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Experimental study on mid-channel bar formation in alluvial river

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Dynamic bar pattern is one of the key elements in alluvial river evolution process, which is still not fully understood at present. In the current study, laboratory experiments were carried out in a large flume with a mobile bed using graded sand to investigate the mechanism of mid-channel bar formation. Time varying water levels were measured at 16 sites using ultrasonic sensors, and the bed level was measured using a three-dimensional laser scanner. Results showed that under the steady flow condition it was difficult to develop a stable mid-channel bar in a suddenly widening channel. This is because the model river was able to automatically adjust its bed slope so that the bed-load from upstream can be transported by the flow to the deposit body downstream. Therefore, two series of unsteady flow tests were conducted, including a rectangular form and a sinusoidal form of inflows. For both cases it was found that the evolution of stable mid-channel bar included two stages. Firstly, the bed-load sediment from upstream deposited onto the bed as it moved into the suddenly widening channel. Secondly, a perturbation occurred in upstream channel as the inflow decreasing, and then the flow entering into the widening river began to swing, bifurcate and cut the deposit body. Afterwards, two main branches were developed. The morphological characteristics of mid-channel bar, such as horseshoe shape and rhombus, were mainly depended on the initial velocity profile of water flow coming into the widening channel. The river bed was coarsened during the process of mid-channel bar evolution, especially over the bar.
Keywords: alluvial river; mid-channel bar; deposition; bifurcation; bed coarsening