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TITLE: Monitoring tree health with a dual-wavelength terrestrial laser scanner

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Forests are a vital part of the Earth's carbon cycle and drive interactions between the land and atmosphere. Accurate and repeatable measurement of forests is essential for understanding the Earth system. Terrestrial laser scanning can be a powerful tool for characterising forests. However, there are a number of issues that have yet to be resolved. Commercial laser scanners are optimised for measuring buildings and other hard targets. Vegetation canopies are complex and porous, confounding standard interpretation techniques. Commercial systems struggle with partial hits and cannot distinguish leaf from wood (Danson et al 2007).

A new generation of terrestrial laser scanners, optimised for vegetation measurement, are in development. The Salford Advanced Laser Canopy Analyser (SALCA, Gaulton et al 2013) aims to overcome these issues using full-waveform analysis and two wavelengths (1064 nm and 1545 nm), allowing the characterisation of a porous canopy, the identification of leaf and wood and derivation of information on leaf biochemistry.

Gaulton et al (2013) showed that SALCA is capable of measuring the Equivalent Water Thickness (EWT) of individual leaves in laboratory conditions. In this study, the method was applied to complete tree canopies. A controlled experiment simulating a small "forest" of potted broadleaved (Tilia cordata) and coniferous trees (Pinus nigra) was established and groups subjected to different moisture stresses over a one month period. Trees were repeatedly scanned by SALCA and regular measurements were made of leaf EWT, stomatal conductance, chlorophyll content, spectral properties (using an ASD field spectroradiometer) and, for a limited number of trees, leaf area (by destructive harvesting). Trees were arranged so that some were clearly visible to the scanner and could be analysed individually (a best case scenario) whilst others were grouped to form a denser, more realistic canopy (a worse case scenario).

A method was developed to simultaneously extract canopy structure (leaf area, tree height and clumping) and leaf biochemistry (EWT) from the laser scanner data. These results were compared to ground to assess their accuracy.

References

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Additional Details

Previously Presented Material: None has been presented yet.

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