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Flow characteristics around midchannel islands in lowland rivers

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Abstract

Midchannel islands (MCIs) are influential instream geomorphic units generally emerge in lowland rivers. Despite their significant ecomorphological services in the river ecosystem, the flow structures around these self-forming riparian landforms are not fully understood yet. Understanding the flow pattern around these formations enables practitioners to produce cost-effective, sustainable, and eco-friendly river management projects/strategies. From this motivation, the secondary flow pattern around MCIs was analyzed employing RANS based numerical model. Flow around the simplified bodies were simulated to give a more precise analysis regarding flow-island interactions. Once the numerical validation process was completed for the cylinder using an experimental dataset, the validated model was implemented for islands (streamlined island, vertically sloped island (VSI), and realistically sloped island (RSI)). The simulations revealed these findings: 1) The RSI acted like a streamlined object and produced weaker lee-wake vortices with a longer recovery distance. 2) The RSI gained a better streamlined form near the bed than near the water surface due to enhanced elongation. 3) This situation generated highly variable coherent flow structures along the depth behind the MCI. 4) Due to the three-dimensionality of the RSI, the generated large-scale vortices propagated asymmetrically towards sides of the channel rather than remaining around the centerline.

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