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Flow dynamics of bank-attached instream structures

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Numerical simulations and experiments for flow past a bank-attached vane, a widely-used instream structure for stream restoration, are carried out to study the turbulent flow dynamics occurring around the structure. In the numerical simulation, the details of the natural rocks that constitute the vane are directly resolved by employing the recently developed computational fluid dynamics model of Kang et al. (2011). The time-averaged flowfield is shown to be in good agreement with the results of laboratory measurements. Analysis of the simulated flow shows that there exist two counter-rotating secondary flows cells downstream of the vane, one of which is located near the center of the channel and the other is located near the corner between the channel bed and the sidewall to which the vane is attached. The formation of the two counter-rotating secondary flow cells is shown to be linked to the plunging of the mean three-dimensional streamlines originating upstream of the vane onto a point downstream of the vane positioned on the lower part of the sidewall. The laboratory experiment also reveals the existence of such flow structures.