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Assessing the value of cooperation and information exchange in large water resources systems by multi-agent optimization: the Zambezi river case

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Many large-scale water resources systems are characterized by the presence of several and conflicting interests and are often managed by many independent decision-makers, belonging to different institutions or countries, who take into account only their own objectives causing downstream externalities.
In this work we explore the use of multi-agent systems theory to conduct an optimization-based analysis of different levels of cooperation and information exchange in the large water reservoir system of the Zambezi River. The four largest reservoirs in the basin (Ithezhithezhi, Kafue-Gorge, Kariba and Cahora Bassa) are mainly operated for maximizing the economic revenue from hydropower energy production with considerably negative effects on the aquatic ecosystem in the Zambezi delta. We comparatively analyse the ideal situation in which a central decision-maker optimizes a global optimum and the more realistic case where all the decision-makers act independently and non-cooperatively. We then investigate how increasing levels of information exchange can help in mitigating the conflict generated by a non-cooperative setting.