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Modeling hydraulic geometry of stream reaches in hydrographic networks

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The knowledge of temporal variations in river hydraulic characteristics (e.g. width, depth, velocity) across stream networks is a key element of catchment management because hydraulics influence physical habitats, water temperature, nutrients and sediment transport. At-a-station hydraulic geometry relationships describe the variation of depth and width with discharge within a stream reach. Variations of these relationships between rivers are not well understood. This study provides an analysis of at-a-station hydraulic geometry data collected in 659 stream reaches in France. Relationships between the hydraulic geometry parameters and variables describing catchment- and reach-scale characteristics of reaches were analyzed using stepwise linear regression and discriminant analysis. Results show that the reach Froude number and the ratio of median/bankfull width are important predictors of the width-discharge relationship. Fewer significant relationships explained depth-discharge relationships, despite a weak influence of reach Froude, substrate and slope. This study suggests that it is possible to explain the parameters of at-a-station hydraulic geometry with variables easily obtainable in the field or by analyzing aerial images. Using more developed statistical approaches and remote sensing tools, involving descriptors of bank cohesion, and better describing all forms of flow resistance are expected to provide improved models in the future.