Phousporus transport model. Both are based on TOPCAT, a simple hydrological model (which is based on TOPMODEL) that provides time series modelling of flow and of nitrate and phosphates/phosphorus respectively. | Quinn, P.F., Dayawansa, N.D.K. and Hewett, C.J.M., 2003. TOPCAT - The Theory. The TOPCAT website: http://www.ncl.ac.uk/wrgi/TOPCAT/ |

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Abbott, M. B., Bathurst, J. C., Cunge, J. A., O'Connell, P. E and Rasmussen, J., 1986b. An Introduction to the european Hydrological System - Systeme Hydrologique Europeen, "SHE", 2: Structure of a physically-based, distributed modelling system.," *Journal of Hydrology*, vol. 87, pp. 61-77 pp.

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De Wit, M. J. M., 2001. Nutrient fluxes at the river basin scale. I: the PolFlow Model. *Hydrol. Proc*. vol. 15 (5), 743-759 pp.

EPA - Water Quality Models and Tools: http://www.epa.gov/waterscience/models/

EUROHARP Toolbox: www.euroharp.org/toolbox

Ewen, J., Parkin, G., and O'Connell, E., 2000. SHETRAN: Distributed basin flow and transport modelling system.*Journal of Hydrologic Engineering*, vol. 5, No. 3, 250-258 pp.

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http://www3.bae.ncsu.edu/Regional-Bulletins/Modeling- Bulletin/modeling-bulletin.pdf

Quinn, P.F., Dayawansa, N.D.K. and Hewett, C.J.M., 2003. TOPCAT - The Theory. The TOPCAT website: http://www.ncl.ac.uk/wrgi/TOPCAT/

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Shaffer, M.J. and Pierce, F.J. 1982. Nitrogen-tillage-residue management (NTRM) model: user'smanual. Res. Rep. USDA-ARS, St. Paul, Minnesota.

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Ward, Jr., George H. & Benaman, J. 1999. A survey and review of modeling for TMDL Application in Texas water courses. Online Report CRWR-99-8. Center for Research in Water Resources. The University of Texas at Austin Austin, Texas 78712 December 1999. www.crwr.utexas.edu/reports/pdf/1999/rpt99-8.pdf

Whitehead, P. G., Wilson, E. J. and Butterfield, D. 1988. A semi-distributed Integrated Nitrogen model for multiple source assessment in Catchments (INCA): Part I-model structure and process equations, *The Science of the Total Environment,* 210/211, 547-558 pp.

Young, R.A., Onstad, C.A. Borsch, D.D. and Anderson, W. P., 1989. AGNPS: A Nonpoint-Source Pollution Model for Evaluating Agricultural Watersheds. *Journal of Soil and Water Conservation* Vol. 44, No. 2, 168-173 pp.

Yuri G. Motovilov, Lars Gottschalk, og Kolbjørn Engeland, 1999. ECOMAG: Regional model of hydrological cycle. Application to the NOPEX region. Dep. of Geosciences. University of Oslo, Norway.

# Appendix A

This appendix provides a full listing of all database properties in the extended Toolbox.

| REGISTRATION OF NEW USER (MODEL REGISTRATOR) | | | |
|---|---|---|---|
| | | | |
| Name | | | |
| E-mail (user name) | | | |
| Organisation | | | |
| Web site of organisation | | | |
| Password | | | |
| Password repeated | | | |

| REGISTRATION OF DIFFUSE LOSSES MODEL | Type | Required (Yes/No) | Fields in current Toolbox |
|---|---|---|---|
| | | | |
| **GENERAL INFORMATION** | | | |
| Model name | free text | Yes | Yes |
| Model accronym | free text | No | Yes |
| Model version | free text | No | No |
| Main contact | free text | Yes | Yes |
| Alternative contact | free text | No | Not explicitly |
| Main objective /purpose of model | free text | Yes | free text |
| Short description of model | free text | Yes | Yes |
| Model web site (if any) | free text | No | Yes |
| Country/continent of origin | Combo box | No | No |
| Applications outside EUROHARP | free text | No | No |
| Comment on ownership, origin, etc | free text | No | No |
| Last updated | free text | Yes | No |

| **INPUT, OUTPUT, PROCESSES AND APPLICATIONS** | | | |
|---|---|---|---|
| What are the input data requirements? | free text | No | No |
| What are the operational data needs/driving variables? | free text | No | Yes |
| What are the output data? | 1. Diffuse nutrient load to surface waters (point sources to be specified explicitly)<br>2. Nutrient export from catchment<br>3. Unknown | No | No |
| Output on nutrient fluxes/concentrations | 1. Fluxes from soil to surface water<br>2. Concentration in surface water<br>3. Export from catchment<br>4. Unknown | No | No |
| Comment on output | free text | No | Yes |
| Model calibration routine/validation | free text | No | |
| Temporal resolution | free text | No | Yes |
| Spatial resolution - lumped or distributed? | Lumped/Distributed/Unknown | Yes | No |
| Spatial resolution - details on distributed | Spatial grid/Spatial units (shapes)/Unknown | No | No |
| Spatial resolution - comment | free text | No | Yes |
| Has the model been tested with the field data? | free text, yes/no | No | Yes |
| Catchments where the model has been applied | free text | No | Yes |
| References for model description and application | free text | No | Yes |
| Which subroutines does the model have? | free text | No | |
| What computer platform does the model run on? | free text | | |
| What computer language is your model coded in? | free text | No | No |
| Upload of schematic overview of model (picture file or eqvivalent) | picture file | No | Yes |
| | | | |
| **HYDROLOGICAL PROCESSES INCLUDED IN THE MODEL** | | | |
| wb model prediction river hydrograph | yes/no/unknown + free text | No | Yes |
| hydrograph separation approach | yes/no/unknown + free text | No | Yes |
| rainfall interpolation corrections | yes/no/unknown + free text | No | Yes |
| evapotranspiration | yes/no/unknown + free text | No | Yes |
| frost processes | yes/no/unknown + free text | No | Yes |
| snow processes | yes/no/unknown + free text | No | Yes |
| hortonian overland flow | yes/no/unknown + free text | No | Yes |
| preferential flow | yes/no/unknown + free text | No | Yes |

| | | | |
|---|---|---|---|
| tile drainage | yes/no/unknown + free text | No | Yes |
| travel time | yes/no/unknown + free text | No | Yes |
| groundwater input loss | yes/no/unknown + free text | No | Yes |
| | | | |
| **CHEMICAL COMPONENTS TAKEN INTO ACCOUNT IN THE MODEL** | | | |
| total N | yes/no/unknown + free text | No | Yes |
| nitrate N | yes/no/unknown + free text | No | Yes |
| ammonium N | yes/no/unknown + free text | No | Yes |
| nitrite N | yes/no/unknown + free text | No | Yes |
| riverflow DIN (dissolved inorganic N) | yes/no/unknown + free text | No | Yes |
| dissolved organic N | yes/no/unknown + free text | No | Yes |
| particulate organic N | yes/no/unknown + free text | No | Yes |
| total P | yes/no/unknown + free text | No | No |
| soluble inorganic P | yes/no/unknown + free text | No | Yes |
| dissolved organic P | yes/no/unknown + free text | No | Yes |
| particulate organic P | yes/no/unknown + free text | No | Yes |
| particulate inorganic P | yes/no/unknown + free text | No | Yes |
| | | | |
| **CAPABILITY FOR RIVER BASIN MANAGEMENT ANALYSIS** | | | |
| Capability to simulate nutrient management and the effect on N-losses | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Capability to simulate nutrient management and the effect on P-losses | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Capability to simulate land use changes and the effects on N-losses | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Capability to simulate land use changes and the effects on P-losses | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Capability to simulate water measures and the effects on N-losses | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Capability to simulate water measures and the effects on P-losses | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |

| | | | |
|---|---|---|---|
| **CAPABILITY TO SIMULATE RUNOFF FROM DIFFUSE SOURCES UNDER VARYING CONDITIONS** | | | |
| | | | |
| **Climatic region** | | | |
| Northern Europe (No, Swe, F) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| West Europe (UK, Ire, Dk, NL, Be, Fr) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Mid Europe (Ger, Au, Sw, Csz. Rep.) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Southern Europe (Sp, It, Gr) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Eastern and South Eastern Europe (HU, SK, SL, RO, HR, YU, BG, MO) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| North Eastern Europe (PL, ES, LT, LI) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| | | | |
| **Landscape** | | | |
| Mountainous slope > 10 % | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Hilly 2-10 % | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Plains 0-2 % | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Deltas | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Riperian zone | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| | | | |
| **Flow paths** | | | |
| Runoff / overland flow | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |

| | | | |
|---|---|---|---|
| Subsurface drainage | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Artificial drainage (tile drainage) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Deep groundwater flow | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| | | | |
| **Agricultural intensity** | | | |
| Intensive: > 500 kg N/ha/y and/or > 25 kg P/ha/y | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Moderate: 200-500 and/or 5-25 kg P/ha/y | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Extensive: < 200 and/or < 5 kg P/ha/y | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| | | | |
| **Soil conditions** | | | |
| Unstructured Deep soils | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Unstructured Shallow soils (non permeable layer within 1-2 meters) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |
| Structured soils (e.g. clay and peat) | highly capable/capable/ partly capable/ not capable /unknown + free text field (explanation) | No | Yes |

# Appendix B

Appendix B provides a list of models that simulate diffuse losses and nutrient concentrations/loads, but do not handle these processes as their main focus, in contrast to models listed in table 3.1 that simulate nutrient runoff from diffuse sources on a catchment-scale as their main purpose.

| Acronym | Name | Contact name/Institute | Contact e-mail | Web | Description | Model Reference |
|---|---|---|---|---|---|---|
| AQUATOX | | Marjorie Coombs Wellman, Office of Science and Technology, U.S. EPA, Washington DC, USA | wellman.marjorie@epa.gov | http://www.epa.gov/waterscience/models/aquatox/ | AQUATOX is a simulation model for aquatic systems. AQUATOX predicts the fate of various pollutants, such as nutrients and organic chemicals, and their effects on the ecosystem, including fish, invertebrates, and aquatic plants. | |
| CoupModel | Coupled heat and mass transfer model for soil-plant-atmosphere system | Prof. Per-Erik Jansson Dep. of Land and Water Resources Engineering Royal Institute of Technology, Sweden | pej@kth.se | http://www.lwr.kth.se/vara%20datorprogram/CoupModel/index.htm | CoupModel is a system of different sub-models for simulating water and heat fluxes, C- N- and plant dynamics and salt transport in a layered soil profile, either bare soil or soil covered with vegetation (arable crops or forest). The basic structure of the model is a depth profile of the soil. The two main sub-models are updated versions of SOIL (water and heat), and SOILN (C and N). The model is recommended for simulating water, heat and nitrogen balances and transport of salt tracers. | Jansson, P. E. and Karlberg, L., 2004. Coupled heat and mass transfer model for soil-plant-atmosphere systems. Royal Institute of Technolgy, Dept. of Civl and Environmental Engineering, Stockholm 435 pp. |
| Daisy | Daisy | Associate Professor Søren Hansen, University of Copenhagen, Denmark | sha@kvl.dk | http://www.dina.kvl.dk/~daisy/ | Daisy is a Soil-Plant-Atmosphere system model designed to simulate water balance, heat balance, solute balance and crop production in agro-ecosystems subjected to various management strategies. It is a one-dimensional agro-ecosystem model. | Hansen, S., Jensen, H.E., Nielsen, N.E. and Svendsen, H. (1990) DAISY: Soil Plant Atmosphere System Model. NPO Report No. A 10. The National Agency for |

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| | | | | | Special emphasis is put on nitrogen dynamics in agro-ecosystems. The agricultural management model allows for building complex management scenarios. A facility to link the model to hydrological catchment models exists. This facility has been applied to link Daisy to the distributed hydrological catchment model MIKE/SHE. | Environmental Protection, Copenhagen, 272 pp. |
| ECOMAG | ECOlogical Modell for Applied Geophysics | Dr Yuri G. Motovilov, Russian State Institute for Applied Ecology, Moscow, Russia | motol@aha.ru | http://www.geocities.com/siae.geo/ecomag/tsld001.html | ECOMAG is a space-distributed physically-based model of hydrological cycle and pollution transformation on a watershed in a regional scale. Primarily the model was developed for applied tasks of a regional ecological monitoring in the Russian State Institute for Applied Ecology by Dr Y. G. Motovilov and A.S.Belokurov. Since 1997 the model has been further develoved in co-operation with the group of Prof. L.Gottschalk from the Department of Geosciences at Oslo University (Norway). A develoved ECOMAG-N includes solute transport. | Yuri G. Motovilov, Lars Gottschalk, og Kolbjørn Engeland, 1999. ECOMAG: Regional model of hydrological cycle. Application to the NOPEX region. Dep. of Geosciences. University of Oslo, Norway.<br><br>Motovilov, Y., Sokrut, N. and R. Thunvik. (2000). Simulation of nitrate transport in the Vemmenhög catchment in Southern Sweden, using the distributed hydrological model ECOMAG, VASTRA Working Paper, Div. of Land and Water Resources, Dep. of Civil and Environmental Engineering, Royal Institute of Technology. |
| ERNOR | Erosion model for Norwegian conditions | Associate Professor Helge Lundekvam, UMB, Norway | helge.lundekvam@umb.no | | Daily empirical, dynamic erosion model. Simulates run-off and particle loss on the surface or through subsurface (drain flow). Total-P can be estimated in areas of cereal production | Lundekvam, H., 2002. ERONOR/USLENO – Empirical erosion models for Norwegian conditions. Report no: 6/2002 from |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | as a function of particle loss. Particle-N can also be simulated. The simulation requires input from a hydrological model. Recommended for soil loss calculations on homogenous agricultural fields. | Agricultural University of Norway, 40 pp. |
| HSPF | Hydrological Simulation Programme FORTRAN | Hydrocomp, Inc. Menlo Park, CA, USA | info@hydrocomp.com | http://www.hydrocomp.com/HSPFinfo.htm | The HSPF model is a conceptual, continuous watershed simulation model designed to simulate all the water quantity and water quality processes that occur in a watershed, including sediment transport and movement of contaminants. HSPF has its origin in the Stanford Watershed Model developed by Crawford and Linsley and further developed by Hydrocomp with its origins in research on mathematical modeling of hydrologic processes at Stanford University.<br><br>The HSPF model is usually classified as a lumped model, but it can reproduce spatial variability by dividing the basin in hydrologically homogeneous land segments and simulating runoff for each land segment independently, using different meteorologic input data and watershed parameters. | |
| MIKE BASIN WQ | MIKE BASIN WQ | DHI- Denmark | dhi@dhigroup.com | http://www.dhigroup.com/Software/WaterResources/MIKEBASIN.aspx | MIKE BASIN is a network model in which the rivers and their main tributaries are represented by a network of branches and nodes. With the Water Quality (WQ) module, MIKE BASIN can simulate transport and degradation of the most important substances affecting water quality in rivers. Point sources as well as non-point pollution can be modelled. Non-point pollution | *See MIKE BASIN website for references:* http://www.dhigroup.com/Software/WaterResources/MIKEBASIN.aspx |

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| | | | | | includes total nitrogen and phosphorus loads, including their seasonal variation. MIKE BASIN WQ has facilities for calibration of non-point pollution loads and transport times in rivers. | |
| MIKE-SHE | MIKE-SHE | DHI- Denmark | dhi@dhigroup.com | http://www.dhigroup.com/Software/WaterResources/MIKESHE.aspx | MIKE SHE is a dynamic, user-friendly modelling tool that can simulate the entire land phase of the hydrologic cycle. Is applicable on spatial scales ranging from single soil profiles (for infiltration studies) to regional watershed studies. | *See MIKE-SHE website for references:* http://www.dhigroup.com/Software/WaterResources/MIKESHE.aspx |
| NTRM | Nitrogen Tillage - Residue Management model | Marvin J. Shaffer United States Department of Agriculture, Agricultural Research Service, USA | shaffer@gpsr.colostate.edu | http://dino.wiz.uni-kassel.de/model_db/mdb/ntrm.html<br><br>http://eco.wiz.uni-kassel.de/model_db/mdb/nleap.html | NTRM (Nitrogen Tillage - Residue Management) is a simulation model examining soil-plant interactions. The model is used to determine soil management strategies and the effect of climate change on crop yields and nitrate leaching. The model, using daily time steps, provides tabular graphs containing a range of information on plant growth, water and solute transport and soils temperatures as output based on input of soil properties, daily weather data and management options. | Shaffer, M.J. and Pierce, F.J. 1982. Nitrogen-tillage-residue management (NTRM) model: user'smanual. Res. Rep. USDA-ARS, St. Paul, Minnesota. |
| NUARNO | NUARNO | Prof. P.E. O'Connell, Newcasle University, UK | p.e.o'connell@ncl.ac.uk | http://www.ncl.ac.uk/wrgi/wrsrl/models.html | Semi-distributed modelling of integrated flow and transport in river basins based on the ARNO hydrological model developed at the Centro Idea, University of Bologna. The model requires calibration against stream discharge records. It can be used for giving coarse-scale predictions of stream discharges, soil water storage levels and water-table levels. NUARNO has been integrated in a decision-support package, where it is used to predict the likely direction and | |

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| | | | | | magnitude of hydrological changes resulting from proposed changes in land-use. | |
| NuCM | Nutrient cycling model | Ronald Munson, Tetra Tech, Inc., Research and Development, USA | ron.munson@tetratech.com | http://www.epri.com/eprisoftware/y2ksoftware/y2k206.html | The nutrient cycling model, NuCM, simulates vegetation growth, litterfall and decay, soil biogeochemical processes, and movement of water. The model was developed as part of the Electric Power Research Institute's Integrated Forest Study. Output of the model includes the available nutrients in soil strata and vegetation pools and the fluxes between pools on a weekly, monthly or annual basis. | Liu, S., Munson, R., Johnson, D.W. ,Gherini, S., Summer, K., Hudson, R., Wilkinson, K. and Pitelka, L., 1991. Applications of a nutrient cycling model (NuCM) to northern mixed hardwood and southern coniferous forest. Tree Physiol. 9, 173-182 pp.<br><br>Sogn T.A., Abrahamsen G., 1997. Simulating effects of S and N deposition on soil water chemistry by the nutrient cycling model NuCM. Ecological Modelling, Volume 99, Number 2, 30 June 1997, 101-111 pp. |
| OVERSEER® | OVERSEER® nutrient budgets model | AgResearch Ltd, New Zealand | overseer@maf.govt.nz | http://www.agresearch.co.nz/overseerweb/ | The OVERSEER® Nutrient Budgets model combines nutrient budgets with indices derived from these nutrient budgets, to provide users with a tool to examine the impact of nutrient use and flows within a farm on nutrient use efficiency and possible environmental impacts. | |
| PIT | Phosphorus Indicators Tool | Prof. Louise Heathwaite Heathwaite Lancaster Environment Centre, Lancaster University, UK | louise.heathwaite@lancaster.ac.uk | http://www2.defra.gov.uk/research/project_data/More.asp?I=PE0112&M=CFO&V=USF#Desc | The Phosphorus Indicators Tool provides a simple, transparent framework which identifies key indicators of P loss based on existing, national (UK) coverage databases of climate, soil type, topography and land use at the 1km$^2$ scale. | Heathwaite, A. L., Fraser, A. I., Johnes P. J., Hutchins M., Lord E. &Butterfield D., 2003. The Phosphorus Indicators Tool: a simple model of diffuse P loss from agricultural land to |

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| | | | | | | water. Soil Use and Management, 19, 1-11pp. |
| QUESTOR | QUality Evaluation and Simulation TOol for River systems | Head of WQ section David Boorman Centre for Ecology & Hydrology, UK | dbb@ceh.ac.uk | http://www.ceh.ac.uk/products/software/CEHSoftware-QUESTOR.htm<br><br>http://www.ceh.ac.uk/products/software/documents/questorguidenew.pdf | QUESTOR represents a river as a series of river reaches within which physical, chemical and biological processes operate. The determinands and processes modelled are not fixed within the QUESTOR modelling environment, but are tailored to the particular application. | Boorman, D.B., 2003. LOIS In-stream Water Quality Modelling. Part 1: Catchments and Methods, Science of the Total Environment, vol 314-316, 335-378 pp.<br><br>Boorman, D.B., 2003. LOIS In-stream Water Quality Modelling. Part 2: Results and scenarios, Science of the Total Environment, vol 314-316, 397-411 pp. |
| QSIM | The water quality model of the Federal Institute of Hydrology (BfG) | Dipl.-Ingenieur Volker Kirchesch Bundesanstalt für Gewässerkunde, Germany | volker.kirchesch@bafg.de | http://www.bafg.de/servlet/is/11872/QSim%20Info%20english.pdf | The water quality model QSim describes in a mathematical way the complex chemical and biological processes in running waters. An important feature of QSim is the close linkage of hydraulic with ecological modules. The model is suited to simulate processes in simple channels as well as in complex river networks and water bodies with variable flow directions like estuaries. The major purpose of QSim is to determine and evaluate the consequences of engineering measures on the water quality of federal waterways. Furthermore, problems of water and catchment management are examined with QSim. | Kirchesch, V. and Schöl, A., 2002. Das Gewässergütemodell QSIM - Ein Instrument zur Simulation und Prognose des Stoffhaushalts und der Planktondynamik von Fließgewässern. *Hydrologie und Wasserbewirtschaftung* 43, 302-308 pp (in german). |
| QUAL2K | River and Stream Water Quality Model | U.S Environmental Protection Agency, | rowan.tim@epa.gov | http://www.epa.gov/ATHENS/wwqtsc/html/qual2k.html | QUAL2K (or Q2K) is a river and stream water quality model Point and non-point loads and abstractions are simulated. | |

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| | | USA | | http://www.epa.gov/ATHENS/wwqtsc/QUAL2K.pdf | | |
| SHE | Système Hydrologique Européen | Prof. P.E. O'Connell, Newcastle University, UK | p.e.o'connell@ncl.ac.uk | | SHE is a deterministic, fully-distributed and physically-based modelling system for describing the major flow processes of the entire land phase of the hydrological cycle. SHE was developed in the mid-eighties as a joint effort by Institute of Hydrology (UK), SOGREAH (France) and Danish Hydraulic Institute. Regarding water quality modelling, SHE was first used for nitrogen simulations. The model has since then been further developed, particularly into two versions that are widely used for water quality purposes: MIKE SHE and SHETRAN. | Abbott, M. B., Bathurst, J. C., Cunge, J. A., O'Connell, P. E and Rasmussen, J., 1986a. An Introduction to the european Hydrological System - Systeme Hydrologique Europeen, "SHE", 1: History and philosophy of a physically-based, distributed modelling system. Journal of Hydrology vol. 87, pp. 45-59 pp.<br><br>Abbott, M. B., Bathurst, J. C., Cunge, J. A., O'Connell, P. E and Rasmussen, J., 1986b. An Introduction to the european Hydrological System - Systeme Hydrologique Europeen, "SHE", 2: Structure of a physically-based, distributed modelling system.," Journal of Hydrology, vol. 87, pp. 61-77 pp. |
| SHETRAN | Système Hydrologique Européen TRAnsport | Prof. P.E. O'Connell, Newcastle University, UK | p.e.o'connell@ncl.ac.uk | http://www.ncl.ac.uk/wrgi/wrsrl/rbms/rbms.html#SHETRAN | SHETRAN is a 3D, coupled surface/subsurface, physically-based, spatially-distributed, finite-difference model for coupled water flow, multi-fraction sediment transport and multiple, reactive solute transport in river basins. It gives a detailed | Ewen, J., Parkin, G., and O'Connell, E., 2000. "SHETRAN: Distributed basin flow and transport modelling system". Journal of Hydrologic Engineering, vol. 5, No. 3, |

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| | | | | | description in time and space of the flow and transport in the basin, which can be visualised using animated graphical computer displays. The SHETRAN system was developed by the WRSRL, and is based on the SHE (Systeme Hydrologique Europeen) developed by international collaboration between groups in the UK, Denmark and France. | 250-258 pp. |
| WASP | Water Quality Analysis Simulation Program | U.S Environmental Protection Agency USA | rowan.tim@epa.gov | http://www.epa.gov/athens/wwqtsc/html/wasp.html<br><br>http://www.epa.gov/athens/wwqtsc/WASP.pdf | The WASP model helps users interpret and predict water quality responses to natural phenomena and manmade pollution for various pollution management decisions. WASP allows the user to investigate 1, 2, and 3 dimensional systems, and a variety of pollutant types. The time varying processes of advection, dispersion, point and diffuse mass loading and boundary exchange are represented in the model. WASP also can be linked with hydrodynamic and sediment transport models that can provide flows, depths velocities, temperature, salinity and sediment fluxes. | |