Stochastic Variability Of Fluvial Hydraulic Geometry And Contribution To Uncertainty In Flow Prediction

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Abstract. A major contributor to uncertainty in engineering predictions of river flows is the spatial variability and measurement error associated with channel geometry. A descriptive spatial stochastic model of depth-based hydraulic geometry is developed in application to five dense data sets from the Mississippi River, Red River, and Muddy Creek. To represent the irregularity in flow area and hydraulic radius as functions of flow depth, at-a-station cross-section geometry is defined using regressed power functions, accompanied by random residuals. More than 1900 surveyed cross sections are analyzed to describe trends in the spatial variance, and gradual (large-scale) and periodic (medium scale) trends in the spatial mean of cross-sectional geometry parameters and channel bed slope. Also described are the probability distribution and correlation structure of each parameter's random component. Relationships between spatial statistics of hydraulic geometry and bankfull width, channel sinuosity (meander patterns), bed elevation and riffle-pool spacing, and bank composition are briefly explored. The contribution of geometric parameter variability to uncertainty in predictive models of river processes is demonstrated in a stochastic gradually-varied flow model of Muddy Creek.

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