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Assessing the value of seasonal forecasts in informing reservoir operations in water-stressed Mediterranean basins

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Population expansion and socio-economic development have been increasing the pressure on water resources, which are often exploited in a non-renewable way. Besides, climate change can modify hydroclimatic patterns and exaggerate freshwater water stress. Flexible operation of existing water reservoirs is one of the most cost-effective ways to mitigate water-related stress, by storing water when it is abundant and releasing it when droughts persist. In this context, medium - to long-term hydroclimatic forecasts are set to cover a central role for properly informing reservoir decision-making and operation policy design. State-of-the-art hydroclimatic forecast products are indeed becoming more and more skillful at seasonal or longer lead-times, especially in regions characterized by climate teleconnections or by predictable hydrological behavior, such as baseflow- or snow-dominance. Nevertheless, the link between forecast skill and forecast value, i.e. the performance improvement obtained thanks to the use of the forecasts, is neither easily predictable nor necessarily positive. Each system indeed requires specific forecasts according to its characteristics, such as climate and hydrological regime, size of the reservoir, management objectives, and the skill of existing forecast systems do not necessarily translate into a significant gain in system performance.

In this work, we quantify the value of seasonal forecast information in informing the operations of the Faneromeni reservoir on the Crete island. The reservoir is primarily used to provide water to an important agricultural district during the dry summer season. Current operation of this reservoir is based on the available storage at the beginning of the irrigation season, which, in normal conditions, allows the supply of the irrigation demand if the reservoir is completely full; otherwise, the reservoir releases are modulated according to the storage shortage. We instead investigate alternative policies for the operations of the Faneromeni reservoir by using the Evolutionary Multi Objectives Direct Policy Search (EMODPS) method, which allows the design of flexible rules to cope with the variability of the hydrologic conditions as well as to include forecast information for conditioning operational decisions.

Preliminary results show that EMODPS policies can improve the existing operation of the Faneromeni reservoir. Moreover, these solutions also allow to mitigate the negative impacts of climate change and flexibly adapt the reservoir operations to the projected hydroclimatic conditions.

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