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Wood entrainment factors analysis using a fixed flume experiment

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The dynamical mechanism of wood debris entrainment is a complex behavior in the natural river. We, thus, used a fixed flume experiment and simplified some complex impacts to simulate the individual wood entrainment. Using different woody characteristics, such as different lengths (15∼30 cm), diameters (3∼5 cm) and densities (428 ∼1142 kg/m3) of wood, and the flow angles between the wood and the central flow, such as parallel, oblique, and transverse, and bed roughness (5 and 8 mm) to explore the influences for the flow surrounding the wood. The results indicated that wood diameters and densities are the key factors to keep the wood debris stable; special, the wood density had the effect significantly. In addition, the other factor affected wood to keep stability in the channel was the flow angle between the wood. Wood entrainment has a interaction with buoyant force significantly and drag force unobtrusively as the wood paralleling the flow. Following the depth increases gradually, the buoyant force development and the friction force decrease until the wood start to entrain by semi-floating and semi-sliding. The drag force drove wood to entrain as the wood was oblique or transverse to the flow. The drag force and channel bed roughness had a positive relationship in this case. While the wood accessed greater channel bed roughness, the wood entrainment needed more drag force to rolling to the downstream. Summarized the results, we used regression analysis to show significant models of the wood entrainment. The model established Y* (the relative buoyancy), X* (the normalized ratio of the drag force and resistance to movement of the log), and used wood densities to distinguish four different wood entrainment thresholds (300∼600 kg/m3, 600∼800 kg/m3, 800∼1000 kg/m3, and >1000 kg/m3). With the wood densities increasing, the wood entrainment thresholds are reducing slightly. Finally, we hope that these results could provide accessible principles to predict the wood entrainment in the rivers.