Dam reoperation for controlling water-related diseases: the potential of floating solar for compensating hydropower losses

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Malaria is one of the leading causes of death in Sub-Saharan Africa, affecting around 200 million people in the region each year. In the proximity of hydropower reservoirs, the presence of large areas with stagnant water creates greater reproduction opportunities for Anopheles mosquitoes, and the number of disease cases is usually higher. In this context, a soft mitigation strategy which is gaining much attention in recent years is controlling the water level in the lake to expose the Anopheles eggs right after laying. However, this operation strategy usually leads to both losses and fluctuation in hydropower production.

In this study, we evaluate the capability of floating solar technology to effectively compensate the loss in energy production occurring when avoiding the spread of malaria becomes an important factor in reservoir management. To do so, we implement a modelling framework where the floating solar plant size and the dam operation are jointly optimized with the objective of minimizing energy deficit, costs and malaria spread. As a demonstration, we study the Zambezi River, where the Kariba dam (shared between Zambia and Zambezi) is mainly operated for hydropower production. Here, we explore the potential tradeoffs between power generation and malaria spread by solving a joint planning (solar plant capacity)-management (dam operations) optimization problem using Evolutionary Multi-Objective Direct Policy Search (EMODPS). Numerical results show how a doubling in power generation can be obtained by covering about 1% of Kariba lake with floating solar panels. This highlights the potential of floating solar penetration in tropical climates, and the key role that the technology can play in both controlling water-related diseases and compensating hydropower production, especially in dry seasons.