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Geomorphological evolutions of river courses following three centuries of severe hydro-morphological engineering for timber floating in an upland catchment of central France (Yonne River).

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The river courses of the upper catchment of the Yonne River (central France) are generally considered as of high quality in terms of ecology and natural landscape. However this catchment experienced heavy anthropogenic pressure between the 16th and the 19th centuries through timber floating. Indeed, the Yonne basin was the main region of wood production to heat the fast growing city of Paris. Rivers quickly turned out to be the best way to supply the high energy needs of the city with heating wood. Nowadays, though the river seems pristine, geomorphological scars from this period may be observed once the channel characteristics are carefully examined. Indeed, in order to facilitate the downstream journey of the logs, small streams in the upper catchment were engineered: the hydrological regime was modified and river courses were channelised. A dense network of small reservoirs was built, allowing the creation of artificial floods that caused massive erosion in the headwater streams and sediment wave propagation further downstream.
A first study based on historical archives allowed the research team to reconstruct the discharge and the frequency of the artificial water releases. It shows that 2 or 3 times per week between November and March from the second part of the 17th to the first part of the 19th century, 2 to 4 m wide streams experienced two-hour floods with a discharge of 3 to 4 m3/s. These short but frequent and intense hydrological pulses highly increased sediment transport in the steep headwater courses and probably caused bed incision. Further downstream, because of gentler slopes, larger widths but identical discharges, the sediment transport was strongly slowed down and river beds would have experienced aggradations. Until recently this schema showing incision in the upper part of the course and aggradation in the middle part was only supported by a few field observations and was still hypothetical.
This paper gives the first results allowing this hypothesis to be partly verified through the study of a 1.5 km long reach at the lower end of the upper part of the Yonne River. In this reach, the channel flows 1.5 to 2 m higher than the floodplain. On one hand an analysis of several sediment cores made in the floodplain shows that the channel has been progressively perched through successive floods. The orientation and the composition of the sediment layers clearly indicate that the sediment mainly originates from the present-day perched bed. On the other hand historical archives show that the channel has been displaced and reshaped to facilitate log transport. Sediment accumulation and bed aggradation is therefore posterior to the bed displacement and a consequence of the floating activity. One may finally state that a large amount of coarse sediment did indeed travel through this reach during this period verifying at least partly the hypothesis presented early on.