German Remote Sensing Data Center (DFD)

Identifying Tree Species from Space: A New Approach for Germany Using Sentinel-1 and -2 Time Series

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BACKGROUND

- Understanding tree species composition and distribution is essential for biodiversity conservation, ecosystem resilience, sustainable forest management, and climate adaptation
- Existing remote sensing products rely on National Forest Inventory (NFI) data
- NFI data is not publicly available due to privacy and data protection concerns
- Alternative data sources can provide valuable species-level information

APPROACH

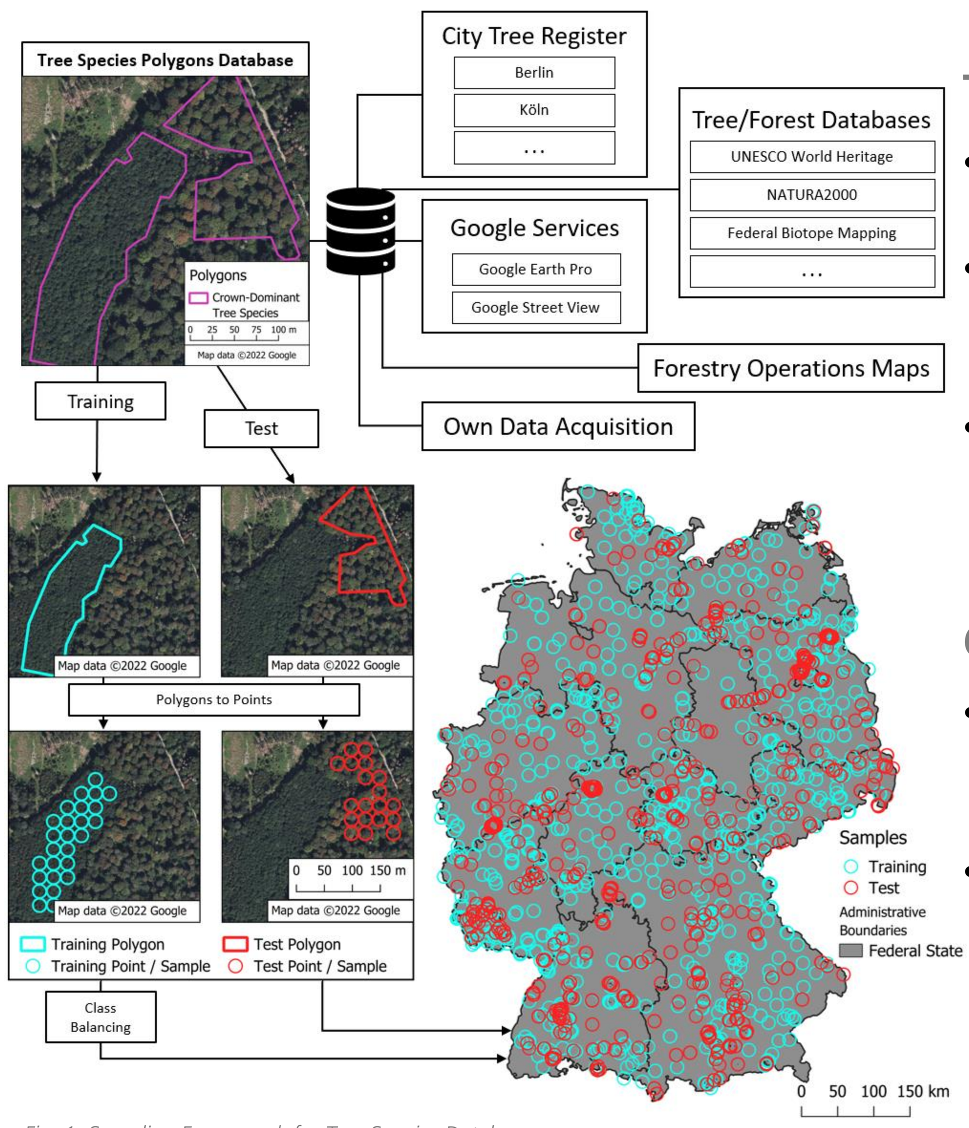

Fig. 1. Sampling Framework for Tree Species Database.

Tree Species Database

- Integration of **multiple data sources** (Figure 1)
- Collection over **80,000 samples** on dominant tree species across Germany
- A custom **top-of-canopy reference database** for tree species

Classification Model

- **Spatio-temporal composites** from Sentinel-2 (Figure 2), Sentinel-1 and a digital elevation model.
- Evaluation of two machine learning algorithms (**Random Forest** and **XGBoost**) with different data combinations (S2+S1+DEM, S2+S1, S2+DEM, S2, S1)

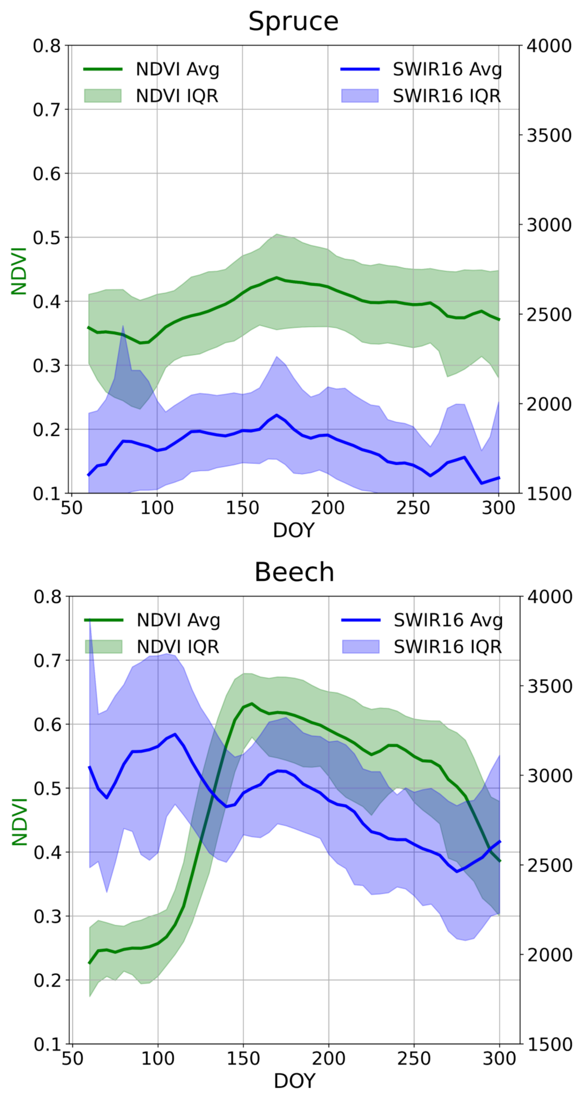

Fig. 2. Spectral Signatures of two dominant tree species of Germany

RESULTS

- Distribution **of ten tree species groups** across Germany in 2022
- **10-meter resolution** continuous mapping
- Best results with the combination of **Sentinel-2, Sentinel-1, and DEM**
- Overall **F1-score of 0.88**
- **Sentinel-2 alone** with a strong **F1-score of 0.85**
- F1-scores of the best model between 0.75 and 0.98 for pine, spruce, beech and oak
- For other species (birch, alder, larch, douglas fir and fir), F1-scores from **0.74 to 0.97**
- **Cost-effective**, **repeatable** and **to other years transferable method**
- Enabling of **reliable and continuous monitoring** of tree species in changing forest environments

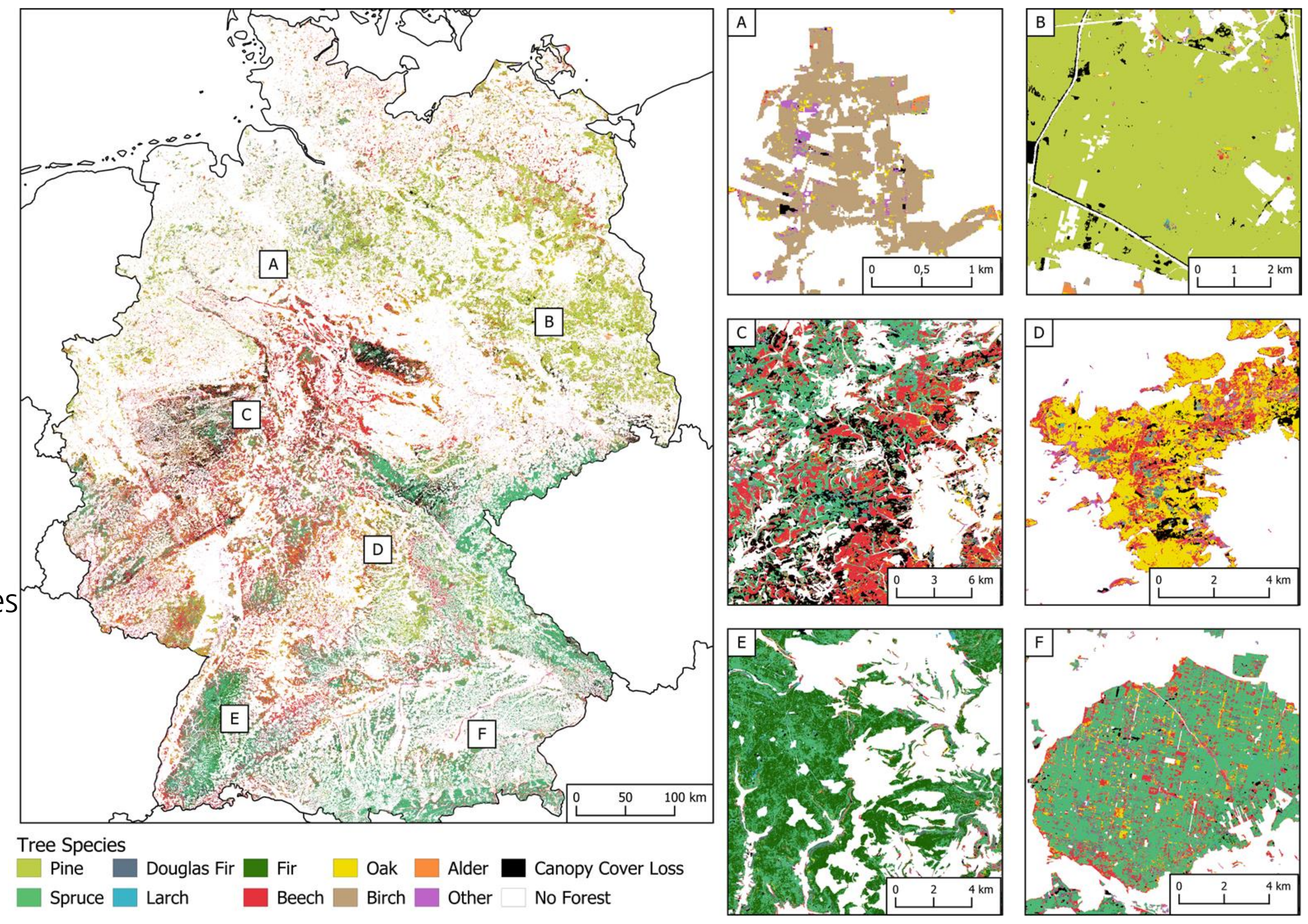

Fig. 3. Tree Species Map of Germany (2022) with six detailed zooms

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ForstEO

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