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INFLUENCE OF THE POSITION AND ANGLE IN THE FLOW AND SEDIMENT TRAPPING EFFICIENCY IN BIFURCATIONS ALONG BENDS

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Abstract. The permanence of secondary channels in natural bifurcations depends on various factors, including geomorphological, geotechnical, geometric, and hydro-sedimentology conditions, particularly their capacity to capture both flow and sediment. In this regard, at bifurcations, secondary channels can either capture the entire flow, be abandoned, or reach steady flow and sediment distribution with respect to the main channel. While there are studies that analyze partition dynamics, very few have been conducted at bifurcations on bends reaches (with complex flow structure), which are the most common in large alluvial rivers. To analyze the impact of the position and angle of bifurcation around a bend, we conducted a series of two-dimensional fluvial-morphological numerical simulations under different geometric scenarios. We carried out nine cases, modifying the position of the secondary channel outlet relative to the main channel (upstream, at the apex, and downstream), and for each of these, we varied the angle (0, ±10°). The simulations represent two-dimensional hydrodynamics, sediment transport (bed and suspended sediment), and morphological changes, using the TELEMAC 2D model coupled with the Sisyphe module. The results indicate that the position of the bifurcation along the bend influences sediment and flow capture (and, consequently, the permanence of the channels). Firstly, it is worth noting that bifurcations located upstream of the apex achieve a higher flow capture (between 7-25% more than the other positions, at the apex and downstream), resulting in secondary channels with higher erosion rates. Simultaneously, the main channel experiences a loss in total transport capacity, leading to significant deposition processes. Secondary channels positioned downstream of the apex are more efficient at capturing sediment, leading to a rapid equilibrium over time and a lower capture of flow by the secondary channel (20-40% of the main channel). Similar results are observed for bifurcations positioned at the apex. The angle of the secondary channel's exit does not seem to significantly affect the overall behavior, with percentage deviations of 2-5% in each of the positions. Regarding the free surface, it undergoes modulation during the process of adapting flow and sediment distribution. An increase in water surface elevation upstream of the bifurcation enhances the gradient energy in the secondary channel, intensifying its capacity to capture sediment transport. Lastly, it is important to note that the development of maximum velocities along the bend could affect flow partitioning, as the higher flow inertia on the main channel reduces the capture capacity of the secondary channel.