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Limiting the development of riparian vegetation in the Isère River: physical and numerical modelling study

Nicolas Claude (1), Kamal El Kadi Abderrezzak (1,2), Marion Duclercq (1), Pablo Tassi (1,2), and Clément Leroux (1)

(1) EDF R&D, Laboratoire National d'Hydraulique et Environnement (LNHE), 6 quai Watier, 78401 Chatou, France (nicolas-n.claude@edf.fr), (2) Laboratoire d'Hydraulique Saint Venant, 6 quai Watier, 78401 Chatou, France

The Isère River (France) has been strongly impacted during the 19th and 20th centuries by human activities, such as channelization, sediment dredging and damming. The hydrology and river morphodynamic have been significantly altered, thereby leading to riverbed incision, a decrease in submersion frequency of gravel bars and an intense development of riparian vegetation on the bars. The flood risk has increased due to the reduction of the flow conveyance of the river, and the ecological status of the river has been degraded.
To face these issues, a research program involving EDF and French state authorities has been recently initiated. Modification of the current hydrology, mainly controlled by dams, and definition of a new bed cross-sectional profile, are expected to foster the submersion frequency and mobility of the bars, thus limiting the riparian development. To assess the performance of these mitigating solutions, a physical and numerical modelling study has been conducted, applied to a 2 km long reach of the Isère River.
The experimental setup consists of an undistorted movable bed designed to ensure the similarity of the Froude number and initial conditions for sediment particle motion. The resulting physical model is 35 m long and 2.6 m wide, with sand mixture composed of three grain size classes.
The numerical simulations performed with the Telemac Modelling System (www.opentelemac.org) show, for the current morphology, a limited sediment mobility and submersion for flow discharge lower than 400 m3/s, confirming that the actual conditions in the Isère River promote the development of riparian vegetation. Different new bed geometry profiles have been evaluated using the numerical model. Then two configurations, one based on the creation of deflecting bedforms in the thalweg and one based on the transformation of the long bars into small central bars, have been selected and modelled with the physical model.