APPLICATION OF A MANAGEMENT TOOL BASED ON UNCERTAINTY ANALYSIS TO A RESERVOIR IN A MEDITERRANEAN WATERSHED: COST ANALYSIS

Raquel Gómez-Beas[1], Antonio Moñino[2], Cristina Aguilar[1], María José Polo[1]

[1] Fluvial Dynamics and Hydrology Research Group-University of Córdoba. Campus de Rabanales, Edif. Leonardo da Vinci. Área Ingeniería Hidráulica. 14071. Córdoba, Spain. rgbeas@uco.es; caguilar@uco.es; mjpolo@uco.es.

[2] Environmental Flows Dynamics Research Group-CEAMA, University of Granada. Av. del Mediterráneo s/n. 18006. Granada, Spain. amonino@ugr.es.

INTRODUCTION AND OBJECTIVES

There is a need for a management tool which includes the uncertainty of the climate and hydrological processes

Development of a rigorous and efficient operational tool to meet:

1)Water Framework Directive

2)Water supply requirements, especially during spring and summer, and dry years

Objectives:

1) To develop a model as a tool towards optimizing the managements of a reservoir in a Mediterranean watershed.

2) To include a cost analysis for priority of water uses.

METHODS

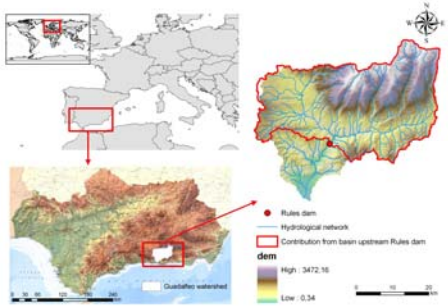
Study site description

Guadalfeo river watershed: Interaction between semiarid Mediterranean and alpine climate conditions, because of its highest altitudes (3482 m) only 40km away from coastline:

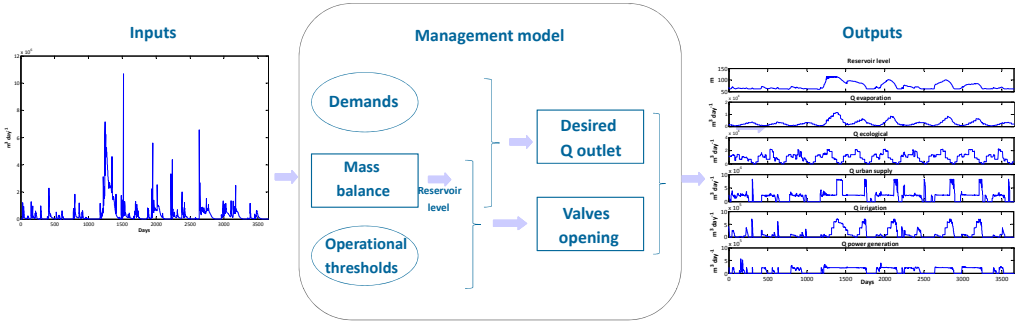
+ Mean Precipitation: 656 mm year^{-1}
+ Mean input flows to the reservoir: 107.5 hm^3 year^{-1}

Rules reservoir: System of the regulation and control of the water supply for:

+ Urban consumption: 13 hm^3 year^{-1} (6% of total volume)
+ Irrigation: 112 hm^3 year^{-1} (54% of total volume)
+ Hydroelectric power: 79 hm^3 year^{-1} (38% of total volume)
+ Environmental flow: 4 hm^3 year^{-1} (2% of total volume)



Development of management model



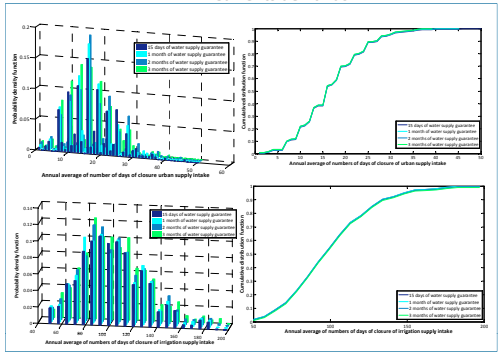
+ Taking the series of inputs, the response of the system is obtained, interpreted as an instantaneous capacity of storage.

+ Mediterranean climate: The annual and seasonal variation of the inflows can be observed in the volume of water stored in the reservoir and in the outflow series.

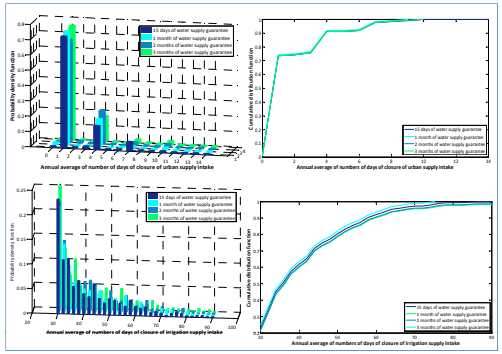
RESULTS

To include the uncertainty of the processes 500 10-year Monte Carlo simulations of daily inflows to the reservoir have been carried out.

Currents demands



50% Currents demands



The results have been obtained under the hypotheses of the maintenance in time of current demands and demand equivalent to 50% of current ones. The reduction of demanded outflows decreases the number of days when closure of intakes is needed, as expected.

Cost Analysis

Non-dimensional analysis:

1: relative cost of failure in urban demand supply.

f: relative cost of failure in irrigation demand supply.

f<1 since urban supply has priority over the rest of uses.

$$N \cdot 1 + M \cdot f = Vu \cdot Cu + Vi \cdot Ci$$

N: annual average of number of days of closure of urban supply intake.

M: annual average of number of days of closure of irrigation supply intake.

Cu: cost of failure in demand urban supply.

Ci: cost of failure in demand irrigation supply.

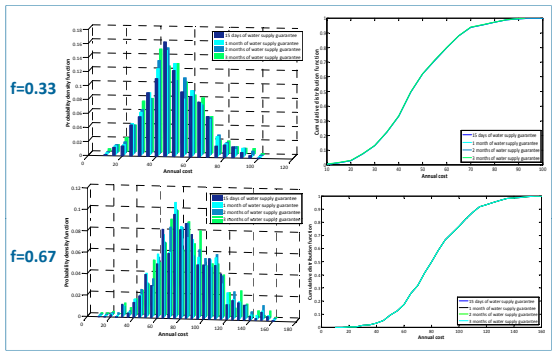
Vu: volume of failure in demand urban supply.

Vi: volume of failure in demand irrigation supply.

Local Variables

The equation sets a reference system for cost analysis where, from local demands and their costs of failure in supplies, the annual cost associated to the water management system could be calculated, along with failure risk probability.

As application example, the probability functions for two *f* values have been calculated.



CONCLUSIONS

✓Using the reservoir management model developed, annual evolution curves of the volume of water stored are obtained, which allows the regulation of the water supply based on some established criteria in a sustainable way with the commitments existing downstream.

✓The operational graphs obtained from the uncertainty analysis constitute a tool for decision making from which the planner can select the criteria of outflow operation through the opening and closing intakes, which lets to optimize the management.

✓In terms of risk, the higher costs are associated to the failure in providing the agricultural supply since urban supply has priority and environmental flow is considered a restriction, so irrigation supply will be interrupted by a 30% more days than the urban supply.

✓Cost analysis could be extrapolated to another area by having knowledge about the monetary cost of failure in demand supply.

ACKNOWLEDGEMENTS

This work was funded by the Andalusian Water Agency of Water in the projects "Pilot study for the integral management of the Guadalfeo river watershed" and "Implementation of the Guadalfeo model and tools for its transfer". Meteorological data used in this study were obtained from the CLIMA subsystem of the Andalusian Government.