



## Near-continuous change detection of river reaches with image-based approaches

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River channel migration and bank erosion pose significant challenges for infrastructure, agriculture, and ecosystem management, particularly in the context of climate change. While numerical modeling techniques offer predictive capabilities, their validation often suffers from limited temporal resolution in morphodynamic data collection. This study presents an innovative approach to near-continuous monitoring of river bank erosion and streamflow dynamics along the Hungarian reach of the Sajó River, where intensive bank erosion causes substantial economic damage.

We implement a network of low-cost photogrammetric observation stations using Raspberry-Pi and trail cameras to capture river bank changes and streamflow data at unprecedented temporal resolution. The methodology combines Structure-from-Motion (SfM) photogrammetry with AI-based image segmentation techniques to simultaneously monitor bank erosion processes and water levels. To ensure data quality, we develop specialized processing chains that improve signal-to-noise ratios and enable automatic workflows for volumetric calculations of erosion events. The system's calibration and validation involve comparative analysis with terrestrial laser scanning and ADCP measurements through comprehensive field campaigns.

Our study specifically addresses technical challenges including optimal camera placement strategies in varying vegetation conditions, ground control point optimization, and image overlap variations for SfM-based change detection. For discharge measurements, we enhance existing neural networks with site-specific training data and combine surface flow velocities (derived through optical flow techniques) with regularly updated river cross-sections.

Expected outcomes include: (1) a validated methodology for near-continuous monitoring of bank erosion rates and discharge variations, (2) quantitative characterization of the relationship between variable discharges and composite bank erosion in meandering rivers, and (3) improved understanding of erosion mechanisms during high-flow events. This research represents a significant advancement in fluvial geomorphology monitoring techniques, offering new possibilities for river management and floodplain rehabilitation strategies in the era of climate

change extremes.

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