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Channel short-term adjustments following mobile dam lowering on a low-energy river: The Yerres River in the Seine Catchment (France)

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In order to reach WFD (2000) objectives of water bodies “good ecological status”, stream stakeholders particularly rely on channel hydromorphological restoration. As a main cause of river hydromorphological alteration, dam dismantling in order to remove the pressure on the hydrosystem is among the most common operations. But even by allowing hydrological and sedimentary continuity, removal of transversal structures does not automatically lead to morphological diversification. On low-energy rivers, channel morphological resilience is weak due to low fluvial dynamics. Though low-energy rivers are accounting for a great part of rivers from the North-West of Europe, that are historically equipped with many hydraulic structures. Thus, they represent a major stake to reach the WFD objectives. In this context, this study aims at assessing efficiency of dam removal on a low-energy river. It has been led on the Yerres river (1000km^2, s=0,09%), a right-bank Seine River tributary located around 30 km upstream of Paris, in the center of the Seine Basin. Due to his vicinity to Paris conurbation, heavy channel modifications and high longitudinal segmentation (a dam every 2km) are characterizing the river, leading to high hydromorphological alterations.
On this river, the seasonal lowering of three small mobile dams (h < 3m) have been studied at reach scale (102 to 103m). High spatial and temporal resolution monitoring of bed topography and sediment-size were carried out between 2015 and 2017 to document channel adjustments to dam lowering through morphological and grain-size change. Thus, high-precision cross-section surveys allowed to monitor spatio-temporal dynamics of channel morphological change for varied flood intensity, ranging from 2-year floods to a more than 100-year flood at spring 2016.
Results show that channel morphological adjustments after dam lowering remained moderate over the 2-year period. Channel morphological change have been variable in space and in time. Firstly, no significant lateral mobility was measured, indicating a remarkable bank stability. Thus, morphological change was mainly bed-related and consisted in bed scour or aggradation. Secondly, bed adjustments were strongly related to flood intensity. While maximal vertical change (either scour of deposit) remains lower than 20cm for 2-year floods, it reaches up to 60cm for the 100-year flood.
Sediment budget of impoundments highlighted that dominant morphological processes were moderate and variable (either erosion of sediment infilling or net deposition) for 2-year floods, with volumetric evolution less than 5% of sediment infilling volume. On the other hand, it showed a significant trend for channel erosion for the 100-year flood, with up to 18% of sediment carried out of the impoundment in a single flood event.
Based on those results, the absence of significant post-removal adjustment processes for bankfull floods, assumed to be morphogenetic floods, is thus questioning post-removal channel evolution model and efficiency of passive restoration on hydromorphological characteristics for low-energy river channel.