Title: Operationalizing the use of ground-based LiDAR technologies in forest inventories: The R package FORTLS

Instructors/Affiliation:

- Juan Alberto Molina-Valero (molina_valero@fld.czu.cz)

Department of Spatial Sciences, Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 00 Prague, Czech Republic

- Adela Martínez-Calvo, adela.martinez.calvo@usc.es

Proyectos y Planificación (PROEPLA), Departamento de Producción Vegetal y Proyectos de Ingeniería, Escuela Politécnica Superior de Ingeniería, Universidade de Santiago de Compostela, Benigno Ledo s/n, Campus Terra, 27002 Lugo, Spain

Description: This workshop provides a hands-on, applied introduction to the use of ground-based LiDAR technologies -Terrestrial Laser Scanning (TLS) and Mobile Laser Scanning (MLS)- in forest inventory applications, particularly within a statistical sampling framework. Participants will learn to process LiDAR data from acquisition to validation and export of results using open-source tools, specifically the R package FORTLS. The content will cover an overview of commonly used terrestrial LiDAR systems in forestry, estimation of both tree- and stand-level variables through case studies, the role of plot design, and methods to correct occlusion-related biases. Additionally, the workshop will introduce statistical inference techniques, including both probabilistic and model-based methods, to derive forest metrics such as volume per hectare and estimate associated errors.

The workshop is intended for participants with a BSc, MSc, or PhD background in Forestry or related fields. It emphasizes a practical approach, supported by theoretical concepts to enhance understanding, and involves exercises using real data and validated field measurements.

Participants will gain the knowledge and skills to process ground-based LiDAR data to estimate key forest inventory variables, including stand density, basal area, stem volume, and height and diameter. They will also learn to evaluate and apply appropriate forest inventory methodologies based on technical criteria and specific forest measurement goals.

Learning Objectives: By the end of the workshop, participants will:

- Understand the basics of Terrestrial and Mobile Laser Scanning systems used in forestry.
- Learn to process ground-based LiDAR data from acquisition to validation using the FORTLS R package.
- Estimate tree- and stand-level variables such as height, diameter, volume, and basal area.
- Apply statistical inference methods to derive forest metrics and associated errors.
- Identify and correct occlusion-related biases in LiDAR data.

Target audience: Graduate and advanced undergraduate students (BSc, MSc, PhD), researchers, and professionals in Forestry or related fields interested in forest inventory, LiDAR technologies, and statistical sampling methods.

Format & Activities: This is a hands-on workshop combining short lectures with practical exercises. Participants will work with real LiDAR datasets and use open-source tools (specifically the FORTLS R package) to process data and perform forest inventory analyses. Activities will include data preparation, variable estimation, statistical modeling, and interpretation of results.

Expected outcomes: Participants will:

- Gain practical experience processing ground-based LiDAR data
- Be able to estimate forest inventory variables like stand density and volume
- Learn to apply statistical methods for inference and error estimation
- Understand how to design and implement forest inventory using LiDAR and open-source tools

Language: English

Requirements: Participants should have a beginner/intermediate level of knowledge with R software and some experience in handling LiDAR data.

The workshop will be developed in R (using RStudio) and CloudCompare software will be also used. In addition, it would also be necessary to have Python installed

To be able to fluently follow the classes participants must attend with their own desktop or laptop computer, for which the following minimum requirements are recommended:

- Processor: Intel I5 or higher (or AMD with similar performance).
- Memory: minimum 16 GB.
- Hard disk: solid (SSD).
- Video camera and microphone.

Schedule: October 23, 9:00 AM – 2:00 PM (EST)

Duration: 4 hours.

Instructor Biography: Juan Alberto Molina-Valero is affiliated with the Department of Spatial Sciences at the Czech University of Life Sciences in Prague. His work focuses on spatial data analysis and environmental applications, with experience in academic and applied geospatial research across Europe. He contributes to international collaborations and training initiatives in GIS, remote sensing, and environmental modeling. Adela Martínez-Calvo is part of the PROEPLA group at the Universidade de Santiago de Compostela, working within the Department of Plant Production and Engineering Projects. Her expertise lies in planning and implementation of agricultural and environmental projects, with a focus on integrating geospatial technologies into engineering and land management practices. She has actively participated in interdisciplinary projects and workshops across Spain and Europe.

Agenda

Eastern Time (ET)	Topic	Instructor
9:00 - 10:00	Overview of Terrestrial LiDAR Systems in Forestry	Juan Alberto Molina-Valero
10:00 – 11:00	Estimation of tree and stand level metrics/variables	Juan Alberto Molina-Valero
11:00 – 12:00	**Break**	
12:00 – 13:00	Optimization of plot design	Adela Martínez-Calvo
13:00 – 14:00	Statistical Inference and Application	Adela Martínez-Calvo