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Hyporheic interactions under a hydropeaking scenario: a multi-scale approach

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Sudden flow changes caused by hydropeaking are likely to become more frequent with increasing demand for renewable energy. These sudden fluctuations affect both the surface and subsurface flow regime and change the hydrological interaction patterns occurring in the hyporheic zone. The hyporheos plays an important role in freshwater ecology, especially for early stages of salmon embryo development. Hydrological hyporheic interactions and associated larger scale hydrological processes have hardly been investigated in a hydropeaking scenario.

The works presented aim (i) to investigate detailed hydrological processes occurring in the hyporheic zone at the micro-scale during hydropeaking; (ii) to upscale the findings at the meso-scale by repeating the same detailed experiments in differentiated morphologies; and (iii) to use the outputs for establishing more environmentally sound hydropower operations at the catchment scale.

An experimental set-up was started in December 2011 in the river Lundesokna (central Norway). A total of 14 pipes were buried at several depths (from 20 to 70 cm) across and along a 5 x 20 m side bar subject to regular drying out and dewatering due to hydropeaking operations. Water pressure sensors were placed in the pipes to monitor the hyporheic water level and flow with 1-2 minutes time resolution. In addition, temperature, conductivity and dissolved oxygen are collected at the same site for an expected period of 3 months, coinciding with early stages of salmonid egg development in this catchment.

Results to date show sudden and high groundwater dominated inflow as a consequence of the quick surface water drop during dewatering episodes. But slow reaction spots where surface water remains for longer periods in form of water pockets has been observed. Such processes have the potential to influence the survival of salmon eggs at both smaller and larger scales.