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TITLE: Quantifying the Attenuation Due to Geometry Interactions in Waveform Lidar Signals

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ABSTRACT BODY: As a lidar pulse propagates through a forest canopy, it interacts with various components of the forest e.g., leaves, branches, ground, etc. At each interaction, the number of photons available for subsequent interactions is reduced due to a combination of reflection, transmission, absorption, and scattering events. In addition, the number of photons per unit area decreases with range due to the divergence of the laser pulse. These factors combine to produce a waveform signal with lower amplitude than would be observed for identical structure without the previous canopy structure interactions. Currently, our limited understanding of attenuation means that the inversion of the waveform to biophysical structure becomes difficult in terms of object representation within the canopy. Knowledge of the mechanics of the attenuation may reduce the uncertainty in inferring the structure from a waveform signal, e.g., leaf area index (LAI), sub-canopy gaps, and understory biomass.

We present an experiment to quantify this waveform attenuation at various interactions. For this experiment we used two datasets: (i) The Dual Wavelength Echidna® Lidar (DWEL) was used to scan tree branches, spaced at measured distances, to simulate a forest canopy. Branches were selectively removed/reordered from this simulated canopy to record waveform lidar signals with and without preceding canopy interactions. (ii) Additionally, the Digital Imaging and Remote Sensing Image Generation (DIRSIG) model was used to simulate the same forest structure at different locations in the canopy. This allowed precise simulation of our experimental setup, with the ability to control forest structure geometry and evaluate the effects on the observed lidar signal.

For both data sets, we evaluated the signal attenuation by performing Gaussian decomposition on the waveform signal and comparing the parameters of the resultant Gaussians. This was done for various levels of canopy structure complexity, in terms of LAI and leaf distribution. This study attempts to bridge the gap between simulation and collected lidar data by (i) evaluating the signals at the interaction scale, (ii) creating an improved understanding of how previous intercepted object structure affects subsequent signal generation in a waveform lidar system, and (iii) assessing the impact of geometry order on the waveform signal. Detailed results will be presented at the conference.

KEYWORDS: 0480 BIOGEOSCIENCES Remote sensing.

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