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Linking hydroinformatics tools towards integrated water resource systems analysis

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The management of complex water resource systems requires system-wide decision-making and control, to fulfil multiple and often contradictory water uses and constraints, maximize benefits and simultaneously minimize risks or negative impacts. The rapidly developing area of hydroinformatics provides a variety of methodologies and tools that are suitable to solve specific computational problems and demands an integrated framework of model co-operation and linking. A holistic water resource systems analysis framework is presented, comprising conceptual and stochastic hydrological models, hydrosystem simulation models, and algorithms for both linear and non-linear optimization. The key concepts are the formulation of parsimonious structures that are consistent with the available data, the conjunctive representation of physical and man-made processes, the quantification of uncertainties and risks, the faithful description of system dynamics, and the use of optimization to provide rational results within multiple modelling scales. The hydrosystem schematization is based on a network-type representation of real-world components, including both physical (basins, rivers, aquifers, etc.) and artificial ones (reservoirs, aqueducts, boreholes, demand points, etc.). Hydrological inflows are synthetically generated, through a multivariate stochastic simulation scheme that preserves all essential statistical properties as well as the time- and space-correlations across different time scales. Hydrosystem operation is represented through a low-dimensional approach, based on generalized parametric rules, which are assigned to the main hydraulic controls. All water resource management aspects, including technical, economical and environmental data are effectively handled through a generalized graph optimization approach, which simultaneously preserves a detailed description of the related processes and computational efficiency. A global optimization approach, also implemented on a multiobjective ba-

sis, is used to provide suitable management policies and support decisions. Besides, the stochastic representation of all hydrosystem fluxes enables the assessment of results on a reliability basis.