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Monitoring strategies associated with the controlled drawdown of a hydropower reservoir

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Reservoirs are important in context of an increased demand on renewable energy and water for irrigation and drinking water purposes. Thus reservoir management is an important task. Beside the technical and the economically feasibility ecological factors are important issues. Thus, an integrative monitoring concept was developed and applied during a controlled drawdown of the Gepatsch reservoir in the Austrian Alps.The controlled drawdown (December 2015 - March 2016) was done slowly, with the consequence of moderatesuspended sediment concentrations (SSCs) in the downstream Inn river. The water was released through the penstock towards the turbines and directly into the Inn River. However, to limit the erosional impact on turbines only one Twin-Pelton turbines was operated during the controlled drawdown. The monitoring program itself was subdivided into monitoring of the sediments in the penstock to determine the amount and the composition of sediments which were sluiced through the turbine, monitoring of the turbine itself to quantify the damages of the turbine and a monitoring related to SSCs in the downstream river reach. In order to detect possible changes, measured discharge and turbidity values were examined. In addition, the flow velocity was modelled (1D). The goal was to monitor the observed peaks concerning their temporal shift and to draw conclusions on the storage capacity of fine sediments in the river substrate. Moreover, detailed fine sediment depositions on gravel bars along the Inn river were monitored and the grain size distribution of the river bed was determined. The monitoring started already in April / November 2015 with the aim to survey and analyses the turbidity, suspended load and fine sediment deposits on gravel bars along the River Inn as well as its biota (macroinvertebrates and fish) for “undisturbed” conditions. The SSCs were measured in a pre-analysis and during the drawdown itself in the penstock and in the outlet channel with turbidity meters, a LISST-StreamSide and a Coriolis Flow Density Meter. In addition gravimetric samples were collected on a daily basis, where subsequently the SSC and the particle size distribution were quantified in the laboratory. The material
erosion of the Pelton runner, which was used during the drawdown, was measured in equal intervals to obtain a relationship between the turbine damage and the suspended sediment emission on the turbine. Concerning the studies on fine sediment deposits on gravel bars only four gravel bars showed statistically significant changes comparing the surface deposits before and after the controlled drawdown. Therefore the assumption that an increase in deposited sediments is coupled with a high rate of turbidity did not appear. The changes in river bed composition by freeze-cores delivered additional information on the fine sediment dynamics. High turbidity values resulted in a higher share of fine particles in the vertical stratigraphy especially at the first sampling sites downstream of the power plant. The same effect was monitored concerning an increase of overlaying sediments on the gravel bars. The developed integrative monitoring concept for the controlled drawdown of the Gepatsch reservoir, including continuous and periodical measurements, was a novel reach-scale approach to integrate hydrology, erosional aspects of sediments on turbines, fine sediment transport dynamics and variability in the river, and determination of ecological impacts.