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The influence of flow discharge variations on the morphodynamics of a diffluence-confluence unit on the Mekong River

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Bifurcations represent key morphological nodes within the channel networks of anabranching and braided fluvial channels, playing an important role in controlling local bed morphology, the routing of sediment and water, and defining the stability of the downstream reaches. Herein, we detail field observations of the three-dimensional flow structure, bed morphological changes and partitioning of both flow discharge and suspended sediment through a large diffluence-confluence unit on the Mekong River, Cambodia, across a range of flow stages (from 13,500 m3 s-1 to 27,000 m3 s-1) over the monsoonal flood-pulse cycle.

We show that the discharge asymmetry (a measure of the disparity between discharges distributed down the left and right branches of the bifurcation) varies with flow discharge and that the influence of upstream curvature-induced cross-stream water surface slope and bed morphological changes are first-order controls in modulating the asymmetry in bifurcation discharge. Flow discharge is shown to play a key role in defining the morphodynamics of the diffluence-confluence unit downstream of the bifurcation. Our data show that during high flows (Q $\sim$ 27,000 m3 s-1), the downstream island complex acts as a net sink of suspended sediment (with 2600 kg s-1 being deposited between the diffluence and confluence), whereas during lower flows, on both the rising and falling limbs of the flood wave, the sediment balance is in quasi-equilibrium. We propose, therefore, that the long term stability of the bifurcation, as well as the larger channel planform and morphology of the diffluence-confluence unit, is therefore controlled by annual monsoonal flood pulses and the associated variations in discharge.