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Impact of Halting Dam Operations on Downstream Flow: A Modern Modelling Approach

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Europe confronts a critical environmental challenge, with only one-third of its rivers meeting the “good ecological status” criteria of the EU Water Framework Directive as many river systems are impacted by damming and regulation. Our research focuses on the Myllykoski hydropower dam on Kuusinkijoki River, which has been operational since 1957. The hydropower dam is set to cease operations, marking a transformative step to restore the natural riverine environment. The cessation plan involves diverting water back to the long-unused Piilijoki River, reinstating its ecological role and improve the ecological status of the main Kuusinkijoki River that was disrupted post-dam construction. Our data collection strategy employed field campaigns, capturing high-flow conditions in spring, and low-flow conditions in autumn. Cutting-edge sensors were employed in this endeavour, utilizing the Otter Unmanned Surface Vehicle (USV) for underwater topography scans, Acoustic Doppler Current Profiler (ADCP) for flow characteristic measurements, and water level data loggers for monitoring water level time series. The collected data is then used to create a highly accurate seamless 3D map of the river channel and floodplain. Leveraging this intricate map, we deploy an advanced hydraulic model to comprehensively analyse hydraulic processes and assess flow characteristics following the planned halting of the Myllykoski hydropower dam. Our study's multifaceted objectives include evaluating the spatio-temporal variability of downstream flow in three distinct study sites: (a) an unused natural channel alongside the dam, (b) a man-made channel downstream, and (c) a natural channel downstream, including the riverine lake along the course of the Kuusinkijoki River. Furthermore, we aim to investigate the influence of various flow scenarios on downstream river flow characteristics, analyse spatio-temporal trends in flow dynamics, and identify any significant changes in response to the cessation of dam operations. A crucial aspect of our study involves evaluating the influence of dam halting on river hydrodynamics and ecology using modern sensors and analytical tools.