



Remote sensing based monitoring of bark beetle infestation in CZ

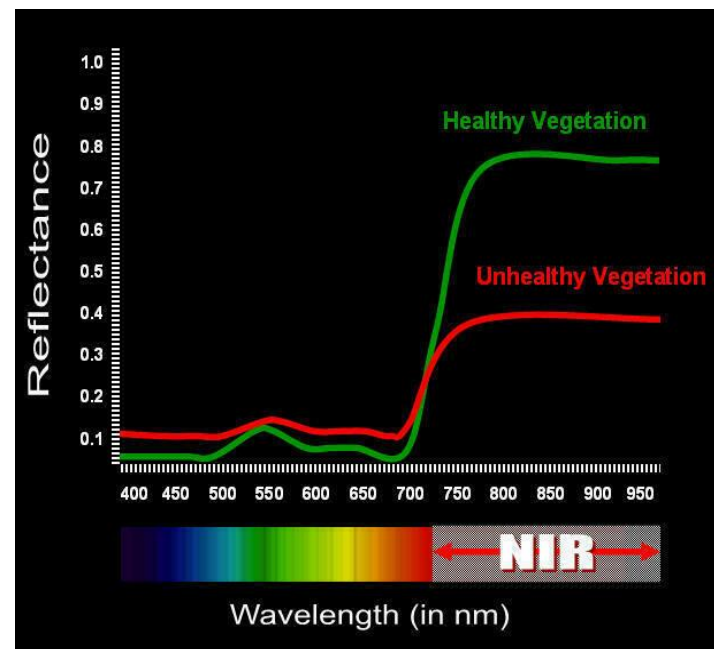
Kick-off meeting | 9th April 2021

Mendel University in Brno



Infestation phases, spectral behavior

- (1) the green attack stage, when the tree needles remain green
- (2) the red attack, when needles turn progressively from green to
- (3) the grey attack, when dead needles fall and the bare tree stands grey
- Current systems detect red and grey phase infestation well, green attack detection is most important, but still in development

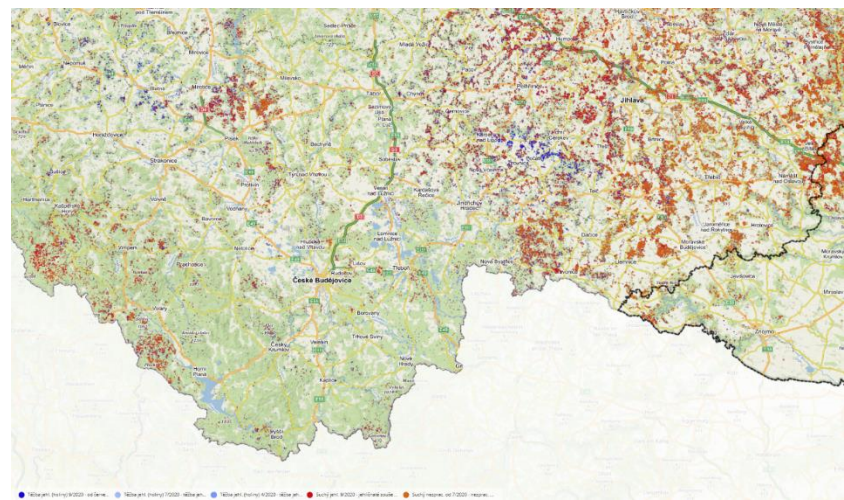
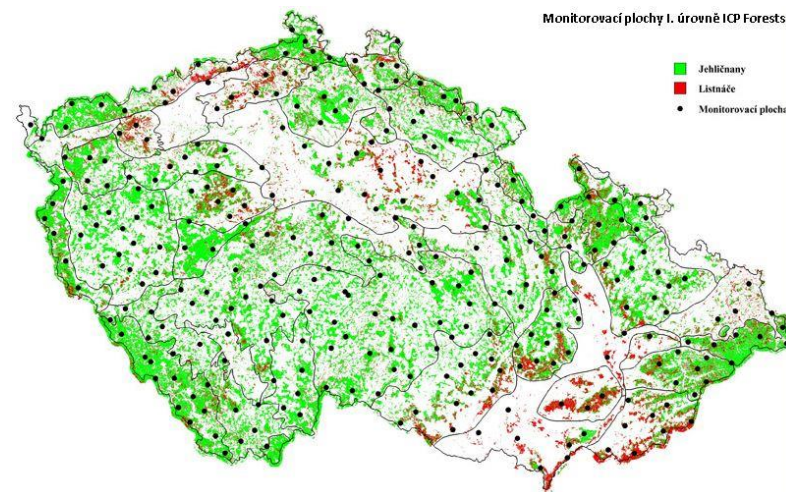


- Multispectral x hyperspectral data
- Spectral bands
- Spatial resolution



Current state of health monitoring in CZ

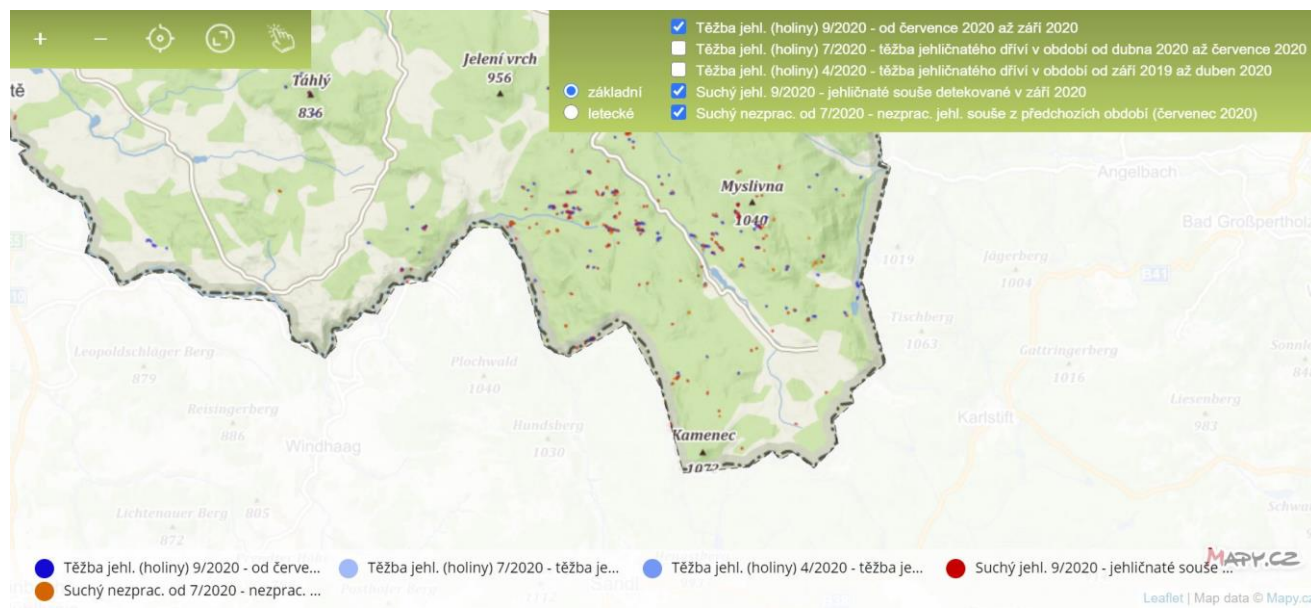
- Since 1986 – ground assessment using systematic network ICP Forest, systematic evaluation unbiased by a subjective factor in ground visual assessment using Landsat images
- Since 2016 – Sentinel-2 images – LAI changes validated with LAI and defoliation ground surveys
- Since 2018 – detailed mapping of bark beetle outbreaks – monitoring system to detect salvage cutting and standing dead wood using Planet images – www.kurovcovamapa.cz





Kůrovcová mapa – bark beetle map - workflow

- (1) Areas dominated by spruce and higher than 12 m.
 - Sentinel-2 – forest tree map – spectral response, NFI plot training data
 - CHM = DSM-DTM to erase trees below 12 m threshold
- (2) Map of LAI decrease, which detects either the clear-cuts or dead wood.
 - Normalized difference vegetation index (NDVI) images at 3 m spatial resolution and two additional categories are detected: standing dead forest and newly established clear-cuts.
 - These categories are distinguished based on the Triangular Greenness Index (TGI)





Green phase detection – MENDELU contribution

- Output of H2020 project – MySustainableForest
 - <https://mysustainableforest.com/>
- Cooperation with GMV Aerospace and Defence, S.A.U.
- <https://www.mdpi.com/2072-4292/12/21/3634>





remote sensing



Article

Monitoring Bark Beetle Forest Damage in Central Europe. A Remote Sensing Approach Validated with Field Data

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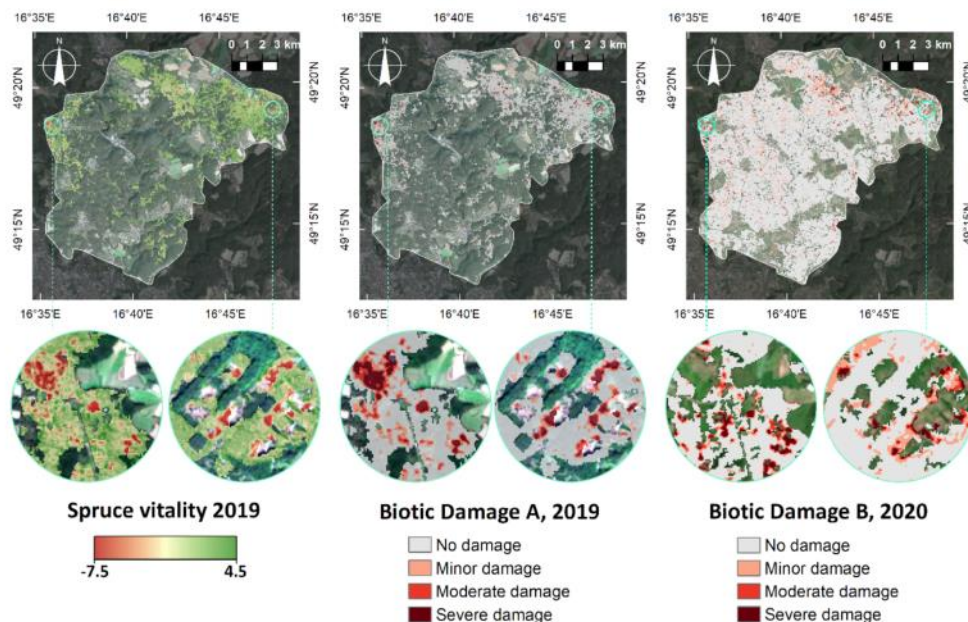
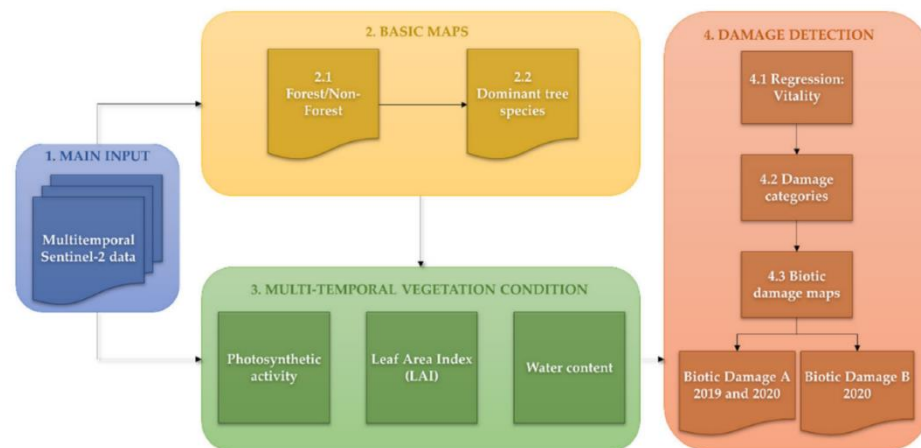
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Green phase detection – MENDELU contribution

- Bitemporal regression in vegetation indices derived from Sentinel-2
- NDVI, MSAVI, NDMI and LAI_{green}
- Residue of regression models are the infested trees
- Validation with salvage cutting reports





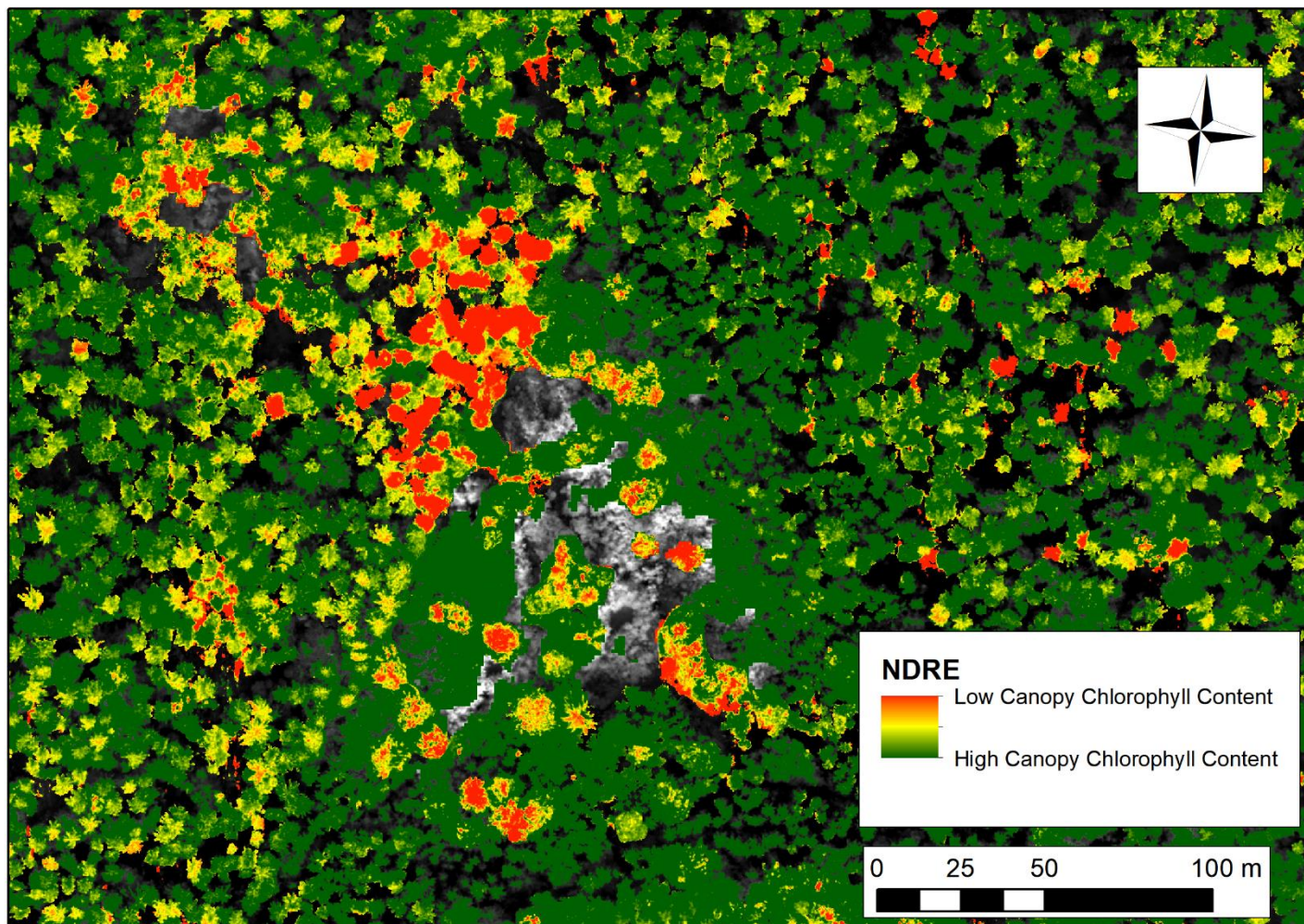
Use of UAV in bark beetle monitoring

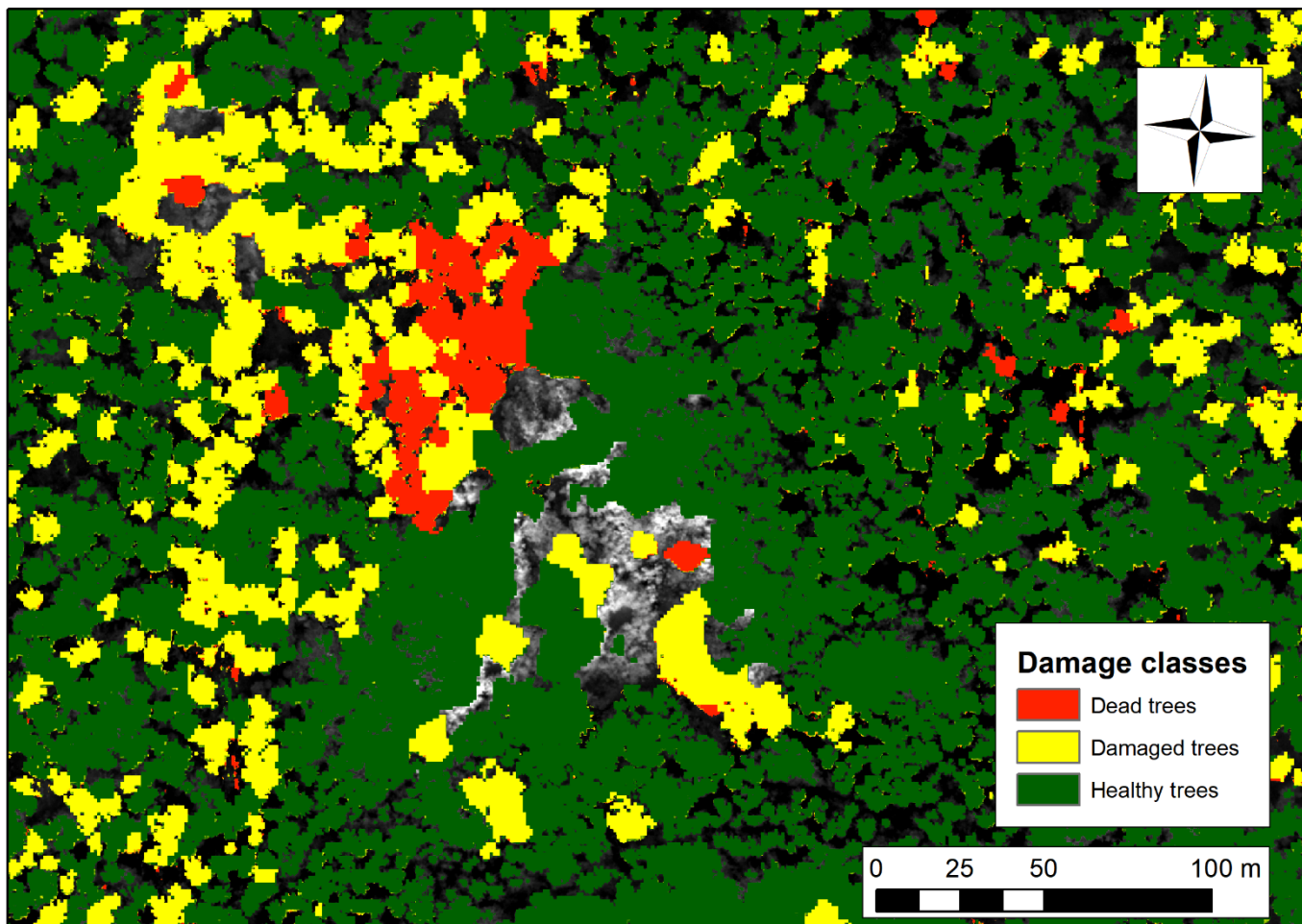
- UAV – senseFly eBee Plus
- Multispectral camera
Parrot Sequoia+
 - Green (550 nm)
 - Red (660 nm)
 - Red Edge (735 nm)
 - Near IR (790 nm)
- Vegetation indices
 - NDVI
 - NDRE

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

$$NDRE = \frac{NIR - Red\ Edge}{NIR + Red\ Edge}$$







- Multispectral data are not commonly sufficient for green phase infestation monitoring
- Bi-temporal regression ?



Future

- Shortwave infrared– correlation with water content
- Multitemporal data – time series
- Machine (deep) learning
- Assessment in real-time– cloud computing, 5G network development

Thank you for your attention

