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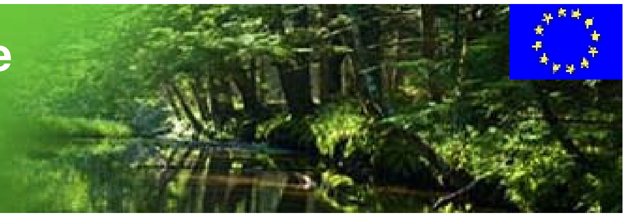

Content

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New Release of the Garp3 Collaborative Workbench

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(University of Amsterodam)

A new version (1.3.8) of the Garp3 Collaborative Workbench has been released for general use, as of April 18th, 2007. Garp3 is a tool for Qualitative Reasoning and Modelling that supports domain experts and novices in building conceptual models of system behaviour [1]. A model in Garp3 consists of model fragments (specifying situations or processes) and scenarios, which can be simulated to generate predictions. The result of a simulation is a graph consisting of qualitative states and transitions involving changes in quantity values and/or (in)equality statements, representing behavioural change. Garp3 consists of several screens and editors that are organized into three environments: (1) the Build environment, which provides editors to build the basic model ingredients (e.g., entities, quantities, values), model fragments, and scenarios; (2) the Sketch environment, which provides editors to create preliminary sketches (concept map, structural model, causal model, and expected state-transition graph); and (3) the Simulate environment, which provides control over the simulation and views on the simulation results (e.g., state-transition graph, values and dependencies per state, value and inequality histories over multiple states). Compared to the previous release version, a number of substantial improvements have been made to each of the three environments, as well as to the simulation tracer, and the qualitative reasoning portal, as described in the paragraphs below.

In the Build environment, the copy functionality has been improved to facilitate sharing parts of models more efficiently, by reusing existing knowledge definitions. For example, when pasting a model fragment that includes other model fragments into another model, Garp3 will now reuse existing model fragments in the target model wherever possible, instead of creating extra copies of each conditional model fragment. It is also possible to copy more complex modeling concepts (i.e., refinements) than was previously possible.

The Sketch environment has been improved in several respects, based on requests from Garp3 users in the NNR project. The new version allows saving and loading sketches, so that users can edit and store multiple versions of each type of sketch (and export them as postscript figures). The interface for editing inequalities, quantities and values in the sketch state-transition graph editor has been improved to better handle the different kinds of (in)equality statements. Other improvements relate to the import functionality, which allows importing parts of one sketch to another sketch, following the modeling framework described in [2].

The Simulate environment (see figure 1) has been improved in several ways to address two issues: (1) in complex simulations, users had trouble finding the possible behaviours; and (2) users sometimes need more control over the simulation engine to manage the complexity of the simulation. To address the first issue, the functionality for searching behaviour paths has been improved by using a more efficient search algorithm, and adding options for searching for end states, cyclic paths or complete paths (from a begin state to an end state, or an end loop) in a state-transition graph. To address the second issue, the inequality reasoning has been improved, and the set of preferences has been revised, to provide better, and more intuitive control over the reasoning of the simulation engine.

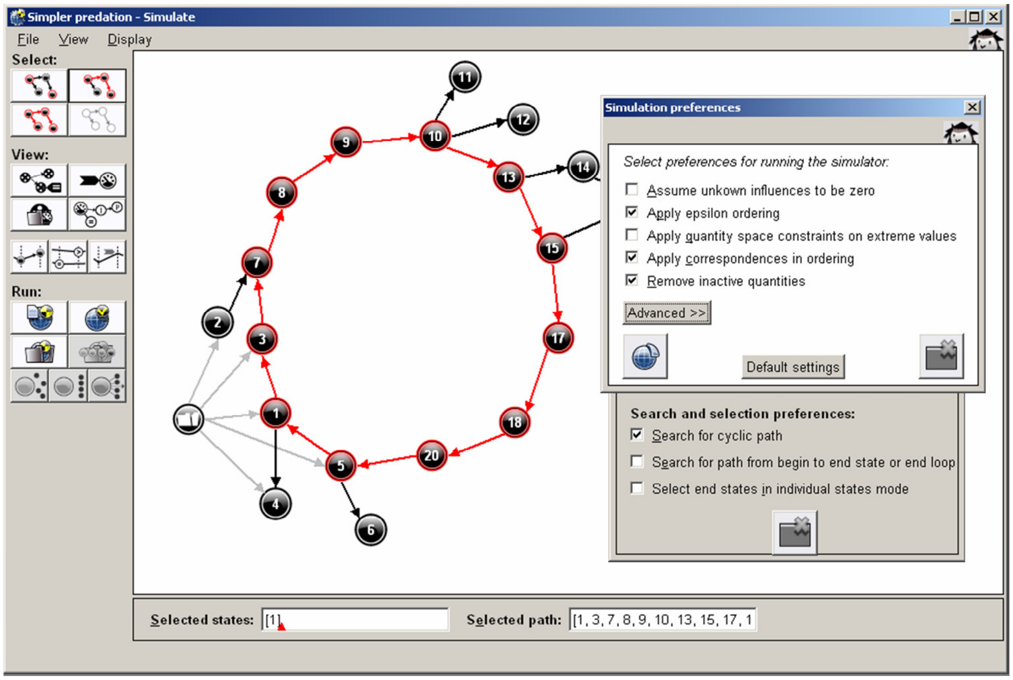

Figure 1. A screenshot of Garp3, illustrating the new functionality related to simulation control and search in the state-transition graph.

The tracer functionality provides insight into the reasoning of the Garp3 simulation engine. The tracer presents, among other things, information about model fragments that are being considered, inequality reasoning being performed, and terminations, which possibly lead to state transitions. The tracer has been completely revised to provide more information, in a better readable format, and also includes a new general/critical category to highlight the most important feedback from the simulation engine, which makes it easier for users to diagnose problems with their model. Furthermore, the tracer works significantly faster than before.

The QRM (Qualitative Reasoning and Modelling) portal website provides an overview of the Garp3 software, documentation, and related research publications, as well as example models and results from the NNR case studies described elsewhere in this newsletter. The major new addition is an extensive collection of help pages about the Garp3 collaborative workbench, explaining all of its functionality. Each help page contains, among other things, a description of the task at hand, the context, related tasks, and, in most cases, an example with a screenshot. The help pages can be accessed directly from Garp3 (provided an internet connection and browser) in a context-sensitive manner. This means that whenever the user clicks on the Help-icon (the owl) in Garp3, the relevant help page for the currently active screen will appear. To support novice users in acquiring the vocabulary of qualitative reasoning and modeling, the terms used in the Garp3 interface are described in a glossary.

Visit the QRM portal website at http://www.garp3.org for further details and to download the most recent version of the Garp3 software.

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[1] J. Liem, A. Bouwer, and B. Bredeweg, 2006. Collaborative QR model building and simulation workbench, Naturnet-Redime, STREP project co-funded by the European Commission within the Sixth Framework Programme (2002-2006), Project no. 004074, Project Deliverable Report D4.3.

[2] B. Bredeweg, Salles, P., Bouwer, A., and Liem L, 2005. Framework for conceptual QR description of case studies, Naturnet-Redime, STREP project co-funded by the European Commission within the Sixth Framework Programme (2002-2006), Project no. 004074, Project Deliverable Report D6.1.

Troubleshooting Qualitative Models

Jochem Liem and Bert Bredeweg

(University of Amsterdam)

This paper describes the issues modellers encounter when developing qualitative models, and initial work started in the NaturNet-Redime (NNR) project to automatically detect and solve these issues. Ecologists working on different case studies in the NNR project are developing qualitative models in which they capture their knowledge about how river ecology relates to sustainable development. The captured knowledge is organized in *model fragments* that describe small parts of the structure and behaviour of a system. The main purpose of model fragments is the introduction of causal relations between quantities given a certain system structure.

Qualitative models allow these ecologists not just to formalise their knowledge, but also to discover the implications of that knowledge through simulation. An initial situation of the system (called a *scenario*) created by the modeller serves as input for the simulation engine that generates the behaviour of the modelled system. The behaviour has the form of a state graph, and shows how the quantities in the system change in time. The simulator works by determining which model fragments apply to the system described in the scenario and augments the scenario with the causal relations introduced by these model fragments. These causal relations make it possible to calculate the value of the derivatives of the quantities, and thus the successor states of the initial state can be determined. For each of the successor states the same procedure is performed to create a complete state graph.

One of the main issues encountered by modellers developing qualitative models is dealing with undesired simulation results. For example, simulating a scenario may result in having no states, an end state could contain a changing quantity that has not yet reached its final value, and magnitudes and derivatives could be missing. Furthermore, simulations may result in too many states, some behaviour could be missing, and other behaviour might be undesired. It is often difficult to determine which model ingredients are responsible for an issue, and equally difficult to figure out how and which model ingredients should be changed to solve the issue. Currently, modellers ask qualitative reasoning experts to help them troubleshoot their models. However, at the end of this project, the software should support modellers well enough for them to solve issues without the help of qualitative reasoning experts anymore.

Consider the following example from a case study describing how river planning affects the recruitment of salmon through different life states. Figure 1 shows a scenario that represents a river containing a population of salmon divided into different life stages. Each part of the population lives in the same river (according to this model), and each life stage migrates into the next life stage. The part of the population in the first life stage has a high number of individuals, while the other life stages have a normal amount of individuals.

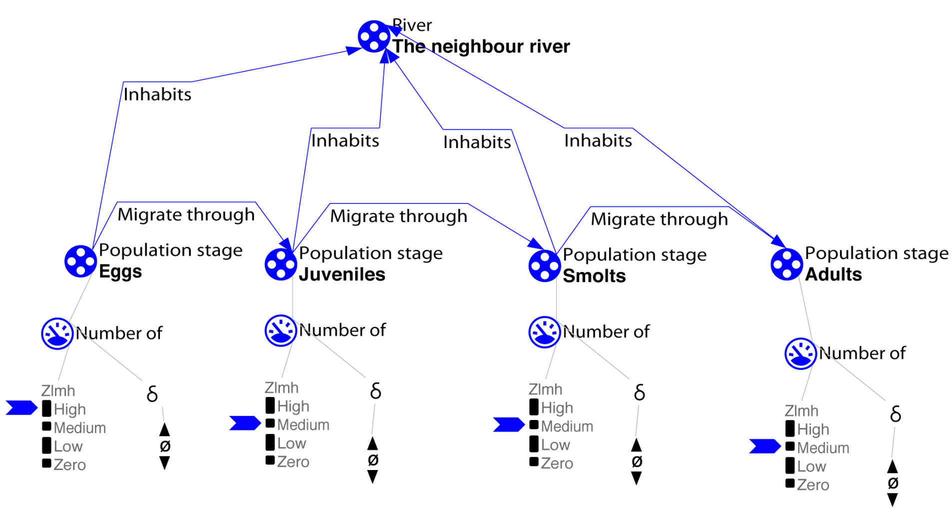

Figure 1: A scenario describing the number of individuals of a population in different life stages living in a river.

An expert created a model fragment capturing his knowledge about how different parts of the population recruit from one life stage into the next (see Figure 2). The model fragment requires two parts of a population to inhabit a river. The first life stage should migrate into a second life stage. When these conditional model ingredients are present, new knowledge is added to the scenario. A recruitment rate quantity is introduced, and its value is calculated by subtracting the number of individuals in the first stage from the number of individuals in the second stage. When the number of individuals in the first stage is bigger than the number of individuals in the second stage, the recruitment rate is positive. If they are equal, the rate is zero. And if the second stage is bigger, the rate is negative. The influence (I+) sets the derivative of the second number of individuals to positive if the recruitment rate is Plus, negative if it is Min, and Zero if it is zero. The proportionality (P+) sets the derivative of the recruitment rate to increasing if the number of individuals of the first stage increases, to decreasing if it decreases, and to stable if it is stable.

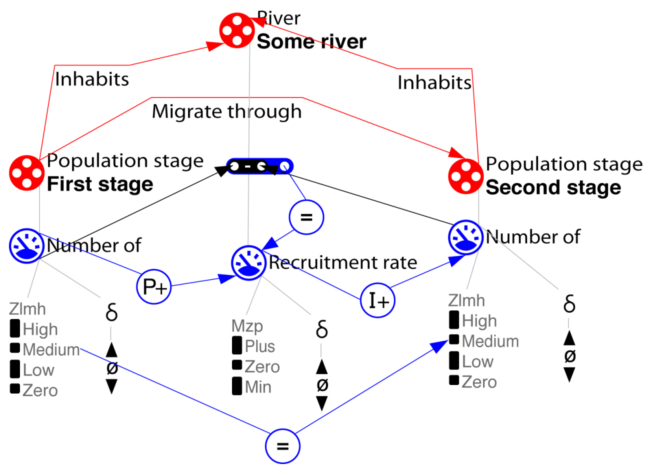

Figure 2: The recruitment model fragment representing the causal relations involved in the recruitment process.

When simulating the scenario, the model fragment fits on the scenario 3 times (on the eggs and the juveniles, on the juveniles and the smolts, and on the smolts and the adults). However, the simulator generates no states. This is a typical example of a modelling issue that is difficult to solve for the modeller. When a scenario is simulated and no model fragments are active, there is only a single state in the state graph, i.e. the state describing the scenario itself. When there are no states, the introduced knowledge causes a contradiction, e.g. two incompatible inequalities are true, or a value has multiple values.

In this case, the issue with the model fragment is that the recruitment rate is associated to the river. Since there is only a single river, only a single recruitment quantity is introduced, even though there are three interactions. Calculating the recruitment rate for the juveniles to the smolts and the smolts to the adults yields a value zero. However, for the eggs to the juveniles the recruitment rate yields the value Plus.

Therefore, the single recruitment rate quantity is set to both the value Plus and the value Zero, which is impossible. Therefore no states are generated.

Associating the recruitment rate to one of the population stages instead of the river can solve the issue, as it would result in a recruitment rate quantity to be introduced for each interaction.

In the last half-year of the NNR project, we aim to develop model-troubleshooting support within Garp3[1] that will automatically detect these kind of issues within models and suggest possible solutions. We will analyse the intermediate modelling results created by the modellers working on case studies to determine what the most frequently occurring issues are, and how they could be solved. Furthermore, we are looking at existing model-based diagnosis literature to see how existing methods can contribute to a solution. Model troubleshooting support should make it easier for domain experts to capture their knowledge about sustainable development.

[1] http:www.garp3.org

A qualitative model about sustainability in the Brazilian Riacho Fundo water basin

Paulo Salles (University of Brasilia)

A qualitative model exploring sustainability issues in the Riacho Fundo water basin (Brasilia, Brazil) was developed by the Naturnet – Redime project and in the next months this model will be presented to stakeholders for evaluation. The model goal is to support stakeholders in understanding and decision-making about water resources management. Relevant concepts were selected according to stakeholders opinions, and are expressed in the model with everyday vocabulary and diagrams, in order to make them accessible to the general public. This article explains some features of the Riacho Fundo basin addressed by the model and how the evaluation process will be done.

The Riacho Fundo is a small water basin in Brasília, Brazil. Since the new capital was built in the late 50's, it has been impacted by changes of natural landscapes into rural and urban areas. The most important economic activities in the basin are those related to services, including business offices, commerce and car repair garages. Industrial activities include food, dyed fabric and clothes production. Vegetables and corn production are the main activities for most of the farmers, and cattle, pork and sheep are the most important herds in the Riacho Fundo region. Agriculture represents a small part of the regional GDP, but it is important as it contributes to keep green areas and parts of natural vegetation. As a consequence of these economic activities, soil and water contamination with pesticides, industrial effluents and organic matter have been reported. Besides that, urbanization has caused deforestation and loss of biodiversity and erosion resulted in the disappearance of springs and small streams.

According to Brazilian legislation, decisions on water management are made in Water Basin Committees (WBC), institutions that gather representatives from the government, productive sectors and civil society. Riacho Fundo water resources are now managed by the Paranoá river WBC, recently created after five years of stakeholders and community mobilization. Since the preparatory meetings, the WBC has been the *locus* for discussions about what is required for the Riacho Fundo basin to be sustainable. From these activities, it became clear that there is a need for tools to improve understanding of the complex problems the WBC has to decide upon, and to express people's ideas and proposals using a formal language. Qualitative Reasoning models may be useful in this case. An evaluation study with Latvian students, reported in the *Naturnet-Redime Newsletter* last November (Bredeweg et al. 2006) confirms the potential of such models to communicate sustainability concepts. The qualitative model developed by the Naturnet – Redime team for the Riacho Fundo focuses on the following aspects: (a) the influence of urban drainage systems on soil conditions, economic activities and human well being; (b) the dynamics of erosion and water infiltration in the soil, and their influences on springs, streams, and economic activities in semi urbanized areas; and (c) the effects of soil protection on springs and river conditions, biodiversity and agricultural production.

The Riacho Fundo model will be evaluated in a series of meetings with members and people involved in the WBC – Paranoá river. A general workshop is being organized to present the results of the Naturnet-Redime project. Next to that, the Naturnet – Redime team will run a number of evaluation sessions with volunteers, in which different aspects of the model will be actually evaluated. Given its potential for educational purposes, some of these meetings will include teachers and students. As in similar activities previously done, qualitative model evaluation starts with discussions about representations of concepts and simulation results. Using diagrammatic representations of cause-effect relations encoded in the model as the basis for representing knowledge, evaluators are asked to discuss how to solve conflicting situations, and to draw (using paper and pencil) alternative diagrams to express their own views. Finally, the evaluators give their opinion in questionnaires and interviews about different aspects of the model, such as the clarity of concepts represented in the model, significance for improving understanding and usability of the model as a tool to support decision-making. The results of the evaluation will be described in the next issue of the *Naturnet-Redime Newsletter*!

Reference:

Bredeweg, B.; Salles, P.; Bouwer, A.; Bakker, E. and Liem, J. (2006) Successful use of Garp3 by stakeholders. *Naturnet-Redime Newsletter*, number 4, November 2006, pp.: 10 – 12. ISSN 1801-6480.

Qualitative Reasoning Model – the modelled system functioning study: Danube Delta Biosphere Reserve case study

Eugenia CIOACA (Danube Delta National Institute Tulcea, Romania), Bert BREDEWEG (University of Amsterdam), Paulo SALLES (University of Brasilia), Tim Nuttle (University of Jena, Germany)

Danube Delta Biosphere Reserve (DDBR) is one of the five case studies considered in the FP6 NaturNet-Redime project to develop Qualitative Reasoning (QR) models.

Model System: DDBR, located at the mouth of the Danube River before it reaches the Black Sea, has an area of 5,800 sq. km, making it one of the greates t wetlands in the world.

In order to construct a model of a real system using the Qualitative Reasoning concept [1], it is necessary to understand this system functions. It requires a good knowledge of the system components, their structural and cause-effect relationships, which leads to a better understanding of the overall system's behaviour. This is achieved as a preliminary study necessary in preparing the Qualitative Reasoning (QR) model ingredients. It follows the *Framework for conceptual QR description of case studies* [2], through Concept map, Global causal model, and Structural model graphics. They are focused on describing the system's features related to those causes and their effects which delimit the sustainable development actions. The three conceptual structures (Concept map, Causal model, and Structural model) focus on water pollution negative effect propagation from water to aquatic biota (plants, zooplankton, macroinvertebrates, **fish**, birds) and ultimately to **human health.**

Concept map is presented in Figure 1. It contains the modelled system components and the functional relationships among them, in the framework of basic physical, physical-chemical and biological processes. The DDBR main components are aquatic ecosystems. Their behaviour depends on water quality. The concept map stresses the **Water pollution** process. This process "negatively affects" both aquatic biological components status and human health. The influences can be direct or indirect.

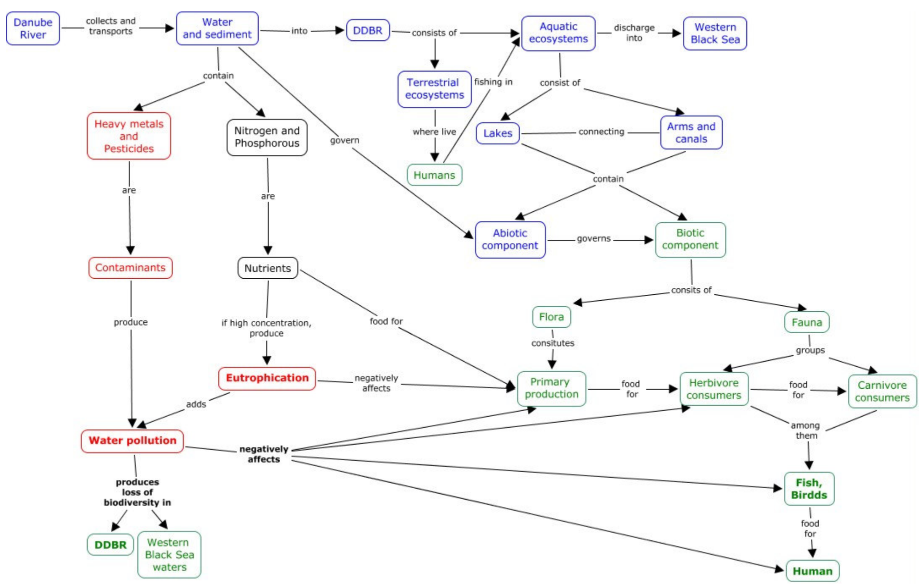

Figure 1. Concept map for Danube Delta Biosphere Reserve water pollution.

Full Structural model, for the two types of ecosystems terrestrial and **aquatic,** is shown in Figure 2. It contains the system entities and their structural relationships hierarchical organised [3, 4,5], as they are necessary to be later implemented in Garp3 – QR specialised software.

Structural relationships hierarchical organised [3, 4, 5], as they are necessary to be later implemented in Garp3 – QR specialised software.

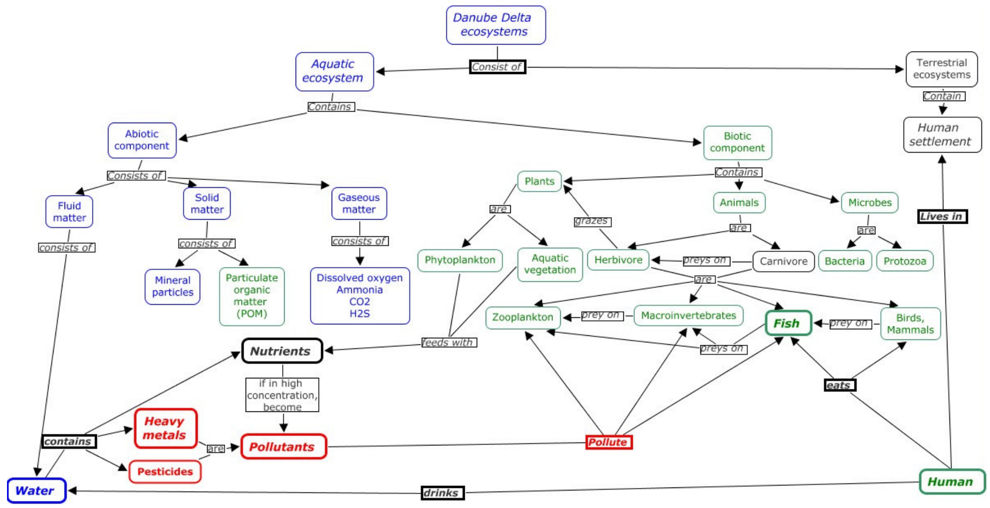

Figure 2. Structural model of the Danube Delta Biosphere Reserve aquatic ecosystems.

Global Causal model contains the modelled system quantities and the causal relationships among them, governed by active processes. In total, 12 processes are active in the DDBR aquatic environment, which influence the quantities that represent the amount of each organism. Changes in these amounts propagate to other quantities, as effect of one organism group behaviour to another one. The quantities and causal dependencies (Influence : I+/I- or Proportionality: P+/P-) among them are presented in Figure 3: DDBR global causal model. Influence (I+, positive rate or I-, negative rate) indicates a direct effect of a process rate on other quantity, causing this quantity value change: increase or decrease, respectively. Proportionality indicates an indirect effect of a quantity change (P+, quantity increase, or P-, quantity decrease) that causes other quantity value change: increase or decrease, respectively.

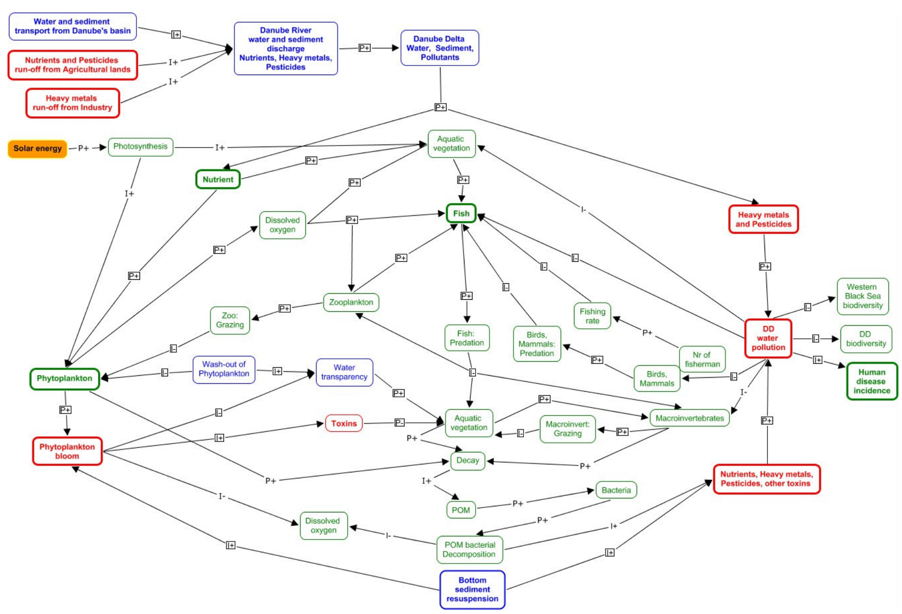

Figure 3. Global Causal model for Danube Delta Biosphere Reserve aquatic ecosystems water pollution.

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3. E., Cioaca, B., Bredeweg, T., Nuttle, 2006 - *The Danube Delta Biosphere Reserve: a Case Study for Qualitative Modelling of Sustainable Development*. QR-06 20th International Workshop on Qualitative Reasoning PROCEEDINGS, pp.151-156. Dartmouth College, Hanover, New Hampshire, USA.
4. E., Cioaca, S., Covaliov, L., Torok, Ibram, O., 2006 - D6.2.1 Textual description of the Danube Delta Biosphere Reserve case study focusing on basic biological, physical, and chemical processes related to the environment http://www.naturnet.org/Internal section/Deliverables list
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Danube Delta Biosphere Reserve Case Study Qualitative Reasoning Model - an Environmental System Sustainable Development Decision Making Support

Eugenia Cioaca (Danube Delta National Institute Tulcea, Romania), Bert Bredeweg (University of Amsterdam), Paulo Salles (University of Brasilia)

Qualitative Reasoning (QR) models may serve as mediators in decision making process on Sustainable Development. For that purpose, a QR model can be said to capture (to document) an explanation of how a system behaves. The documentation has two distinguished parts: QR model components **description** as they are represented in Garp3 software [1] and the model scenarios **simulation results**. This paper presents a summary of the Danube Delta Biosphere Reserve (DDBR) QR model documentation [2]. Within the DDBR area, aquatic ecosystems are the most extensive and important natural resource of this area, both from the biodiversity and the human being perspective. Due to its impacts, **water quality** is a central focus of concern from the Strategy of Sustainable Development point of view. Nevertheless, water pollution is a major problem in the DDBR and has caused loss of biodiversity over the last several decades. Additionally, human population relies on DDBR resources for fresh water and food, so they are implicitly negatively influenced by water pollution. To progress and reduce these negative effects, it is necessary to understand and communicate how water pollution affects biodiversity and human health in DDBR. The DDBR QR model is therefore constructed to model the behaviour of DDBR aquatic ecosystem flora and fauna populations as well as human health, indicator of people living in or around this area. The behaviour of these components is modelled as related to the basic aquatic ecosystem physical, chemical and biological processes. The main DDBR QR model consists of the following ingredients: 18 entities, hierarchical structured as shown in Figure 1; 17 Scenarios, as shown in Figure 2, and 57 Model fragments. The description of the Scenarios and Fragments, and Simulation results, presented in this paper, refers to the DDBR aquatic ecosystems **water pollution process**.

Scenarios

To model the DDBR water pollution process, there 3 scenarios have been constructed. Here is presented the DD Water pollution and DD aquatic biodiversity Scenario (Figure 3.). It concerns the modelled system's *Entities*, their associated *quantities*, the *Configurations* among Entities participating in this process. It configures the process negative effects and the ways it propagates to aquatic biotic component (*Aquatic biological entities).* This Scenario contains:

1. The modelled system's external influences (Agents): *Agriculture*: *Nutrient run-off* (which participates in the water pollution process only if in high content. For values equal or smaller than Medium it participates in Plant growth process as main food resource for any Plant species) and *Industry*: *Heavy metals (*which have the property of bioaccumulation in any aquatic biological organism, leading to that entity pollution, even Mortality if in Medium/High concentration in water).

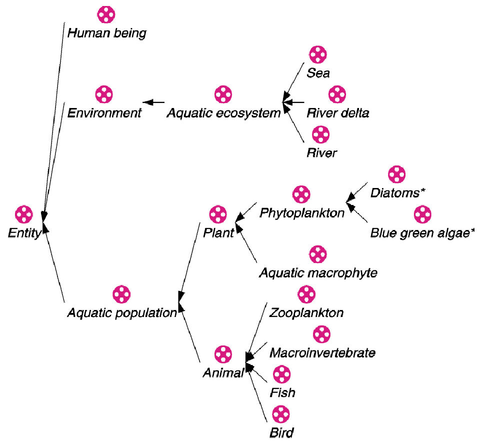

Figure 1. Entity hierarchy of the DDBR system.

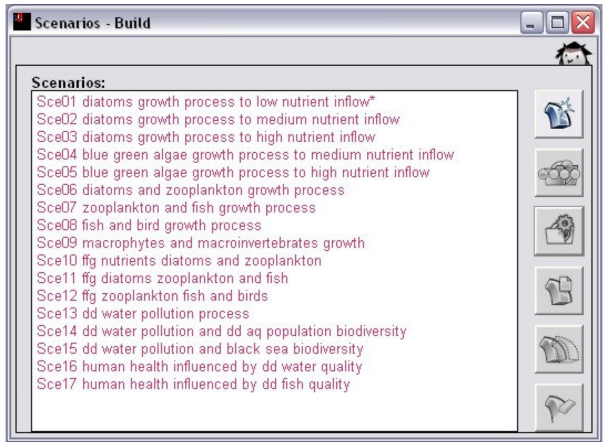

Figure 2. The DDBR system QR model Scenarios.

2. The third water pollution component is given, mainly by *Cyanotoxins*. They are produced in water if there is a content of some poisoning species of Blue-green algae (Cyanobacteria), which contain Cyanotoxins in their cells.

3. To reduce the simulation complexity, *Assumptions* are introduced in the Scenario construction: "Assume nutrient consumption is zero and steady", "Assume Migration is zero and steady", and "Assume Production is medium and steady".

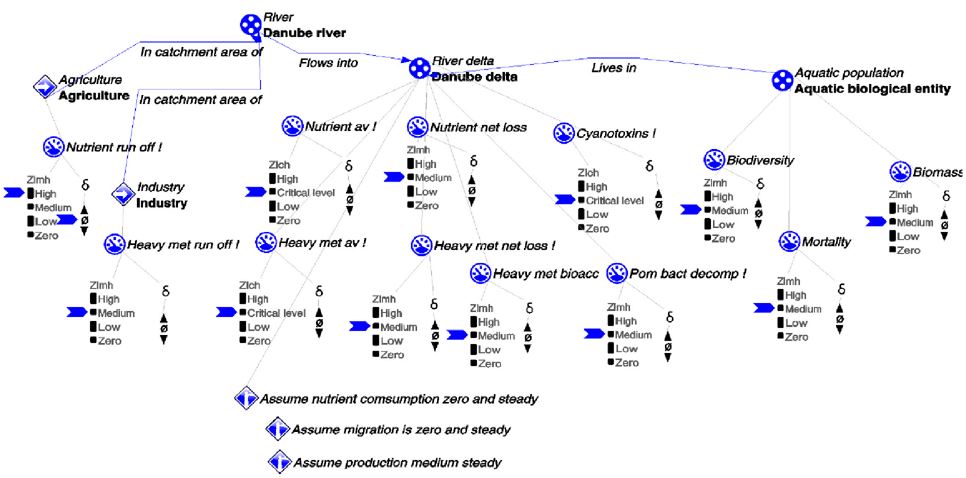

Figure 3. DD Water pollution and DD aquatic biodiversity Scenario

Model fragments

In the Qr software that we use there are three types of Model fragments: Static, Process, and Agent.

A process is presented in this paper in Figure 4. DD Water pollution and DD aquatic population biodiversity.

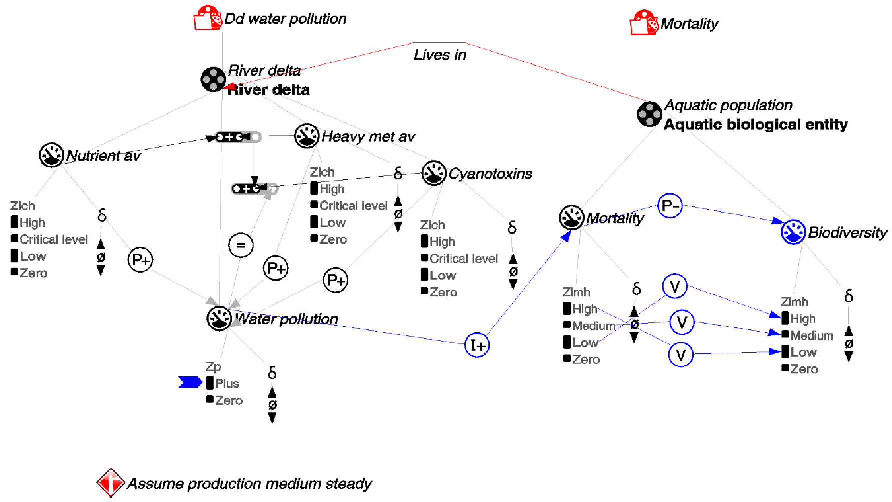

Figure 4. DD Water pollution and DD aquatic population biodiversity - Process MF.

It figures the structural and behavioural relationships between *River delta* and the *Aquatic population*, related to *River delta*: *Water pollution* influence on Aquatic population components behaviour, as follows: positive influence (I+) on *Aquatic population*: *Mortality* and negative proportionality (P-) on *Aquatic population*: *Biodiversity*. It emphasizes the causal conditions which have been generating the loss of DDBR biodiversity, in order to delimit those objectives for a sustainable use of natural resources and a Sustainable Development Strategy addressing the aquatic ecosystems.

DDBR QR Model output: Scenarios simulation results.

One of the scenario simulation results is presented for the DD Water pollution and DD aquatic population biodiversity Scenario. This is the Dependency diagram (Figure 5), which provides information on structure and causality (Influence I, or Proportionality P), correspondence (Q, dQ) and in/equality (=, >, <) dependency relationships among the system's water pollutants (*Nutrients*, *Heavy metals* and *Cyanotoxins*), any *Aquatic biological entity*, involved in Water pollution process and its effect on Aquatic populations, as follows:

1. *Danube River: Nutrient inflow* and *Heavy Metals inflow* main resources are the two system's external influences (*Agents*): *Agriculture* and *Industry,* localised "*In catchment area of*" the *River*. There is a close relationship (P+ and Q) between *Nutrient run-off* from Agriculture lands and *Nutrient* that enters the *Danube River*. The same relationship occurs between *Heavy metals run-off* from *Industry* and *Heavy metals* entering the *Danube River*. From the *River*, these two main water pollutants reach the *Danube Delta* aquatic ecosystems.
2. A part of *Danube Delta*: *Nutrient inflow* stays in the system and contributes to *Nutrient available for Plant* species growth while another part is lost (*Nutrient net loss*), either through *Nutrient outflow* or *Nutrient consumption* (by aquatic *Plant* species only).
3. So happens with *Danube Delta*: *Heavy metals inflow*.
4. A part of *Nutrient net loss* and *Heavy metals net loss* is recycled from dead organic matter as result of Particulate Organic matter bacterial decomposition (*Pom bact decomp*) process.
5. *Danube delta*: *Water pollution rate* is the result of three main water pollutants: *Danube delta*: *Nutrient available*, *Heavy metals available* and *Cyanotoxins;*
6. *Danube delta*: *Water pollution rate* has a direct positive influence (I+) on any *Aquatic biological entity*: *Mortality*.
7. *Aquatic biological entity*: *Mortality* has an indirect negative influence (P-) on any *Aquatic biological entity*: *Biomass*.

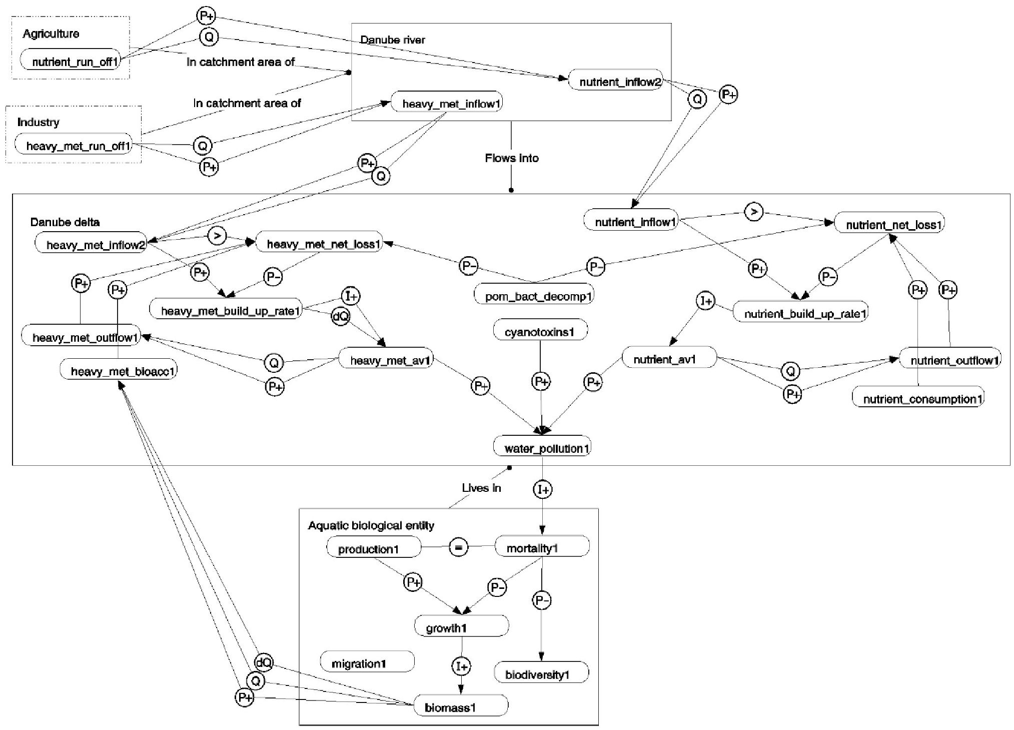

Figure 4: Dependency diagram of the Water pollution process.

Knowledge about the aquatic ecosystems behaviour within the DDBR system, as it is presented in the DDBR QR Model, may supportdecision-making activities on natural resources protection, as well as achieving the environmental Sustainable Development within this system.

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Curriculum for Learning about Sustainable Development Using Qualitative Reasoning.

Tim Nuttle (University of Jena, Germany), Paulo Salles (University of Brasilia, Brazil), Bert Bredeweg (University of Amsterdam, The Netherlands), Eugenia Cioaca (Danube Delta National Institute, Romania), Elena Nakova (Central Laboratory of General Ecology, Bulgaria), Richard Noble (University of Hull, England), Andreas Zitek (Vienna University of Applied Life Sciences, Austria).

Work Package 6 partners have been hard at work producing Qualitative Reasoning (QR) models and simulations of sustainability issues pertaining to case studies in different river catchment areas. Models from the case studies for the River Mesta (Bulgaria), Danube Delta Biosphere Reserve (Romania), and Riacho Fundo (Brazil) are completed and models for the River Kamp (Austria) and Yorkshire River Ouse and River Trent (England) are progressing well according to plan. Papers from each of these cases studies are being presented in a special session dedicated to the NaturNet-Redime project at the 21st International Workshop on Qualitative Reasoning, to be held 27-29 June 2007 in Aberystwyth, Wales (http://monet.aber.ac.uk/qr07/).

These case studies focus on different parts of the sustainability domain and will be integrated into a common curriculum where learners can interact with models to learn about cause and effect in sustainable development scenarios. The learning endeavor will be supported by a curriculum and assignments that guide learners through the learning process.

Assignments for exploring QR models from each case study will follow a newly developed standard assignment template, which can be reapplied to future models as they are developed. This template follows basic principles in pedagogy, where learning progresses from basic levels focusing on understanding definitions of terms (i.e., “knowledge” in Bloom’s Taxonomy of cognitive understanding), through application of knowledge, to synthesis and evaluation of sustainable versus unsustainable scenarios. This assignment organization also progresses through the hierarchical levels of the model, from structure (What are the components of the system and how are they related?) to causality (How do the relations between components affect each other?) to dynamics (How do the causal relationships cause the system to change through time?).

As with the other NaturNet-Redime learning materials, assignments for learning about sustainability in each of the case studies will be presented using Moodle software, an open source course management system that applies sound pedagogical principles to help educators create effective online learning communities (www.moodle.org). Each assignment is structured as follows:

1. **Goal**: the expected learning outcome of completing this assignment.
2. **Introduction**: a textual description of the system and its key features and issues.
3. **Overview**: a list of the main concepts that will be covered in the exercises.
4. **Exercises**: a series of questions about the model system and instructions on how to interact with the model to discover the answers.

Here, we provide an example of some of the questions that learners would seek to answer while exploring the Riacho Fundo case study:

Sce ur01a: What happens when there is no drainage in a city?

→ Open scenario Sce ur01a drainage zero constant and run the simulation (for the initial state/s only).

Q1. (structure) Explain in your own words the system being modeled by this scenario.

Hint: Select state [1] and open the entity relations view. Rearrange the elements as necessary.

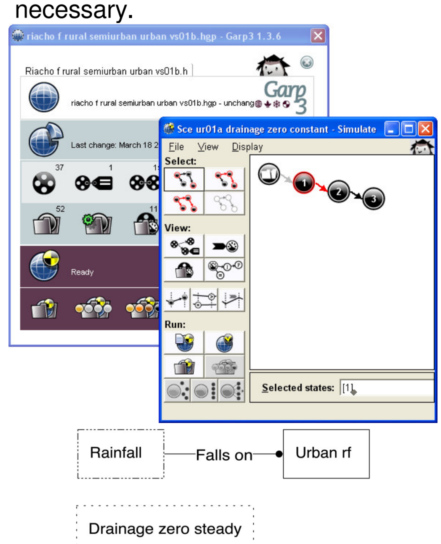

Figure 1. The Garp3 workbench and state graph for the Scenario (top) and the Entities Relations view for state [1] (bottom).

After following the instructions (and the hint), the learner would see that the system being modeled is one where rainfall falls on the urban Riacho Fundo and where there is no drainage (Figure 1). The learner would progress through several more questions (not shown) to explore structure and causal relationships that result from that structure. Then learners are asked to make predictions based on that causality:

Q6. (causality) Predict what will happen throughout the system and why. Will the system evolve towards a final end point? What will that end point be?

Hint: Display the causal dependencies for state [1]. Reason through the causal dependencies to see how they cause and propagate change through the system.

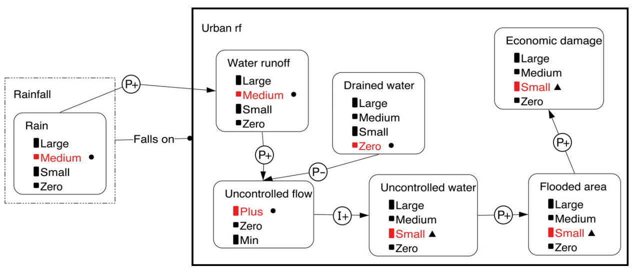

Figure 2. Causal dependencies from state [1].

Learners would follow the instructions, producing Figure 2, and write a paragraph describing their predictions. They would then compare their predictions to those produced by the Garp3 reasoning engine:

Q7. (dynamics) Describe what the model predicts to happen in the system over time.

Hint: Run the full simulation. Note the general nature of the state graph (cycles, branching paths, etc.).

Select a path. View the value history, focusing on what happens to the state variables. Repeat for several paths (if there are more than one).

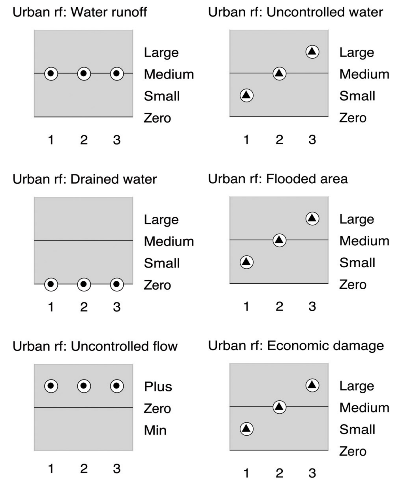

Figure 3. Value History for the path (Figure 1 left) showing the change in the modeled scenario.

Learners would see that with a medium amount of water runoff and zero drained water, there is uncontrolled flow (value *plus*) in the urban Riacho Fundo (three value histories on the left of Figure 3). When there is uncontrolled flow, this causes the amount of uncontrolled water to increase. As uncontrolled water increases in the catchment, flooded area increases as does the amount of economic damage.

This simple scenario demonstrates how the model of the Riacho Fundo case study transmits the expert knowledge contained in the model to the learner. Subsequent questions in the assignment lead the learner to evaluate whether this system is sustainable or unsustainable, and how sustainability of the system might be better achieved. Further assignments address other scenarios in the Riacho Fundo, including more possibly more complex scenarios that involve more processes, as well as point to other models and case studies where related concepts can be explored.

Once the assignments for each case study model are completed, they will be evaluated by stakeholder and student groups to assess the degree to which they help meet the learning goals established in the assignment.

Look for assignments for each of the case studies to appear on the NaturNet-Redime web portal (www.naturnet.org) in the coming months.

Events of interest

9th – 11th May, Maputo

IST-Africa 2007 Conference and Exhibition is the second in an Annual Conference Series which brings together delegates from leading commercial, government & research organisations across Africa and from Europe, takes place in Maputo, Mosambique, South Africa

http://www.ist-africa.org/Conference2007/

10th – 11th May 2007, Dresden

The 6th Saxonian GI Strategy – Forum GI 2007. Dresden, Germany. European week

http://gdi-sn.blogspot.com/

15th – 16th May 2007, Prague

Information systems in agriculture and forestry 2007, XIII. European conference, themed Living Labs Prague, Czech republic.

http://www.isaf.cz/index_en.php?iMenu=10

21st May 2007, Prague

FP7 Information Day - will be specifically dedicated to FP7 opportunities in 2007 in the fields of ICT for the environment and ICT for energy efficiency, Prague, Czech Republic

http://www.isess.org/conferences.asp?Conf=5

22nd May – 24th May 2007, Prague

The International Symposium on Environmental Software Systems. ISESS 2007 is part of a series organized by IFIP (International Federation for Information Processing) Working Group 5.11 "Computers and Environment". Crowne Plaza Hotel Prague, Czech

http://www.isess.org/

12th June – 15th June 2007, Brussels

Green Week will provide a unique opportunity for debate, exchange of experience and best practice among non-governmental organisations, businesses, various levels of government and the public, Brussels, Belgium

http://ec.europa.eu/environment/greenweek/home.html

27th June – 29th June 2007, Aberystwyth

QR07: 21st Annual Workshop on Qualitative Reasoning, Aberystwyth, U.K

http://monet.aber.ac.uk:8080/monet/qr07/QR07/Home.html

2nd – 5th July 2007, Glasgow

EFITA/WCCA 2007 , Environmental and rurals sustainability through ICT, Glasgow Caledonian University, Glasgow, Scotland

http://www.efitaglasgow.org/

4th – 6th July 2007, Porto

13th GI & GIS Workshop. GISDIs for environmental analysis, monitoring, and modelling; environmental protection, natural hazards prediction and mitigation, and other applications areas , Porto, Portugal

http://www.ec-gis.org/Workshops/13ec-gis

4th – 9th November 2007, Papeete

MUTL 2007, International Workshop on Mobile and Ubiquitous Technologies for Learning, Papeete, French Polynesia (Tahiti)

http://www.iaria.org/conferences2007/MUTL.html

SIXTH FRAMEWORK PROGRAMME

Educational programmes on social, economic, and environmental tools for the implementation of the EU Strategy on Sustainable Development at both EU and international levels

NATURNET-REDIME

New Education and Decision Support Model for Active Behaviour in Sustainable Development Based on Innovative Web Services and Qualitative Reasoning

Project no.	004074		
Instrument:	SPECIFIC TARGETED RESEARCH PROJECT		
Thematic Priority:	SUSTDEV-2004-3.VIII.2.e		
Start date of project:	1st March 2005	Duration:	30 months
Web:	http://www.naturnet.org		
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Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)

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