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The beautiful River Satsunai: Quantifying the effect of artificial flushing flows on channel planform morphology.

Ellie Crabbe^{2,1}, **Georgios Maniatis**¹, and Ryota Tsubaki³

¹University of Brighton, School of Applied Sciences, Brighton, United Kingdom of Great Britain – England, Scotland, Wales (g.maniatis@brighton.ac.uk)

²WSP, Water Risk Management Department, London, UK (e.crabbe15@gmail.com)

³Nagoya University, Department of Civil and Environmental Engineering, Nagoya, Japan (rtsubaki@civil.nagoya-u.ac.jp)

The introduction of river dams has resulted in a deleterious simplification of the geomorphological and hydrological characteristics within fluvial environments. To ensure riverine geomorphic diversity in dammed rivers, a variety of watercourse management techniques have been utilised. Flushing flows (the intermittent release of water and sediment from the dam reservoir) have been demonstrated to improve the longitudinal continuity of sediment flux, through the partial reinstatement of periodic flooding. Those flushes are designed to emulate hydrological disturbance events that correspond to natural flow regimes. However, few investigations have sought to characterise nor quantify the geomorphic impacts of flushing flows on channel planform morphology.

Prior to the operation of the Satsunaigawa Dam in 1998, the Satsunai River (Hokkaido, Japan) was renowned for its geomorphic diversity, featuring a plethora of braided channels with double-row bars. After the reported depletion of such features, flushing flows have been used as part of a wider management (2012-ongoing) towards improving the geomorphic diversity of the river.

To quantify the geomorphic impacts of the flushing flow on the planform morphology, a chronology of satellite images (between August 2014 and May 2020) were used to track the lateral mobility of the channel centreline across a 10.4 km reach of the river. Centreline lateral mobility tracking is then used as a proxy for the geomorphic response and differentiate between geomorphic change cause by: a) natural hydrological forcing and, b) artificial annual flushing flows as part of the restoration program.

Results from statistical tests of difference identified significant changes in centreline lateral mobility, both spatially and temporally, within the study reach. The intense natural hydrological forcing is also linked to statistically significant increase of the variability for the lateral mobility of the channel centreline.

Spatial comparisons indicate certain sub-reaches exhibiting high lateral mobility consistently in contrast to areas with statistically constant median values over the entire study period. In this context, the position of the sub-reaches in relation to the dam is formally tested as a predictor

for the intensity of geomorphic change.

By contextualising the patterns of centreline lateral mobility within the wider hydrology of the Satsunai catchment, the geomorphic implications of the flushing flow can be critically assessed. This is the missing link between previous studies that focused either on the local study of hydraulic forcing or on the assessment of the ecological impact of the artificial flushing within the Satsunai catchment.