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Challenges in Crown Spread and DBH Estimation from Segmented Tree Crown Polygons

Tree traits such as crown area (CA), crown radius (CR), and diameter at breast height (DBH) provide insight into a tree's growth dynamics, biomass, and the overall biophysical and biochemical processes of ecosystems. Accurately measuring these traits is essential for carbon estimation, urban tree management, and biodiversity assessments. The allometric relationships between CA, CR, and DBH are often nonlinear and can vary significantly across regions due to differences in climate, species composition, and management practices. Multi-species allometry is especially challenging due to the variability in species-specific growth forms, particularly when comparing needleleaf and broadleaf species. Traditional field measurements for these parameters are often labor-intensive and time-consuming, especially in large-scale studies or densely forested areas.

We used the segmented tree crown polygons from the DeepTrees tree crown delineation model to calculate crown area and crown spread of individual trees. We evaluated the accuracy of 4 different crown spread calculation methods by comparing them to verified ground-truth data from a local tree inventory ("Baumkataster" Halle/Saale). The best calculation method gave a 31 % match with the Baumkataster data and 87 % of the modelled crown spread fell within an acceptable margin of the ground-truth data. Trees with particularly small (< 5 m crown spread) or very large (> 15 m crown spread) crowns tend to be more challenging to estimate accurately, indicating that better estimations are only possible with more accurate tree crown segmentations since the segmentation model has large error rates for small and large trees.

The DBH-calculation was based on different functions evaluated by Song et al. [1] and used the calculated crown spread as input. This calculation proved to be more challenging, not resulting in good matches with the ground-truth data.

These findings highlight the potential and some of the challenges in accurately assessing tree traits from 2D tree crown segmentations.

Reference:

1. Song, X., Li, J., & Zeng, X. (2024). Parameterization of height–diameter and crown radius–diameter relationships across the globe. Journal of Plant Ecology, 17(2), rtae005.

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