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² CzechGlobe, Brno, Czech Republic

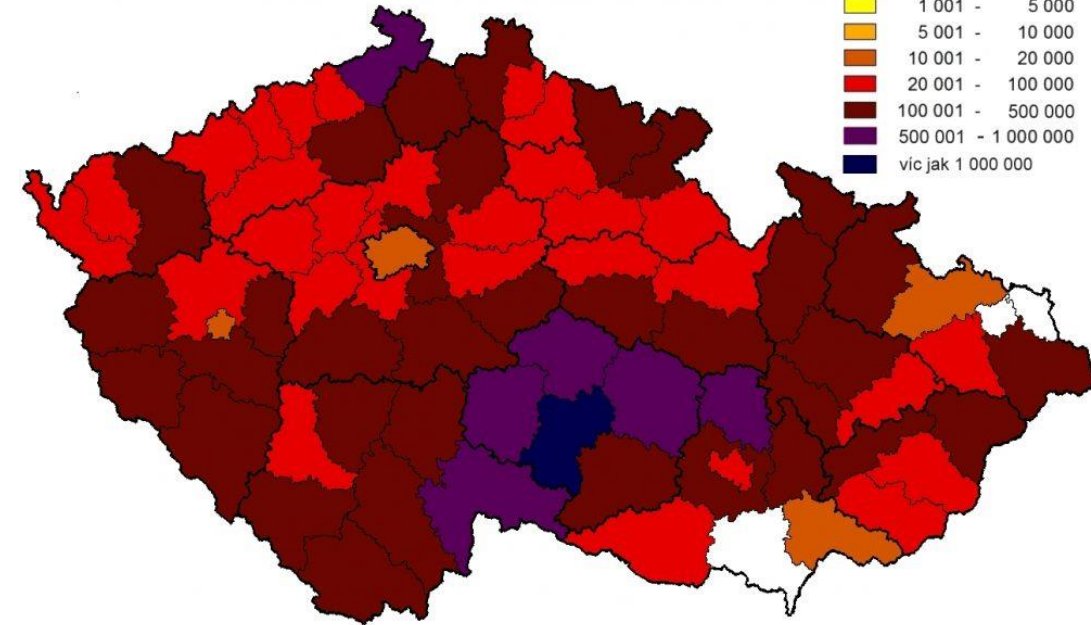
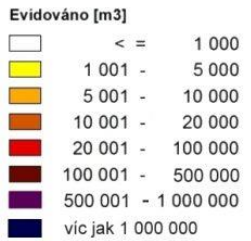
INTRODUCTION

SCERIN Region:

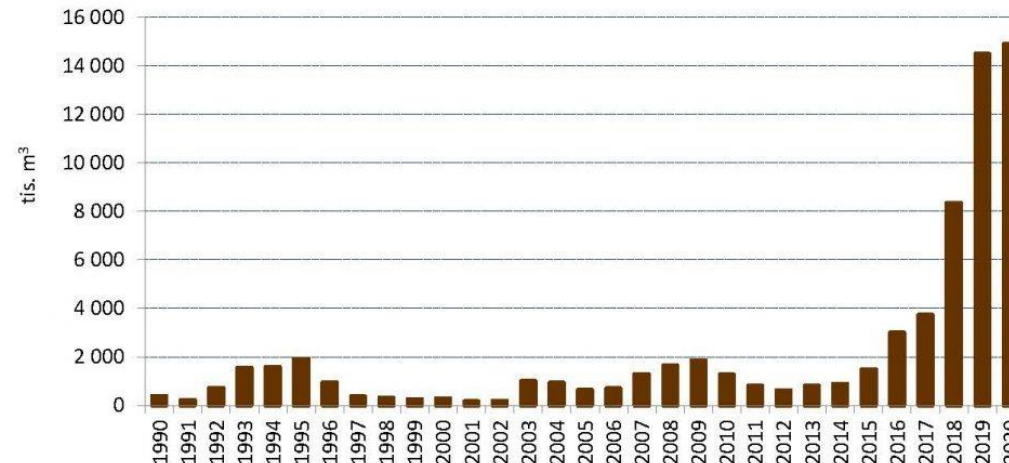
- Natural hazards: climate changes brings more common meteorological extremes
- Heat and drought waves in forests cause susceptibility to insect outbreaks, attacks
- Endangered carbon sequestration, crop yield

CZECHIA:

- Majority of spruce monocultures from historical reasons
- 2013-2018 series of very dry years led to **bark beetle calamity (*Yps. spp.*) in spruce forests**
- Calamity induced timber logging, clearcuts,
- **NEED OF AFFORESTATION WITH MORE CLIMATE-RESISTANT TREE SPECIES, SUCH AS SILVER FIR, BEECH, OAK**



Map: Recorded volume of spruce timber due to bark-beetle calamity in the Czech Republic in 2020 (m²)



Graph: recorded volume of harvested spruce timber in the years 1990–2020

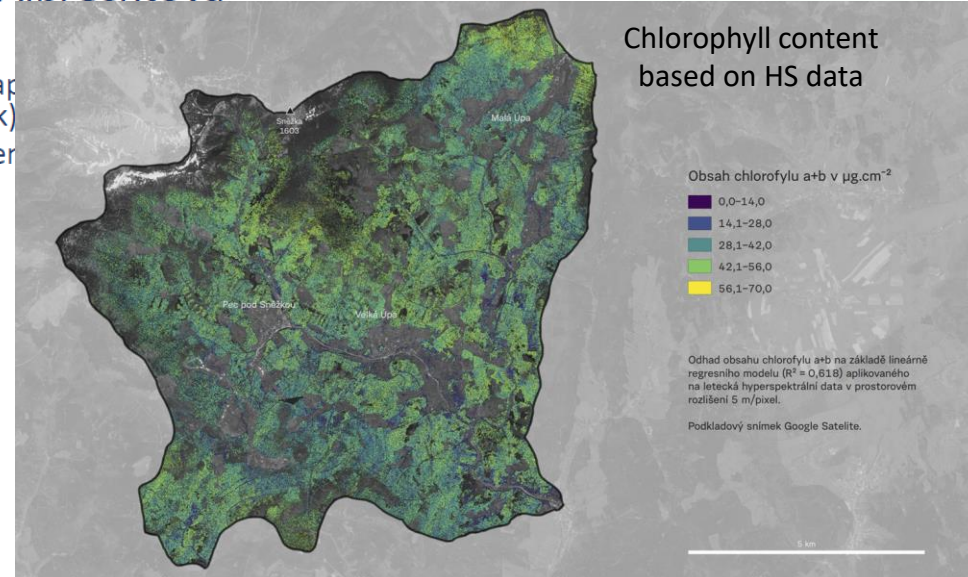
Evaluating the potential of UAV image data for bark beetle infestation monitoring: a case study in the Krkonoše Mts., Czechia

Salma Bijou¹, Lucie Kupková¹, Markéta Potůčková¹, Lucie Červená¹, Jakub Lysák¹, Zuzana Lhotáková², Eva Neuwirthová², Jana Albrechtová²



¹ Charles University, Faculty of Science, Department of Applied Geoinformatics and Cartography (marketa.potuckova, lucie.cervena, jakub.lysak)
² Charles University, Faculty of Science, Department of Plant Experimentation

Chlorophyll content based on HS data

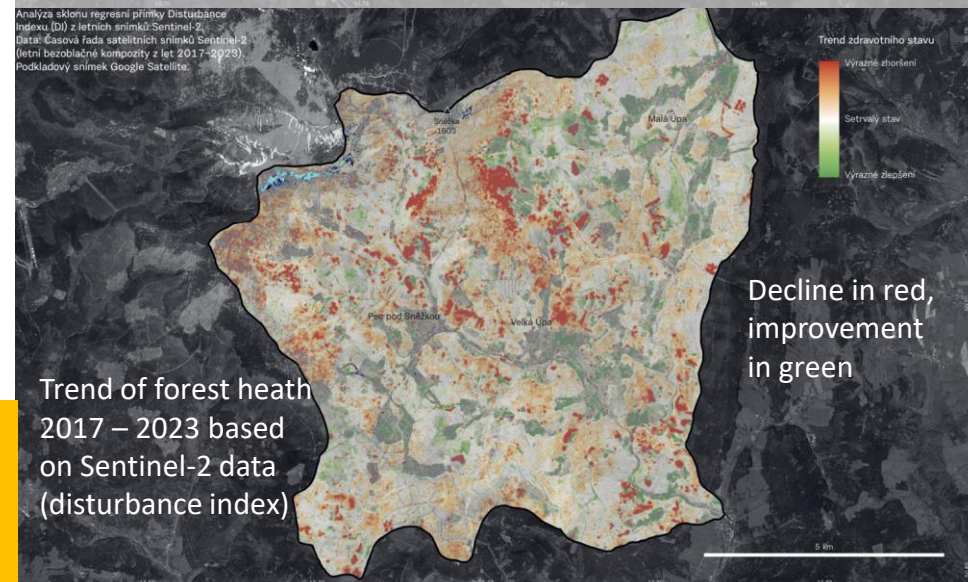


Part of the project TACR: „Assessment of the impact of land cover changes on local hydrology and climate in the Krkonoše Mts. National Park using remote sensing and hydrological modelling“

Collaboration with CzechGlobe (Lucie Homolová, Petr Lukeš, Václav Bárta and Institute of Hydrodynamics CAS – Václav Šípek, Lukáš Vlček)

Team: Lucie Kupková, Lucie Červená, Jakub Lysák, Markéta Potůčková, Zábaj Hrázský, Jana Albrechtová, Zuzana Lhotáková, Eva Neuwirthová, Adam Kulich, Mojmír Polák, Daniela Dančejová, Alex Šrollerů

- Used multispectral data: Sentinel-2A, Landsat series
 - Used hyperspectral data: CASI + SASI + TASI sensors
 - Evaluation of forest cover change from 1985 till 2023
 - Forest health evaluation
- inputs for hydrological modelling (influence of forest cover change on local hydrology)
- Outputs:
 - Map of potential forest threats
 - Methodology for monitoring the impact of land cover change on local hydrology using RS and hydrological modeling.



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Main goal: explore the specific detection timeframe at which infested trees exhibited an abnormal spectral response compared to healthy trees and to evaluate factors that could influence the detectability of green attacks/early stage of infestation from MS UAV imagery.

Analysis: We, 1. Examined spectral profiles of each infested tree. 2. Selected a sample of 20 infested trees out of 36 (excluding those with drought stress or without visible symptoms) and 20 healthy trees for each time period. 3. Tested spectral data for normality using the Shapiro-Wilk test. 4. Conducted t-test (normal data) or Wilcoxon rank-sum test (non-normal data) to assess significance between healthy and infested trees. 5. Used variance analysis (p-value 0.01) to compare spectra and identify sensitive spectral bands/features across time periods.

Area of Interest: Krkonoše Mountains National Park (KRNAP), in the Czech Republic.



Date	Time	Number of infested trees
16-may	15:20 pm	0
03-june	11.50.am	10
08-june	11:27.am	13
15-June	12.12.pm	23
24-june	11.18 am	32
01-july	10.53 am	35
19-july	12.40 pm	36
04-august	10.26 am	36
25-august	13.22 pm	36

Data acquisition: UAV imagery acquired before and during the swarming period on nine dates with the DJI Phantom 4 Multispectral RTK. (Table.1), in blue, green, red, red edge, near infrared and RGB.



Technology Agency of the Czech Republic (project SS05010124)

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Results

- First-period (15 May to the end of June 24) : p-values (>0.01) indicated that the spectral response of the infested trees in comparison to the healthy trees displayed atypical characteristics of the bark beetle infestation (flowering and the appearance of new shoots as one of the reasons of fluctuation in this first period interval).
- Second-period (July 1st and 19th of July): No separability between the 2 classes in the 5 bands and NDVI, with p-values (>0.01).
- Third-period (04th and 25th of August) : Separability (with p-values < 0.01) detected in the Red, Rededge, and NIR parts of the spectrum.
- The most accurate detection of tree vitality using multispectral images occurs at the end of summer (the end of July and the beginning of August).
- We demonstrated that distinguishing between healthy and infested trees becomes more feasible over time, particularly in the Red, RedEdge, and NIR parts of the spectrum in the middle of summer, but we were unable to identify any subtle changes or separability that would allow us to differentiate between the two groups during the green stage (end of spring/early summer).
- The results showed that there was no improvement in the detectability of the green attack using multispectral imagery despite the use of very high spatial resolution images, the accurate pre-processing methods including precise generation of forest mask and relative radiometric correction (based on precise visual interpretation and the choice of the green pixels with uniform lighting conditions), and different combinations of independent samples of the healthy trees (used in the comparison using the statistical test).
- Hyperspectral imagery could be better for more precise identification and characterization of the spectral signature of the infested trees, during the green stage.

Date	P-value (NDVI)
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A potential of silver fir regeneration for afforestation after bark beetle outbreak in the Czech Republic: pilot study for RS-based physiological evaluation using leaf-level reflectance and needle functional traits.

Zuzana Lhotáková¹, Eva Kabilková¹, Pavel Bednář², Jana Albrechtová¹

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² Forestry and Game Management Research Institute, Department of Silviculture in Opočno, Czech Republic



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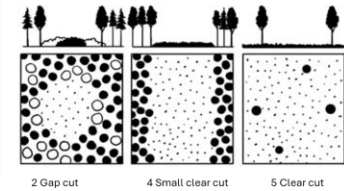
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- Heat and drought waves in forests cause susceptibility to insect outbreaks, attacks
- CZECHIA:
- Lot of spruce monocultures
- 2013-2018 series of very dry years led to bark beetle calamity (*Yps. Spp.*) in spruce forests

Bark beetle outbreak in the Czech Republic



Site location and the light microclimate: natural regeneration and reforestation types



Type of regeneration - abbreviation	Location (name)	Location (coordinates)	Altitude (m a.s.l.)	Degree of shading
1 Natural regeneration - NR	Holícky	49.9140528°N; 15.6992531°E	385	moderate ☀️
2 Shelter-wood cut - ShW	Kocanda 2	49.6635094°N; 15.9746097°E	740	high ☀️
3 Gap cut - GC	Kocanda 3	49.6695486°N; 15.9929700°E	740	moderate ☀️
4 Small clear cut - SCC	Kocanda 4	49.6660833°N; 15.9929950°E	740	moderate ☀️
5 Clear cut - CC	Znetínek	49.4812589°N; 15.9258356°E	579	low ☀️



Funding: NAZV - the National Agency of Agricultural Research of the Czech Republic, Project QL24010275

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Part of the NAZV project: White fir as a tree for species transformations forest stands of the Czech Republic and the effect of applied renewal fellings in interaction with the conditions of forest habitats on its growth, vitality, resistance to phytopathogens and development mycorrhizal associations

Introduction and aims:

After the massive bark beetle outbreak and large-scale emergency logging of Norway spruce monoculture stands across the Czech Republic, silver fir (*Abies alba* Mill.) is a candidate tree species in the process of forest transformation. Thanks to its better growth in conditions of mild drought, silver fir appears very promising. However, as a very shade tolerant species, silver fir may be prone to various abiotic stressors in more open stands.

The present pilot study explores the variability in needle functional traits and leaf-level optical properties in relation to the stand light microclimate.

- **We aim on the evaluation of the physiological status of young fir based on needle functional traits.**
- **The light-environment related variability in the leaf-level reflectance is evaluated for future remote sensing application.**

Funding: NAZV - the National Agency of Agricultural Research of the Czech Republic, Project QL24010275

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TAKE HOME MESSAGE

- The QY_{max} and the REIP values proved good physiological status of young fir across the light microclimates.
- Silver fir needle functional traits were sensitive to different light microclimates.
 - Leaf-level optical properties showed a potential for distinguishing stands adapted to different light microclimate.
- Differences in the leaf-level reflectance are promising for remote sensing (e.g. UAV-based) evaluation of silver fir physiological status for reforestation.

Funding: NAZV - the National Agency of Agricultural Research of the Czech Republic, Project QL24010275

Current and future joint SCERIN – U.S. Projects:

1) LCLUC Program NASA CSD (2024-2025):

“Commercial Smallsat data analysis for advancing the HLS products for agricultural and forest productivity”
NASA/ROSES 2023;

- PI –P. Campbell, International Collaborators: J. Albrechtová, P. Lukeš

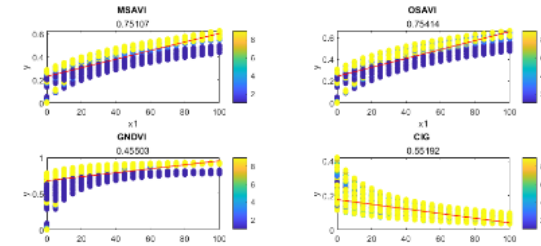
2) Ministry of Education, Czechia (submitted 10/07/2024, planned duration 2025-2028):

Integration of Earth Observation, in situ Leaf Functional Traits, and Continuous Dendronetwork Measurements for Assessing Changes in Forest Stands Vitality in Czechia

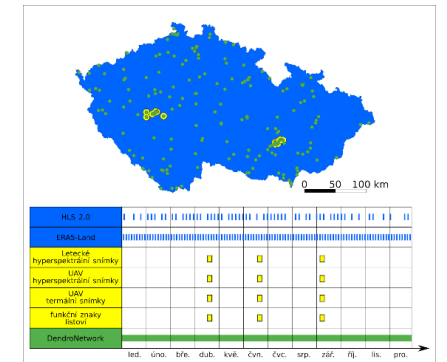
PI – J. Albrechtová, Co-I, P. Lukeš, collaborators from NASA LCLUC Program:

U.S. collaborts: P. Campbell UMBC / GSFC NASA; H.Epstein, Univeristy of Virginia;

J.Eitel, University of Idaho USA



Simulated chlorophyll VIs with wide range of structures



Proposed database of in-situ and RS observations for extrapolating forest vitality from plot to country scale

New joint publications from last SCERIN meeting:

1. [Neuwirthová, E., Lhotáková, Z., Červená, L., Lukeš, P., Campbell, P. and Albrechtová, J., 2024.](#) Asymmetry of leaf internal structure affects PLSR modelling of anatomical traits using VIS-NIR leaf level spectra. *European Journal of Remote Sensing*, 57(1), p.2292154.
2. [Stejskal, J., Čepl, J., Neuwirthová, E., Akinyemi, O.O., Chuchlík, J., Provazník, D., Keinänen, M., Campbell, P., Albrechtová, J., Lstibůrek, M. and Lhotáková, Z., 2023, Nov.](#) Making the genotypic variation visible: hyperspectral phenotyping in Scots pine seedlings. *Plant Phenomics*, 5, p.0111.

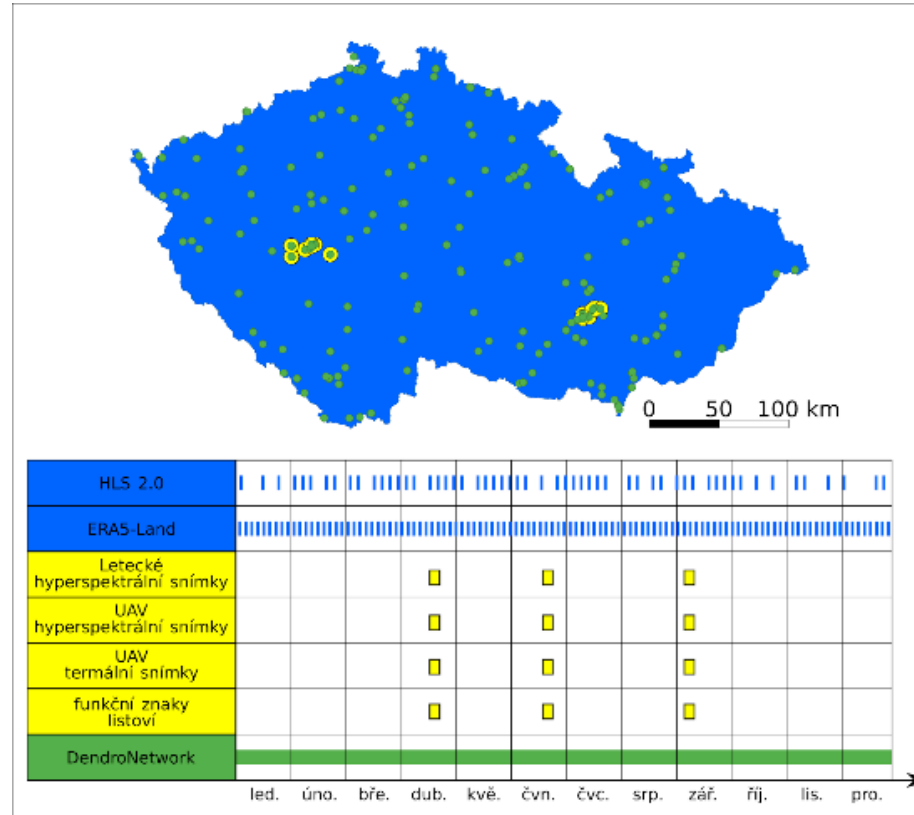
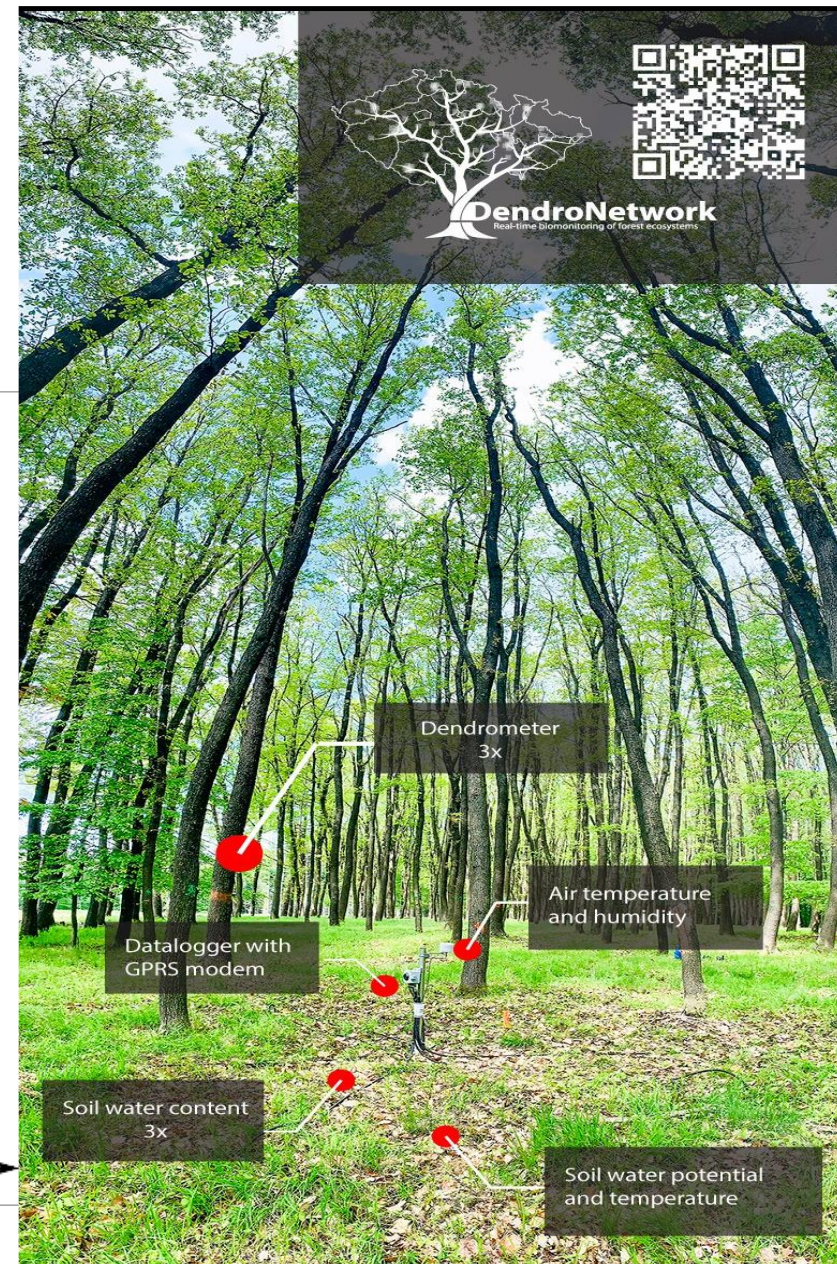
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