The ODUSSEUS project: Developing an advanced software system for the analysis and management of water resource systems – Part 1

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1. Project summary

The **ODYSSEUS project** (from the Greek acronym of its full title "Integrated Management of Hydrosystems in Conjunction with an Advanced Information System") aims at providing support to decision-makers towards **integrated water resource management**. The **end-product** comprises a system of co-operating software applications, suitable to handle a wide spectrum of water resources problems. An **interactive** framework enables the exchange of data between the various modules, either off-line (through a central database) or on-line, via appropriate design of common information structures. The whole system is in the final phase of its development; parts of it have been already tested in **operational applications**, by water authorities, organisations and consulting companies.

2. Fundamental methodological concepts

➢ Parsimony regarding model parameterisation and data requirements;
➢ Model structures consistent with the available data;
➢ Use of geographical information systems;
➢ Holistic approach, regarding the following issues:
   ▪ conjunctive representation of physical and man-made processes;
   ▪ representation of both quantitative and qualitative characteristics and requirements of water management;
   ▪ hierarchical representation of water uses;
   ▪ representation of environmental and economical aspects.
➢ Adaptation of automatic calibration methods, on a multiobjective basis;
➢ Quantification of uncertainties and risks, through stochastic simulation;
➢ Low-dimensional formulation of optimal control problems, through appropriate parameterisations;
➢ Faithful representation of processes and handling of physical and operational constraints trough simulation;
➢ Use of optimisation to provide rational results within multiple modelling scales;
➢ Both detailed and simplified implementation of models;
➢ Attempt to keep computational effort as low as possible.

3. Software architecture
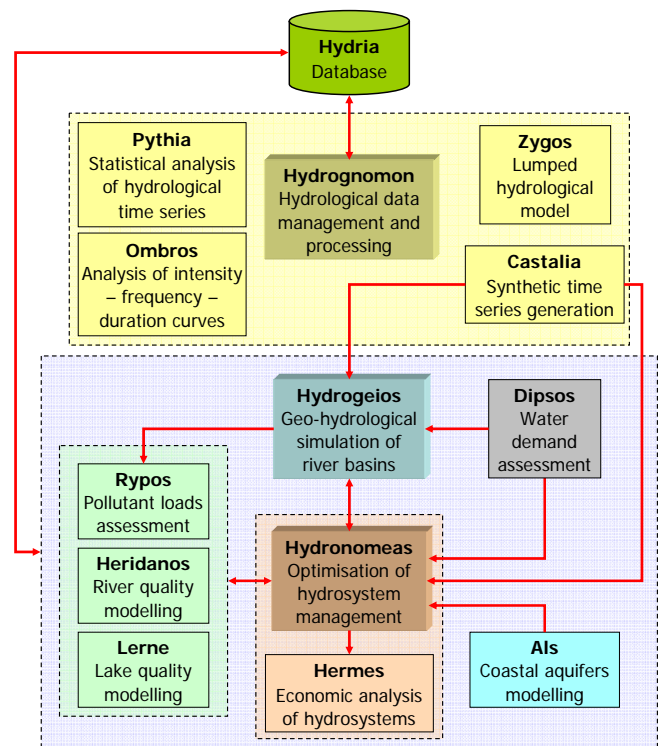
4. Model cooperation framework and application fields

➢ The modelling components are developed within an integrated information system, that will be operational by the end of 2006.
➢ The end-product could be used by:
   ▪ consulting companies;
   ▪ water companies;
   ▪ public organisations;
   ▪ academic institutes.
➢ An appropriate combination of models provides the framework to handle:
   ▪ small-scale hydrological and water management studies;
   ▪ water resources planning and management at a river basin scale;
   ▪ design and evaluation of large hydraulic structures;
   ▪ water quality and environmental impacts assessment, harmonised with the 2000/60 EU Directive.

	Hydrognomon	Hydrogeios	Hydronomeas	Castalia	Pythia	Ombros	Zygos	Dipsos	Rypos	Heridanos	Lerne	Ais	Hermes
Hydrological modelling at river basin scale		X					X						
Optimisation of reservoir operation			X										
Conjunctive representation of surface and groundwater processes		X	X										
Water resource systems planning and management		X	X					X	X	X	X	X	X
Economical analysis of hydrosystem operation			X										X
Hydropower production			X										X
Water needs assessment	X							X					
Hydrological data management and processing	X				X								
Stochastic simulation of hydrosystems		X	X	X									
Hydrological extremes					X	X	X						
Hydrological and demand-supply balance	X	X	X					X	X				
Pollutant loads assessment									X	X	X		
Pollutant loads modelling		X							X				
Coastal aquifers modelling												X	
Evaluation of water resource infrastructures		X											X
Co-operation with GIS	X	X	X						X	X	X	X	

The ODUSSEUS project: Developing an advanced software system for the analysis and management of water resource systems – Part 2

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Hydrognomon: Data management and processing

- Uses client-server architecture;
- Enables data management based on geographical organisation to entities, comprising physical properties, technical characteristics, time series and multimedia;
- Implements time series processing and specific hydrological applications, such as:
  - evapotranspiration modelling;
  - stage-discharge analysis;
  - water balance analysis.
- Provides tools for data visualisation and co-operation with GIS.
- Includes four additional modules:
  - the statistical analysis package **Pythia**;
  - the module **Ombros**, for constructing intensity-duration-frequency curves;
  - the stochastic simulator **Castalia** for generating synthetic time series;
 - the lumped hydrological model **Zygos**.
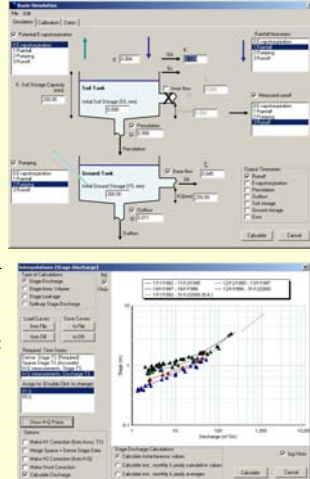
Hydrogeios: Geo-hydrological simulation of river basins

- Implements a hydrological model for conjunctive simulation of surface and groundwater processes and a hydrosystem operation scheme;
- Operates on monthly and daily scales;
- Incorporates GIS tools for the processing of spatial input data;
- Implements innovative methods for multi-response calibration;
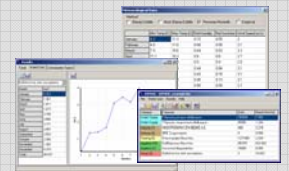- Estimates the hydrosystem fluxes at various control sites.
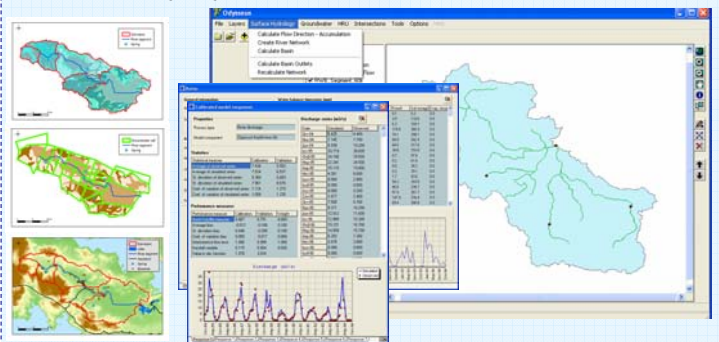
Hydronomeas: Optimisation of hydrosystems operation

- Provides decision support for the optimal design and control of complex hydrosystems, by incorporating numerous physical, technical, economical and environmental aspects of integrated river basin management;
- Represents both the physical and artificial components of a water resource system, and provides graphical tools for an easy schematisation of the network;
- Employs stochastic simulation to handle the inherent uncertainty of hydrological inputs, thus assessing future hydrosystem fluxes in probabilistic terms;
- Ensures the satisfaction of multiple and contradictory water uses and constraints, preserving a pre-specified hierarchy;
- Evaluates the system performance on the basis of multiple criteria that correspond to reliability, cost, energy and safe yield issues;
- Detects the optimal management policy, by means of operation rules assigned to the main hydraulic controls (reservoirs, boreholes);
- Co-operates with the **Hermes** module, for further insight to the economical evaluation of specific management policies.
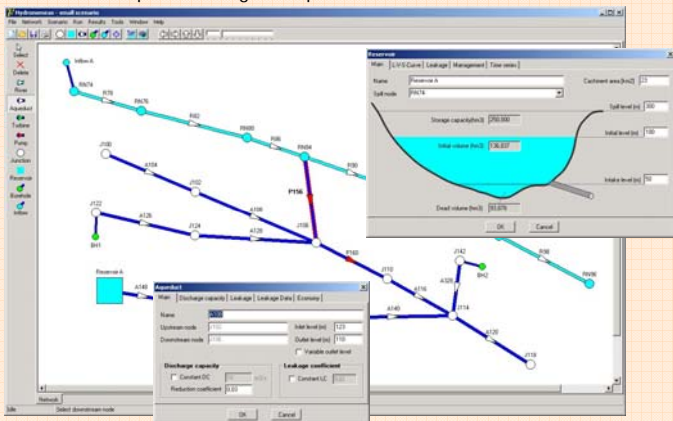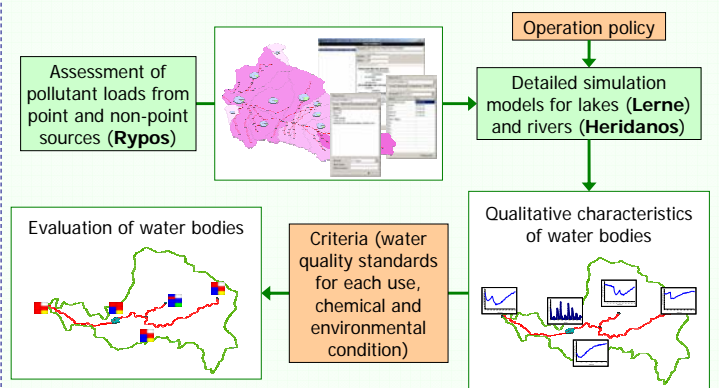
Dipsos: Water demands assessment

- Estimates monthly water demand for domestic, industrial and irrigation uses;
- Data is hierarchically organised, by means of water users and groups of consumers;
- Irrigation needs are estimated through various potential evapotranspiration models, based both on analytical and empirical approaches.

Rypos, Lerne, Heridanos: Water quality models

Operation policy

Assessment of pollutant loads from point and non-point sources (**Rypos**)

Detailed simulation models for lakes (**Lerne**) and rivers (**Heridanos**)

Evaluation of water bodies

Criteria (water quality standards for each use, chemical and environmental condition)

Qualitative characteristics of water bodies

Acknowledgments – Contact info