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Balancing hydropower production and river bed incision in operating a run-of-river hydropower scheme along the River Po

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Water management through dams and reservoirs is worldwide necessary to support key human-related activities ranging from hydropower production to water allocation, and flood risk mitigation. Reservoir operations are commonly planned in order to maximize these objectives. However reservoirs strongly influence river geomorphic processes causing sediment deficit downstream, altering the flow regime, leading, often, to process of river bed incision: for instance the variations of river cross sections over few years can notably affect hydropower production, flood mitigation, water supply strategies and eco-hydrological processes of the freshwater ecosystem.

The river Po (a major Italian river) has experienced severe bed incision in the last decades. For this reason infrastructure stability has been negatively affected, and capacity to derive water decreased, navigation, fishing and tourism are suffering economic damages, not to mention the impact on the environment.

Our case study analyzes the management of Isola Serafini hydropower plant located on the main Po river course. The plant has a major impact to the geomorphic river processes downstream, affecting sediment supply, connectivity (stopping sediment upstream the dam) and transport capacity (altering the flow regime). Current operation policy aims at maximizing hydropower production neglecting the effects in term of geomorphic processes. A new improved policy should also consider controlling downstream river bed incision. The aim of this research is to find suitable modeling framework to identify an operating policy for Isola Serafini reservoir able to provide an optimal trade-off between these two conflicting objectives: hydropower production and river bed incision downstream.

A multi-objective simulation-based optimization framework is adopted. The operating policy is parameterized as a piecewise linear function and the parameters optimized using an interactive response surface approach. Global and local response surface are comparatively assessed. Preliminary results show that a range of potentially interesting trade-off policies exist able to better control river bed incision downstream without significantly decreasing hydropower production.