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Efficient derivation of allometric models using laser scanning for improved AGB estimations

Benjamin Wild[1], Taskin Özkan[1], Florian Pöppl[1], Milutin Milenković[2], Florian Hofhansl[2], Jonas Lamprecht[1], Norbert Pfeifer[1], and Markus Hollaus[1]

[1]Department of Geodesy and Geoinformation, TU Wien, 1040-Vienna, Austria (benjamin.wild@tuwien.ac.at)

[2]International Institute for Applied Systems Analysis (IIASA), Schlossplatz 1, 2361-Laxenburg, Austria

Above Ground Biomass (AGB), the total dry biomass found above the ground, plays a vital role in understanding the global carbon cycle and biodiversity. Recognized by international organizations as an Essential Climate Variable, AGB is a key component for carbon accounting and climate modeling. Despite its importance, accurately estimating AGB remains a challenge.

Allometric models have long been a central focus of research due to their critical importance in estimating variables such as AGB based on the relatively easy-to-measure single-tree parameters such as Diameter at Breast Height (DBH) and Tree Height (TH). This led to the development of numerous species- and biome-specific allometries. Many of these models are accessible through dedicated online platforms or published scientific studies. However, their derivation is resource-intensive, and they exhibit significant variability across different species and ecosystems, both limiting their broader applicability.

Terrestrial Laser Scanning (TLS), provides a non-destructive and highly accurate method for estimating AGB through volume calculation. TLS-generated point clouds can be processed into Quantitative Structure Models (QSMs) by fitting a hierarchy of cylinders to the 3D data, enabling precise AGB estimation. Additionally, these QSM-derived tree volumes can be used to optimize parameters for allometric models.

In this contribution, we explore the application of a novel toolbox to derive allometric models for diverse forest environments and species. The toolbox was employed to generate highly accurate single-tree volume measurements, which were combined with traditional measurements of DBH and TH to develop finely tuned allometric models. A key focus of the research is the investigation of an integrated workflow for enhancing traditional forest inventory practices. This workflow combines TLS-derived QSMs with in-situ measurements of DBH and TH, which, as demonstrated in various studies, can also be increasingly reliable obtained using smartphones. This approach introduces new possibilities for studying and monitoring AGB in forests with greater efficiency and broader accessibility.