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The response of braided river bifurcations to flood events

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The role of river bifurcations has witnessed considerable attention over the last 10 years, primarily reflecting the observation that the way that rivers divide may be as important as the way that rivers join in understanding the interactions between form and process in braided rivers. A substantial body of laboratory measurements have demonstrated the effects of asymmetry in the delivery of both flow and sediment upon bifurcation dynamics, including bifurcation stability. Mathematical analyses of individual bifurcations has generalised these findings using simple stability analyses. However, whilst these analyses identify the processes operating in individual bifurcations, the manifestation of these processes is controlled by the position of these bifurcations within the braided river network. Here, we present the first study the dynamics of bifurcations in a wide gravel-bed river in response to network reorganisations during flood events, using high resolution digital elevation models. We found that systematic changes in bifurcation geometry occurred in response to two observed flood events: the effects of floods was to create less asymmetric bifurcation geometries, with lower bifurcation angles and steeper downstream bed slopes, as well as more bifurcations. Two important observations follow. First, both experimental and theoretical analyses have shown that greater bifurcation symmetry results in greater bifurcation stability and these appear to explain the surprising observation in our field data that bifurcations were remarkably stable in terms of position during the flood events observed. Second, the changes in bifurcation geometry during flood events are likely to increase the ease of sediment transfer in the braided network, emphasising the importance of flood events in maintaining downstream sediment transfer efficiency.