Using portable canopy LiDAR (PCL) to measure canopy structural complexity: forest structure-function relationships at the continental scale

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Introduction

Ecosystem structure-carbon (C) cycling relationships represent a long-standing research area for ecosystem science. Strong relationships between canopy structural complexity (CSC) and rates of C accumulation in plant biomass, or net primary productivity (NPP), have been demonstrated for a limited number of forest sites. Whether CSC-NPP relationships are broadly conserved across an array of structurally variable forest ecosystems is unknown, but the universality of this relationship has important implications for remotely sensing and modeling the terrestrial carbon cycle.

Portable Canopy LiDAR

- Reigl 3100VHS-FLP near infrared pulsed laser firing upwards at 2000 Hz
- Mounted on a custom, aluminum frame worn by the user (uncomfortably) and walked along transect.

Data Processing and Software

- forestr an open-source R package developed during the project (github.com/atkinsjeff/forestr)
- Analyzes PCL data to produce a suite of canopy structural complexity (CSC) metrics
- Future integration of TLS and other data forms

CSC at the Continental Scale



Field work in 2016 included 15 sites, with more slated for 2017

Ecoregions range from complex cove hardwood forests in the Great Smoky Mountains to pineoak savannas in Florida Work in NEON, LTER, Ameriflux,

and University

affiliated sites.

Porosity – ratio of bins with no VAI to total no. of bins. Mean Vegetation Area Index (VAI) – average of columnar VAI.

0.6

0.4 -

0.2 -

0.4

Canopy Structural Complexity (CSC) Metrics Canopy Rugosity – transect variability of column variability of leaf density





*where P_o is mean gap fraction.

Ecological Implications

- CSC varies through stand development
- Drives resource efficiency
- Additional, non-redundant information to LAI





THE ROYAL

High Complexity vs. Low Complexity Forests



High complexity cove hardwood forests in the Great Smoky Mountains of TN (NEON - GRSM)



Low complexity pine-oak Savanna in central, FL (Ordway-Swisher Biological Station (NEON - OSBS))

fPAR and CSC Relationships



Additional Information at goo.gl/1RxIGG Hardiman et al. Forests, 2013 (doi:10.3390/f4030537) Hardiman et al. Ecology, 2011 (doi:10.1890/10-2191.1) Parker et al. 2003 (doi:10.14358/PERS.69.3.267

fPAR measured during direct light conditions using a ceptometer Non-linear relationships w. CSC metrics VAI and Rugosity as strongest predictors of fPAR Potential for informing radiative transfer models

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