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TITLE: Separating Leaves from Trunks and Branches with Dual-Wavelength Terrestrial Lidar Scanning: Improving Canopy Structure Characterization in 3-D Space

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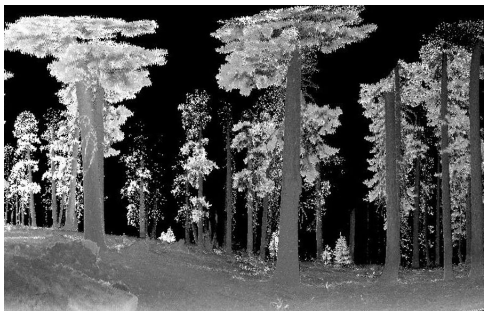
ABSTRACT BODY: Leaf area index (LAI) is an important parameter characterizing forest structure, used in models regulating the exchange of carbon, water and energy between the land and the atmosphere. However, optical methods in common use cannot separate leaf area from the area of upper trunks and branches, and thus retrieve only plant area index (PAI), which is adjusted to LAI using an appropriate empirical woody-to-total index. An additional problem is that the angular distributions of leaf normals and normals to woody surfaces are quite different, and thus leafy and woody components project quite different areas with varying zenith angle of view. This effect also causes error in LAI retrieval using optical methods.

Full-waveform scans at both the NIR (1064 nm) and SWIR (1548 nm) wavelengths from the new terrestrial Lidar, the Dual-Wavelength Echidna® Lidar (DWEL), which pulses in both wavelengths simultaneously, easily separate returns of leaves from trunks and branches in 3-D space. In DWEL scans collected at two different forest sites, Sierra National Forest in June 2013 and Brisbane Karawatha Forest Park in July 2013, the power returned from leaves is similar to power returned from trunks/branches at the NIR wavelength, whereas the power returned from leaves is much lower (only about half as large) at the SWIR wavelength. At the SWIR wavelength, the leaf scattering is strongly attenuated by liquid water absorption. Normalized difference index (NDI) images from the waveform mean intensity at the two wavelengths demonstrate a clear contrast between leaves and trunks/branches. The attached image shows NDI from a part of a scan of an open red fir stand in the Sierra National Forest. Leaves appear light, while other objects are darker.Dual-wavelength point clouds generated from the full waveform data show weaker returns from leaves than from trunks/branches. A simple threshold classification of the NDI value of each scattering point readily separates leaves from trunks and branches and avoids the misclassification of trunk edges as leaves. Such classified waveforms and point clouds can provide gap probabilities of leafy and woody materials separately and thus provide better estimate LAI, thereby characterizing 3-D canopy

structure more accurately for use in modeling radiation regimes and terrestrial ecosystems.

KEYWORDS: 0480 BIOGEOSCIENCES Remote sensing, 0439 BIOGEOSCIENCES Ecosystems, structure and dynamics , 0466 BIOGEOSCIENCES Modeling, 0428 BIOGEOSCIENCES Carbon cycling.



NDI image (part of a scan here) from waveform mean intensities at the two wavelengths. Azimuth angle in X axis and Zenith angle in Y axis

(No Table Selected)

Additional Details

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