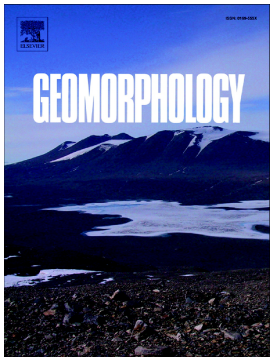

Can high resolution 3D topographic surveys provide reliable grain size estimates in gravel bed rivers?

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Can high resolution 3D topographic surveys provide reliable grain size estimates in gravel bed rivers?

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Abstract

High resolution topographic surveys such as those provided by Structure-from-Motion (SfM) contain a wealth of information that is not always exploited in the generation of Digital Elevation Models (DEMs). In particular, several authors have related sub-metre scale topographic variability (or 'surface roughness') to sediment grain size by deriving empirical relationships between the two. In fluvial applications, such relationships permit rapid analysis of the spatial distribution of grain size over entire river reaches, providing improved data to drive three-dimensional hydraulic models, allowing rapid geomorphic monitoring of sub-reach river restoration projects, and enabling more robust characterisation of riverbed habitats. However, comparison of previously published roughness-grain-size relationships shows substantial variability between field sites. Using a combination of over 300 laboratory and field-based SfM surveys, we demonstrate the influence of inherent survey error, irregularity of natural gravels, particle shape, grain packing structure, sorting, and form roughness on roughness-grain-size relationships. Roughness analysis from SfM datasets can accurately predict the diameter of smooth hemispheres, though natural,