MASTER THESIS (ENVIRONMENTAL ENGINEERING/GEOGRAPHY - EN)

BIOMASS ESTIMATION FROM SINGLE-TREE- AND AREA-BASED APPROACHES IN ALPINE SPRUCE STANDS

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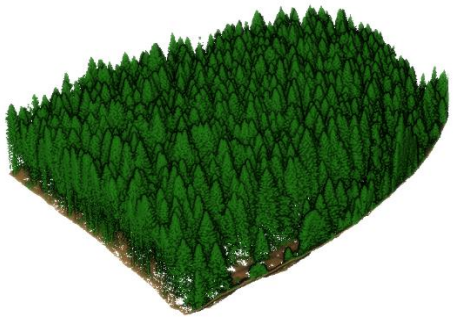
PROVINCIA AUTONOMA DI TRENTO, CORPO FORESTALE

TOPIC

Exact knowledge of biomasses in our forests is critical to understanding how forests deal with management operations and stress, e.g. caused by climate change or pest infestations. The common "area-based approach" (ABA) estimates biomass based on the 3D point distribution in an area of interest but often fails to capture single-tree specifics. Modern airborne laser scanning (ALS) data, however, typically provides sufficient fidelity to extract single tree locations.



3D view of the UAV point cloud of a spruce stand.

DETAILS

Using a UAV point cloud of a spruce stand in Trentino, the ABA should be calibrated on given reference data. Then, single tree segmentation methods should be compared and evaluated (e.g., using watershed or segment-anything model), and a single-tree based biomass model should be calibrated. The output of this model should then be evaluated against the ABA. In addition, an ablation study on point cloud density should be made to simulate different ALS acquisition scenarios. As 3D point clouds are available pre- and post-thinning operations, and the thinning biomass is well-known, the developed methods can also be validated externally.

Main research questions:

- How do single-tree biomass estimation methods compare to the area-based approach at different point densities?
- What is the performance of different tree segmentation approaches and how do they depend on the available data resolution?
- How can pre- and post-thinning data be combined to optimize model calibration and independent validation?

TIMELINE

Start possible from now on. First results are expected by October 2026. A research visit at the *corpo forestale* including field work is desired.

SUPERVISION AND CONTACT

Should you be interested, please contact

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