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Modeling of a climate-adapted tree species distribution for Germany based on National Forest Inventory and remote sensing data

Tree Species Project

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REE SPEC ES

Climate change and future forests

The climate change has a strong impact on European forest ecosystems, reducing their resilience. It must be expected that climate change will alter the site conditions at a faster pace than forest systems can adapted.

A major concern in forestry is therefore the development of adaptation strategies that require accurate information on tree species and site conditions in high spatial and temporal resolution.

Objectives and project goals

The focus of the Tree Species Project is on the development of nationwide maps of tree species distribution, which will then be intersected with further site data in order to formulate risk analyses and forestry recommendations for action.
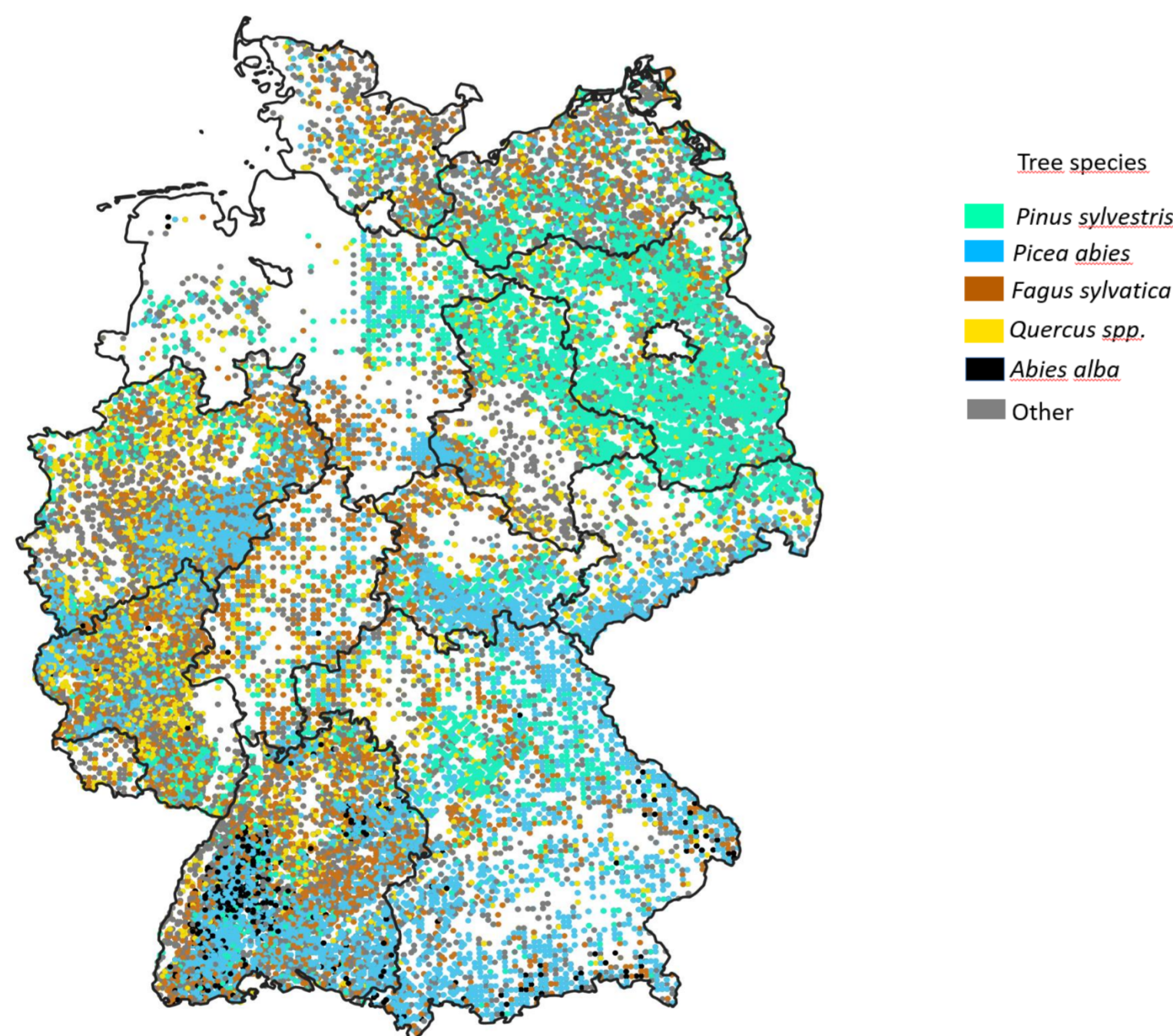
Data currently available / Data we want to obtain

Tree species
- Pinus sylvestris
- Picea abies
- Fagus sylvatica
- Quercus spp.
- Abies alba
- Other

FIG 1: Tree species information from NFI plots (2012[a])

Tree species
- Other hardwoods with high durability
- Other hardwoods with low durability
- Fagus sylvatica
- Pseudotsuga menziesii
- Quercus
- Picea abies
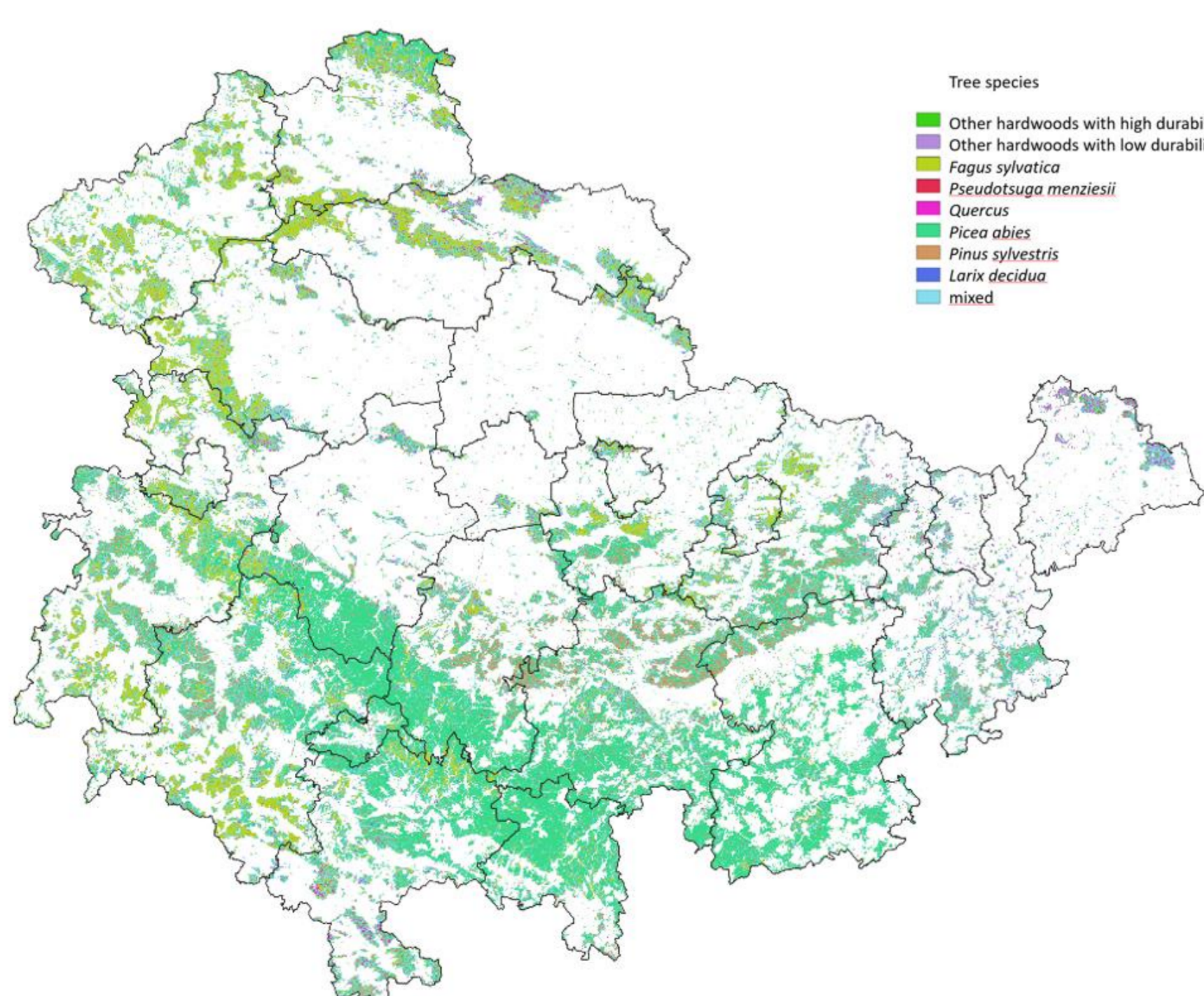- Pinus sylvestris
- Larix decidua
- mixed

FIG 2: Tree species distribution as a wall-to-wall map[b], exemplified for the state of Thuringia using Sentinel-2 data and Random Forest classification with NFI data for training. In the project neural networks and time series data will be used for classification.
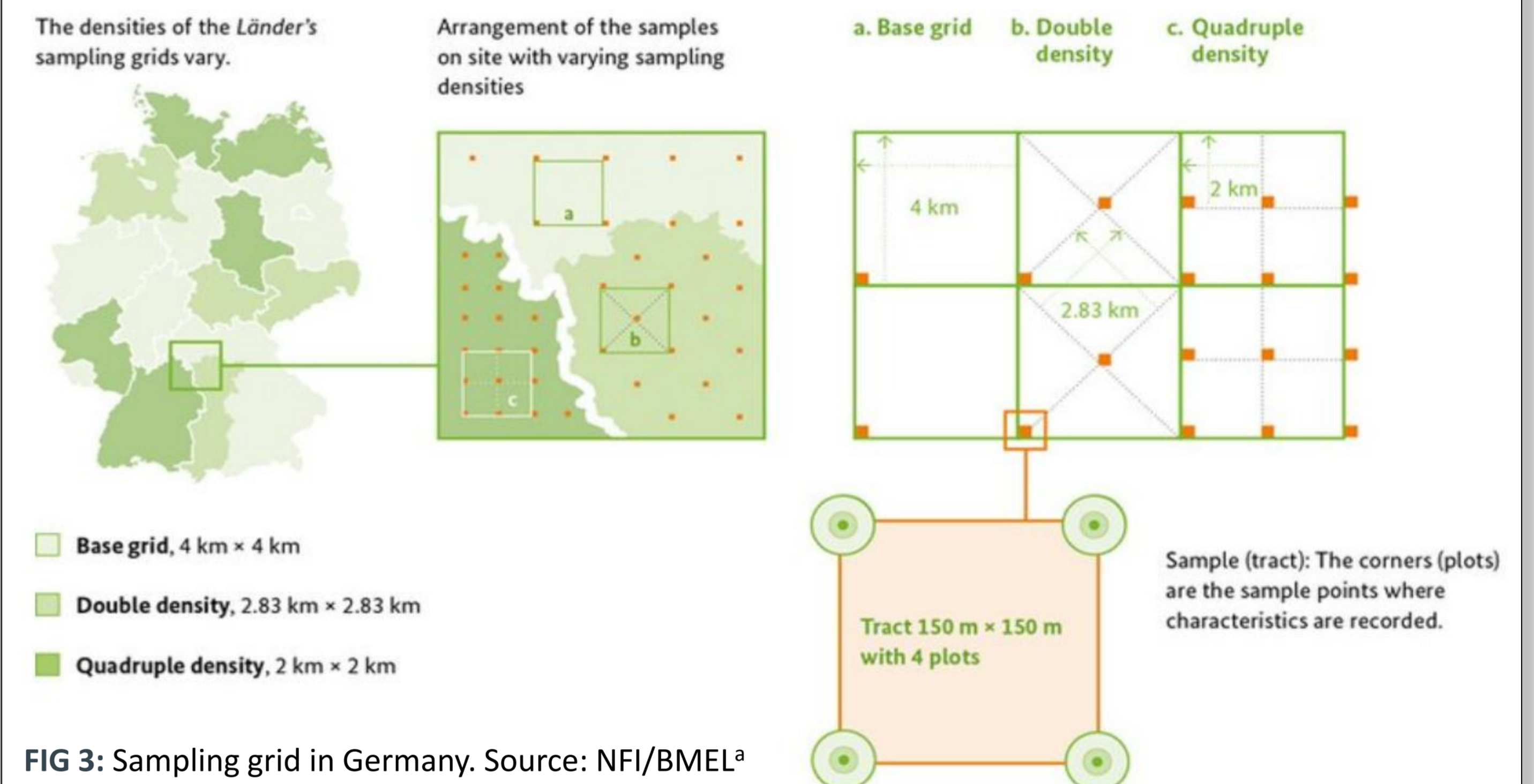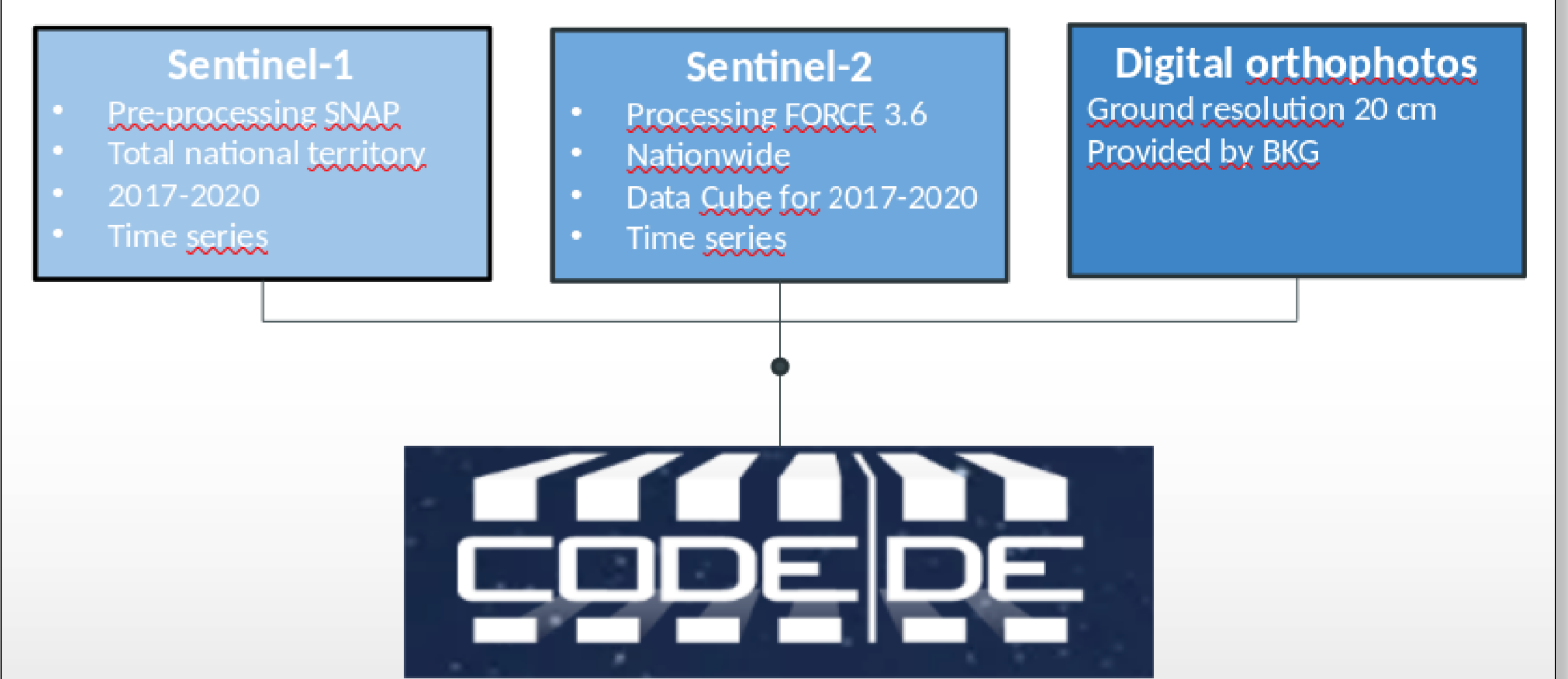
Database – National Forest Inventory (NFI)

The densities of the *Länder's* sampling grids vary.

Arrangement of the samples on site with varying sampling densities

a. Base grid b. Double density c. Quadruple density

4 km   2 km

2.83 km

- Base grid, 4 km × 4 km
- Double density, 2.83 km × 2.83 km
- Quadruple density, 2 km × 2 km

Tract 150 m × 150 m with 4 plots

Sample (tract): The corners (plots) are the sample points where characteristics are recorded.

FIG 3: Sampling grid in Germany. Source: NFI/BMEL[a]

Databases – Remote Sensing

Sentinel-1
- Pre-processing SNAP
- Total national territory
- 2017-2020
- Time series

Sentinel-2
- Processing FORCE 3.6
- Nationwide
- Data Cube for 2017-2020
- Time series

Digital orthophotos
Ground resolution 20 cm
Provided by BKG

CODE|DE

Tree species information from NFI combined with Remote Sensing Data

Angle count sampling[b]

Delineated tree crowns[b]

NFI Plot[b]

Expected results

- A tree species composition map for entire Germany, covering the most dominant species
- Open database for training and validation of deep learning models
- Pre-trained deep learning models
- Application to Copernicus data
- Resilience indicator map
- Map showing tree species distribution adapted to site conditions and future climate
- A set of forest management options that lead to the establishment of stable forest ecosystems

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