Continuing Project Report

Quantifying carbon sequestration as a function of silvicultural treatment in loblolly pine

(CAFS 21.89)

Tilak Neupane (UGA), Sameen Raut (UGA), Nawa Raj Pokhrel (UGA), Joe Dahlen (UGA), Cristian Montes (UGA), Dan Markewitz (UGA), Tom Eberhardt (USFS)

Presenter: Joe Dahlen (UGA)

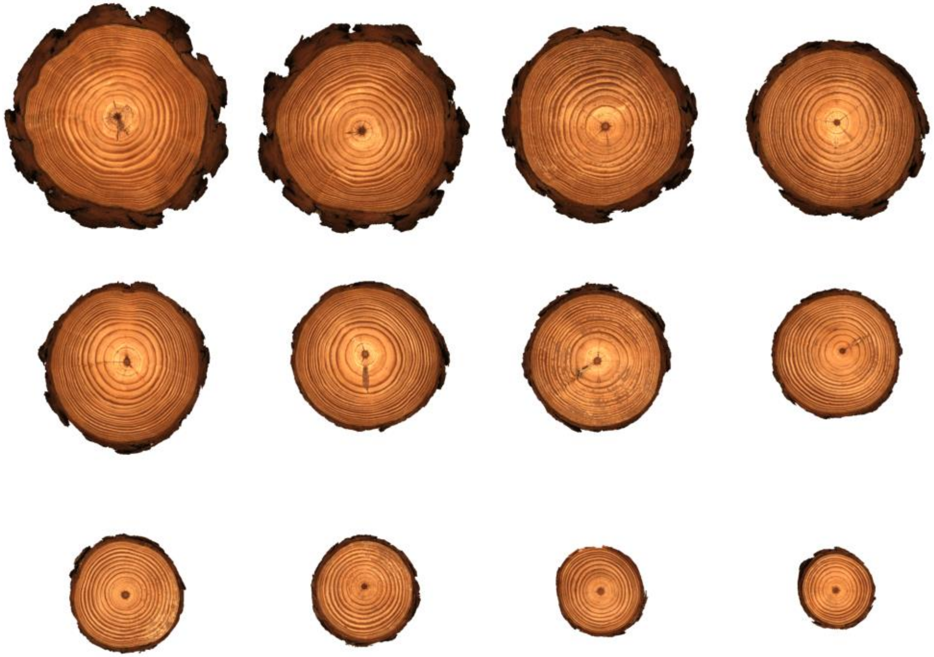
Continuing Project Report

Updated title
Quantifying carbon content in standing loblolly pine trees
(CAFS 21.89)

Tilak Neupane (UGA), Sameen Raut (UGA), Nawa Raj Pokhrel (UGA), Joe Dahlen (UGA), Cristian Montes (UGA), Dan Markewitz (UGA), Tom Eberhardt (USFS)

Presenter: Joe Dahlen (UGA)

- Growing interest in quantifying carbon in managed forests
- According to Joe - Carbon fcn Volume, SG, Carbon%



nature geoscience

ARTICLES

https://doi.org/10.1038/s41561-018-0246-x

Global patterns in wood carbon concentration across the world's trees and forests

Adam R. Martin[1,2*], Mahendra Doraisami[1] and Sean C. Thomas[3]

Wood carbon concentrations play a central role in forest carbon accounting, and are fundamentally linked to the growth strategies of woody plants. Yet there are no comprehensive assessments of wood carbon among trees globally, and coarse approximations of wood carbon (for example, 50%) are employed in virtually all benchmark models and assessments of forest carbon. We consolidated the largest database for any wood chemical trait—2,228 wood carbon observations from 636 species across all forested biomes—to derive robust wood carbon fractions for forest carbon accounting. Carbon fractions show substantial variation among forest biomes, and indicate errors in the existing forest carbon estimates of 4.8%, on average, and most extreme errors of 8.9% in tropical forests. The data also demonstrate that wood carbon concentrations show a phylogenetic signal and are co-evolved with, and negatively related to, wood density, thus representing a key plant trait that links plant functional biology to ecosystem processes worldwide.

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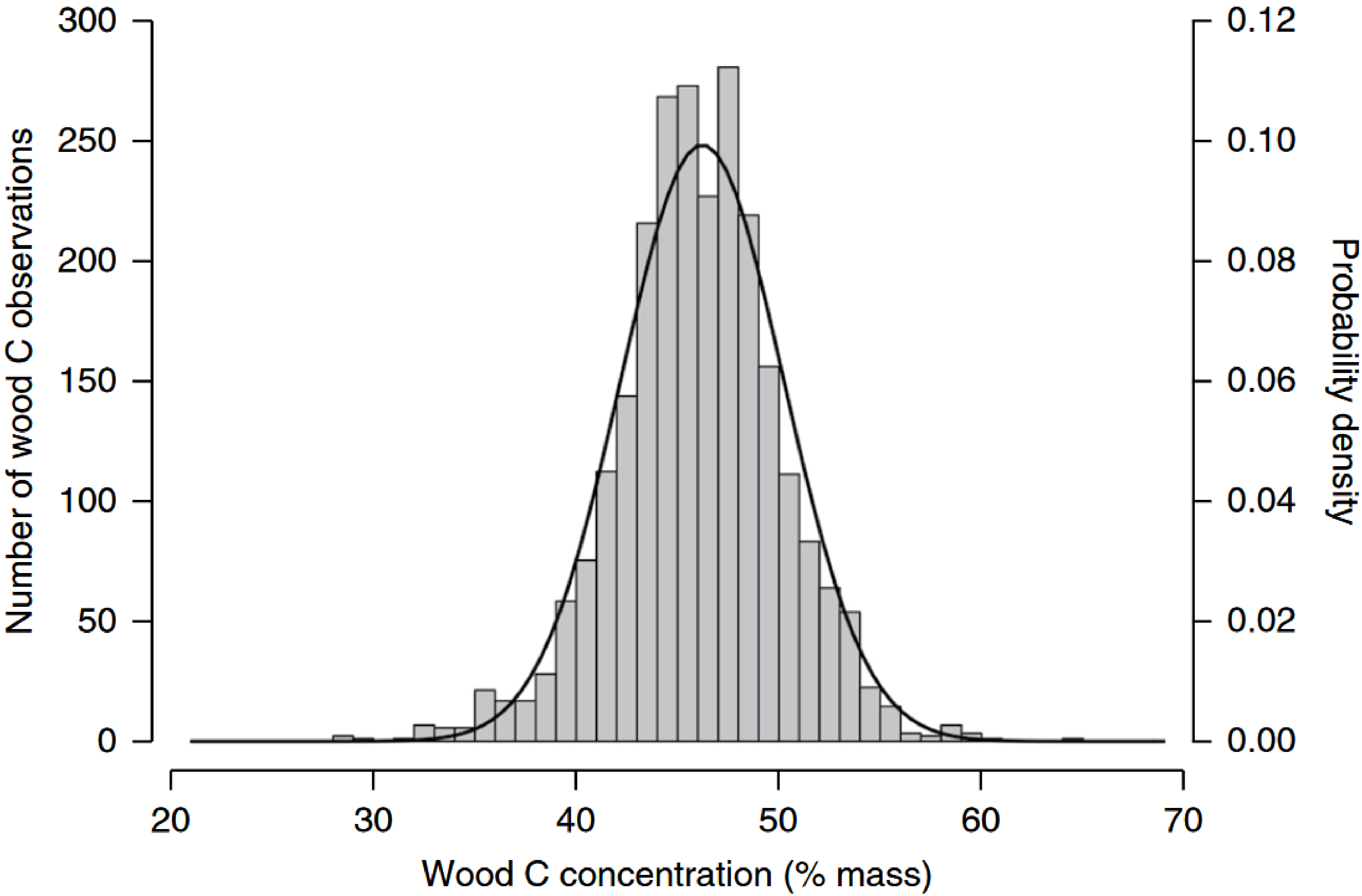
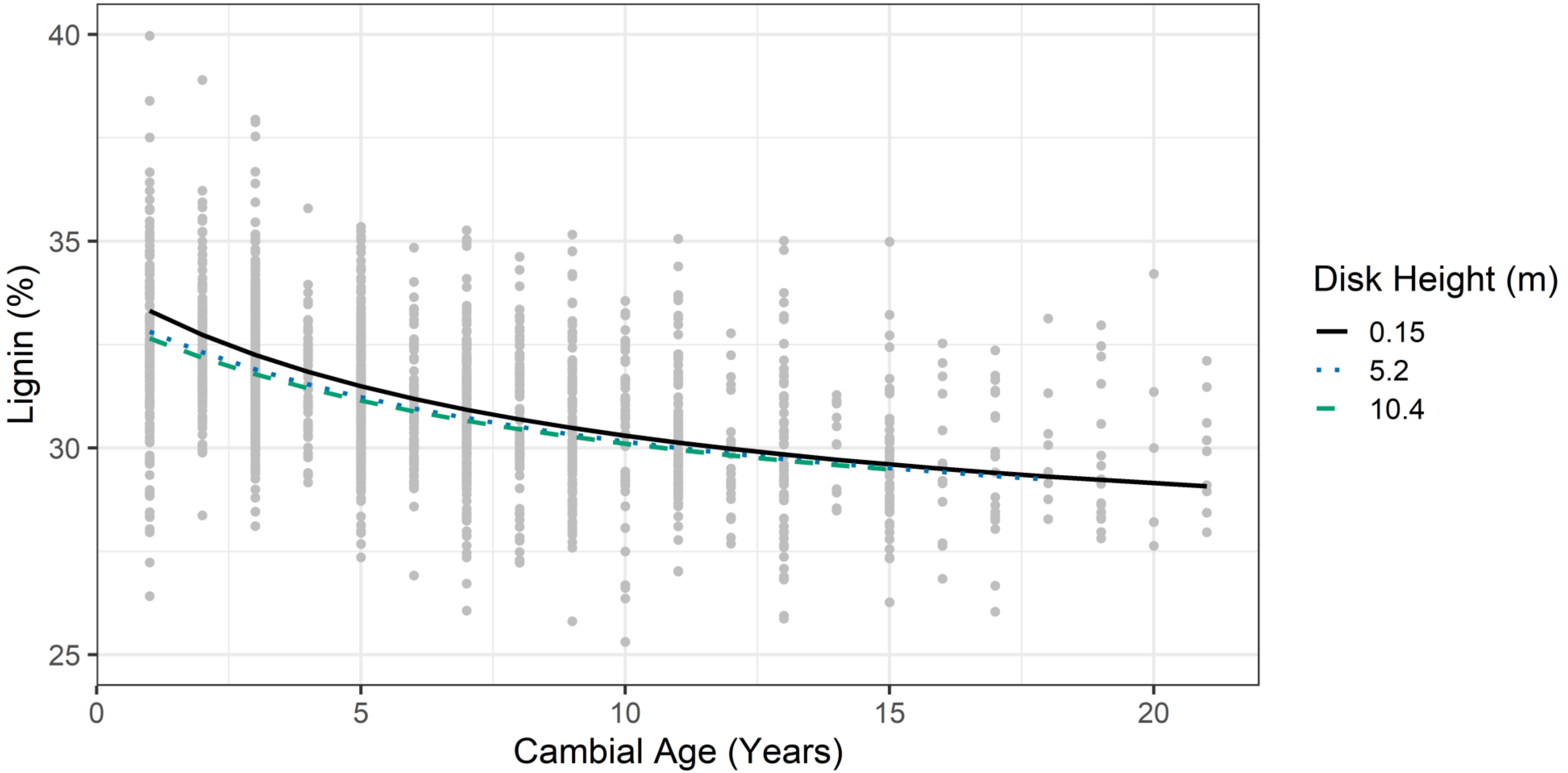


Carbon % largely a function of:
1) lignin to cellulose content



Carbon % largely a function of:
2) Extractives content

Objective 1
Develop lignin, extractives, and carbon % models for loblolly pine
Supplement reference data with NIR

Specim FX17

- 931 to 1718 nm wavelength range
- 2 lights 45° from camera
- Dark & white reference
- Tray width = 170 mm
- Tray length = 600 mm

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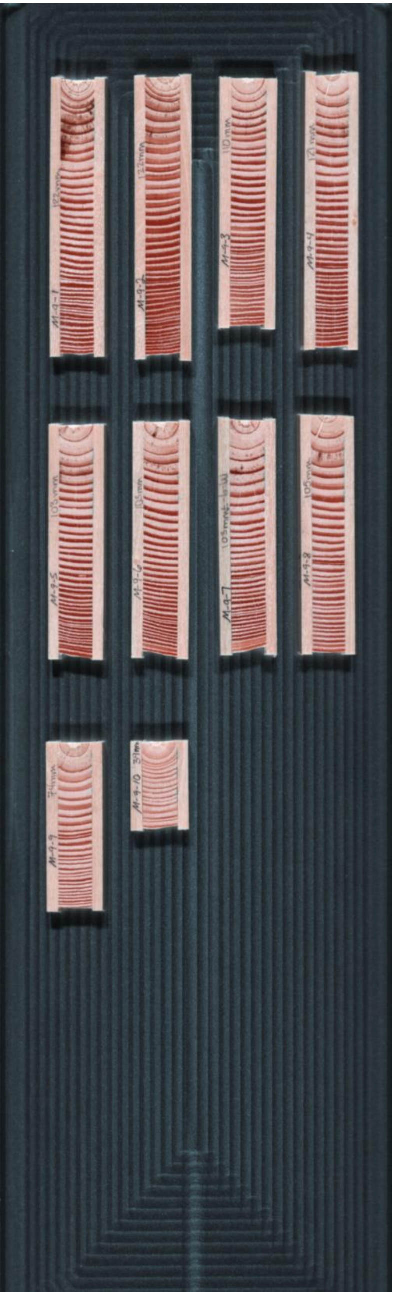
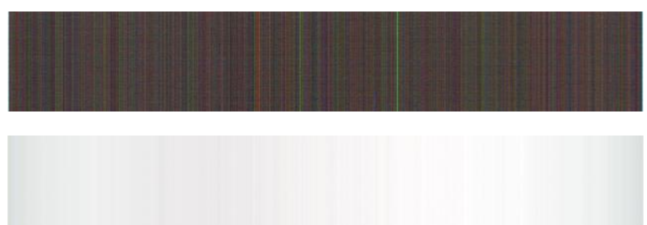
Example image



- 10 radial samples cut from disks from 1 tree
- Columns (H) = 640 pixels
- Rows (V) = 2,100 pixels
- Depth = 224 wavelengths
- >300 million data points
- >14 million data points from dark and white reference



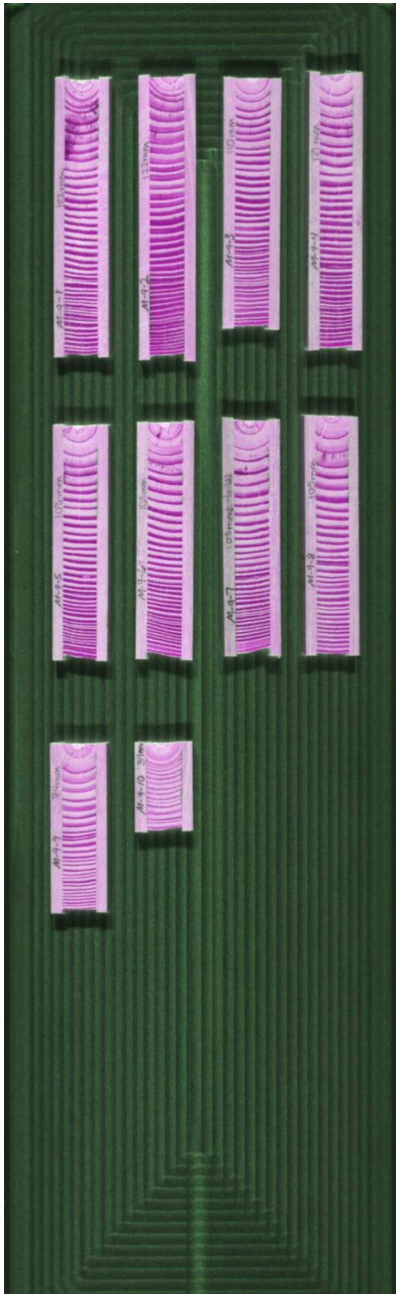
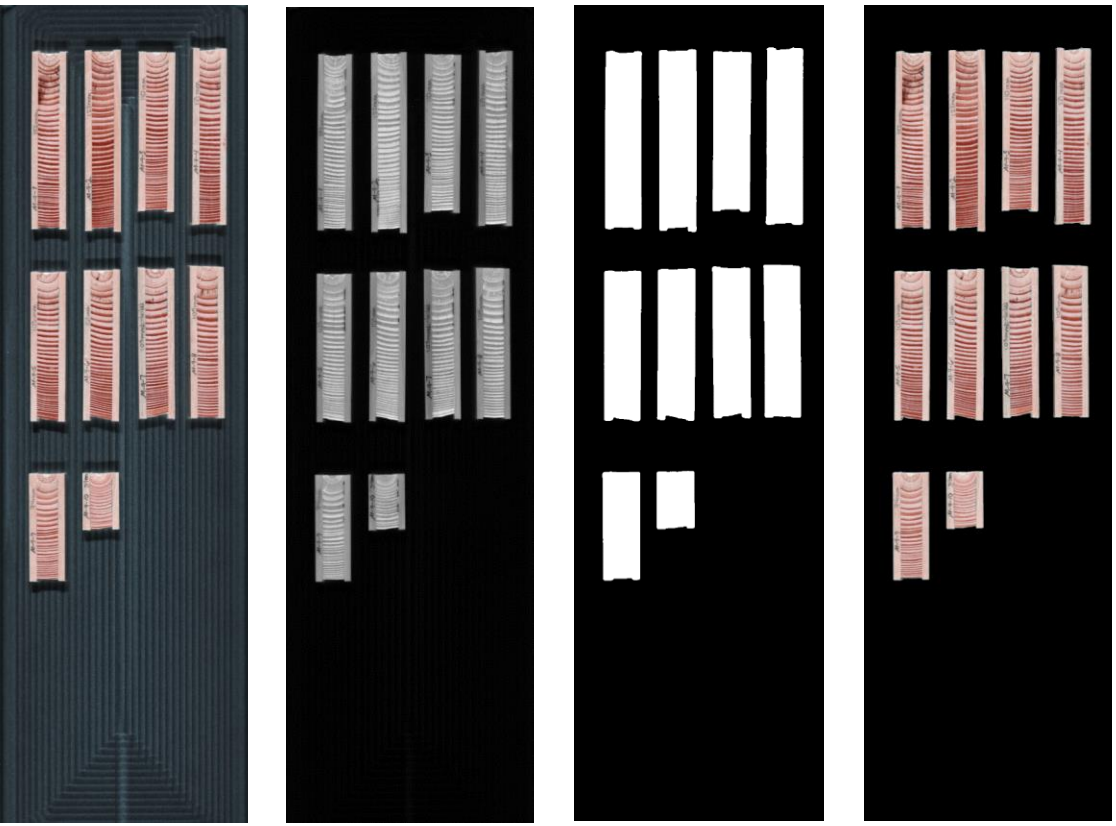
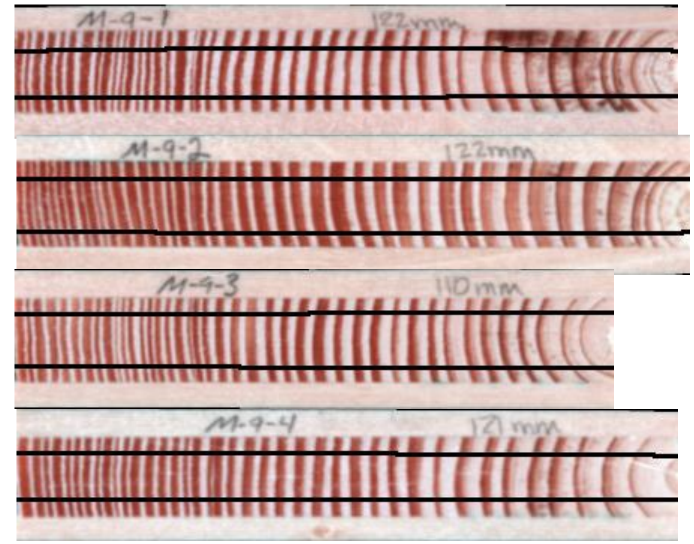
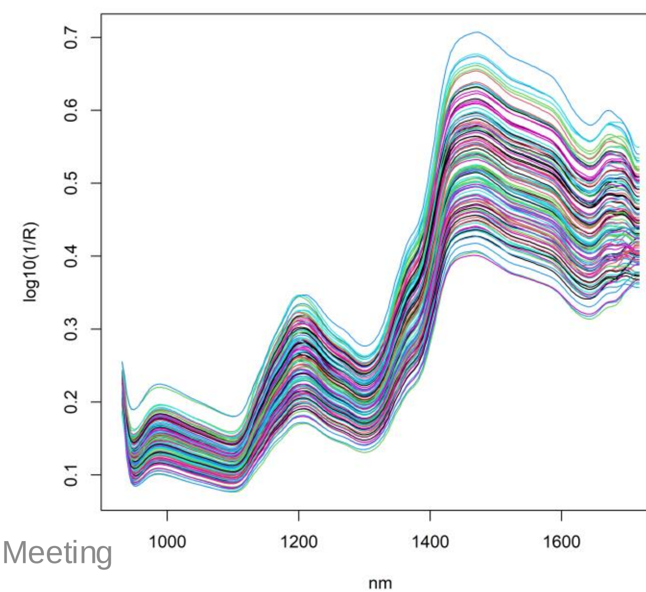


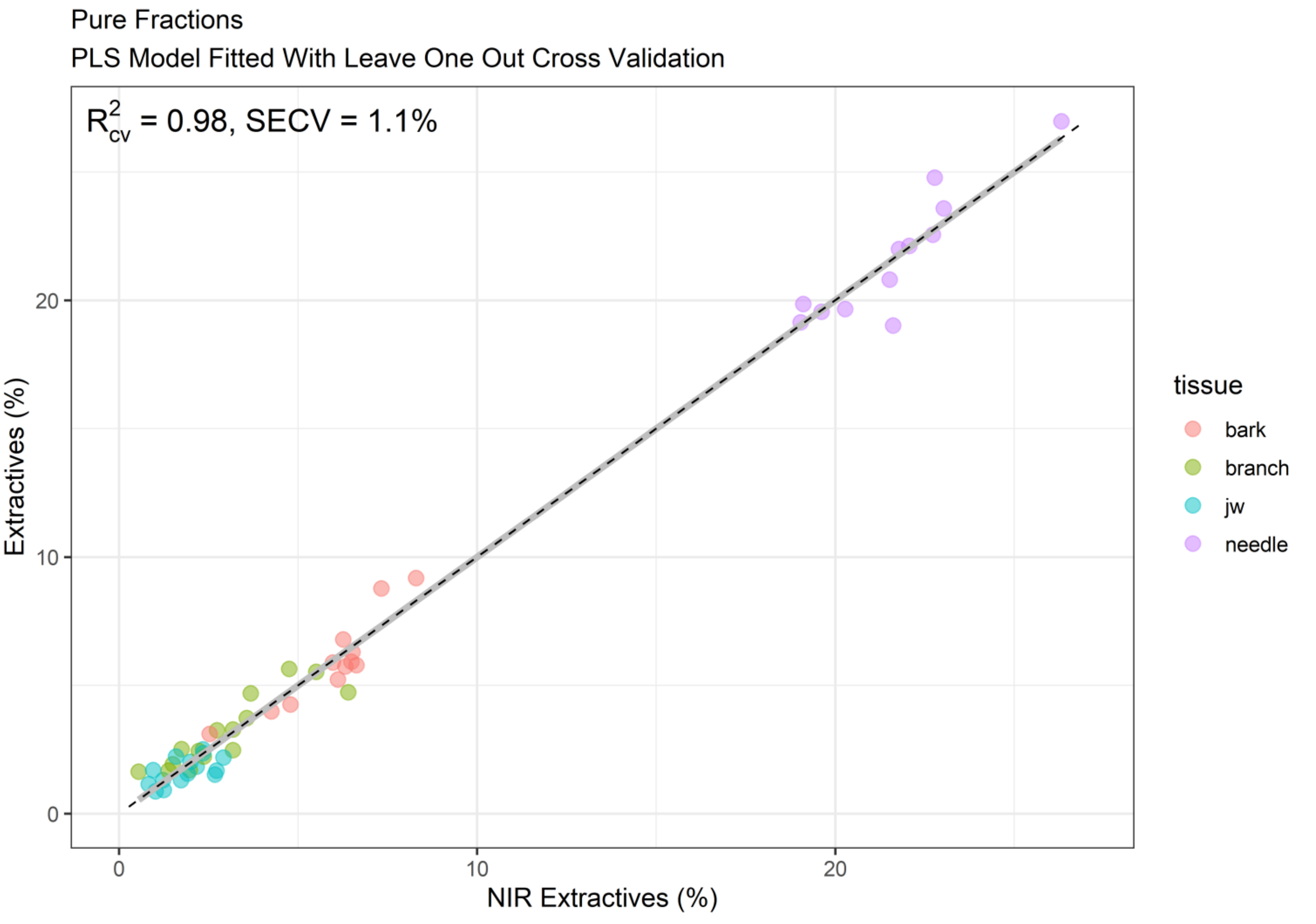
Image processing



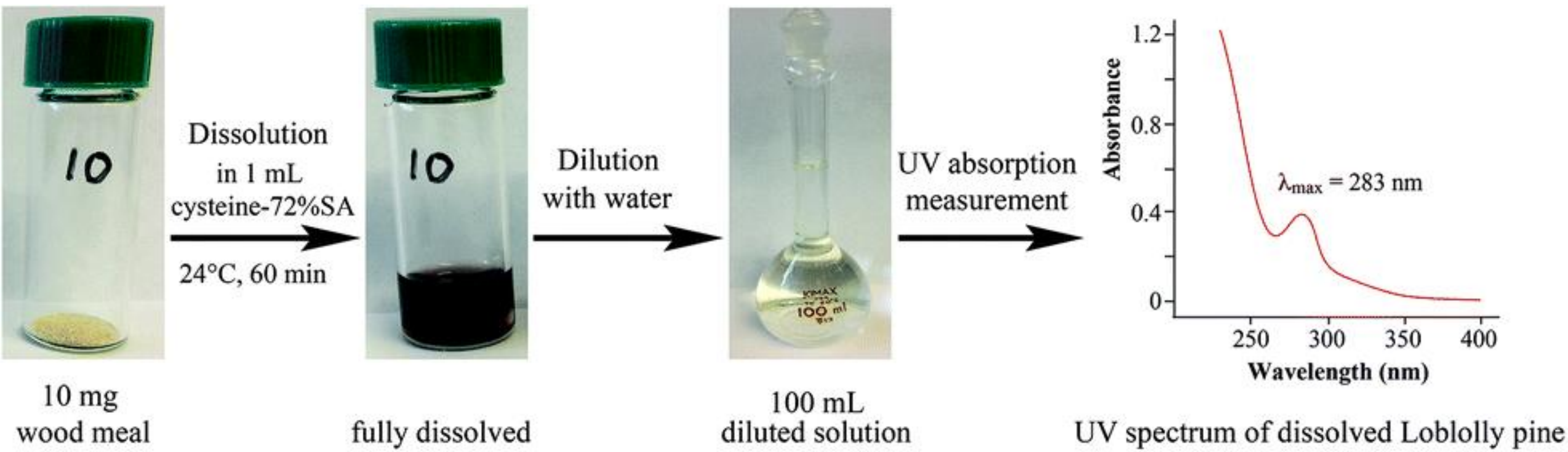




Extractives model for southern pine forest residues (example)



Currently working on extractives (summer/fall), lignin (summer/fall) and carbon (fall) from radial samples



Lu et al. 2021

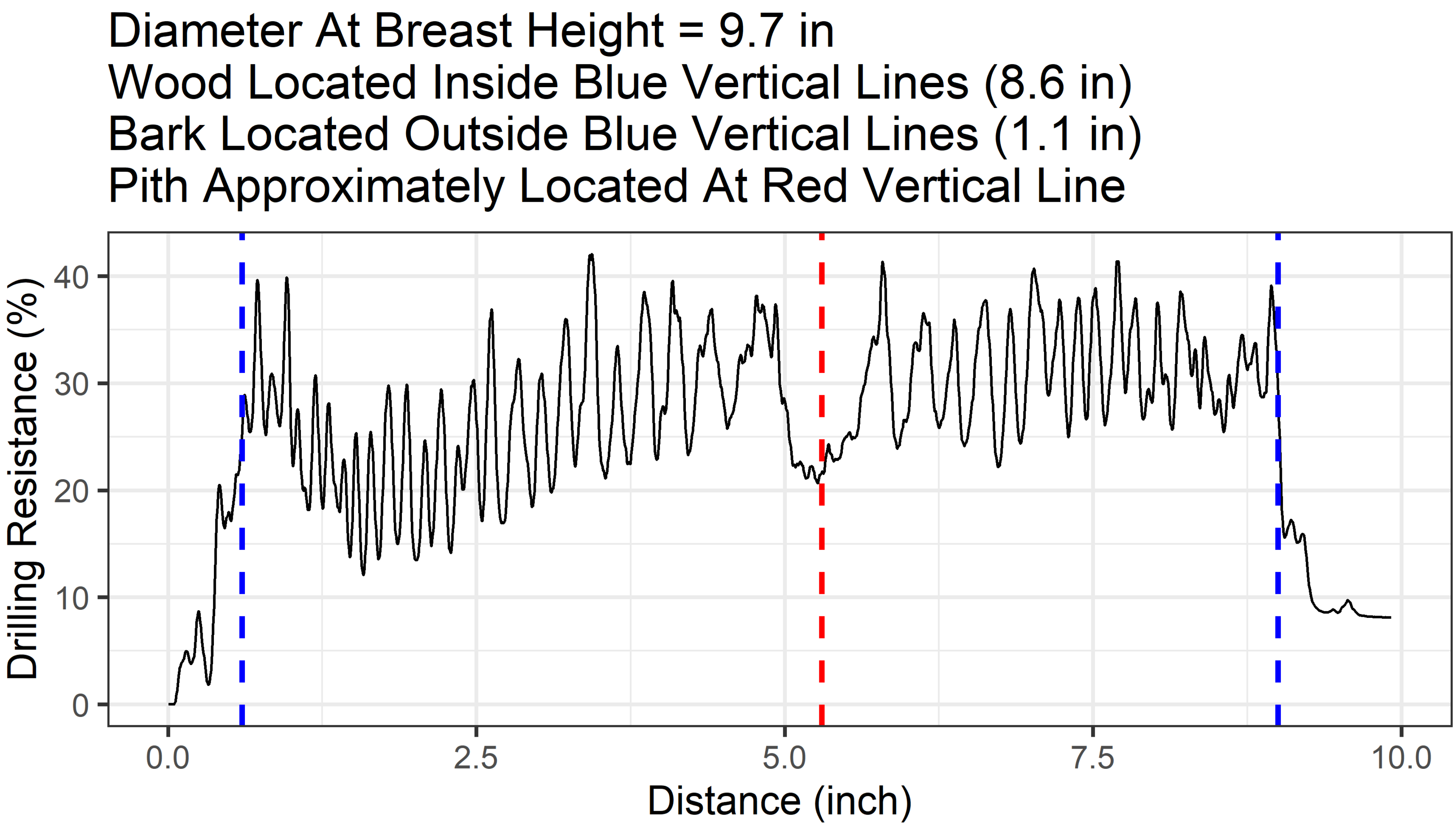
Objective 2
Utilize resistance drilling to estimate wood SG

IML PD400

- Measures torque via drilling resistance (%) in 0.1 mm resolution

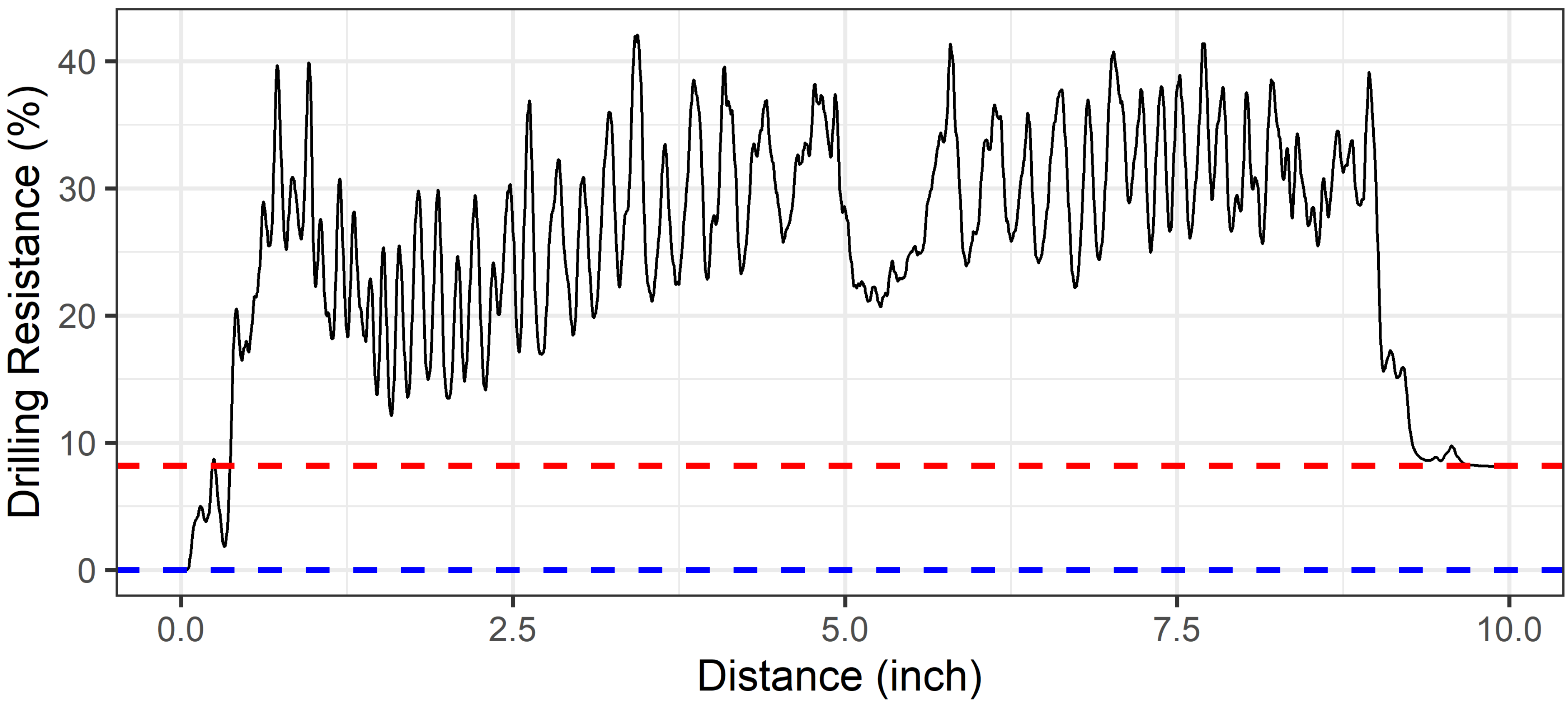
3 mm needle with resistance recorded from bark to bark

Resistance drill example trace
Signal processing important



Resistance drill example trace Signal processing important

Needle Enters Tree at 0.0 inch
Needle Exits Tree at 9.7 inch
Drilling Resistance Increases With Distance Due to Friction



Methods for Resi drill

- Signal processing with R using ‘densitr’ package (Krajnc et al., 2021)
    - Isolate wood from bark
    - Correct baseline shift with distance from entry point

- Linear regression between SG and mean drilling resistance amplitude

Results from colleagues in Australia

forests

MDPI

Article

Thinning Influences Wood Properties of Plantation-Grown *Eucalyptus nitens* at Three Sites in Tasmania

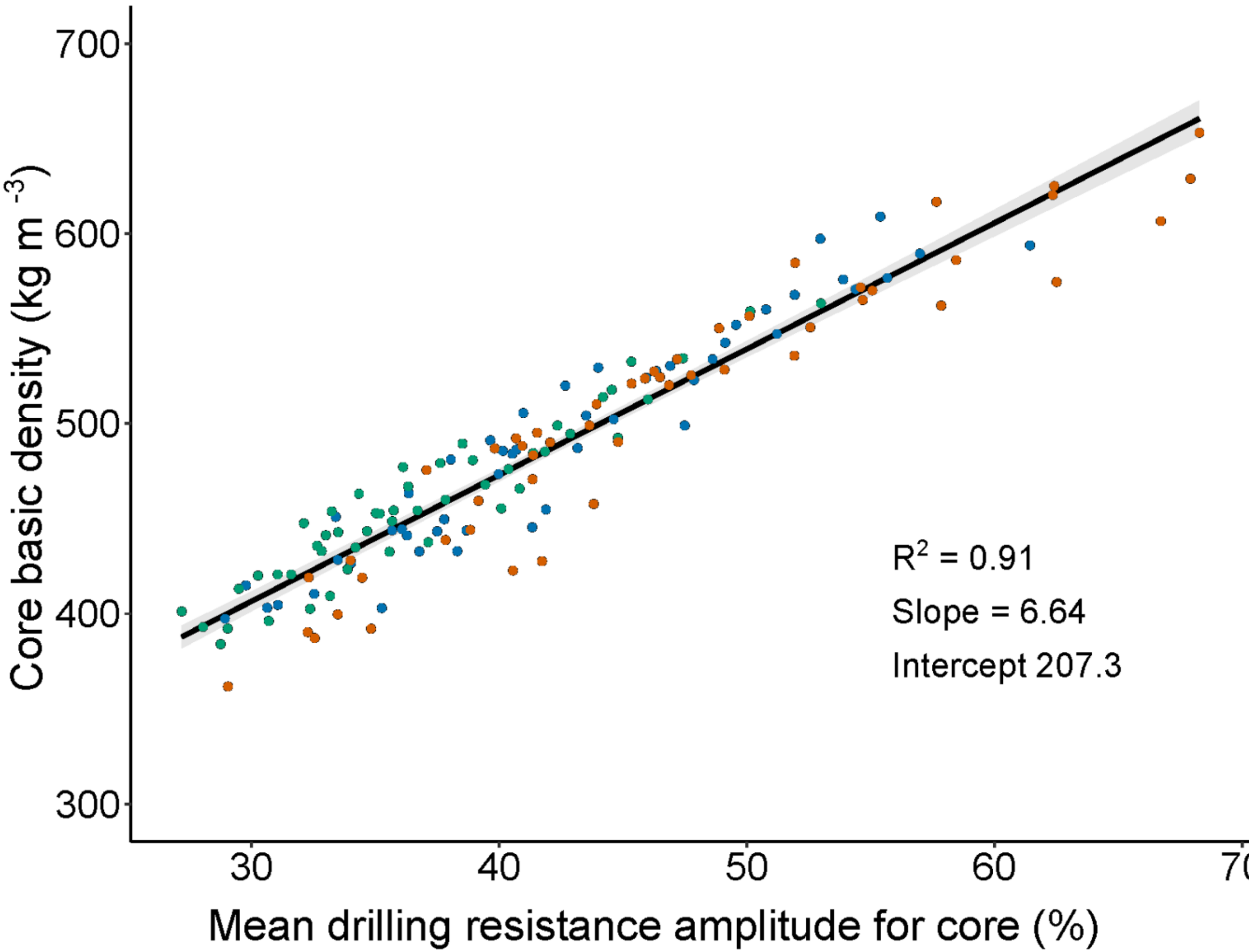
Vilius Gendvilas [1,*], Geoffrey M. Downes [2], Mark Neyland [1], Mark Hunt [1], Peter A. Harrison [1], Andrew Jacobs [3], Dean Williams [4] and Julianne O'Reilly-Wapstra [1]

NSF

Center for Advanced Forestry Systems

Gendvilas et al. 2021

Experienced operators obtain strong relationships between wood density and drilling resistance in *Eucalyptus nitens*



Holzforschung 2021; 75(6): 508–516 DE GRUYTER

Original article

Vilius Gendvilas*, Geoffrey M. Downes, Mark Neyland, Mark Hunt, Andrew Jacobs
and Julianne O'Reilly-Wapstra

Friction correction when predicting wood basic density using drilling resistance

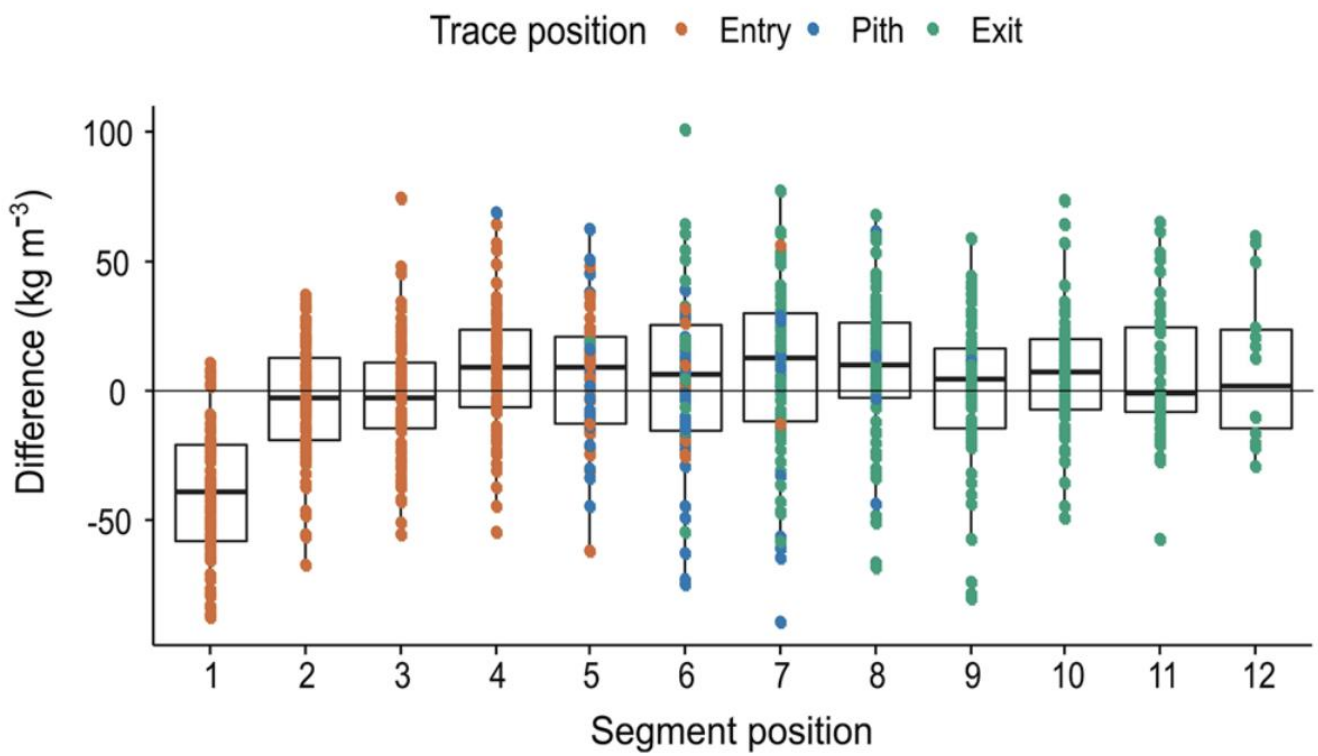


Figure 4: Difference by segment position between laboratory-measured basic density and Resi-predicted density after applying linear friction correction (Downes et al. 2018). Boxplot showing the median, range, 25 and 75% quantiles in each segment position group. Dots are individual segment values.

Deliverables and Company Benefits

- Models for lignin, extractives, and carbon % models for loblolly pine

- Developing protocols for the use of resistance drilling in loblolly pine

- When combined with volume, these two objectives will yield more accurate carbon estimates in standing trees

Thank You and Questions?

- NSF CAFS
- Members of the Wood Quality Consortium and Plantation Management Research Cooperative

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