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Combining terrestrial laser scanning and physical modelling experiments to characterise the structure and drag of vegetation.

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Vegetation affects flow and, because of its ubiquity in nature, plays a significant role in modulating geomorphic change. Plants function as large-scale obstacles that exert additional drag on water flows. The vegetative drag applied is a function of the structure and configuration of the plant and these attributes influence both local scale turbulence and the structure of the boundary layer. Whilst several approaches have been developed to describe the relationship between plant structure and drag, such as using bulk parameters, geometric analogies or porous medium approaches, they have previously failed to accurately and precisely characterise the vegetation itself. Terrestrial Laser Scanning (TLS) has the ability to capture structures and forms in 3D with high resolution, precision and accuracy, which provides an opportunity to accurately describe vegetation structure. However, TLS data are essentially an aggregate of dimensionless points in space and the complexity of vegetation biomass means that some of the measured points are erroneous. A method has been developed that is capable of accurately characterising vegetation structure in 3D from dense TLS point cloud data, using a porosity approach. The corresponding fluvial drag of the vegetation is measured in a flume, using a bulk roughness function calculated from precise measurements of water surface slope and a series of high resolution acoustic Doppler velocimetry (ADV) measurements. A series of structurally variable plants were characterised using the methods outlined above and the results are presented herein.