CzechGlobe
GLOBAL CHANGE
RESEARCH INSTITUTE CAS

Zjišťování stavu lesních porostů z dat laserového skenování a optického DPZ

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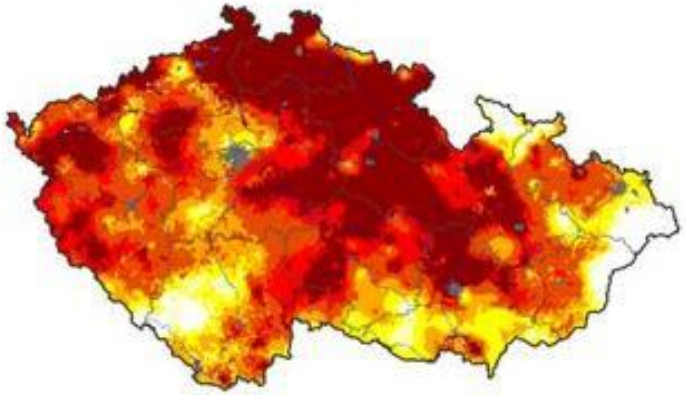
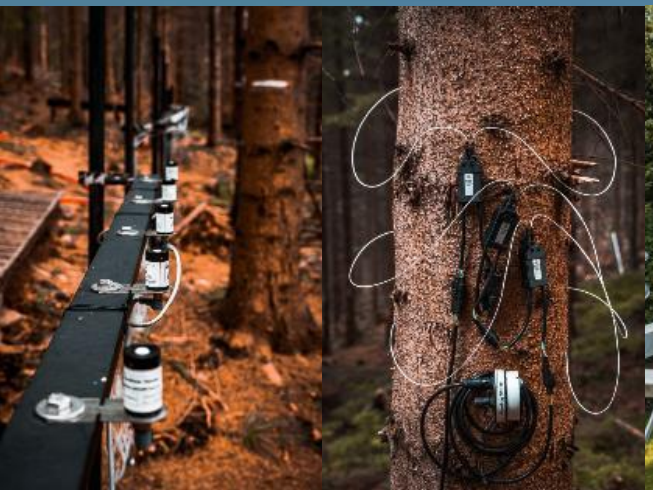
J. Novotný, O. Brovkina, B. Navrátilová, P. Lukeš, M. Švik

- Krátké představení pracoviště DPZ CzechGlobe
- Využití dat leteckého laserového skenování pro mapovaní struktury a biomasy lesních porostů
- Využití optických dat DPZ pro mapovaní biochemických charakteristik lesních porostů

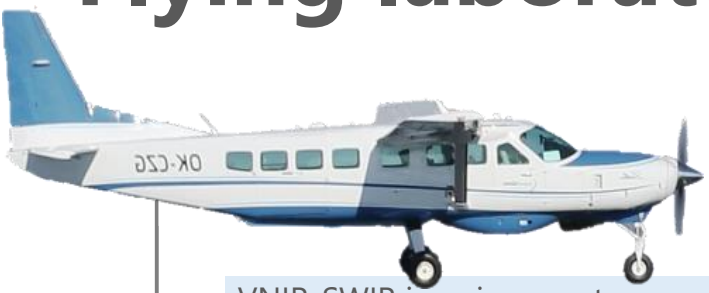
Ústav výzkumu globální změny AV ČR

INTERSUCHO





Flying laboratory of imaging systems (FLIS)



VNIR-SWIR imaging spectroscopy

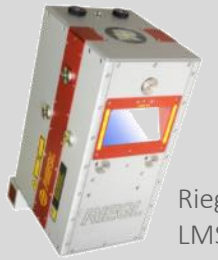
CASI-1500

SASI-600

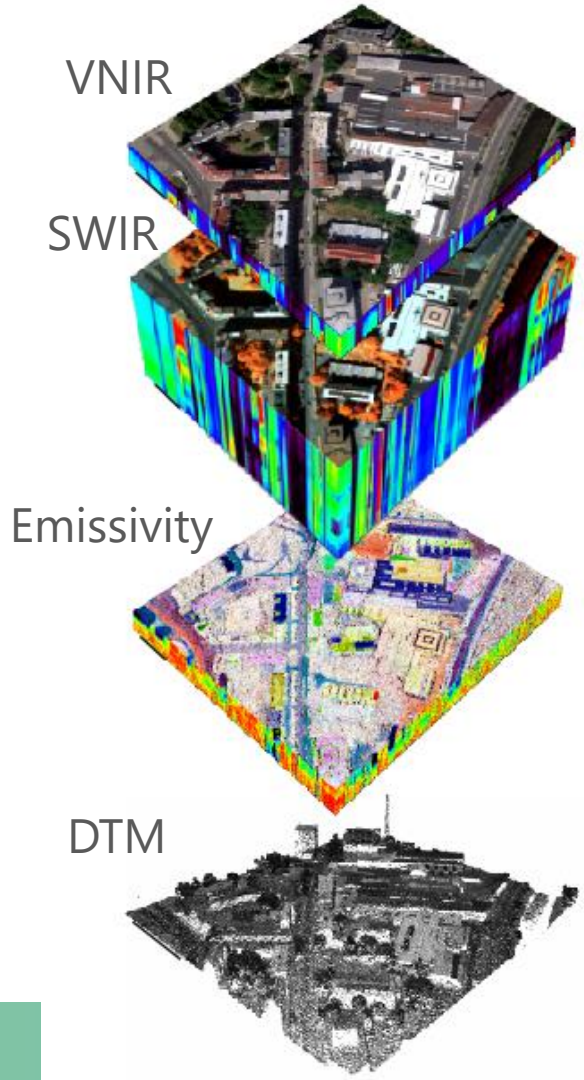
Thermal imaging spectroscopy

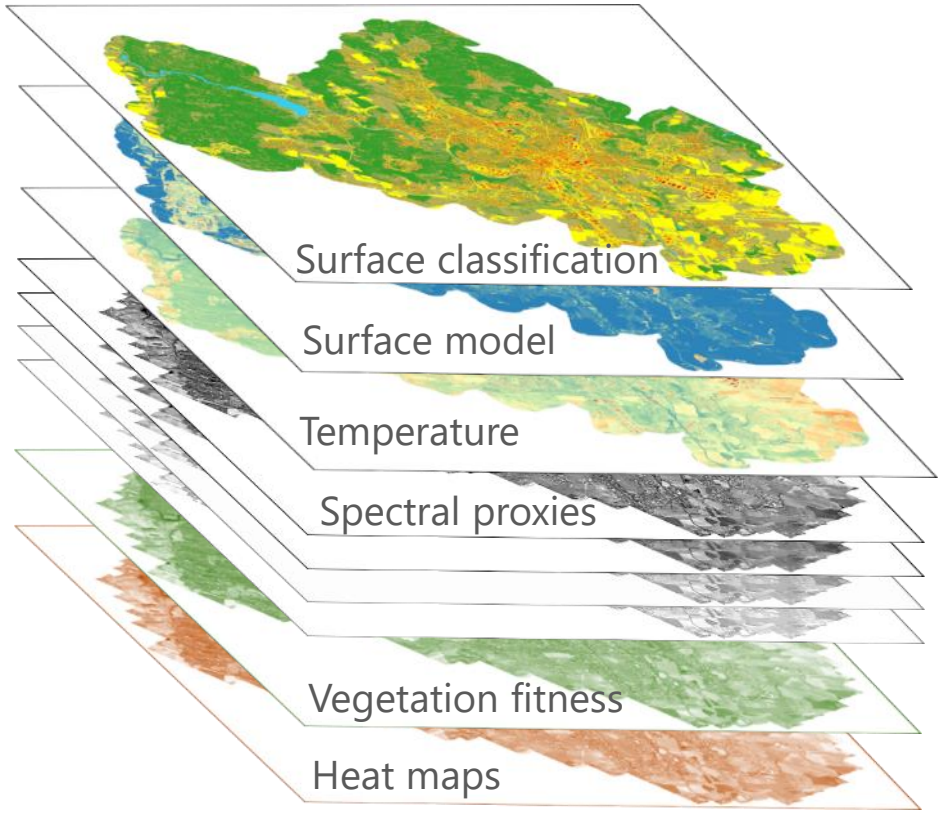
TASI-600

Laser scanning



Riegl
LMS – Q780





Hanuš et al. (2023) https://www.mdpi.com/2072-4292/15/12/3130

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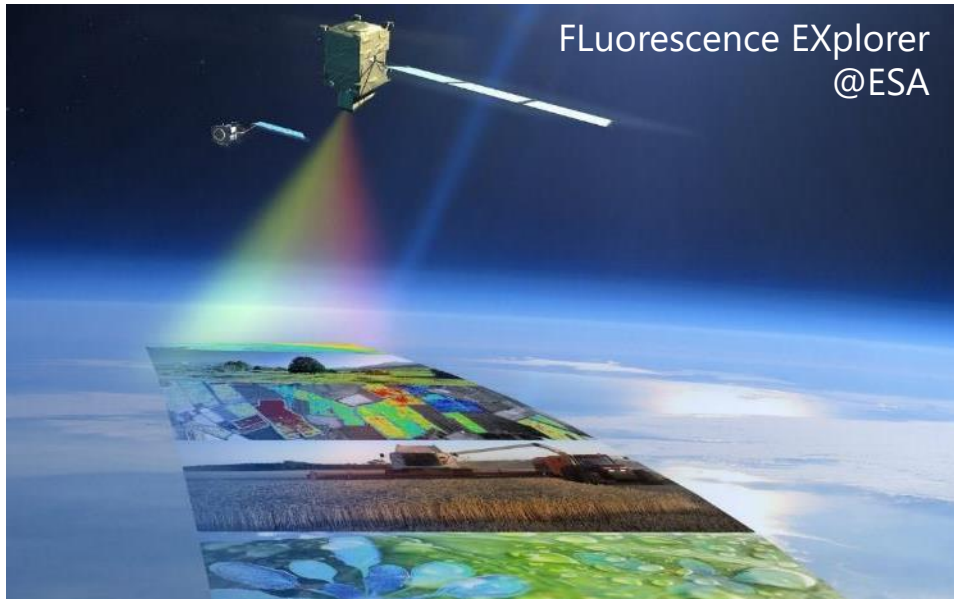
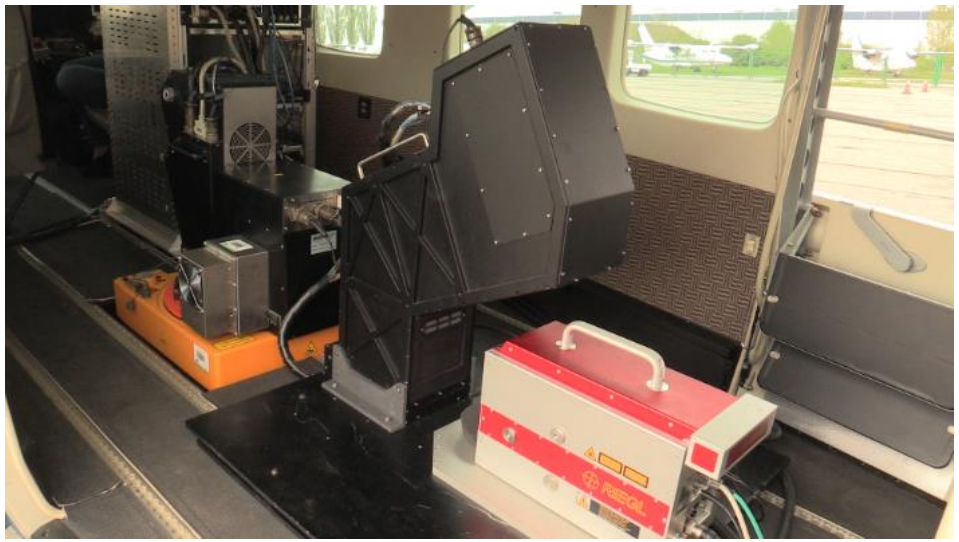
FLIS operations in CZ & Europe research space





esa

Consiglio Nazionale delle Ricerche

PRISMA

Aalto University

JÜLICH FORSCHUNGSZENTRUM

University of Zurich[UZH]

EUFAR European Facility for Airborne Research

cenia

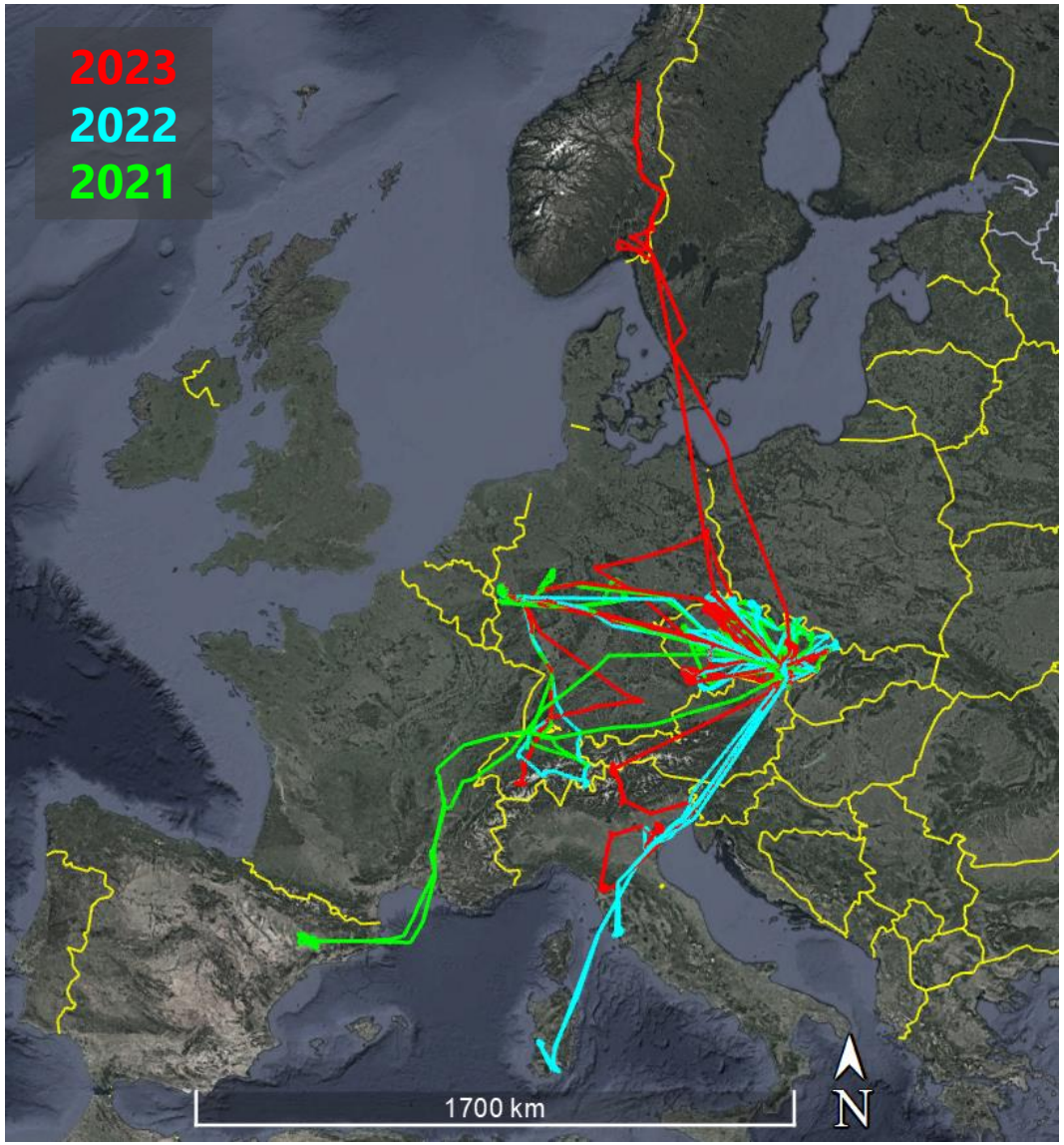
1919 ČESKÁ GEOLOGICKÁ SLUŽBA

MENDELU Faculty of Forestry and Wood Technology

B R N O

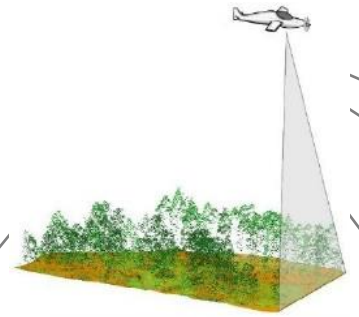
CZU Czech University of Life Sciences Prague

FACULTY OF SCIENCE Charles University

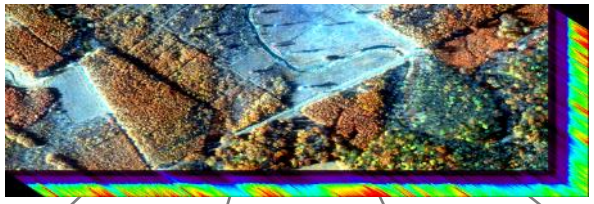


Forest inventory attributes from RS

Airborne laser scanning

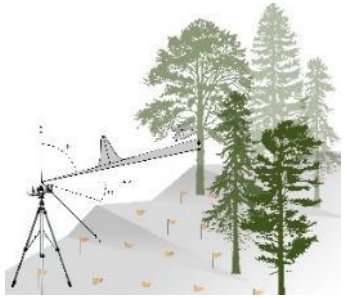


Optical remote sensing



DBH | Tree position | Tree height | Crown base | AGB | Crown width | Species | Dead trees | Health status

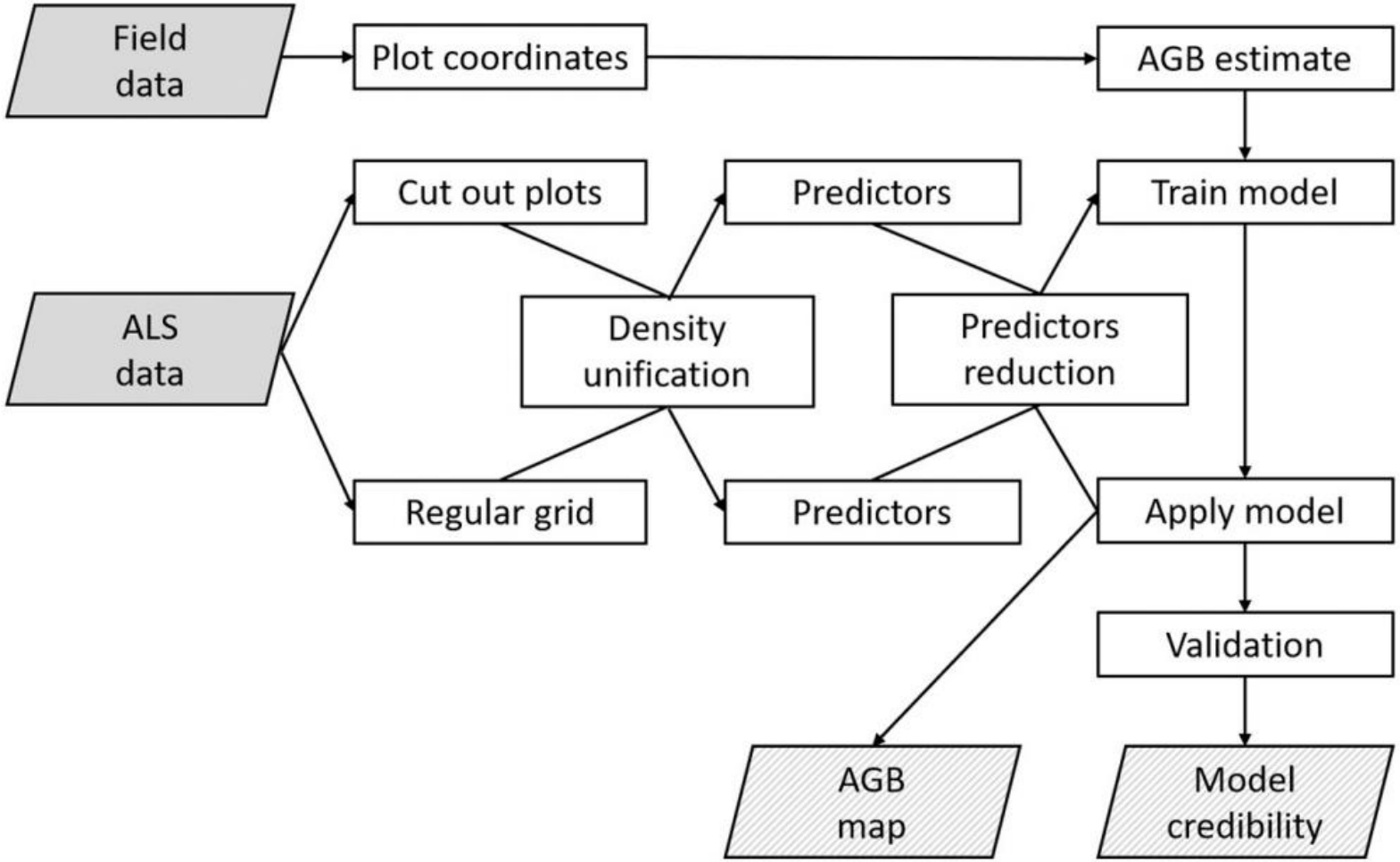
Terrestrial laser scanning



Spectral indices
Plant traits such as:
- Leaf/canopy pigments
- Leaf/canopy nutrients
- Leaf/canopy water
- Leaf mass per area
- Leaf area index

Fluorescence / photosynthesis parameters

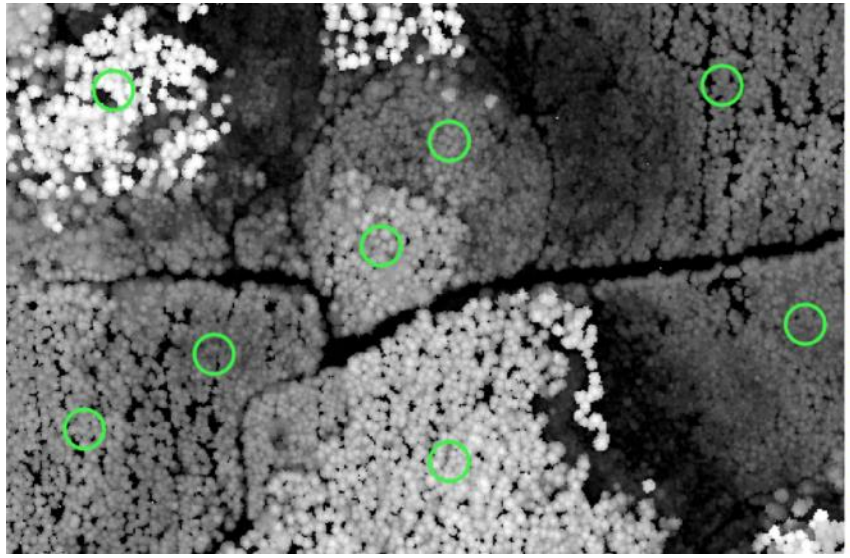
Area-based approach: forest biomass from laser scanning



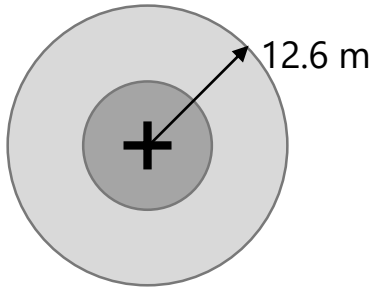
Brovkina et al. (2022) https://doi.org/10.1016/j.ecoinf.2022.101754

Predictors from airborne laser scanning data

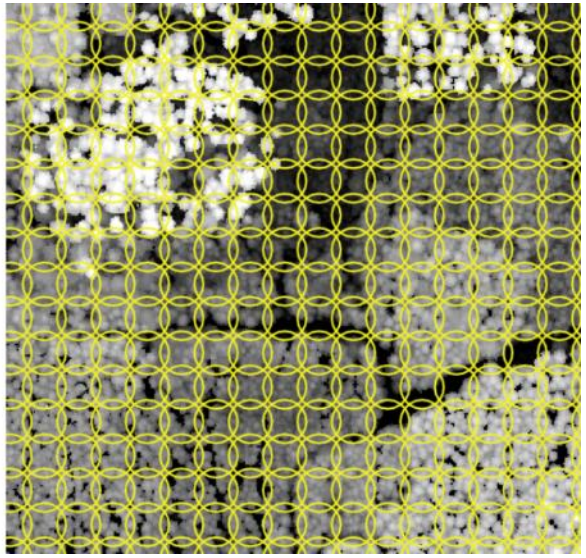
Field plots



500 m^2 plot

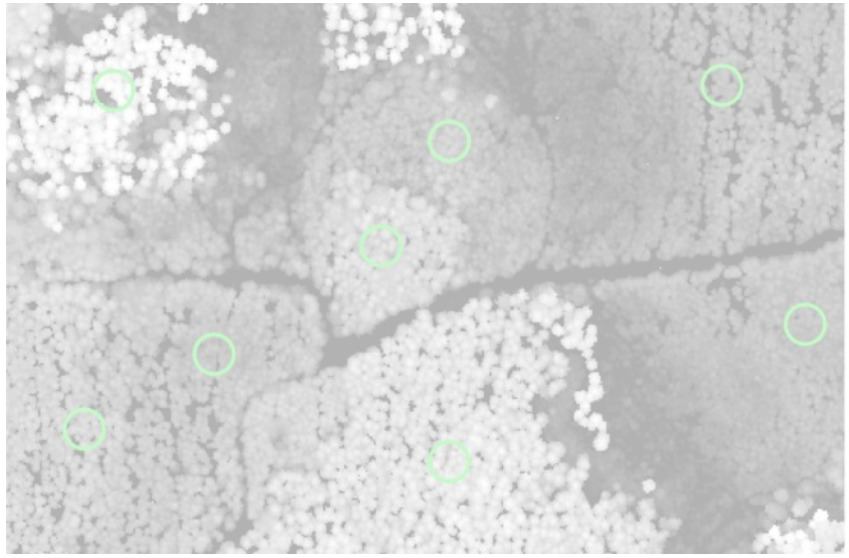


Regular sampling

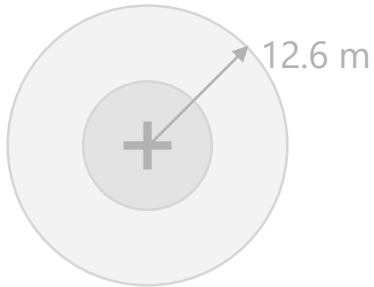


Predictors from airborne laser scanning data

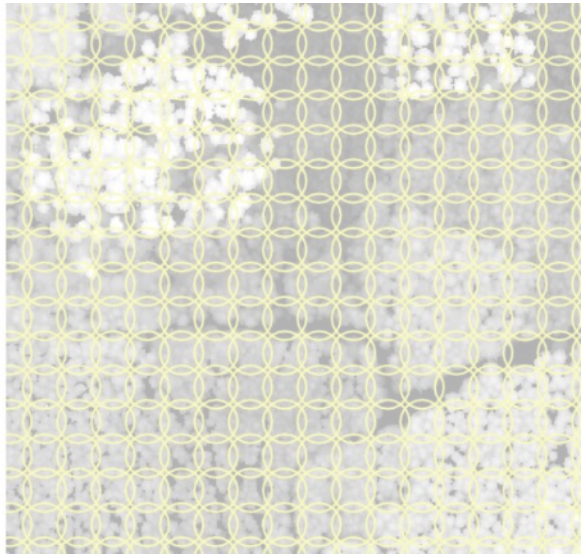
Field plots



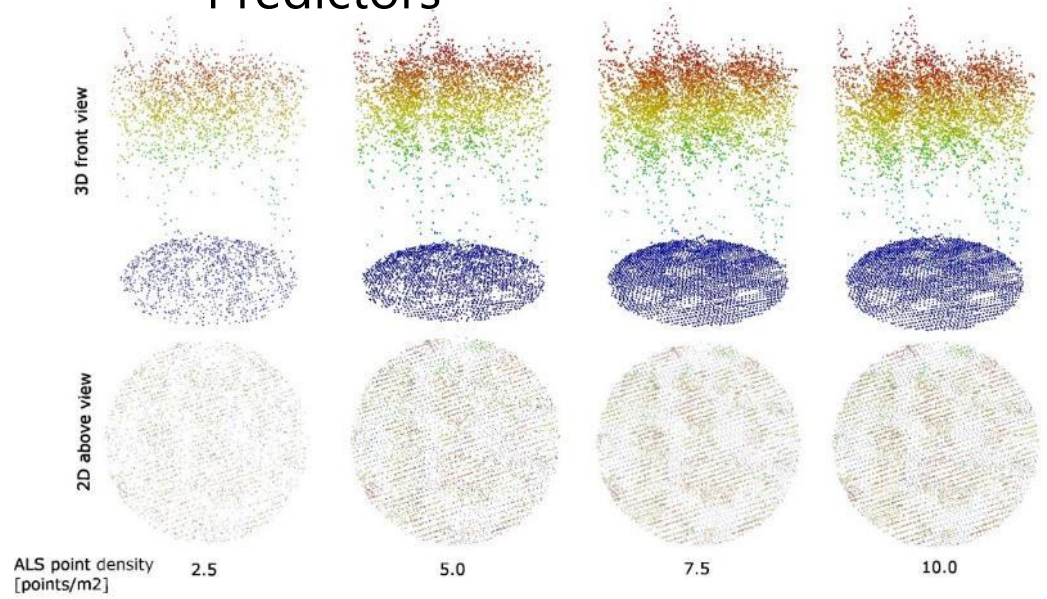
500 m^2 plot



Regular sampling



Predictors



- Descriptive stats such as mean, median, standard deviation, quantiles (Q10, Q20, … Q90), kurtosis, skewness
- Penetration ratios (number of points below Q10, Q40, Q70 divided by all points)

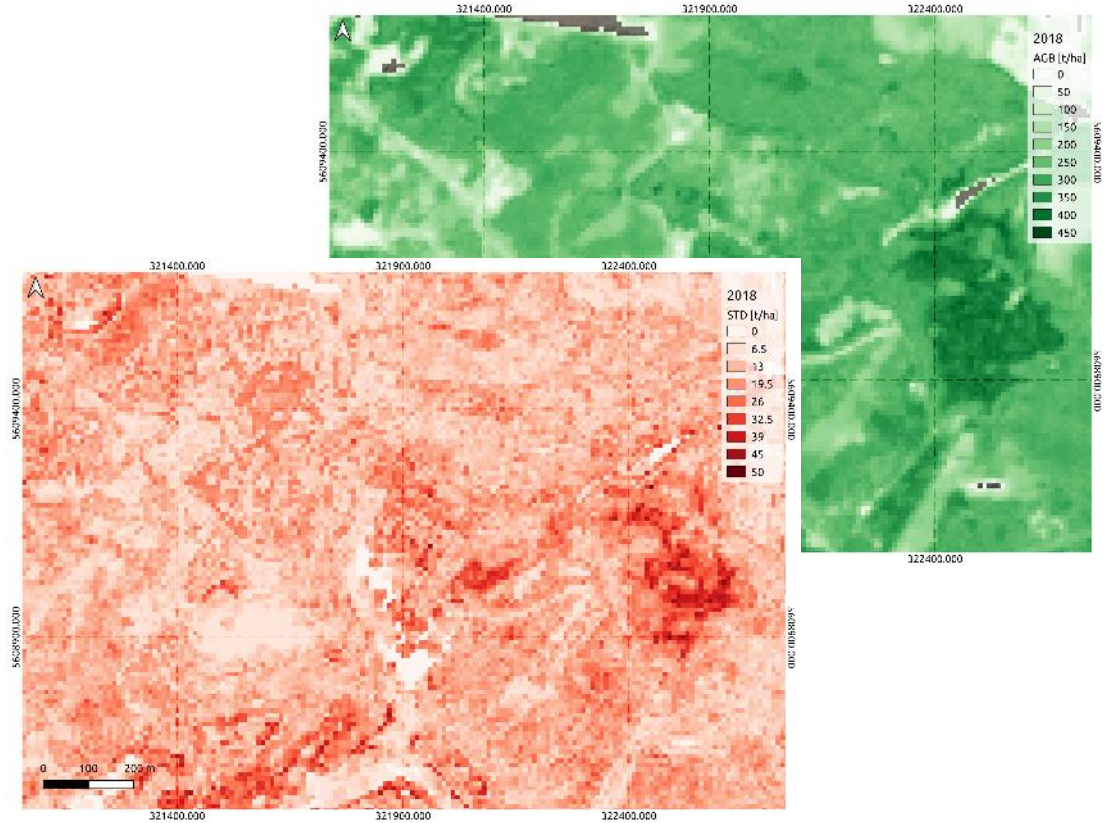
Method

- Field data from multiple campaigns (n > 500)
- Assessing quality and credibility of field plots
- Balanced samples for broadleaf and conifers and for all biomass categories
- Stratified splits to training / validation sets
- Regression methods
  - AdaBoost
  - Random forest
  - Neural networks
  - Bayessian ridge regression

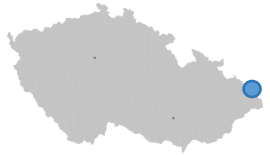
Final model

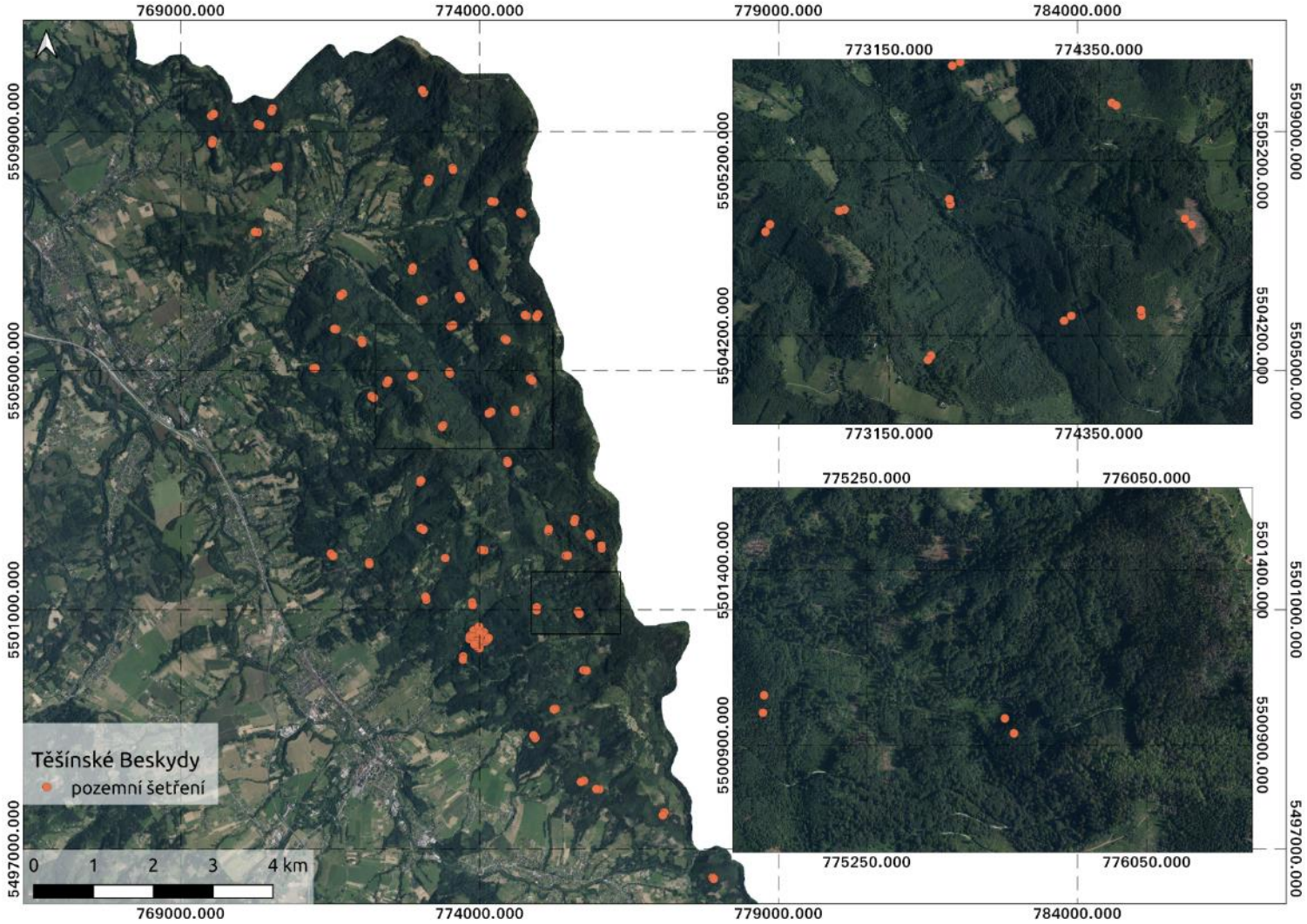
Final model = average of *top10* models

- What is it *top10* ?
  - Best 10 models based on their *score*
  - *Score* combines RMSE, R^2, average angle deviation from 1:1 line, accuracy with assigned tolerance, cross-validation R^2 etc.



Example – Těšínské Beskydy





Brovkina et al. (2022) https://doi.org/10.1016/j.ecoinf.2022.101754

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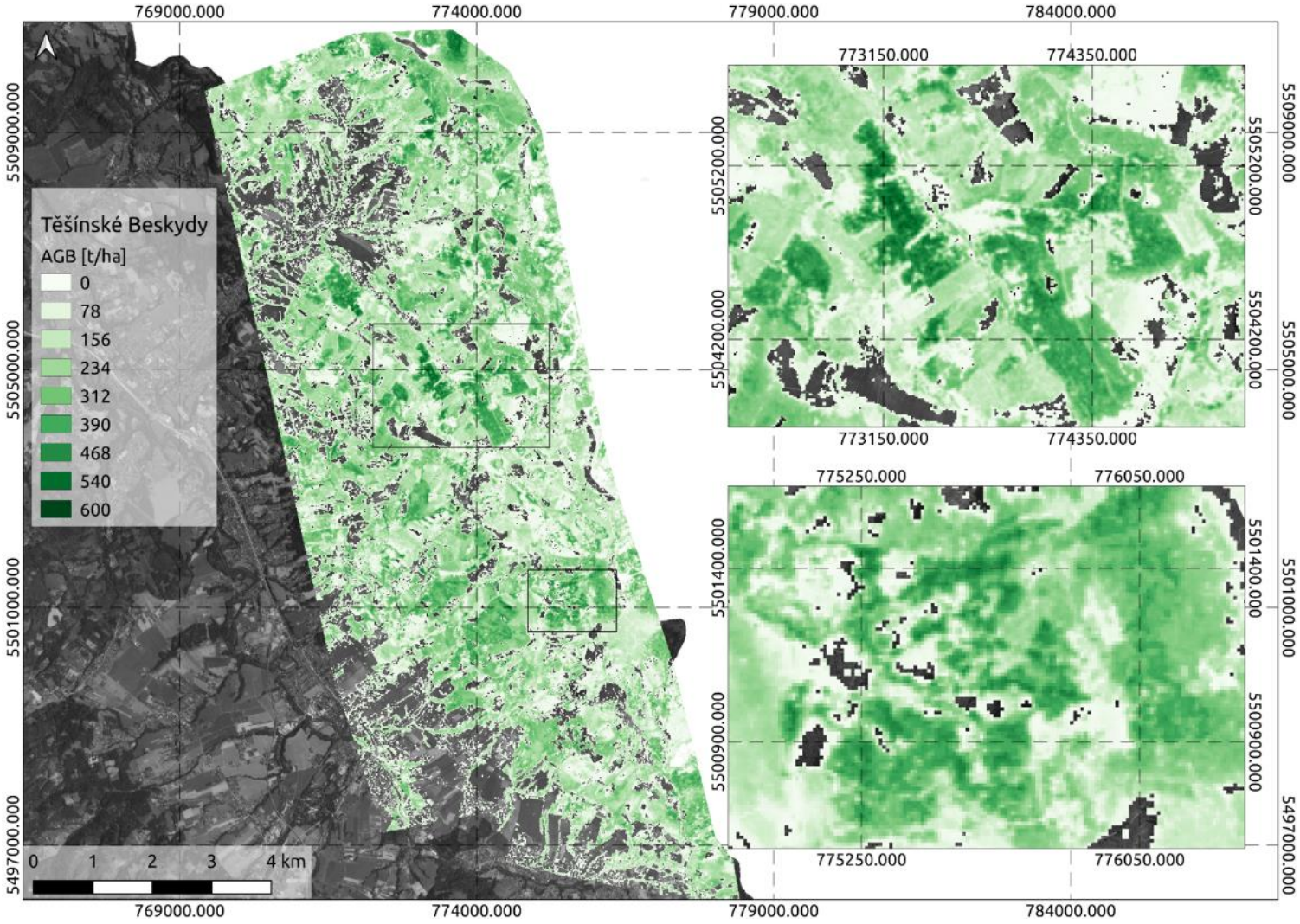
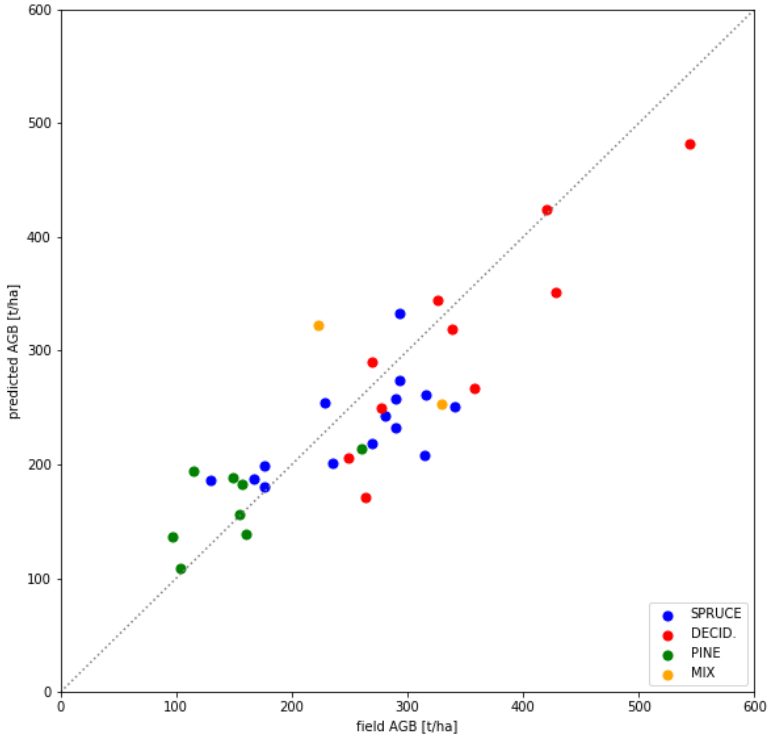


Brovkina et al. (2022) https://doi.org/10.1016/j.ecoinf.2022.101754

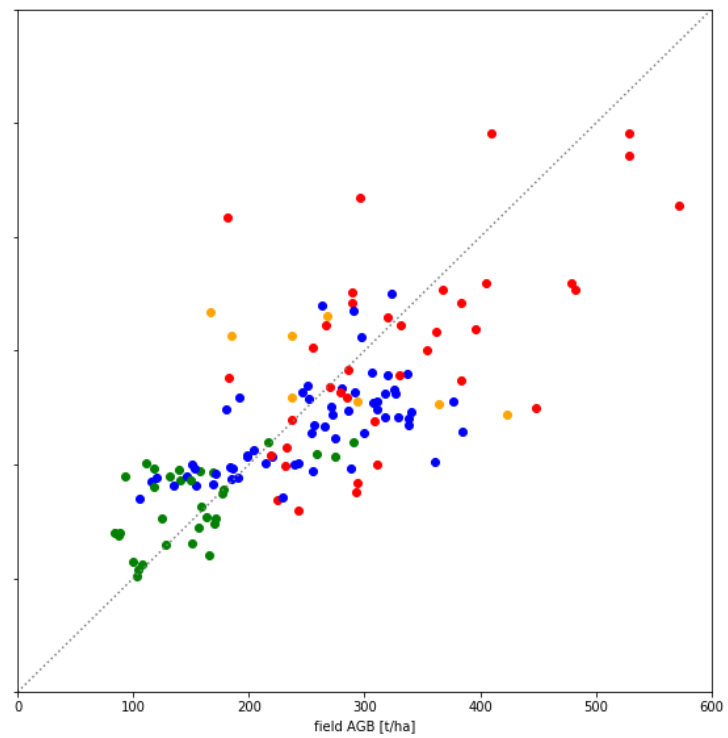
Independent validation using DendroNet

non-param	30×30	15×15
GLOB	**14 %**	**18 %**
L1:Těš. Beskydy	16 %	19 %
L2: Švihov	17 %	24 %
L3: Lanžhot	27 %	25 %
L4: Štítná	19 %	20 %
L5: Bílý Kříž	25 %	26 %

30 x 30 m



15 x 15 m



Forest biomass assessment

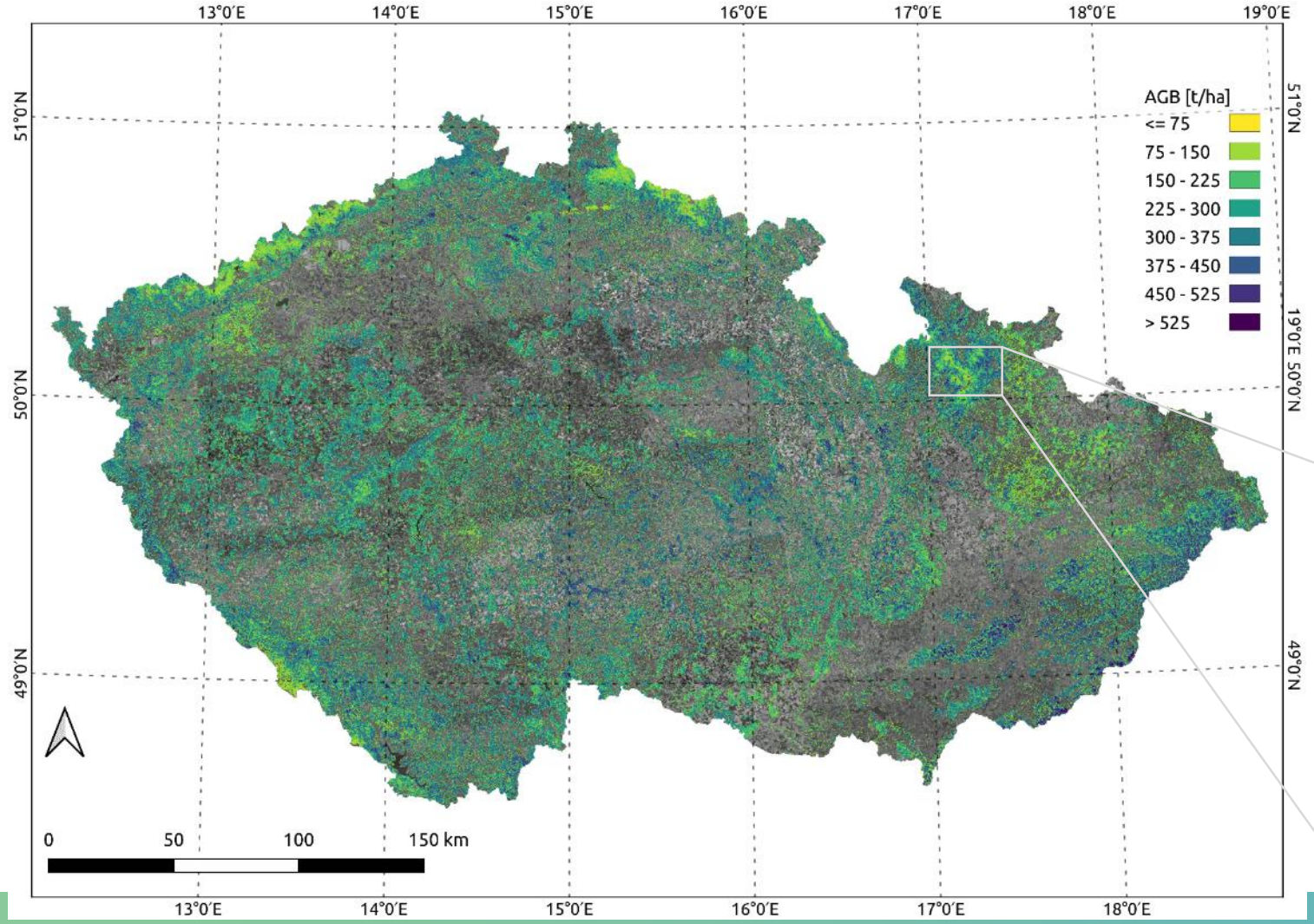
- Inner uncertainty of about 10 % is present in every ABA model.
- ABA map uncertainty is typically twice as high when the model is trained on one site and transferred to another place.
- Test with point densities (2 – 10 pts/m^2) showed little impact on the accuracy.

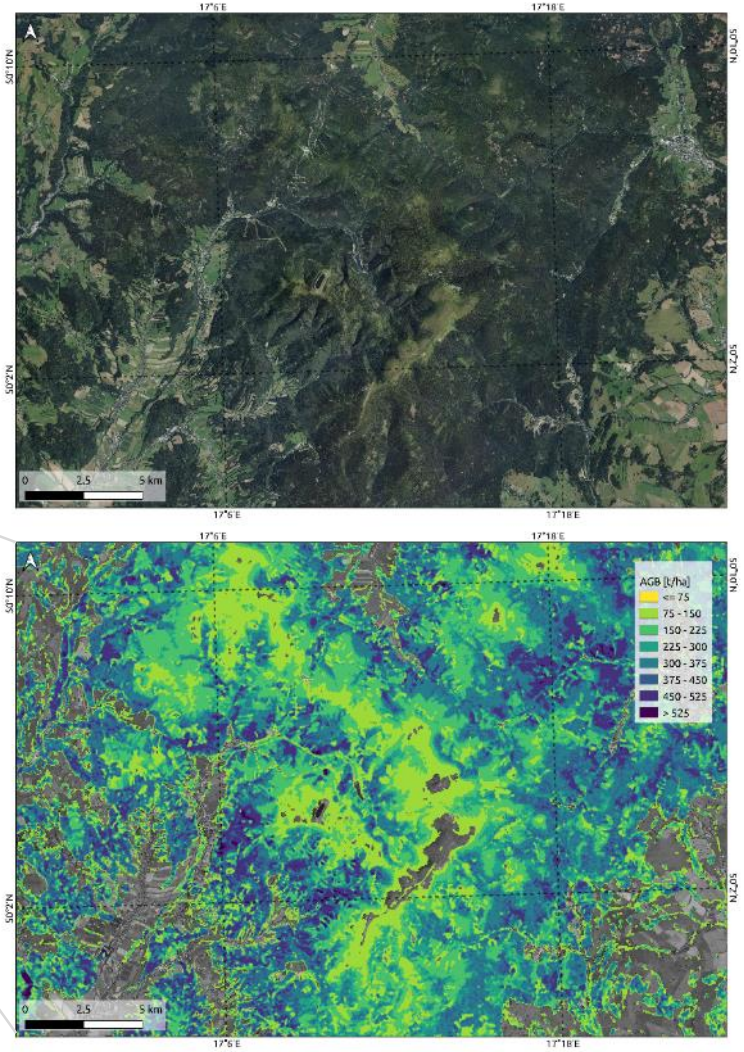
- In the Czech Republic, airborne laser scanning data are limited to selected forest areas only. What are the options for forest biomass mapping at the country scale?

ČÚZK – ortophoto
Since 2003, half of ČR scanned every two years

ÚHUL – surface model
Stereoscopic interpretation resulting in nDSM in 2m/pix

CzechGlobe – AGB
Field data + methods of machine learning -> final map in 20m/pix





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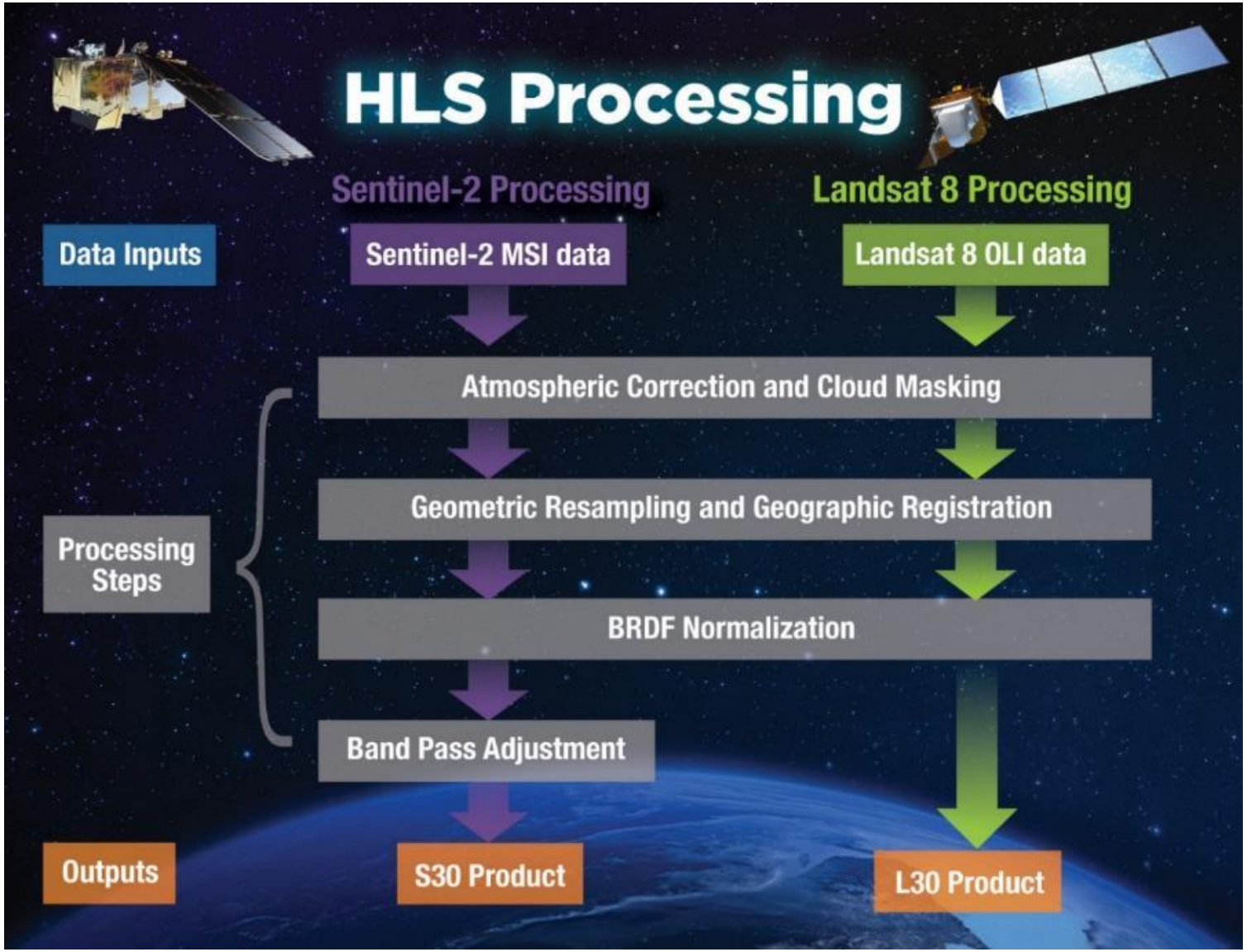
Seasonal course of forest biochemical traits from optical HLS satellite data

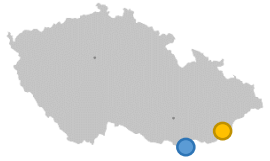


Number of cloud-free images

	L30	S30
2017	9	17
2018	17	37
2019	9	35
2020	14	33
2021	10	33
2022	37	41

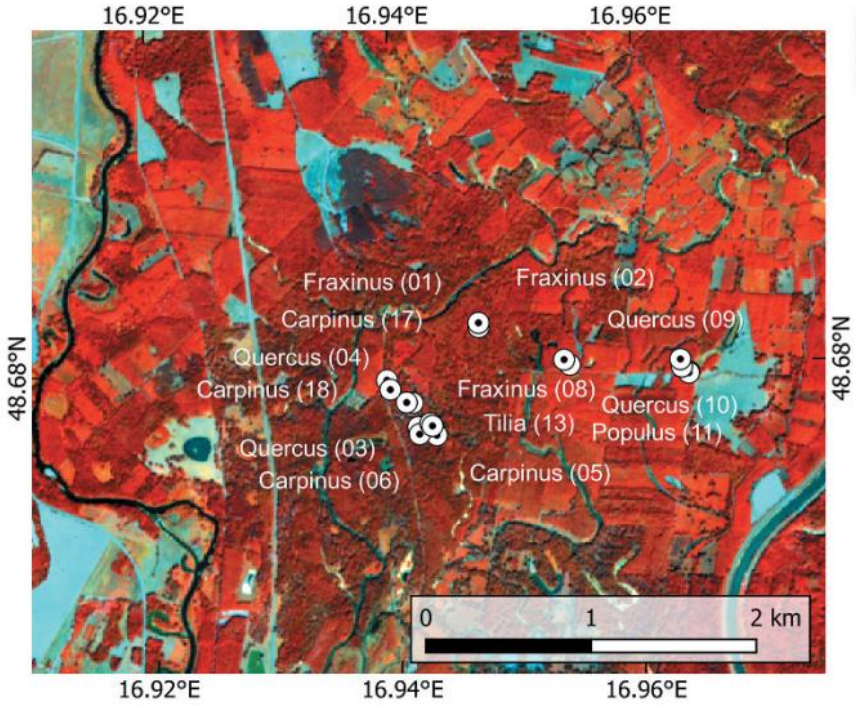
Source: https://hls.gsfc.nasa.gov/

Methods

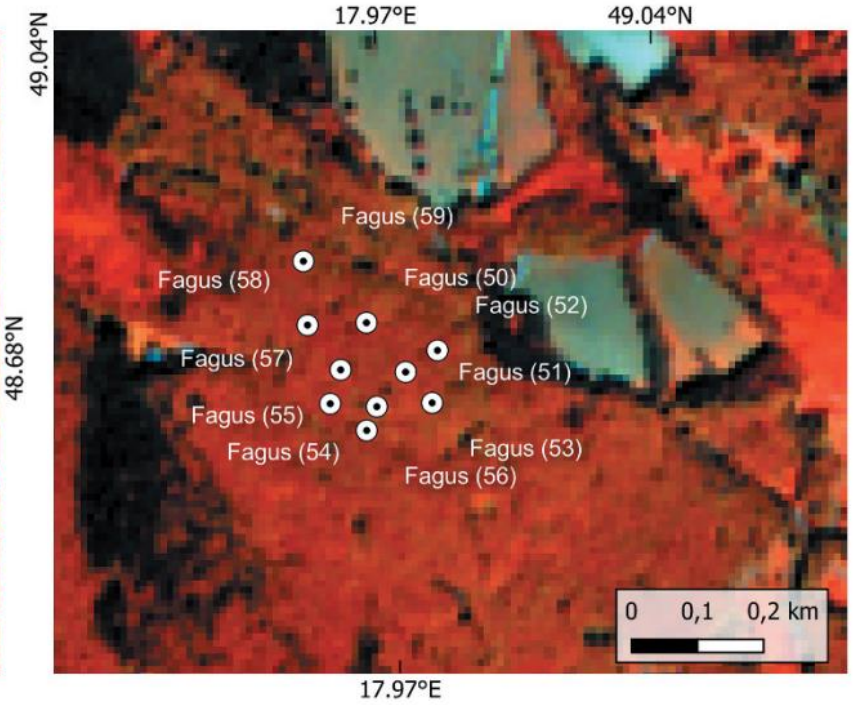


Several field campaigns during two vegetation seasons

Lanžhot
Mixed broadleaf floodplain forest



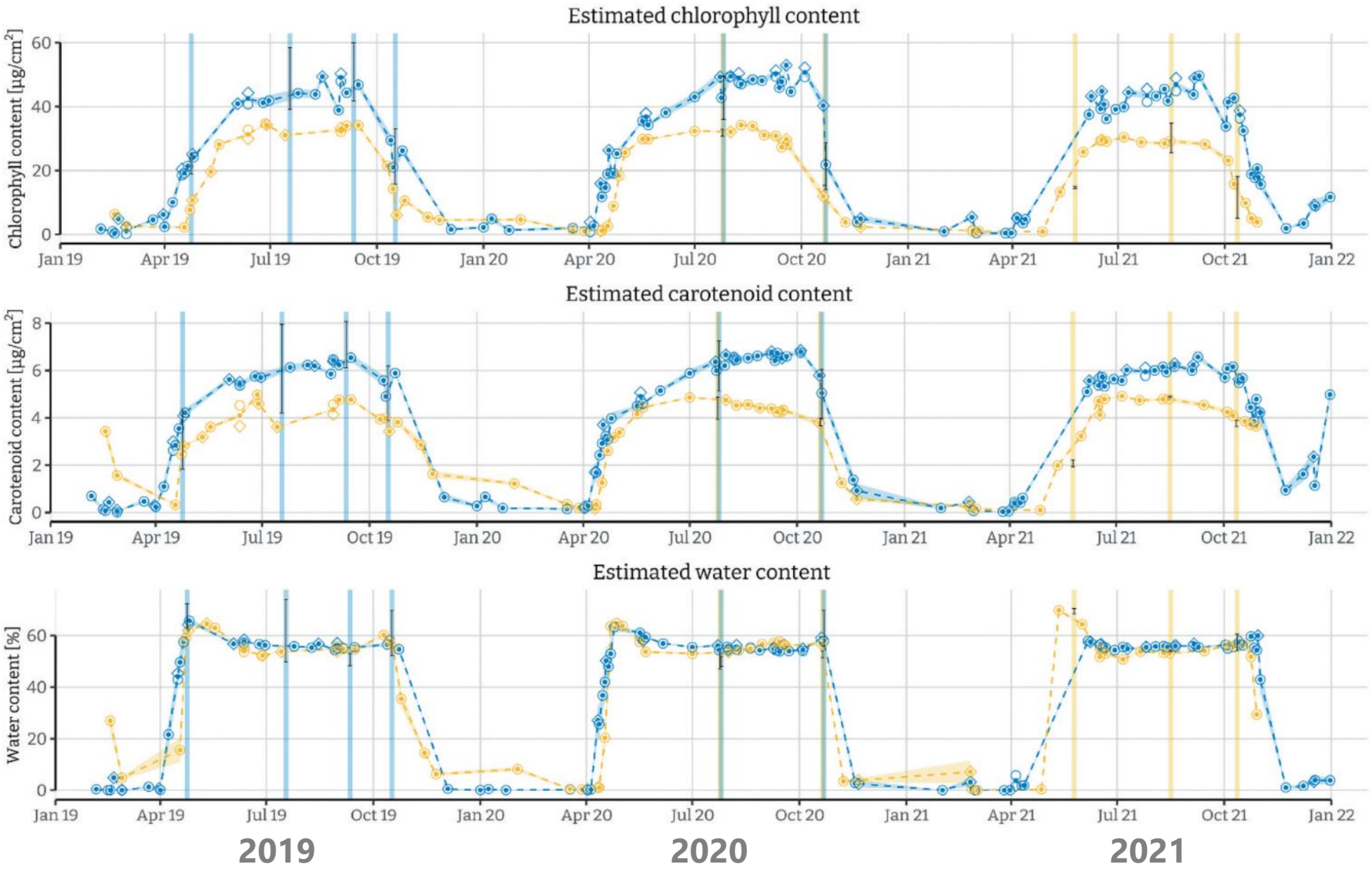
Štítná nad Vláří
Old European beach forest

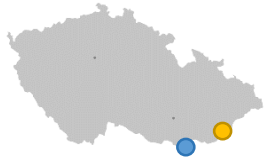


Testing several regression methods in

ARTMO

https://artmotoolbox.com/



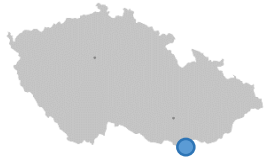


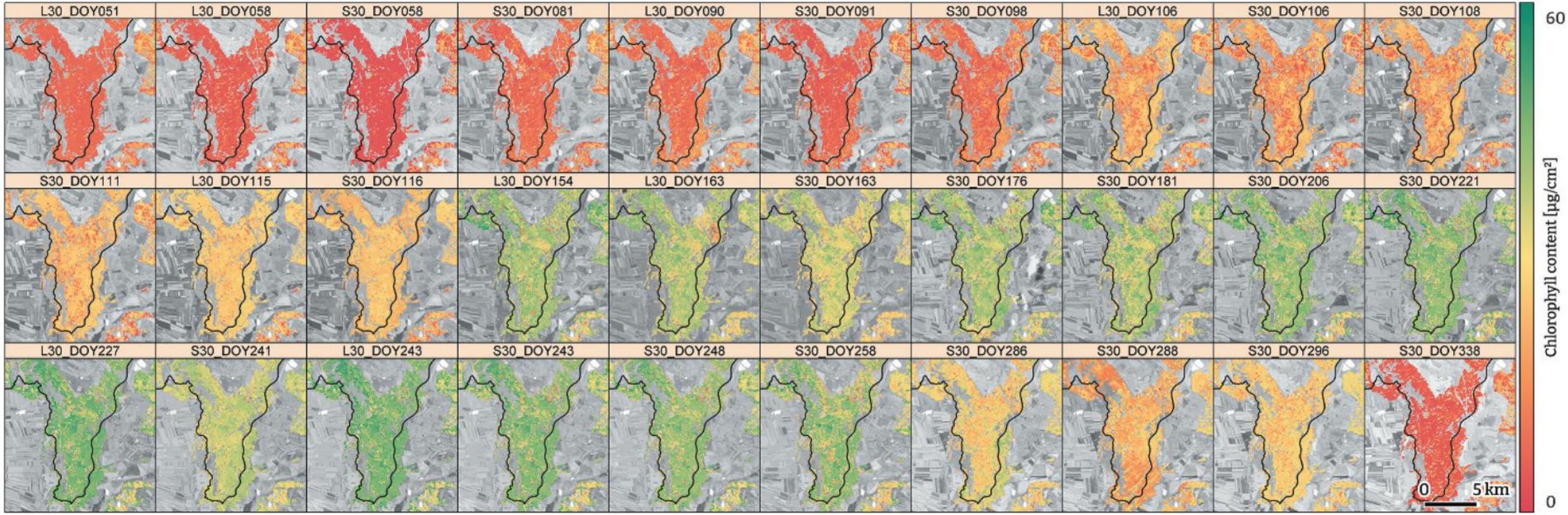
Lanžhot
(mixed broadleaf)

Štítná
(beach forest)

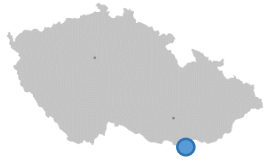
Švik et al. (2023) https://www.tandfonline.com/doi/full/10.1080/01431161.2023.2216847

Spatial pattern of chlorophyll in 2019

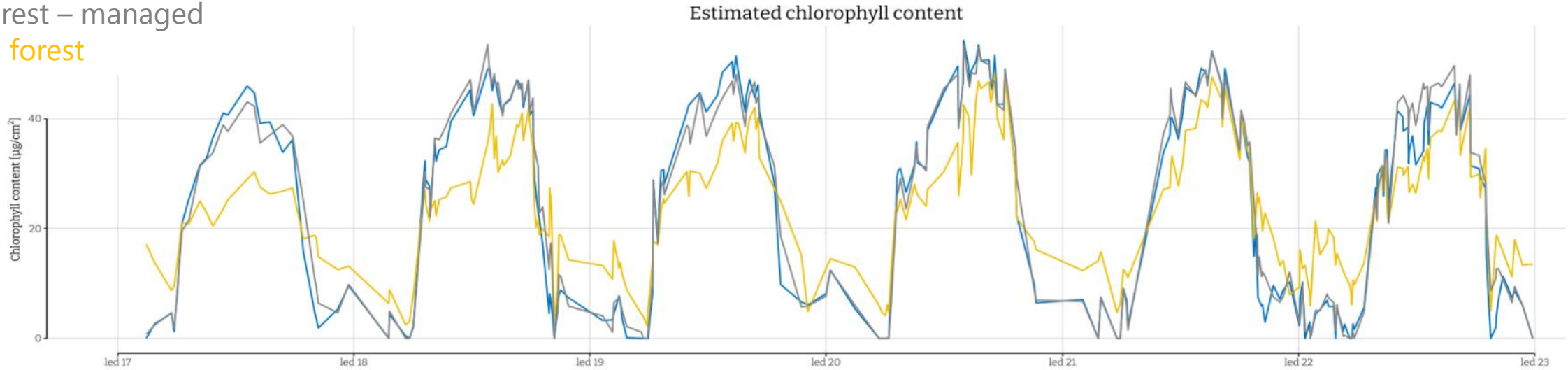




Seasonal patterns (mixed broadleaf)

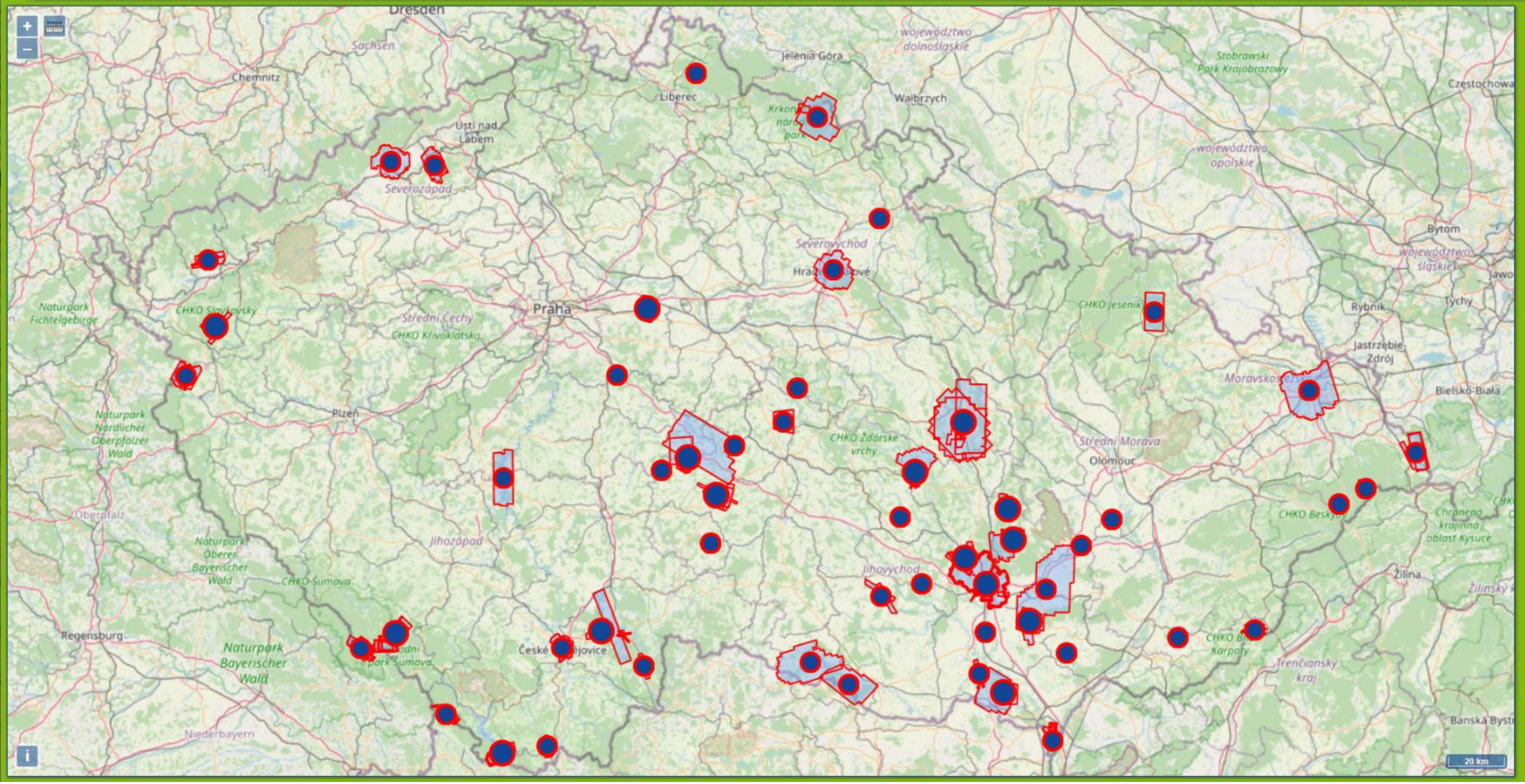


Old forest - protected
Old forest – managed
Young forest



	2017	2018	2019	2020	2021	2022
Temp. (°C)	13,6	14,9	14,4	13,5	12,6	14,0
Precip (mm)	569	492	684	648	479	420

https://mapserver.czechglobe.cz/



Filtry

Typ dat

Typ ekosystému

Lokalita

Přehled lokalit

Seznam lokalit

Územní rozsah

Podkladová vrstva

Základní OpenStreet…

Kontakt: Tomáš Fabiánek

Vytvořil Jiří Kozel, 2012-2020.

Děkuji za pozornost.

Více informací na

https://olc.czechglobe.cz/

https://czechglobe.cz/dpz

https://mapserver.czechglobe.cz/

https://twitter.com/RS_CzechGlobe

Nebo pište na

homolova.l@czechglobe.cz