Geophysical Research Abstracts
Vol. 21, EGU2019-16889, 2019
EGU General Assembly 2019

The influence of hydropower production on river thermal heterogeneity: a modelling approach.

Davide Vanzo (1), Christine Weber (1), Michael Döring (2), and Martin Schmid (1)

(1) Eawag, Swiss Federal Institute of Aquatic Science and Technology, Surface Waters - Research and Management, Kastanienbaum, Switzerland (davide.vanzo@eawag.ch), (2) ZHAW , Zurich University of Applied Sciences, Wädenswil, Switzerland (doei@zhaw.ch)

River water temperature is a fundamental physical property of flowing waters, widely recognized as a key driver in aquatic ecosystems. Its variability occurs at multiple temporal and spatial scales. The temporal variability defines the thermal regime of a river reach, with characteristic patterns from annual to diel cycle, all with a distinct ecological signature. The spatial variability is characterized by longitudinal gradients and local heterogeneity (i.e. lateral gradients) along river corridors. The former are mainly driven by air temperature and flow discharge whilst the latter might be occasionally promoted by local features such as riparian vegetation, hyporheic water fluxes and riverbed morphological structures. The alteration of the natural thermal regime at any of these temporal and spatial scales can adversely affect the river biota, e.g. influencing the development of fish eggs and the behavioural drift of benthic macroinvertebrates. Hydropower plants inevitably affect thermal dynamics, altering temporal patterns, from seasonal to sub-daily scale, and disrupting longitudinal thermal gradients. However, less is known about the effect of hydropower alteration on local thermal heterogeneity.

Hydropower production patterns are likely to change in the near future in the context of climate change adaptation actions and fossil energy production reduction. Increase in storage capacity, alternative production scheme (e.g. pump-storage), and more frequent fluctuations of water levels in the receiving water bodies (hydropeaking) are expected. In such context, the modelling and quantification of river thermal dynamics represents a crucial task for the restoration of freshwater ecosystem integrity. The main goal of this study is to model and quantify the interaction between hydro-thermal alterations due to hydropower production and local river morphology. This will allow us to better understand the temperature temporal and spatial dynamics in hydropeaking rivers, and possibly infer future trends under different hydropower scenarios. The study sites are located in Moesa River and Vorderrhein (Switzerland), and are subjected to sub-daily hydro-thermal alterations due to hydropower production. The study integrates fieldwork and remote-sensing data collection and numerical modelling, in particular i) surface and sub-surface water temperature measurements, to investigate the role of hyporheic fluxes; ii) remote sensing (UAV) of surface water temperature, to understand the thermal mosaic at high and low flow stages for different season; and finally iii) the development of a 2D depth-averaged numerical model to simulate hydro-thermal dynamics for current and future production scenarios. The study approach and preliminary results will be presented.