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Effects of Fluvial Morphology On Orbital Remote Sensing Measurements of River Discharge

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As new orbital remote sensing capabilities have emerged, their potential for monitoring of streamflow is becoming evident. The flow area method, for example, uses river surface area expansion and contraction within defined measurement reaches to infer discharge changes. Also, water surface altimetry can remotely monitor rivers by stage, as at ground gauging stations, but at more infrequent time intervals. In both cases, the reliability of space-based data are assessed by comparison to discharge obtained from the ground. However, the accuracies of such discharge values range from high to poor: depending, in part, on channel morphology, and also on which portions of the overall flow regime are being observed. For example, braided rivers are difficult to measure via traditional gauging stations: the flow is divided into multiple channels, whose bathymetry is variable and changing over time, and "wide loop" rating curves and hysteresis effects are common. Also, high discharges may use the floodplain as the temporary channel, and such peak flows commonly destroy gauging stations or exceed their measurement capability. We hypothesize that remotely-measured reach flow area is a more accurate and consistent indicator of discharge than is stage for channel/floodplain morphologies exhibiting low hydraulic radius values and mobile and braided channels. We also hypothesize that reach flow area provides more accurate maximum discharge values than peak stage as obtained at a single gauging station. The hypothesis is tested for a sample of U.S. rivers with low, medium, and high hydraulic radius values and braiding indices and utilizing available current meter-based discharge measurements. For sites where flow area is a more consistant estimator than is stage, existing orbital sensors offer the clear opportunity for improving national and international river discharge measurements immediately and at a comparatively low cost.

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