Investigating the relationship between crown defoliation and remote sensing indicators of vitality at the single tree level

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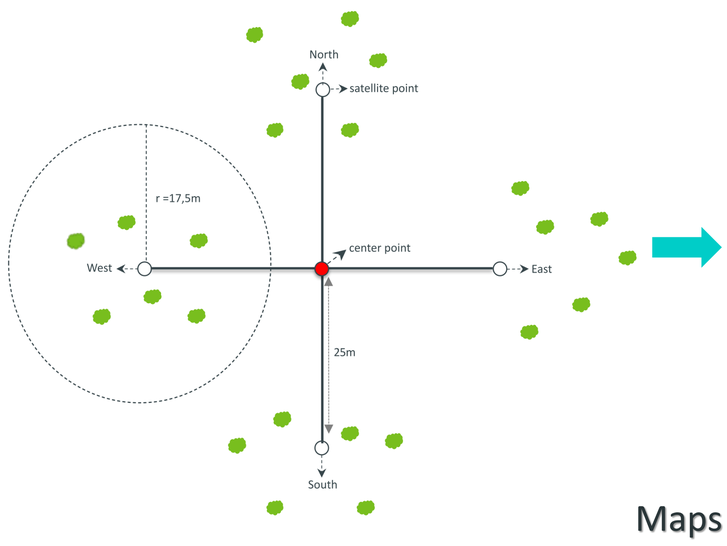
The project aims to bridge the gap between tree-based field surveys (WZE Crown Condition Survey) and area-based remote sensing products. This will be achieved by collecting accurate ground truth (RTK-GNSS data) for multispectral imagery or airborne laser scanning to analyse tree vitality at single tree precision.

Methods

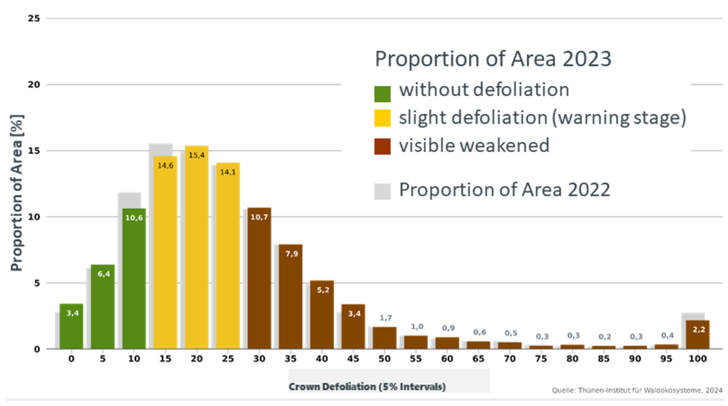
- RTK- GNSS positioning system → **antenna + tablet + software**
- Recording of all four satellite points and the center point
- Calculation of sample tree positions (24 per plot) using polar coordinates (azimuth angle + distance measurement)
- Recording of tree measurements like diameter at breast height (DBH), tree height (h), crown base height (CBH)
- Extracting individual crown polygons from 3D point clouds by applying the adaptive mean shift (AMS3D) algorithm
- Matching crown polygons to sample tree stem positions with crown-stem matching algorithms

Data

WZE Four-Point Cross-Cluster Design with 24 Sample Trees



WZE Crown Defoliation 2023 Vitality Indicator



Field Work / Data Collection

Maps of Recorded WZE Trees and Center Point and Satellite Points

WZE Data Visualisation

Map Legend
Main Layers
- Center and Satellite Points
- Sample Trees

Digital Orthophotos DOP 20 / from Mecklenburg Western Pomerania provided by Landesforst MV

Data Collection: Amelie Mc Kenna & Nikolai Knapp
Map Author: Amelie Mc Kenna

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Studies and Research Questions

I. Investigation of relationships between WZE tree vitality indicators and remote sensing products:

1. Can relationships between remote sensing products of tree vitality and field-survey-based crown defoliation be improved by considering single trees instead of plot averages?
2. Can the relationships be further improved by explicitly considering tree crown size?
3. How well do different remote sensing products match the field-survey-based defoliation?

II. The influence of competition on tree vitality (WZE):

1. How can we characterise tree competition from airborne lidar data?
2. Does competition influence crown defoliation?
3. Can competition indices improve predictions of crown condition?

III. Linking survey-based crown defoliation with remote sensing-based leaf area density in 3D crown models:

1. How good is the agreement between field measurements of crown base height and tree height and lidar derived estimates?
2. Can we establish a relationship between the lidar-derived leaf area estimates and the crown defoliation values of the survey trees?
3. Can we use the lidar-derived leaf area density for calibration and validation of existing satellite-based leaf area index products?

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