



Water allocation in basins with multiple interconnected hydropower plants

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The apparent increase of seasonal variability of hydrological cycle and the expected effects of a potential climate change question the assumption of stationarity, which is generally postulated to derive the operational rules of water systems. This may concern particularly hydropower plants in the Alpine region of Europe, which already strongly affect the streamflow dynamics and, in turn, the riverine ecotone. This study addressed the operating rules of water allocation in a complex alpine hydropower network located in the southern part of the Swiss Alps. We investigated the Maggia River basin, which is regulated by 8 reservoirs that drain waters through 35 water intakes, and supply 6 hydropower plants. The global network develops a total power of 600 MW and produces an annual average energy of about 1300 GWh, which represents the main source of electrical supply of the whole Canton Tessin. The study was carried out by means of an object-oriented dynamic programming software that allows to estimate the optimal water allocation between competing water users on a monthly basis. System's configuration of different detail and complexity were accordingly investigated in order to assess the response of the hydropower network to different operating strategies (thereby including the riparian environment as additional competing user), and to seasonal variability as induced by realistic climatic scenarios. Among others, special attention was given to explore the effects of changes in the magnitude and shape of the water inputs, scheduled maintenance repair of the turbines and failures of either partial or entire part of the network. The corresponding optimal solutions that maximize the energy production are discussed with respect to different time period of analysis. Despite some limitations imposed by the software, the results provide an interesting outlook into understanding, within a real system, the impact of climatic anomalies on optimal water allocation in the presence of multiple users and constraints.