HORIZONTAL RAMPING RATE CALCULATIONS: A TOOL FOR ASSESSING HYDROPEAKING ALTERATIONS

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Abstract

Hydropeaking due to hydropower use have negative impacts on aquatic fauna. One of the damaging processes is linked to the rapid dewatering of habitats. We propose a method in order to recommend flow regime to minimize risks for juvenile fish stranding. When the discharge lowers rapidly, this risk is frequently assessed among others by calculations of vertical ramping velocity. However, the lateral ramping velocity appears more relevant as it allows taking into account the river morphology. Hence, the remaining challenge is to calculate these horizontal ramping rates in complex situations such as braided rivers.With TELEMAC 2D hydraulic steady and unsteady simulations of the Durance, a gravel bed braided river, we have developed an innovative approach for the horizontal ramping rate (HRR) calculations. The algorithms for the calculations requires realizing partitions of the finite elements into wet and drying meshes. These calculations and dynamic 2D and 3D representations will be available in the Habby free and open-source software for several 2D hydraulic models. To recommend rates of lowering discharges during hydropeaking events, we have used the stranding threshold for juvenile cyprinids of 1 m.h-1 of HRR. Further studies are required to evaluate more precisely HRR limits for fish stranding regarding biotic and abiotic parameters: species, sizes, day/night cycle, temperature, substrate,...In the Durance River, long-term monitoring of two sites upstream and downstream hydropeaking events provide us an empirical data set to analyse fish density as a function of hydrology. Extending the global results of HRR provided by the hydraulic simulations, we have been able to calculate HRR for each flow interval in the hydrological record. A strong link between HRR metrics and cyprinids densities has been established for both adults and juveniles. Among the several tested metrics, the annual cumulated HRR appears as a good predictor of adult fish densities (total length>60cm), whereas the threshold of 1 m.h-1 reveals to have a strong negative impact on juvenile densities, especially during spring.

Keywords
2D hydraulic simulations, fish stranding, cyprinids, fish densities, Habby software