Estimation of future scenarios for energy production and its impacts on hydrology in the Hasliaare

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Problematic

Who  Hydropowerplant of KWO (KraftWerke Oberhasli AG)
What  Ecological impact due to hydrological criticity: phenomenon of Hydropeaking
Where  Hasliaare river, Berner Oberland
Actual solution  Retention basin downstream the hydropowerplant: able to manage the mitigation of hydropeaking effects for the actual water flowing in turbines, called Scenario III
Our problem  New catchments: Lake Trift or enlarging Lake Grimsel. Increasing of exploitable water volume

Objectives

1) Predict new water flow for energy production (called Scenarios IV) based on statistical analysis of existing scenarios
2) Verify management of retention basin against Scenarios IV

Method

Strategy  Defining discharge corresponding to “basal flow” and “peaks” in Scenario II time series, in order to increase their value in Scenario IV
Constraint  Amount of available water
Optimization  The calibrated set of parameters is the one which maximizes the exploited volume
Sensitivity Analysis  Testing the efficiency of the algorithm under constraints on amount of available water volume and on desired proportions among different uses
Ecological impact  Running existing algorithm (D.P. 2013, Maire A. & Theiler Q.) with predicted discharge and test if ecological parameters are respected

Results

Scenario IVA

- Additional available volume per winter season: 55 Mio m$^3$
- Volume exploited: 53 Mio m$^3$

Scenario IVB

- Additional available volume per winter season: 110 Mio m$^3$
- Volume exploited: 105 Mio m$^3$

Take home message

- In both Scenario IVA and IVB, the additional water could be distributed efficiently to the flow regime of the powerplants from November 20th to March 10th.
- Retention volume can be used to minimize adverse hydrological effect, as e.g. increasing and decreasing rate. With the respect to fish spawning activity in November the periods with discharge below 20 m$^3$/s decrease in terms of number of event compare to Scenario II. Discussions with fish experts are suggested.
- In order to improve the results, the analysis can be extend to the whole year (winter plus summer season) and mathematical constraints regarding to energy market could be taken into account.