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Measures to mitigate the Negative Effects of Complex Hydropower Schemes on River Systems

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Context

The problem of hydropeaking depends on hydraulic, morphological and ecological parameters. An interdisciplinary approach is mental conditions downstream of hydropower schemes (EPFL, EAWAG and

 \rightarrow Hydropeaking → Degradation of

river ecosystem

High-head storage hydropower plants in Alpine areas are able to complement the irregular production of renewable energy sources, (wind power) in the European power supply system. Sudden opening and closing of the turbines produces highly unsteady flow conditions in the river downstream of the powerhouse outlet resulting in:

Approach

- → Mitigation measures
- \rightarrow Improvement of river ecosystem

Modelling

A numerical model has been developed, calibrated and tested. In the hydrological forecasting tool threedimensional rainfall, temperature and evapotranspiration distributions are taken into account for producing the dominant hydrological processes (Schälchli 2005):

- Snow pack constitution
- Snow melt
- Glacier melt
- Soil infiltration
- Runoff

→ Simulation of

- Routing System (Jordan 2007):
- \rightarrow Integration of routing in rivers → Hydraulic structures (water intakes, reservoirs,
 - spillways and turbines)

Today Alpine catchments Parameter study Tomorrow → Evaluation of mitigation measures Climate Implementation of climate change scenarios (C2SM), influencing the inflow parameters (temperature and precipitation) Hydrology Changes of the hydrological characteristics of the Alpine catchment area (semi-lumped modelling of glacier melt) Simulation of operation mode of power **Hydraulics** plants by taking into account economic issues (market depending price scenarios) Flow Regime Impact of use of the water resources in the downstream river system by hydropeaking indicators on a daily base Habitat Suitability Ecological impacts compared to actual state by Fuzzy-logic approach with biological data from field measurements (EAWAG) Development of mitigation Mitigation measures measures for hydropeaking → Economic, ecological and social rating → Multipurpose hydraulic schemes (Basin, tunnel, cavern, distributed system) → Identification and location in the system

\rightarrow Case study Generally applicable methodology, which is tested for the Hasliaare River (CH)

necessary to address all issues in order to improve the environindustrial partners).