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Bayesian approaches for Integrated Water Resources Management. A Mediterranean case study.

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This study presents the first steps of a short-term/mid-term analysis of the water resources in the Guadalfeo Basin, Spain. Within the basin the recent construction of the Rules dam has required the development of specific management tools and structures for this water system. The climate variability and the high water demand requirements for agriculture irrigation and tourism in this region may cause different controversies in the water management planning process.

During the first stages of the study a rigorous analysis of the Water Framework Directive results was done in order to implement the legal requirements and the solutions for the gaps identified by the water authorities. In addition, the stakeholders and water experts identified the variables and geophysical processes for our specific water system case. These particularities need to be taken into account and are required to be reflected in the final computational tool.

For decision making process purposes in a mid-term scale, a bayesian network has been used to quantify uncertainty which also provides a structure representation of probabilities, actions-decisions and utilities. On one hand by applying these techniques it is possible the inclusion of decision rules generating influence diagrams that provides clear and coherent semantics for the value of making an observation. On the other hand the utility nodes encode the stakeholders preferences which are measured on a numerical scale, choosing the action that maximizes the expected utility [MEU]. Also this graphical model allows us to identify gaps and project corrective measures, for example, formulating associated scenarios with different event hypotheses.

In this sense conditional probability distributions of the seasonal water demand and waste water has been obtained between the established intervals. This fact will give to the regional water managers useful information for future decision making process. The final display is very visual and allows the user to understand quickly the model and the causal relationships between the existing nodes and variables. The input data were collected from the local monitoring networks and the unmonitored data has been generated with a physically based spatially distributed hydrological model WiMMed, which is validated and calibrated.

For short-term purposes, pattern analysis has been applied for the management of extreme events scenarios, techniques as Bayesian Neural Networks (BNN) or Gaussian Processes (GP) giving accuracy on the predictions.