

German National Forest Inventory

Upcoming methodological or technological issues & innovations

Thünen Institute of Forest Ecosystems

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Outline

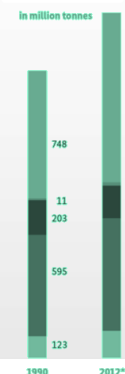
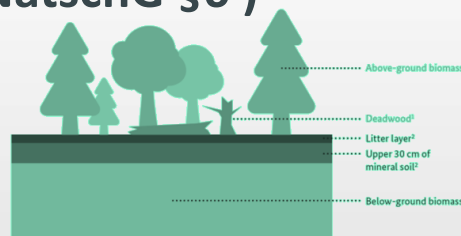
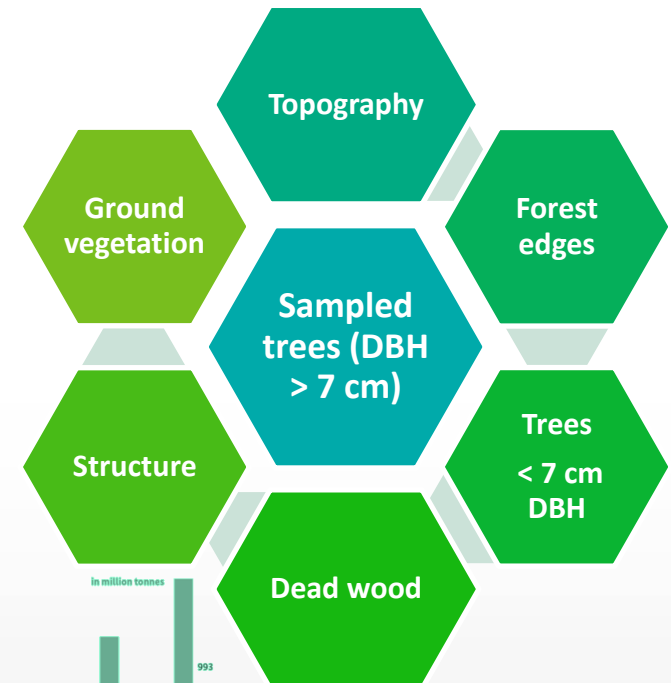
1. NFI
2. Past & future inventories
3. Innovations & issues
4. Specific Examples



German National Forest Inventory

(NFI called “**Bundeswaldinventur**” = BWI)

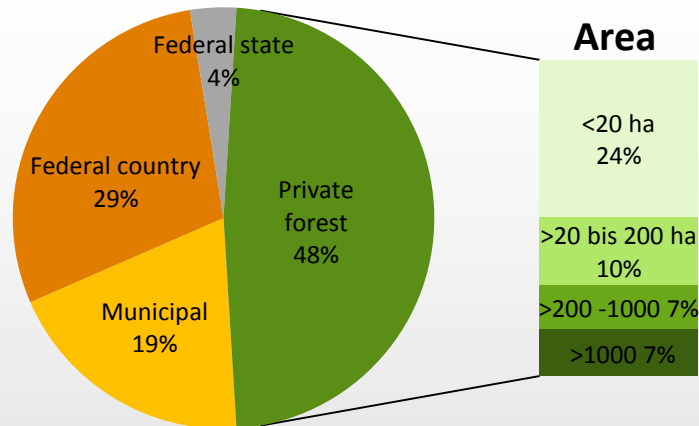
- Legal basis = BWaldG §41a
- Thünen-Institute is responsible for inventory planning & data aggregation
- The federal states are responsible for data collection
- survey focusses on the state of forests
+ production possibilities
+ on changes in forests
+ state natural habitats (BNatschG §6)



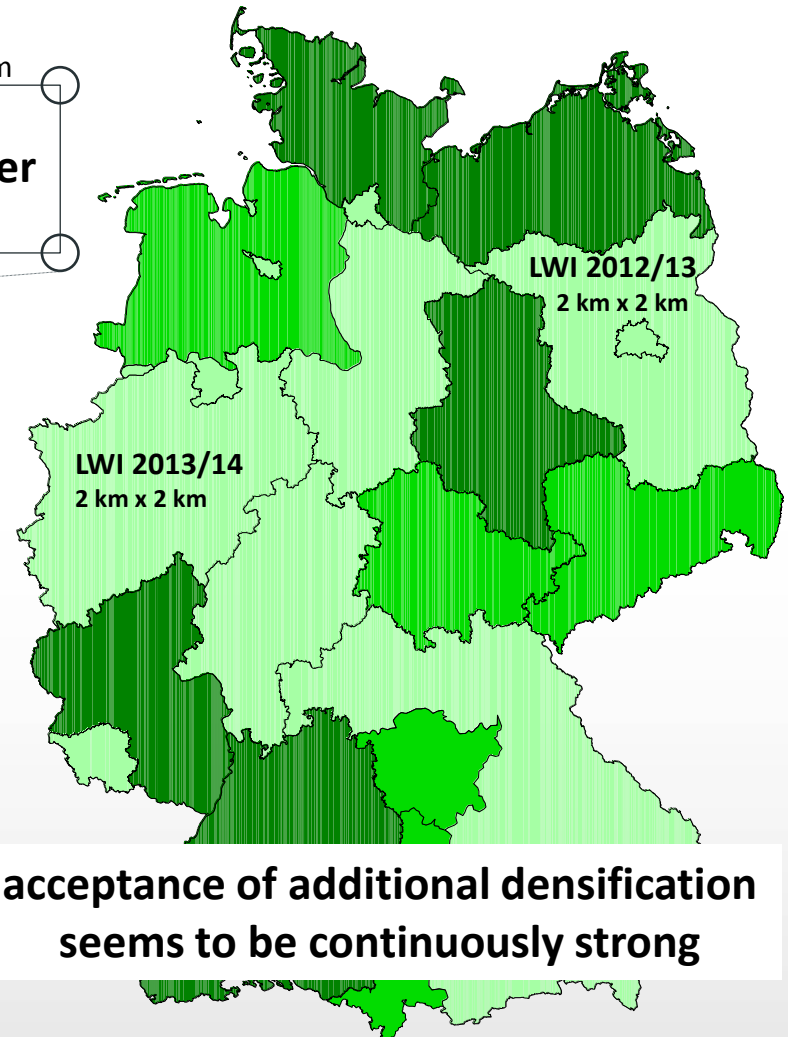
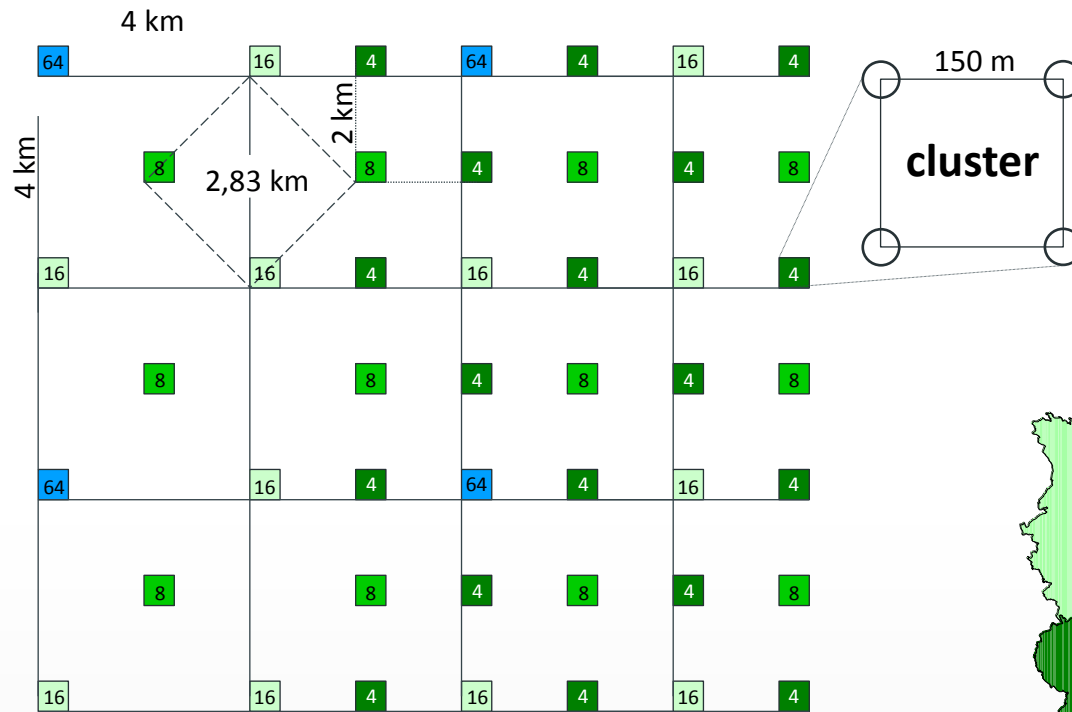
* Projected onto the year 2012 for the soil, measured for the stand

German National Forest Inventory

- **German forest area: 11,419,124 ha (32 %)**
- standardized sampling procedure
- large-scale systematic cluster sample
- assessed every 10 years periodically
- one-phase terrestrial sampling inventory
- uses permanently marked sample points



Sampling Design – grid densities



CI grid

8 x 8 km
= 64 km²

Base grid

4 x 4 km
= 16 km²

46 %

Double density

2,83 x 2,83 km
= 8 km²

22 %

Fourtime density

2 x 2 km
= 4 km²

32 %

German NFI – past and future

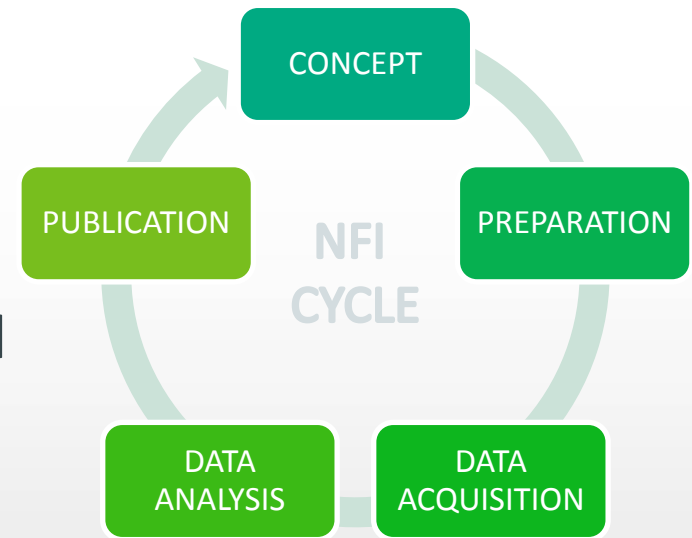
- **complete data for many objects available:**
 - 1st NFI 1987 only in western Germany
 - NFI 2002 & 2012
 - inventory study 2008
 - several specific inventories in the federal states (Brandenburg + Northrhine Westfalia)
 - **UPCOMING:**
 - carbon inventory 2017
→ survey instruction ready
 - 4th NFI spring 2021-2022
→ 3rd successive survey throughout whole Germany
- + time series analysis +**



4th NFI - inventory concept

Basic principle for the next inventory concept

- ❖ changes in methodology
→ only if necessary
- ❖ New methodologies need to be **downward compatible**
- ❖ **Comparability** must be preserved
- ❖ The inventory must respond in a way that it is able to **meet new demands** of **economy, ecology and society**
- ❖ Detected errors may not be continued



4th NFI - inventory concept

- **established structures:**
 - Data restructuring
 - Data Derivation
 - “anonym” estimation
 - Result database & data presentation (NFI & Modeling results on bwi.info)



→ will be evaluated in a **SWOT-Analysis** for optimization

- specific issues during analysis have to be overthought

?New interfaces & gateways?

→ High planning, coordination, testing effort

TIME/SAFETY vs INNOVATION



Upcoming methodological or technological issues & innovations

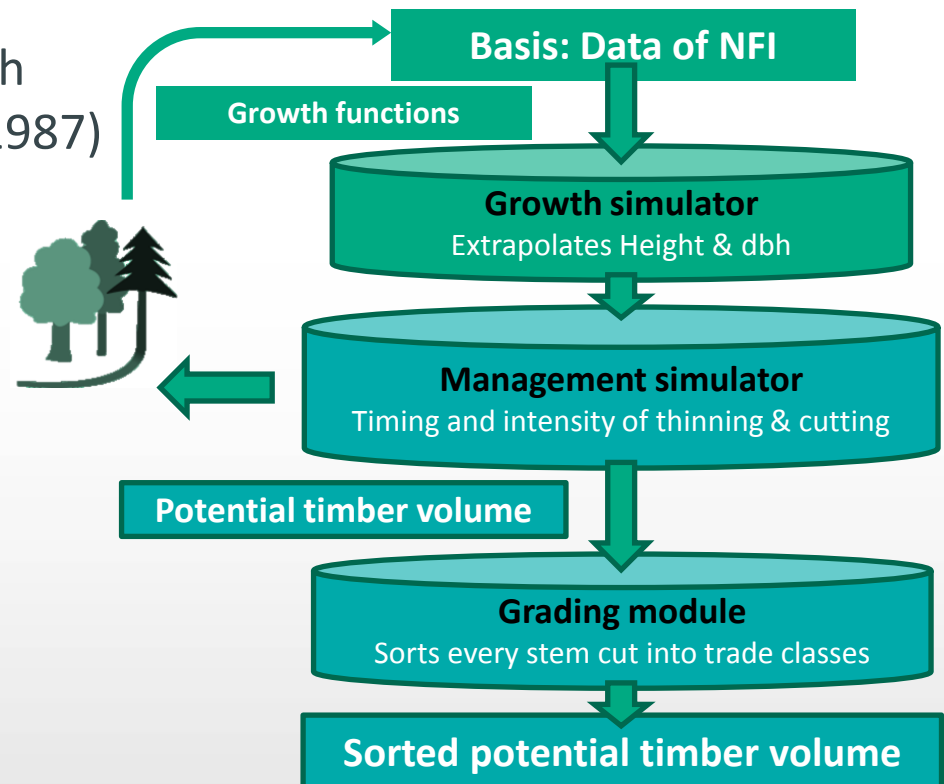
- Quantitative indicators for **structural diversity**
- **Integration of remote sensing data as additional NFI data**
 - small area estimators
 - trees outside forest
- **Representative assessment of state forest** (national property)
- **Regionalization of growth functions** for NFI and the forest development and timber resource model
- **Assessment of the FAO definition** in addition to the national forest definition

Upcoming methodological or technological issues & innovations

- **Hints from the scientific advisory committee for forest politics**
 - Differentiation of clear cut & areas deforested from calamities
 - Systematic assessment of **regeneration**
 - Stand exploitation
- **More specific examples presented:**
 - Renewal Forest development and timber resource modelling
 - Stand space functions
 - Diameter measurement methods for tape equations

Forest development and timber resource modelling

- **WEHAM:** “Waldentwicklungs- & Holzaufkommensmodellierung”
 - An **empirical single tree forest growth model** specifically designed to meet the requirements of and **work with the data provided by the German NFI**
 - Developed by the forest research institute Baden-Württemberg (1987)
 - As **decision support system** for nationwide future forest:
 - resource assessments
 - sustainability checks
 - various ecological, **economic** or **political planning** purposes
 - model consists of 3 main parts



Forest development and timber resource modeling

- **CHALLENGES:**

- **Ongoing demand** at national & international level
- **Low flexibility** of input data, classification possibilities
- **time consuming** input
- WEHAM is **distance independent**

Identification features of a treatment unit

federal state, ownership, tree species, age

Control parameters

thinning type, thinning interval, dbh-Minimum, medium height, target dbh, sampling percent, tolerance, end of production

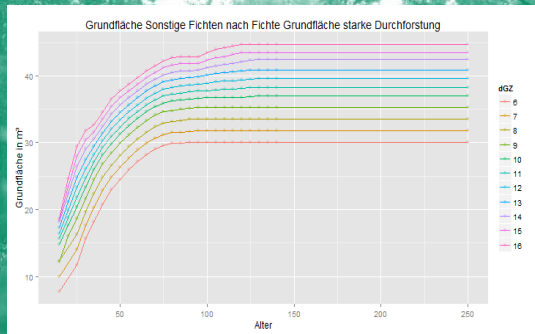
- **REQUIREMENTS:**

- **Open source** & platform independent modeling approach
- More flexible classification of input data
- Integration of stand data , influence of calamities

Development of Forest Modeling

Further development of the forest development and timber resource model

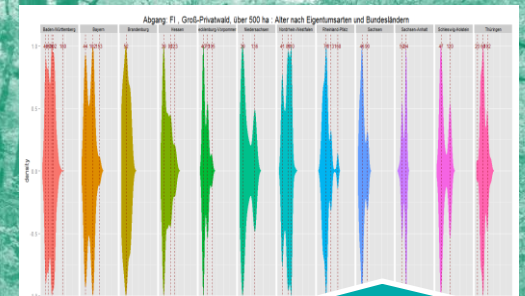
- More automated „Business As Usual Scenario“ development from NFI data



Spruce strong harvest



Spruce harvest analysis



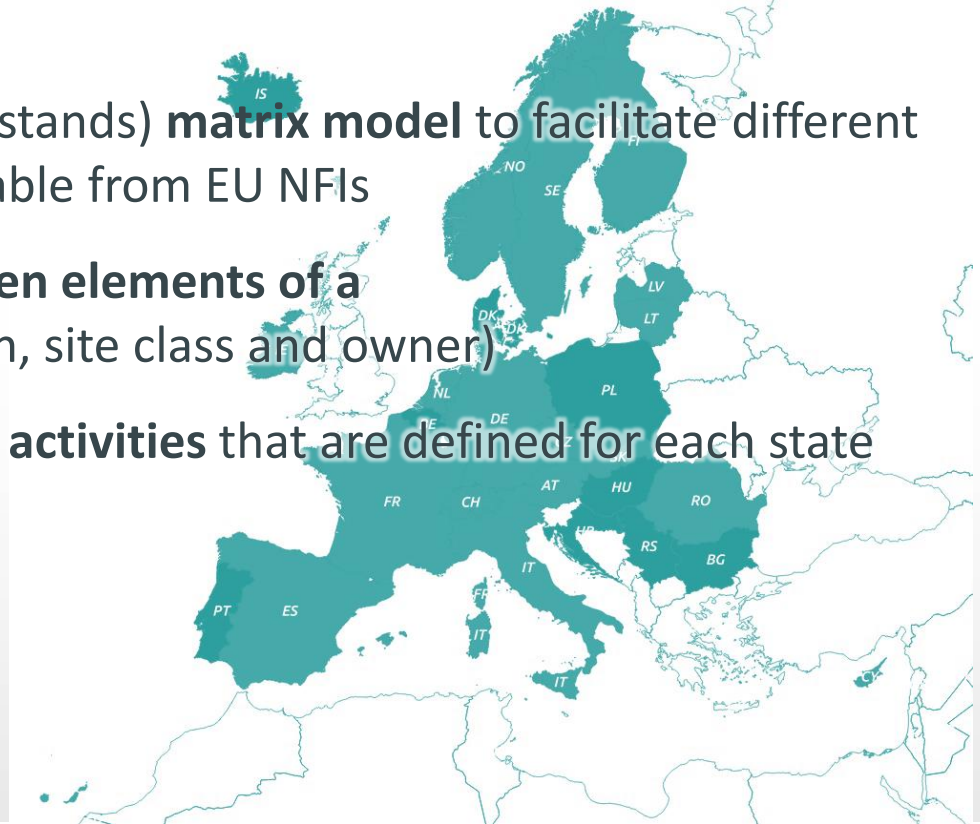
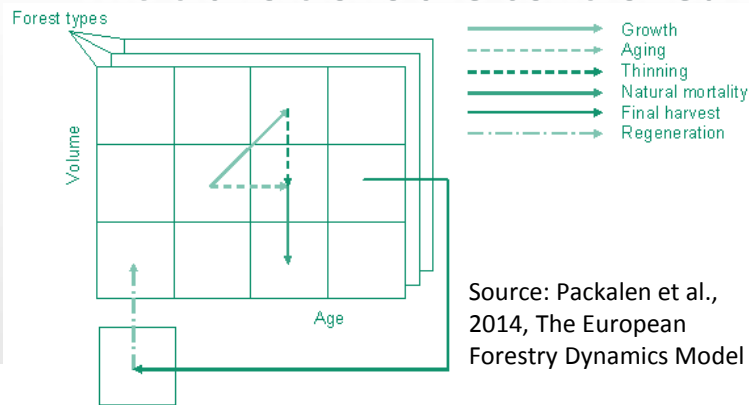
Extraction of harvesting peaks (age classes & dbh) for tree species, ownership & country

Source: Susann Klatt

- Possibilities of **climate sensitive forest growth** models are tested in a project WP-KS-KW („Waldproduktivität-Kohlenstoffspeicherung-Klimawandel“, end 2016)
- **Improvement of mortality model** in the project SURVIVAL-KW („Veränderte Überlebenszeit von Waldbeständen“, end 30.06.2019).

European Forestry Dynamics Model (EFDM)

- joint effort of JRC & NFIs
- project the state of **Europe's forests** given different climatic, economic & management scenarios
- **flexible area-based** (not trees or stands) **matrix model** to facilitate different types of data input that are available from EU NFIs
- forest areas are **transiting between elements of a set of fixed states** (species, region, site class and owner)
- **The transitions are controlled by activities that are defined for each state**



Susann Klatt

2nd International Workshop on
Forest Inventory Statistics

Optimization of stand space functions

- **considering the use of Voronoi-Polygons**
(Thiessen-Polygons/ Dirichlet-Tessellation)
- known method to derive & analyze
 - **proximity,**
 - **distance &**
 - **neighborhood** between spatial objects

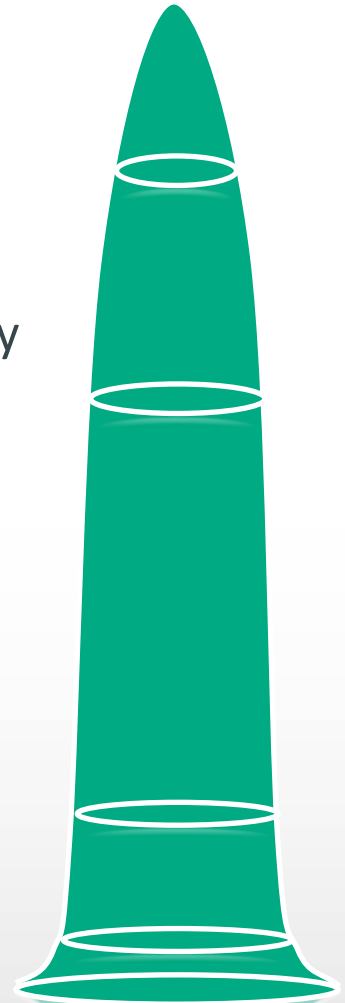
Idea:

- an area (standing area/crown) closest around a point (tree stem) of a set of irregularly distributed points (trees)
- OR calculation of Thiessen-Polygons in Raster as proximity zones (distance transformation) → allows introduction of Weighing factors
- Use of Voronoi-Polygons with ACS must be discussed



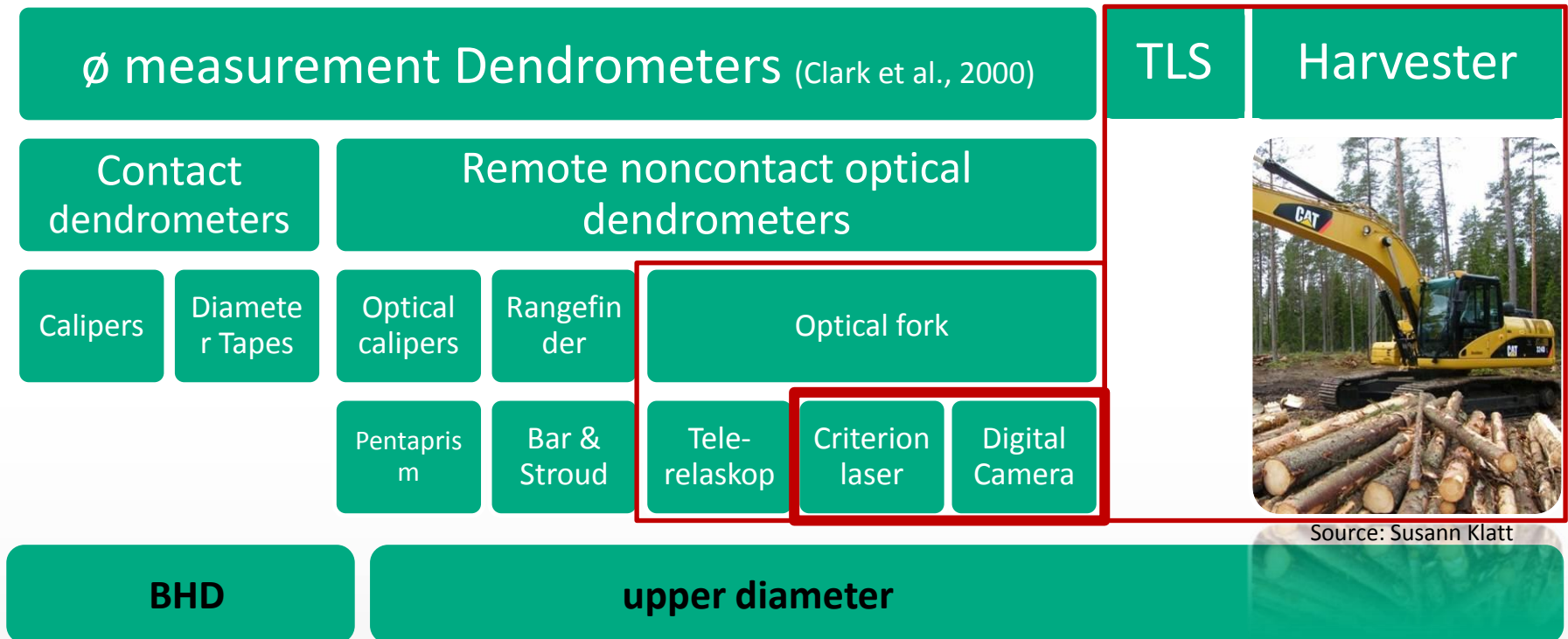
Taper equations – for single tree volume, biomass & growth estimates

- **Change from Bdat to TapeR (R)**
 - Idea of perpetual independent filling of TapeR
- **Comparison of diameter measurement methods**
 - Dbh & upper diameter are descriptors of stem taper & allometry
- **Challenges:**
 - Slow process for adaptation & renewal of taper equations
 - Destructive/ expensive/ slow diameter measurements for taper equation fitting
 - Most data is: historical & originates from monocultures & even-aged stands
 - Forest management, structure, tree composition & stem form might have changed



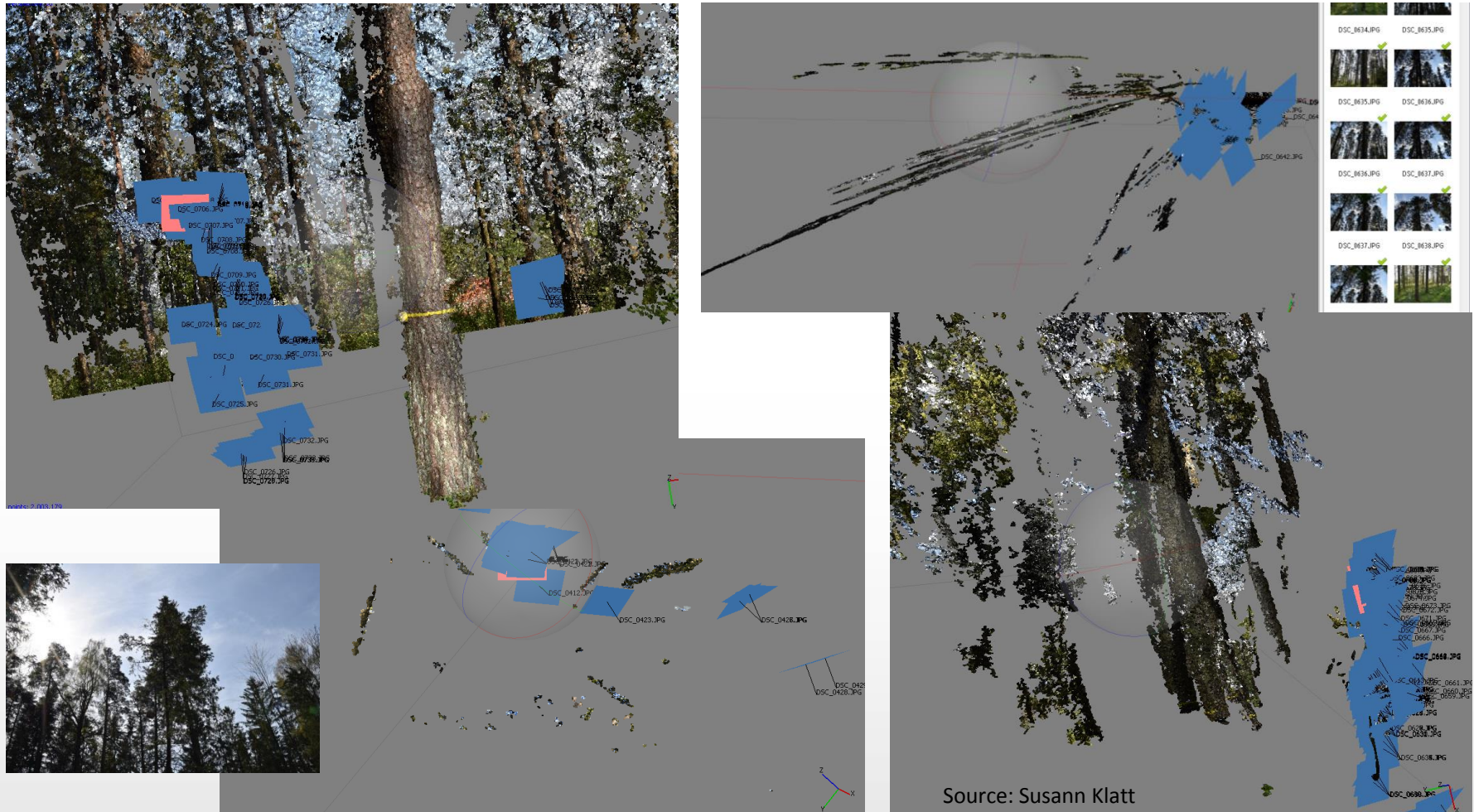
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Diameter measurement methods

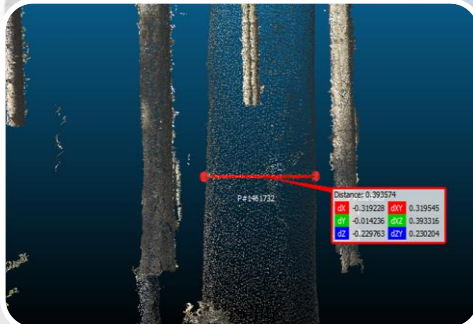
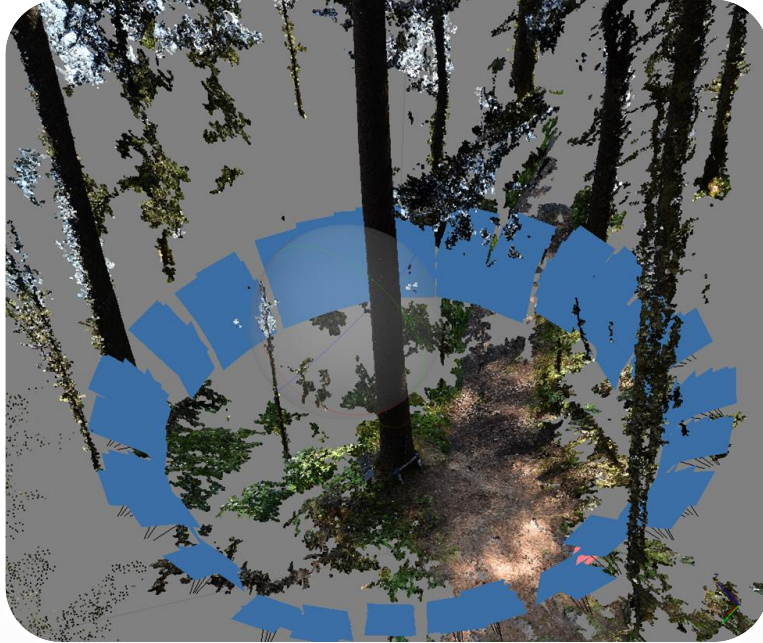


→ **Terrestrial digital photogrammetric methods**, Terrestrial laser scanner, harvester data

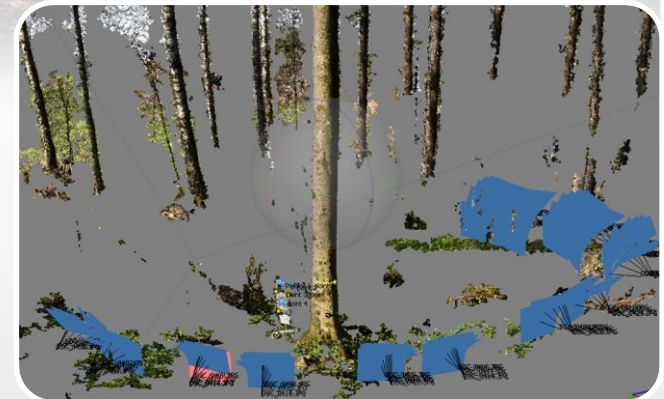
Diameter measurements for stem taper via digital terrestrial photogrammetry



Diameter measurements for stem taper via digital terrestrial photogrammetry



- Optimization of (pre-) processing
- Analysis of:
 - Applicability for NFI
 - Accuracy & precision
 - Time efficiency & Costs

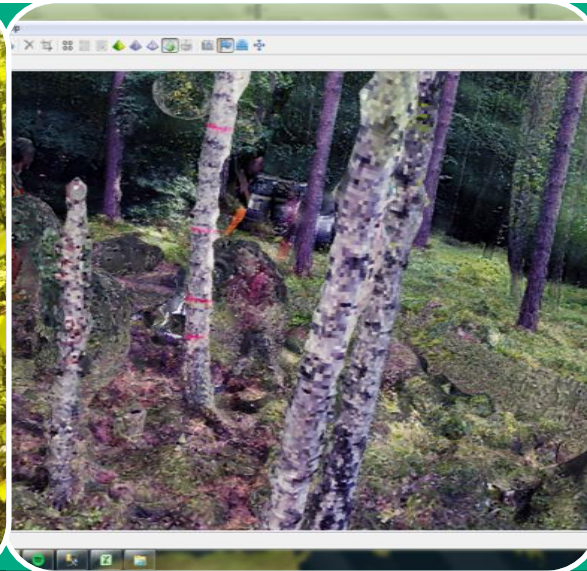


Thank you for your Attention!

Questions?

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Thünen-Institute of Forest Ecosystems



Source: Susann Klatt