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

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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 cooperation with GIS.
- Includes four additional modules:
  - the statistical analysis package Ombros,
  - the module Ombrax, for constructing intensity-duration-frequency curves;
  - the stochastic simulator Castalia for generating synthetic time series;
  - the lumped hydrological model Zygos.

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.

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.

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
- 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
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Project web page: www.odysseusproject.gr Research team web page: www.itia.ntua.gr