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Modelling hydropeaking effects on the riparian aquifer

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Hydropower operations result in sharp water level and temperature fluctuations downstream the river section where water is released intermittently according to the pattern of hydropower generation. It has been widely recognized that these peaking flows cause severe degradation of the affected river reaches, but their biological effects and hydraulic behaviour have been studied mainly referring to the main channel. Field evidence (Sawyer et al., 2009, Loheide & Lundqvist, 2009) demonstrate that surface water level oscillations are associated with significant mass exchanges between the stream and its riparian aquifer that may have relevant, still largely unexplored, biogeochemical implications.
The purpose of this study is to develop a simplified modelling approach to predict the effects of hydropeaking on subsurface flow into the riparian region. We propose a simplified model for surface – subsurface flow exchange where instream hydropeaking is assigned as boundary condition and that solves the unsteady, dimensionless 1D Boussinesq equations for the saturated zone of the riparian aquifer. This allows to quantify the lateral extent of the riparian region affected by hydropeaking oscillations. In particular, with this model we analyzed the temporal variations in the daily mass and thermal exchanges between the channel and the riparian aquifer, and identified the controlling factors. The role of longitudinal variations in channel morphology as well as of seasonal aquifer variations and land cover can also be examined through the proposed modelling framework.

Sawyer, A.H., Cardenas, M.B., Bomar, A., and Mackey, M. 2009. Impact of dam operations on hyporheic exchange in the riparian zone of a regulated river. Hydrol. Process, DOI: 10.1002/hyp.7324
Loheide, S. P., II, and J. D. Lundquist (2009), Snowmelt-induced diel fluxes through the hyporheic zone, Water Resour. Res., 45, W07404, doi:10.1029/2008WR007329.