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A Method for Quantifying Stream Network Topology over Large Geographic Extents

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Abstract

An understanding of stream network topology is necessary for a landscape-level perspective of stream hydrology and ecology. We present a method for quantifying stream network topology that overcomes computational constraints of DEM-based analysis over large geographic extents. This method converts vector stream flow paths to raster flow paths to predict spatially-explicit stream properties from a network-constrained upstream cell count (UCC) to flow origins. UCC data enable calculations of stream network structure at designated grain sizes and spatial extents. UCC values were strongly related

to empirical measures of upstream basin area (R2 = 0.94) and stream width (R2 = 0.65) within the mid-Atlantic highlands, USA, suggesting that UCC data provide a reasonable surrogate for empirical measures of stream size within the stream network. By reducing raster grids to the flow path, the UCC method reduced file sizes by 99% compared to digital elevation models. The UCC method can improve our understanding of fluvial landscape hydrology and ecology by enabling spatial analysis of stream networks over large geographic extents.

Keywords

stream network topology; upstream cell count; landscape ecology; digital elevation models

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