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Event analysis of an artificial flood combined with sediment replenishment in a residual flow reach in a Swiss river using pit tags

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Over half of Swiss electricity is produced by hydropower. Hydropower reservoirs cause severe hydropeaking flows to meet peak energy production to satisfy energy demands. Hydropeaking causes negative impacts on aquatic biota. Water diversion due to dams on the other hand often imposes residual flow regimes downstream. The absence of flood events and regular sediment supply disrupts sediment dynamics and disconnects floodplains, habitats of high value, from main channels.
The residual-flow reach at the Sarine river in western Switzerland is the subject of the present study. The Sarine meanders strongly through a ca. 100 m deep incised valley. This geologic incision causes isolation of the river from surrounding urban areas and is consequently minimally influenced by human structures and shows a natural geomorphology. Since the construction of Rossens dam in 1948, riparian vegetation became established and the active floodplain area decreased, which still is valuable habitat for a wide range of organisms. The dam resulted in a large reservoir upstream of this reach and water is abstracted for hydropower.
In the research performed here, sediment replenishment combined with an artificial flood from Rossens dam was investigated in 2017. A special configuration of four different sediment deposits were placed along the river. The added sediment was excavated from the adjacent floodplain with no sorting or washing of the material. Around 500 stones in the deposits were equipped with PIT tags (radio frequency identification technology), allowing the tracking of the stones in the river and providing data about their redistribution in the river following the flood. With a fix installed antenna downstream of the deposits more information about the erosion process and the critical discharge for the erosion of the deposits was collected. The artificial flood hydrograph showed a peak discharge of 195 m3/s, corresponding to a flood with a return period of 1 year. The flood peak was relatively low and thus did not fully erode all deposits. This led to a high recovery rate of 57% of the PIT tags. The deposits on the left side in the river were stronger eroded than those on the right side. Results show that PIT tag equipped grain sizes of 5.7 mm and 11.3 mm traveled up to 286 m during the flood. The distribution of the replenished material in the river was similar as results observed in flume-controlled laboratory experiments.
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