Factsheet # 20
Calibrating Estimates of Above- and Below- Ground Forests Biomass Using Remotely Sensed Metrics

UW | **R** emote
S ensing &
G eospatial
A nalysis
L aboratory

Understanding multiscale dynamics of landscape change through the application of remote sensing & GIS

Introduction: The project will build on a previously funded and successfully completed CAFS project that utilized terrestrial and aerial laser scanning (TLS and ALS respectively) to assess above-ground biomass through the utilization of leaf area index (LAI). We have now demonstrated that LAI can be effectively extracted from TLS essentially eliminating the need to destructively sample stands to derive at above ground biomass (Zheng and Moskal 2012 a, b and c). However, although hyperspatial active remote sensing utilizing below ground radar (BGR) can allow us to understand the below ground biomass of forest stands (Hruska et al. 1999), no previous work attempting to tie BGR to TLS biomass metrics such as LAI exists. The breakthrough in this theme of research involves exploiting the relationships between BGR and TSL, which could be extrapolated to larger landscape data collections such as ALS acquisitions. This will contribute to the CAFS' mission by laying a foundation to derive spatially explicit techniques capable of assessing effectiveness of intensive plantation silviculture and management techniques.

Research Breakthroughs

- ➤ LAI can be effectively extracted from TLS
- ➤ Root systems can be mapped with GPR (Hruska et al. 1999)
- ➤ No previous work attempting to tie GPR to TLS exists

What Will This Study Address?

- ➤ Metrics between below- and aboveground biomass through hyperspatial remote sensing (GPR & TLS)
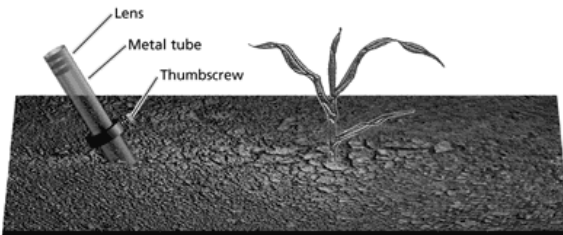
DRI experiment setup

Potential Member Company Benefits:
As ALS and TLS technologies mature, adaptation and mobilization of these tools in precision forestry and environmental monitoring sectors will be facilitated by the techniques developed and demonstrated under CAFS. Furthermore, we will lay the foundation for new techniques for below-ground biomass assessments that utilize BGR.
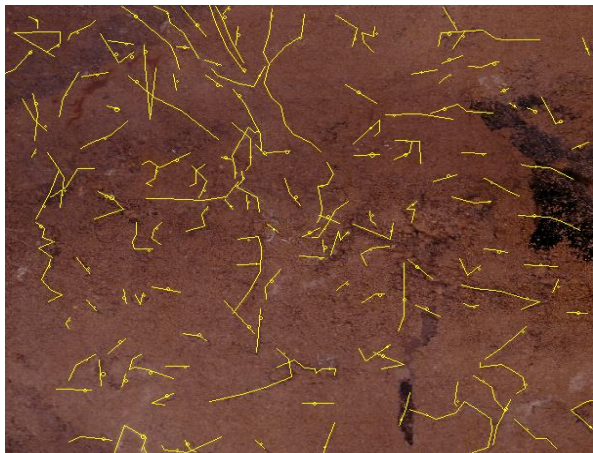

Terrestrial LiDAR (TLS)

Ground RADAR (GPR)
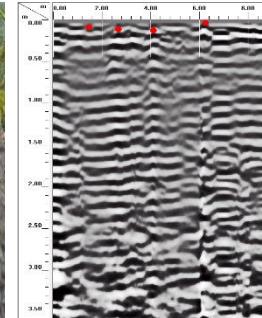
Excavated roots and GPR profiles (red dots represent samples roots)

DRI root structure tracing

Experimental Plan and Approach

- ➤ UW RSGAL and APL have expertize in TLS and GPR data collection and analysis
- ➤ Data will be collected at well established and monitored EEON plot(s) with **digital root imager (DRI) dataset**
- ➤ **DRI** data will be used as truthing data for GPR to develop the GPR-based belowground biomass indices
- ➤ TLS-based LAI will be extracted using RSGAL methods developed by Zheng and Moskal
- ➤ Finally, relationships between TLS-based LAI (aboveground biomass) and GBR-based belowground biomass indices will be explored and demonstrated

THE ISSUE: Using Terrestrial Laser Scanning (TLS) derived Leaf Area Index (LAI) above ground biomass of forests can be predicted and even modeled at a landscape level through Aerial Laser Scanning (ALS). Below ground biomass is difficult to monitor but antenna improvements to sensors such as Ground Penetrating Radar (GPR) and yet to be developed of below ground biomass indices similar to LAI are promising revolutionary techniques for sensing of root biomass.

THE KEY QUESTIONS:
What are the relationships between above ground biomass derived form TLS and belowground biomass estimates from GPR?