BuWaL-Hessen: Search space for Natura 2000 habitat types dominated by beech forests in Hesse

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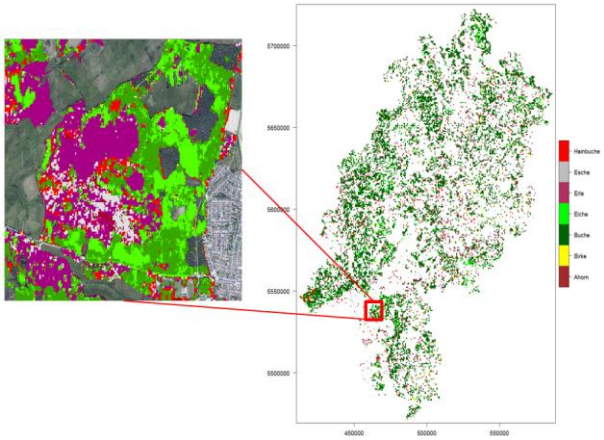
ABSTRACT

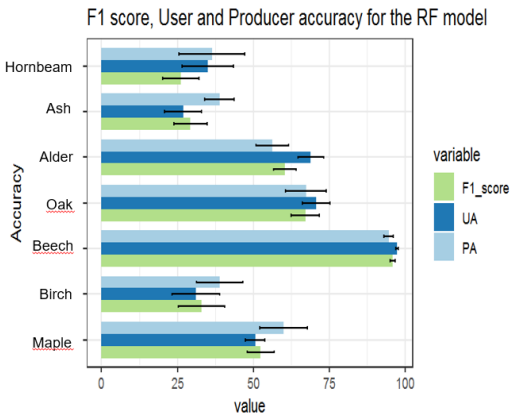
Beech is the most common tree species in the Hessian forests and is crucial for not only forestry but also nature conservation. In Hesse, three of the 45 natural habitat types protected under the European Union Habitats Directive are primarily beech-dominated and can be identified by their habitat codes 9110, 9130, and 9150. While beech trees are prevalent, these habitats are also characterized by accessory tree species, underlying herbaceous layers, climatological, topographical and geological factors, complicating habitat type identification directly through remote sensing. Therefore, this project aims to create a "search space" identifying potential locations of these habitat types within Natura 2000 sites by combining detected beech trees in Hesse using remote sensing techniques, with soil and geological data as a means to support the Hessian terrestrial habitat mapping (Hessische Lebensraum- & Biotopkartierung, HLBK). To map broadleaf tree species in Hesse, four Sentinel-2 mosaics (S2), along with derived vegetation indices and a Digital Elevation Model (DEM) were utilized. Additionally, image-sharpening techniques using the 10m S2 bands to enhance the 20m bands was employed, to evaluate their effect on classification accuracy. A broadleaf forest mask for Hesse was created using Copernicus High Resolution Layer Forest Type 2018 and Hessen Forst's (HF) broadleaf mask. "Pure" species stands from HF's forest management data served as ground truth.

We classified seven tree species including beech using Random Forest. We found that image sharpening reduced tree species classification accuracy by ~14% and hence it was not used further. Overall accuracy based on spatial cross validation for the final classification was ~90% with beech achieving the highest F1 score of 95. Further comparisons based on HF's sampling points with other studies showed that we found better classification results for beech (and alder) than Blickensdörfer et al. (2024) within Hesse. We also found an overall agreement of ~75% between the two maps for common areas and species. Currently, we are testing soil and geological data from various sources (such as soil and geological maps from HLNUG, site maps from HF, etc.) against available habitat data to identify any underlying relationships. Subsequently, the search space for the habitats will be created by combining information from the tree species map with the tested soil maps to infer the habitat types. HLNUG receives valuable information about potential locations of habitat types, which would be useful for optimizing planning and resource allocations for HLBK. Our broadleaf map could help HF as a basis for deriving species-specific biophysical parameters by integrating it with other data sources, and also provides information on species distribution outside state-managed forests. While remote sensing applications for forest habitat type mapping are not as advanced as other forestry-related applications, our project aims to demonstrate how remote sensing can complement expert knowledge, and optimize project planning when it comes to habitat type mapping. We welcome any constructive feedback on the proposed methods, their potential limitations, or insights from the participants, especially if they have had any prior experience

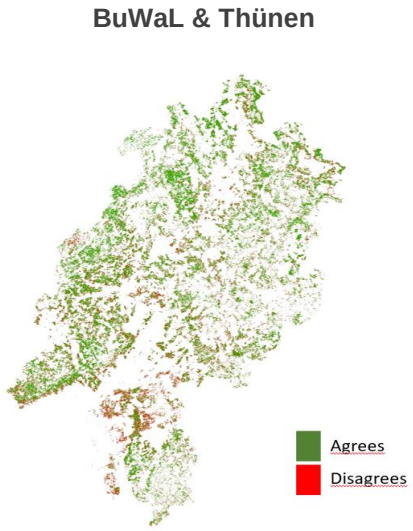
from similar studies or projects. This project highlights how forests are being considered under the Habitats Directive and illustrates how remote sensing can be a valuable tool in bridging the interests of forestry and nature conservation.



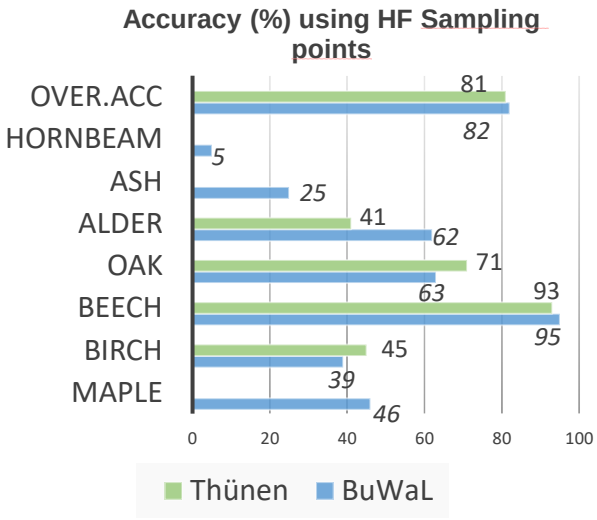
(a)



(b)



(c)



(d)

The images illustrate the following: ***(a)*** *classification results for broadleaf species in Hesse,* ***(b)*** *User accuracy (UA), Producers accuracy (PA) & F1 score based on spatial K-fold cross validation,* ***(c)*** *map highlighting the (dis-) agreements between our map and Thünen (Blickensdörfer et al., 2024) for common species and areas* ***(d)*** *accuracy assessments for BuWaL and Thünen based on sampling points data from Hessen Forst*

Reference

1. Blickensdörfer, L., Oehmichen, K., Pflugmacher, D., Kleinschmit, B., & Hostert, P. (2024). National tree species mapping using Sentinel-1/2 time series and German National Forest Inventory data. Remote Sensing of Environment, 304, 114069.