Towards integrated e-flow assessment at multiple scales

ESR 15 - Helmholtz-Centre for Environmental Research - UFZ
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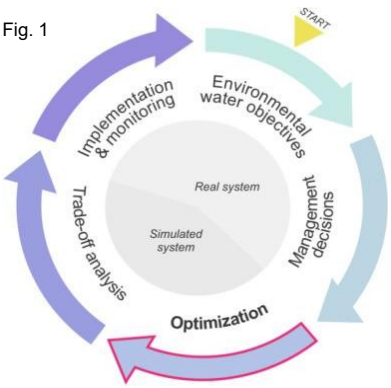
Chapter one[1]

Fig. 1

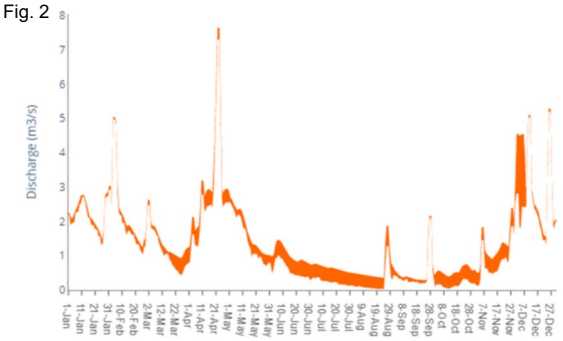


Optimization assessment particularly suits water management problems as it lends itself to framed within an adaptive management framework (Fig.1)

A key issue in optimization model development for water management problems is the selection of spatial and temporal scale representing the system. As a first step, I analysed the trade-off between problem perception and available modelling capability, which can either be resolved by obtaining data needed or tailoring analysis to the data available. The problem perception phase collects system information about objectives, limiting conditions, and management options. The problem formulation phase collects and uses data, information, and methods about system structure and behaviour. What emerges is that optimization procedures development for water management problems needs more transparency in data selection, strategies to implement desired assessment scales, explicit trade-offs in problem development and increased modelling capacity.

Chapter two[2]

Fig. 2

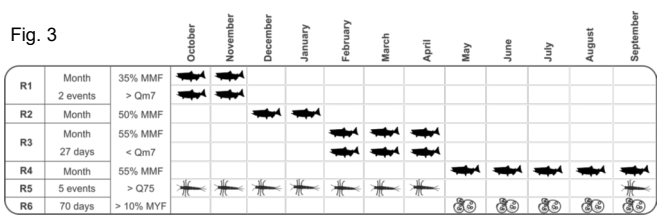


Adaptive water management is a promising management paradigm for rivers that addresses the uncertainty of decision consequences. Optimization assessment can hence be used to explore opportunities for implementation of adaptive management.

As proof of concept, a water diversion problem for selected river segments in the Pas River Basin, was considered in the paper. I defined e-flow to reflect conditions that promote ecological conservation. By drawing from hydrological scenarios, the assessment showed that the overall target water demand can be met, whereas the daily volume of water available for diversion was not constant throughout the year. These results (Fig. 2) suggest that currently the decision making needs to consider the seasonal time frame as the reference temporal scale for objectives adjustment and monitoring. Future applications of the optimization assessment would benefit from an improved characterization of the reference river flow conditions (e.g. increase the scale and the incorporation of alternative land-use/land cover information and climate change scenarios.

Chaper three[3]

Fig. 3



One of the biggest challenges of water management is the readiness to provide for both societal and environmental needs under uncertain future climate conditions. The adaptive water management approach offers a framework for organizing management actions to incorporate such uncertainty throughout the management stages. **While a short term revision considers ongoing objective adjustment, the assessment of water management possibilities under changing environmental conditions in the near term would contribute to increasing the likelihood of management objectives achievement in the long term.** In this paper we assess river water availability for diversion in a river basin in Northern Spain by comparing three future environmental scenarios that combine climate change, conventional land use and blue&green infrastructure prioritization. Environmental flow requirements are incorporated in the optimization problem as hydrological conditions for key local in-river species (Fig. 3). The aim is to uncover spatial-temporal changes in river water availability for human use that can affect demand. Study results are then used to provide recommendations for the harmonization of river water availability for human consumption and the sustainable basin management in application of the adaptive management approach.

1 Derepasko, D., Guillaume, J.H.A., Horne, A.C., Volk, M., (2021): Considering scale within optimization procedures for water management decisions: balancing environmental flows and human needs Environ. Modell. Softw. 139 , art. 104991 doi: 10.1016/B978-0-12-819166-8.00129-8

2 Derepasko, D., Peñas, F.J., Barquín, J., Volk, M., (2021): Applying optimization to support adaptive water management of rivers MDPI Water 13 (9), art. 1281 doi: 10.3390/w13091281

3 Derepasko, D., Witing, F., Peñas, F.J., Barquín, J., Volk, M., (in preparation): Water management and changing climate: basin-scale near term optimization assessment under different future conditions for sustainable river water diversion.