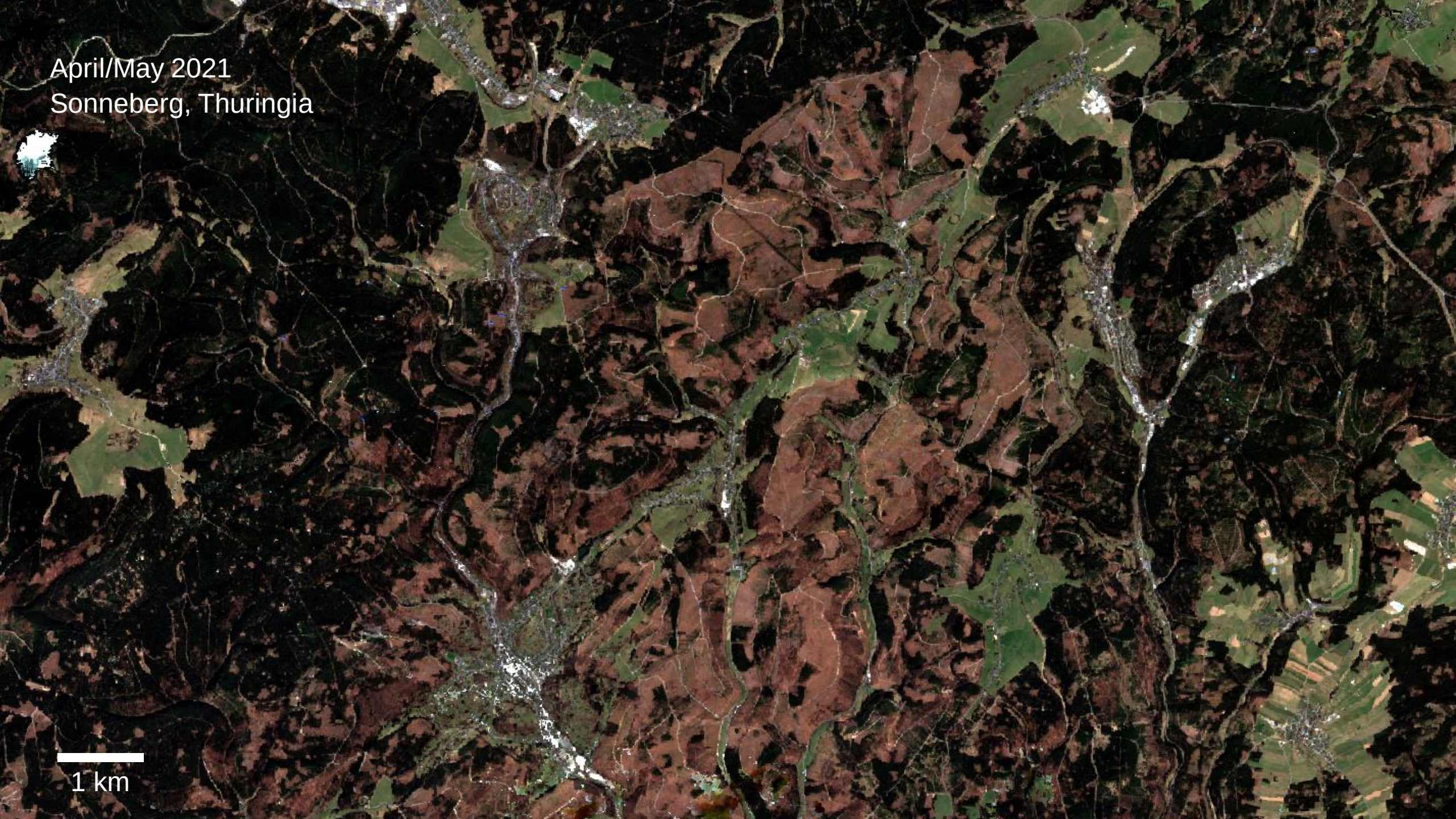
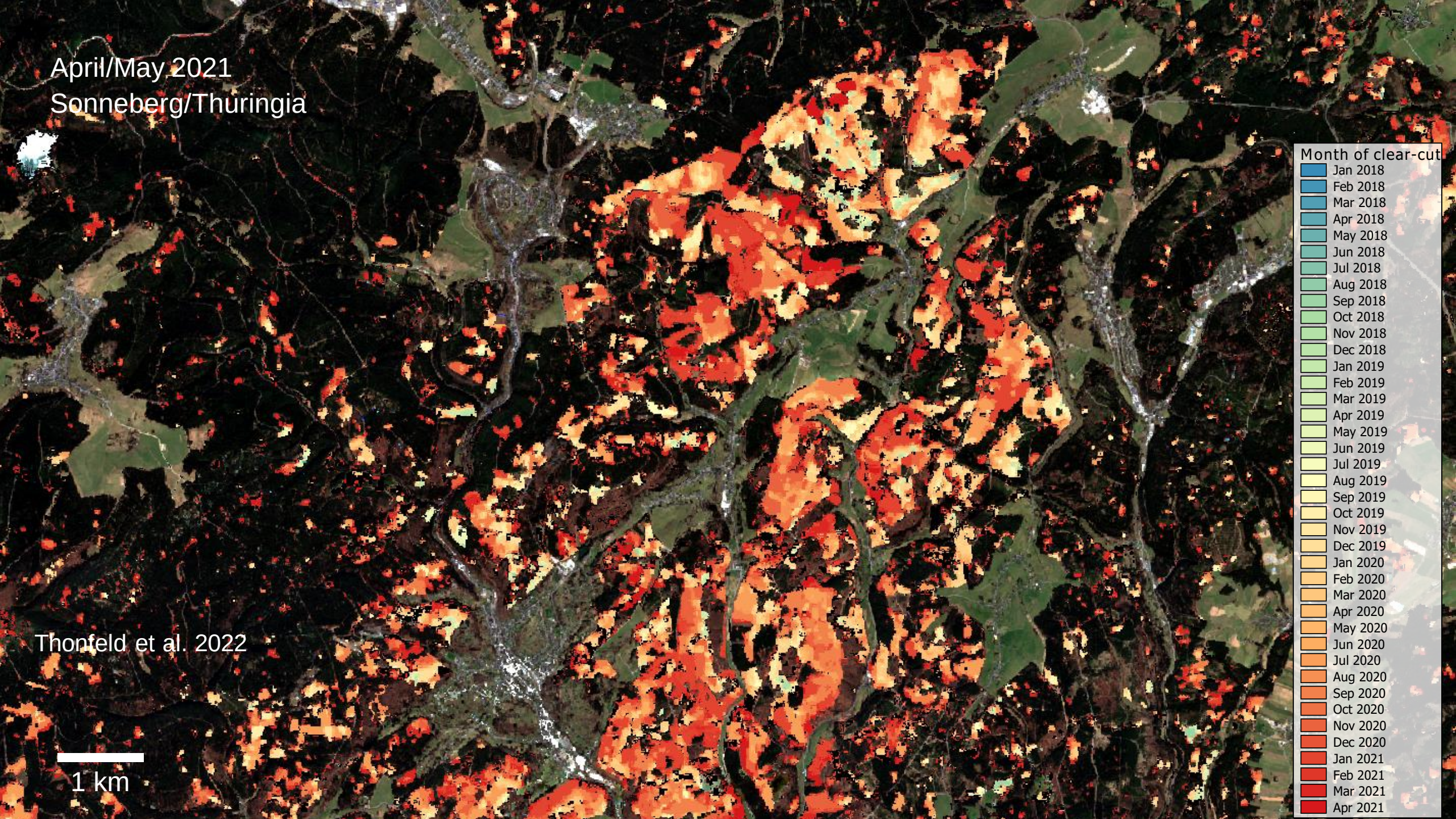
Enhancing the Structural Diversity Between Patches for Improving Multidiversity and Multifunctionality in Production Forests

Novel Earth Observation Techniques for Forest Structure Analysis and Multi-scale Characterization


June 2019
Sonneberg, Thuringia
1 km


April/May 2021
Sonneberg, Thuringia
1 km


April/May 2021
Sonneberg/Thuringia
Thonfeld et al. 2022
1 km
Month of clear-cut
Jan 2018
Feb 2018
Mar 2018
Apr 2018
May 2018
Jun 2018
Jul 2018
Aug 2018
Sep 2018
Oct 2018
Nov 2018
Dec 2018
Jan 2019
Feb 2019
Mar 2019
Apr 2019
May 2019
Jun 2019
Jul 2019
Aug 2019
Sep 2019
Oct 2019
Nov 2019
Dec 2019
Jan 2020
Feb 2020
Mar 2020
Apr 2020
May 2020
Jun 2020
Jul 2020
Aug 2020
Sep 2020
Oct 2020
Nov 2020
Dec 2020
Jan 2021
Feb 2021
Mar 2021
Apr 2021

Preliminary work

remote sensing MDPI

Review

Earth Observation Based Monitoring of Forests in Germany: A Review

Stefanie Holzwarth [1,*], Frank Thonfeld [1,2], Sahra Abdullahi [1], Sarah Asam [1], Emmanuel Da Ponte Canova [1], Ursula Gessner [1], Juliane Huth [1], Tanja Kraus [1], Benjamin Leutner [1] and Claudia Kuenzer [1,2]

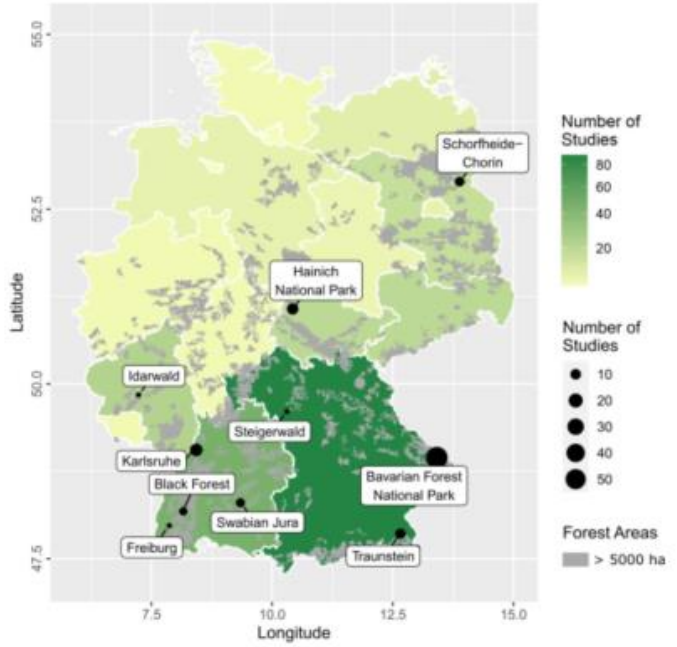


Figure 9. Number of studies per federal state (greenish colours, multiple entries possible), location of top study sites (black dots), and largest continuous forest areas in Germany (grey areas).

remote sensing MDPI

Article

A First Assessment of Canopy Cover Loss in Germany's Forests after the 2018–2020 Drought Years

Frank Thonfeld [1,*], Ursula Gessner [1], Stefanie Holzwarth [1], Jennifer Kriese [1], Emmanuel da Ponte [1], Juliane Huth [1] and Claudia Kuenzer [1,2]

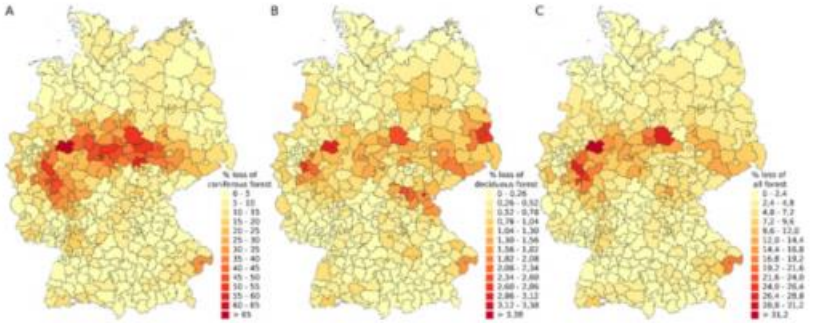


Figure 11. Canopy cover loss in coniferous forests (percentage loss of coniferous forest cover per district, (**A**), deciduous forests (percentage loss of deciduous forest cover per district, (**B**), and all forest types (**C**) for the period January 2018–April 2021.

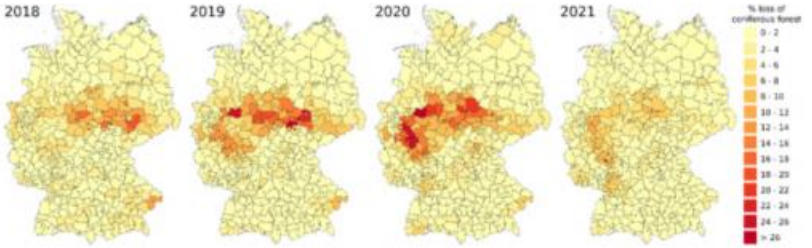


Figure 12. Loss of coniferous forest in 2018, 2019, 2020, and January–April 2021 at the district level.

Preliminary work

remote sensing MDPI

Review

Earth Observation Based Monitoring of Forests in Germany: A Review

Stefanie Holzwarth [1,*], Frank Thonfeld [1,2], Sahra Abdullahi [1], Sarah Asam [1], Emmanuel Da Ponte Canova [1], Ursula Gessner [1], Juliane Huth [1], Tanja Kraus [1], Benjamin Leutner [1] and Claudia Kuenzer [1,2]

remote sensing MDPI

Article

A First Assessment of Canopy Cover Loss in Germany's Forests after the 2018–2020 Drought Years

Frank Thonfeld [1,*], Ursula Gessner [1], Stefanie Holzwarth [1], Jennifer Kriese [1], Emmanuel da Ponte [1], Juliane Huth [1] and Claudia Kuenzer [1,2]

nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-019-12737-x OPEN

Radar vision in the mapping of forest biodiversity from space

Soyeon Bae [1*], Shaun R. Levick [2,3], Lea Heidrich[1], Paul Magdon [4], Benjamin F. Leutner [5], Stephan Wöllauer [6], Alla Serebryanyk[7], Thomas Nauss [6], Peter Krzystek[7], Martin M. Gossner [8], Peter Schall[9], Christoph Heibl [10], Claus Bässler[10,11], Inken Doerfler[11,12], Ernst-Detlef Schulze[13], Franz-Sebastian Krah [14,10], Heike Culmsee [15], Kirsten Jung [16], Marco Heurich[10,17], Markus Fischer[18,19], Sebastian Seibold [11,1], Simon Thorn [1], Tobias Gerlach[20], Torsten Hothorn[21], Wolfgang W. Weisser [11] & Jörg Müller [1,10]

ARTICLES

https://doi.org/10.1038/s41559-020-1245-z

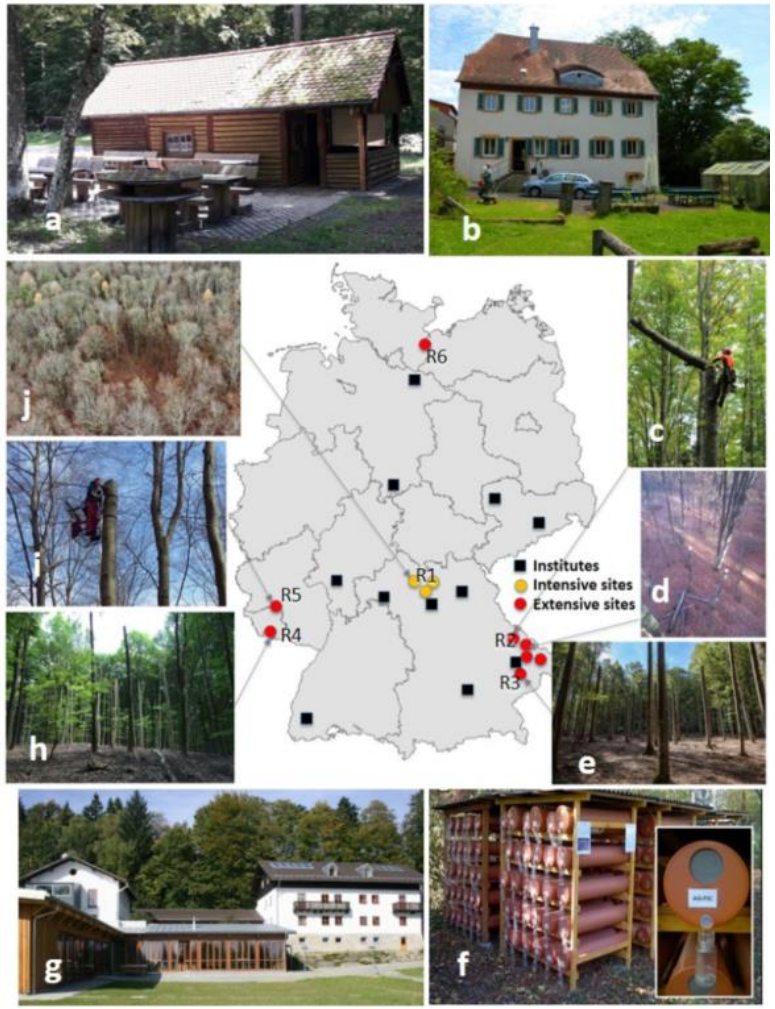
nature ecology & evolution

Check for updates

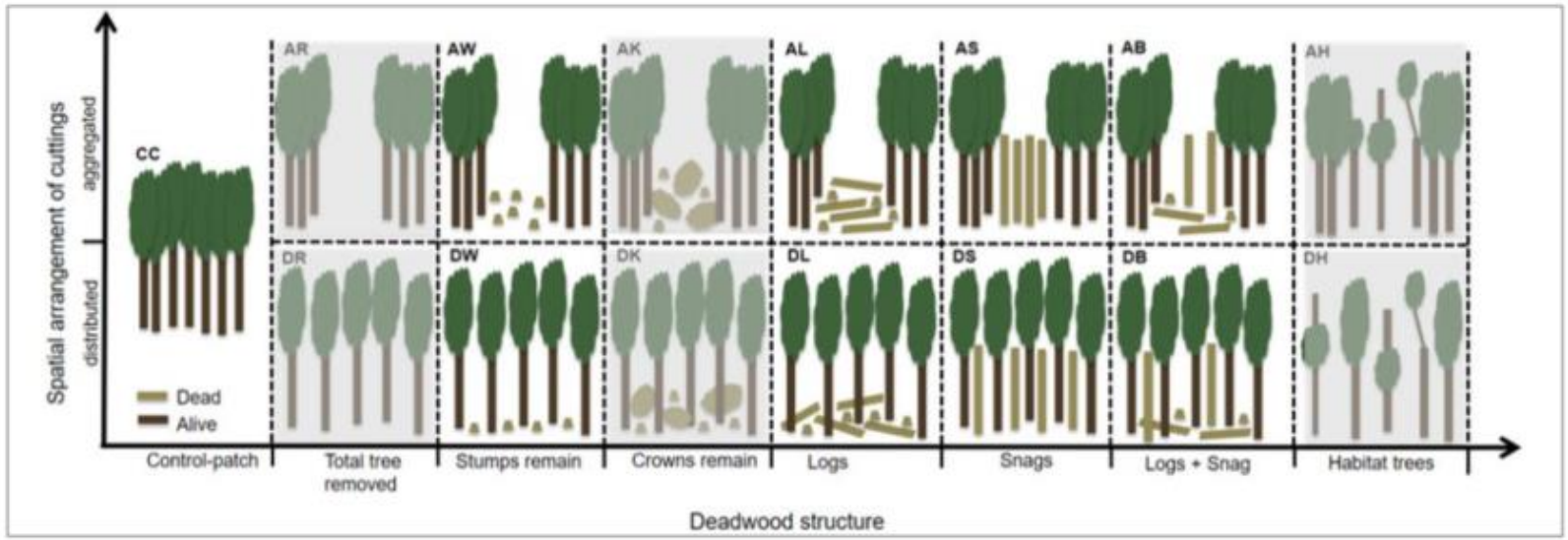
Heterogeneity–diversity relationships differ between and within trophic levels in temperate forests

Lea Heidrich [1]✉, Soyeon Bae[1], Shaun Levick[2], Sebastian Seibold [1,3], Wolfgang Weisser [3], Peter Krzystek[4], Paul Magdon[5], Thomas Nauss [6], Peter Schall [7], Alla Serebryanyk[4], Stephan Wöllauer[6], Christian Ammer [7], Claus Bässler[8,9], Inken Doerfler[3,10], Markus Fischer[11], Martin M. Gossner [12], Marco Heurich[8,13], Torsten Hothorn[14], Kirsten Jung [15], Holger Kreft [16,17], Ernst-Detlef Schulze[18], Nadja Simons[19], Simon Thorn[1] and Jörg Müller [1,8]

Study Areas and prior ESBC treatments



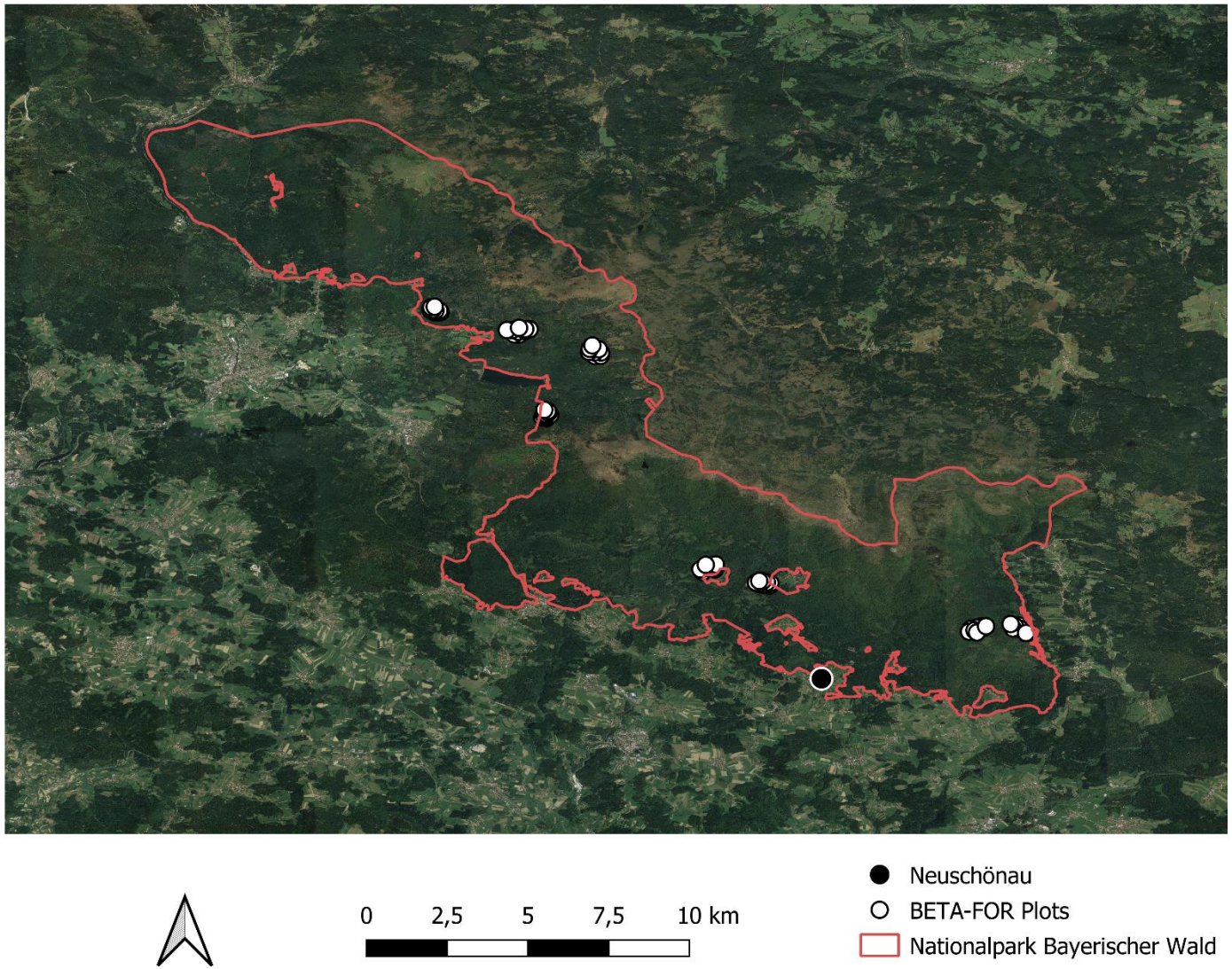
- Six regions of interest
- Preliminary work regarding ESBC treatments has been conducted to monitor environmental response over longer period
- ESBC = Enhancement of Structural Beta Complexity



BETA-FOR Plots in the Bavarian Forest

- 72 plots in total, close to:
  - Jungmaierhütte
  - Buchenau
  - Frauenau
  - Guglöd
  - Waldhäuser
  - Hohenröhren

- Treatments (distributed and aggregated):
  - Control
  - Complete removal
  - Stumps remain
  - Logs
  - Snags
  - Logs + Snags



Complementary EO Sensors: Multiscale Forest Structure Analysis

Sentinel-1: SAR

Landsat 8: Multispectral

LiDAR

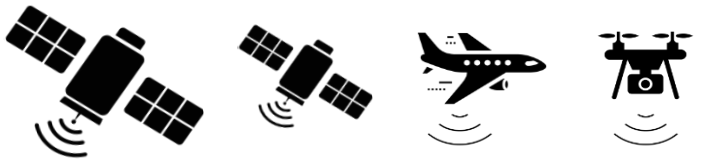
Sentinel-2: Multispectral

Landsat 9: Multispectral

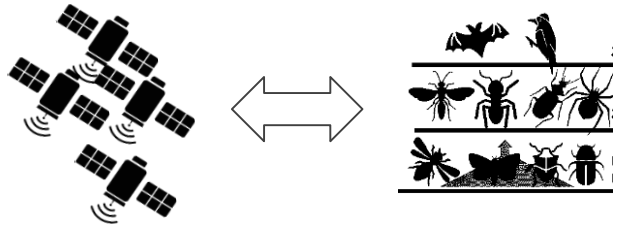
And many others
(airborne sensor, UAV) …

Hypotheses

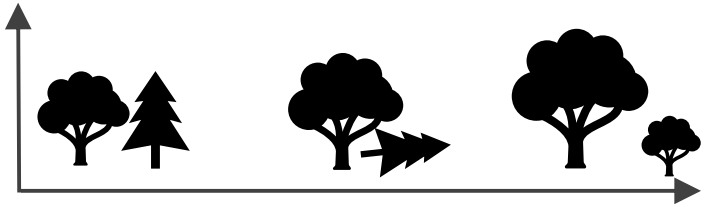
1. The variety of experimental forest disturbances taking place on multiple vertical and horizontal dimensions can be observed by remote sensing data to a **sensor-specific extent**.
   → Testing the capability of different sensors to detect and track experimental forest disturbances



2. **Multi-sensor data** explains the relationship of EO and biodiversity field data (forest beta- and gamma-diversity at patch, district and larger landscape scale) better than single sensor data.
   → Explore performance of data-fusion products compared to single sensor data



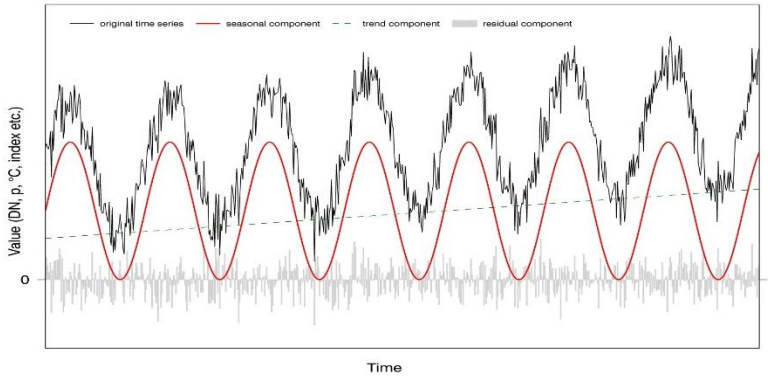
3. Space-borne remote sensing **time-series** data are suitable to capture the variation of beta-diversity and ecosystem function at larger landscape scale over time.
   → Monitor changes in beta-diversity over time at landscape scale



Methods

Stack of spatio-temporal time-series statistics:

- Vegetation indices: NDVI, EVI, IPVI, …
- Physical indices: LAI, LCI, …
- Moisture indices: NDWI, NDMI, …
- Radar metrics: VV, VH, VV/VH, …
- Reflectance metrics: VIS, NIR, SWIR, …
- Tasseled cap features: Br, Gr, Wet
- Structural metrics: canopy height, density, PAI, …



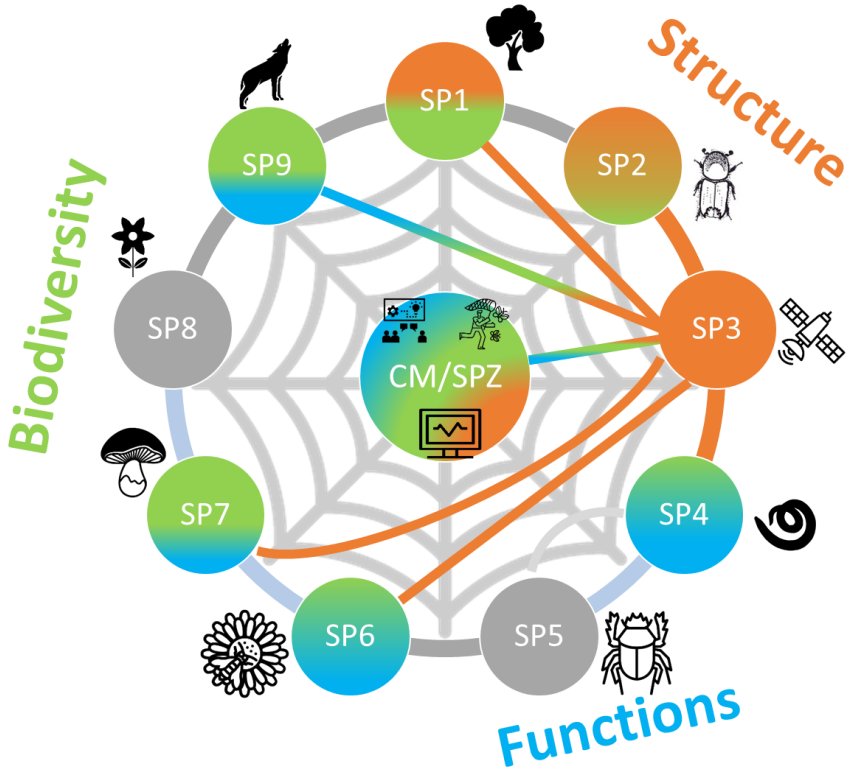
Modelling techniques:

- Machine learning regression models to link EBV with in-situ measurements
- Ordination techniques to visualize and quantitatively describe gradients in species composition
- Methods based on spectral diversity: spectral species concept, spectral information content, …

Novel approach:

integrate **Radar** (Sentinel-1) and **LiDAR** (GEDI) metrics as **dense time-series** in addition to **multi-spectral** products

Transdisciplinary Research Network



Bridging scales:

from in-situ patch to landscape level and beyond

- Correlation to terrestrial laser scanning of **SP1** (exchange on structure and vitality of the patches)
- … with soil and microclimate data of **SP4** and **SPZ** (information on ecosystem function)
- … with taxa data on biodiversity of **SP6, SP7** and **SP9** (training and validation data for the prediction of diversity)

Questions & Comments

Thank you very much for your attention!