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# Quantifying riverbed surface roughness from point cloud data

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Surface roughness is an important control on a wide range of Earth surface processes. The increasing spatiotemporal availability of topographic point cloud data provides scope for advances in quantifying geomorphic surfaces and topography. Here, bedrock riverbed point clouds were obtained from dry riverbeds using terrestrial laser scanning (TLS) and Structures from Motion (SfM) photogrammetry. These data were processed using a unified workflow to extract the channel morphology and multiple different surface roughness. Metrics were calculated based on vertical and horizontal point spacings, cell area and slope, and incorporated multiscale analysis methods. Principal component analysis and hierarchical clustering revealed the concurrent use of multiple metrics is required to comprehensively describe the diversity in bed topographic characteristics. Multiple metrics are required as riverbed characteristics and features are shown to be represented by differing surface roughness metrics. This work further explores the applications of these metrics to advance the understanding of geomorphic and Earth surface processes, including sediment transport processes and hydrodynamics. It is proposed these metrics and analysis approaches can be applied more widely to landscapes beyond riverbeds, yet the most appropriate metric likely depends on the process that is of interest.