CHARLES UNIVERSITY
Faculty of Science

CzechGlobe

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

LUCC4HYDRO

Project TAČR SS05010124

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Project goals

1. To analyze long-term development of land cover (since the 1980s) with emphasis on changes in forest and on the current state of forest health in the upper Úpa and upper Čistá river basins using various types of remote sensing (RS) data.

2. To analyze long-term time series of hydrological and hydrometeorological data and describe the development of climate and hydrology of the monitored area since the 1940s.

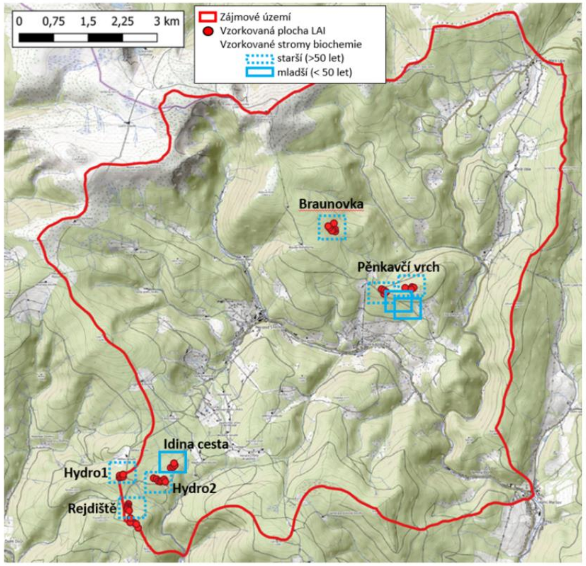
3. To simulate the long-term impact of land cover changes (LCC) on the local climate and hydrology using hydrological modeling and inputs generated under objectives 1 and 2

4. To propose a methodology for monitoring the impact of LCC on local hydrology using RS and hydrological modeling.

5. To design an Application for automated RS data processing and evaluation of hydrological conditions.

Area of interest

The analysis will be carried out in the upper Úpa and upper Čistá catchment areas (see map). The areas have been chosen so that water measuring stations are available from which hydrological data can be obtained. The choice also fulfils the intention to compare a smaller catchment with minimal anthropogenic influence (upper Čistá – 6.53 km2) and a larger catchment (upper Úpa – 82 km2) where anthropogenic influences are much more significant.



Project link:
https://www.lucc4hydro.cz/

Project workflow
Outputs 2022
Galery, etc.

Data and methods

- Climate change as a complex process requires an interdisciplinary approach, and therefore both classical (hydrology, pedology) and innovative approaches (remote sensing, hydrological modelling, forest physiological assessment) are used

The impact of land cover changes on hydrology/climate is analysed at two spatial levels

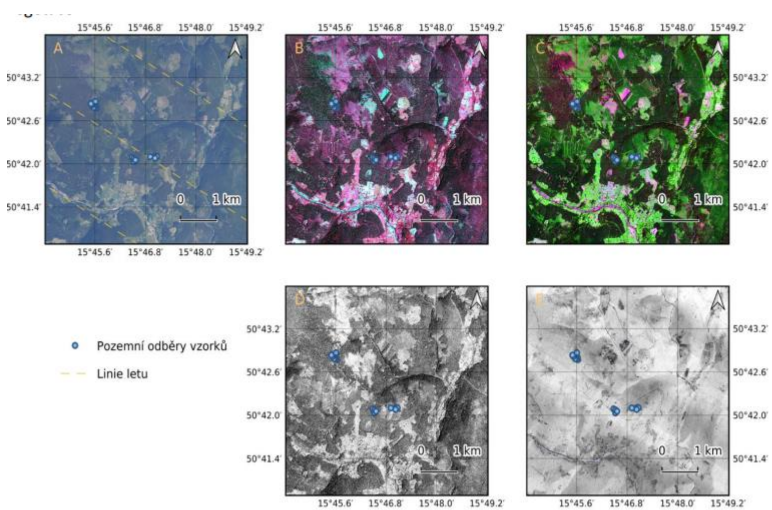
1. Landsat and Sentinel-1,2 satellite data time series, aerial HS images and climatic/hydrological characteristics - the hydrological rainfall-runoff model Soil and Water Assessment Tool - SWAT - impact of land cover changes on the landscape water regime.

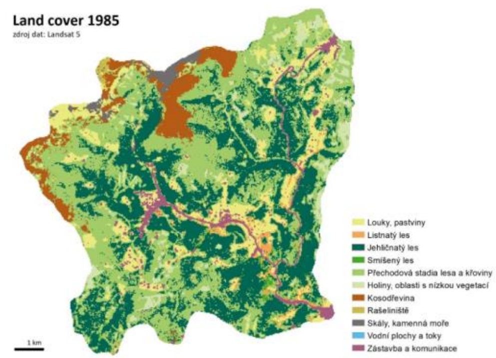
2. At a spatially lower level - the Čistá sub-basin Rašelinový potok - forest dieback due to bark beetle infestation - UAV hyperspectral and multispectral data series in 2 seasons - the Hydrus 1-D hydro-pedological model simulation of the soil water regime after forest decline at a local scale.

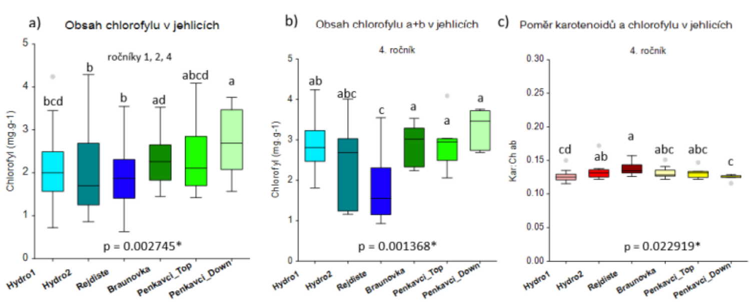
The model will be used to quantify the soil water regime and to quantify the effect of forest decline on soil temperature regime, evapotranspiration and water contribution of the lower parts of the soil profile.

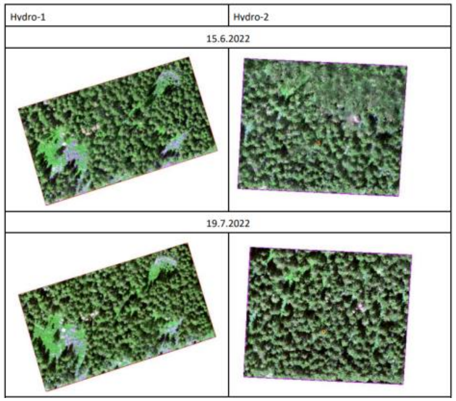

Fieldwork
Visit gallery
Work in laboratory
Visit gallery
Data acquisition
Visit gallery
Teplice
Mladá Boleslav
Mělník
Elbe
Chráněná krajinná oblast Broumovsko
Kudowa-Zdrój
Klodzko
Nysa
Prudnik
Hradec Králové
Kladno
Prague
Pardubice
Chrudim
Dolní Morava
Šumperk
Ústí nad Orlicí
Kutná Hora
Litomyšl
Dobříš
Svitavy
Příbram
Havlíčkův Brod
Chráněná krajinná oblast Žďárské vrchy
Olomouc
Humpolec
Prostějov
Přerov
Tábor
Pelhřimov
Jihlava
Blansko
Písek
Strakonice
Velké Meziříčí
Vyškov
Kroměříž
Třebíč
Telč
Brno
Outputs
Read more

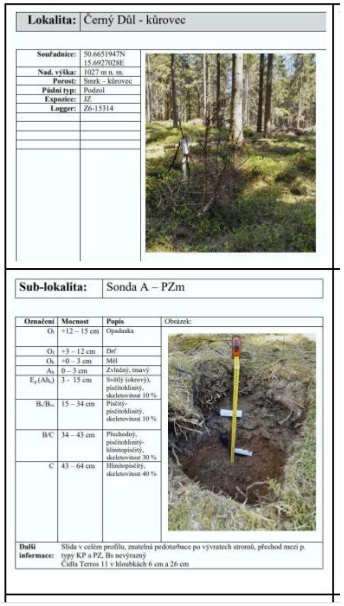
Outputs











Lokalita:	Černý Důl - kůrovec
Souřadnice:	50.6651947N 15.6927028E
Nad. výška:	1027 m n. m.
Porost:	Smrk – kůrovec
Půdní typ:	Podzol
Expozice:	JZ
Logger:	Z6-15314

Sub-lokalita:	Sonda A – PZm

Označení	Mocnost	Popis	Obrázek:
O_l	+12 – 15 cm	Opadanka	
O_f	+3 – 12 cm	Drť	
O_h	+0 – 3 cm	Měl	
A_h	0 – 3 cm	Zvlněný, tmavý	
E_p (Ah_e)	3 - 15 cm	Světlý (okrový), písčitohlinitý, skeletovitost 10 %	
B_s/B_{hs}	15 – 34 cm	Písčitý-písčitohlinitý, skeletovitost 10 %	
B/C	34 – 43 cm	Přechodný, písčitohlinitý-hlinitopísčitý, skeletovitost 30 %	
C	43 – 64 cm	Hlinitopísčitý, skeletovitost 40 %	

Další informace:	Slída v celém profilu, znatelná pedoturbace po vývratech stromů, přechod mezi p. typy KP a PZ, Bs nevýrazný Čidla Terros 11 v hloubkách 6 cm a 26 cm

Evaluation of the bark beetle green attack detectability in spruce forest from multitemporal hyperspectral data: Rašelinový potok case study

Salma Bijou, Lucie Kupková, Lucie Červená, Jakub Lysák, Markéta Potůčková, Václav Jansa

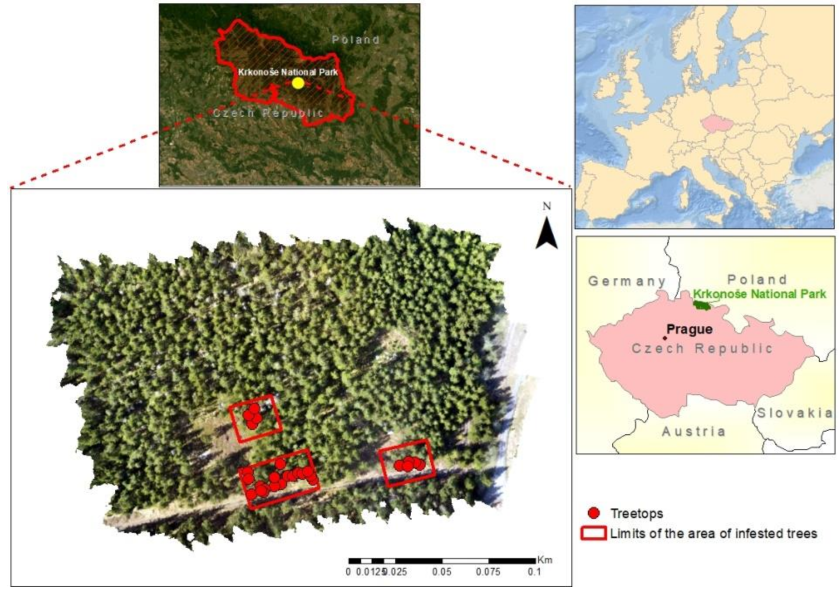
Team of Image and Laboratory Spectroscopy

www.tilspec.cz

Methodology

Acquisition of remote sensing data and field data collection

- Study area: plot 250 x 200 m in the Krkonoše Mts. National Park
- HS imagery: camera Headwall Nano-Hyperspec with 270 spectral bands (VNIR 400- 1000nm) mounted on DJI M600 Pro UAV
- MS imagery: Phantom 4 Multispectral Blue (B): 450 nm ± 16 nm; Green (G): 560 nm ± 16 nm; Red (R): 650 nm ± 16 nm; Red edge (RE): 730 nm ± 16 nm; Near-infrared (NIR): 840 nm ± 26 nm.
- GCP’s

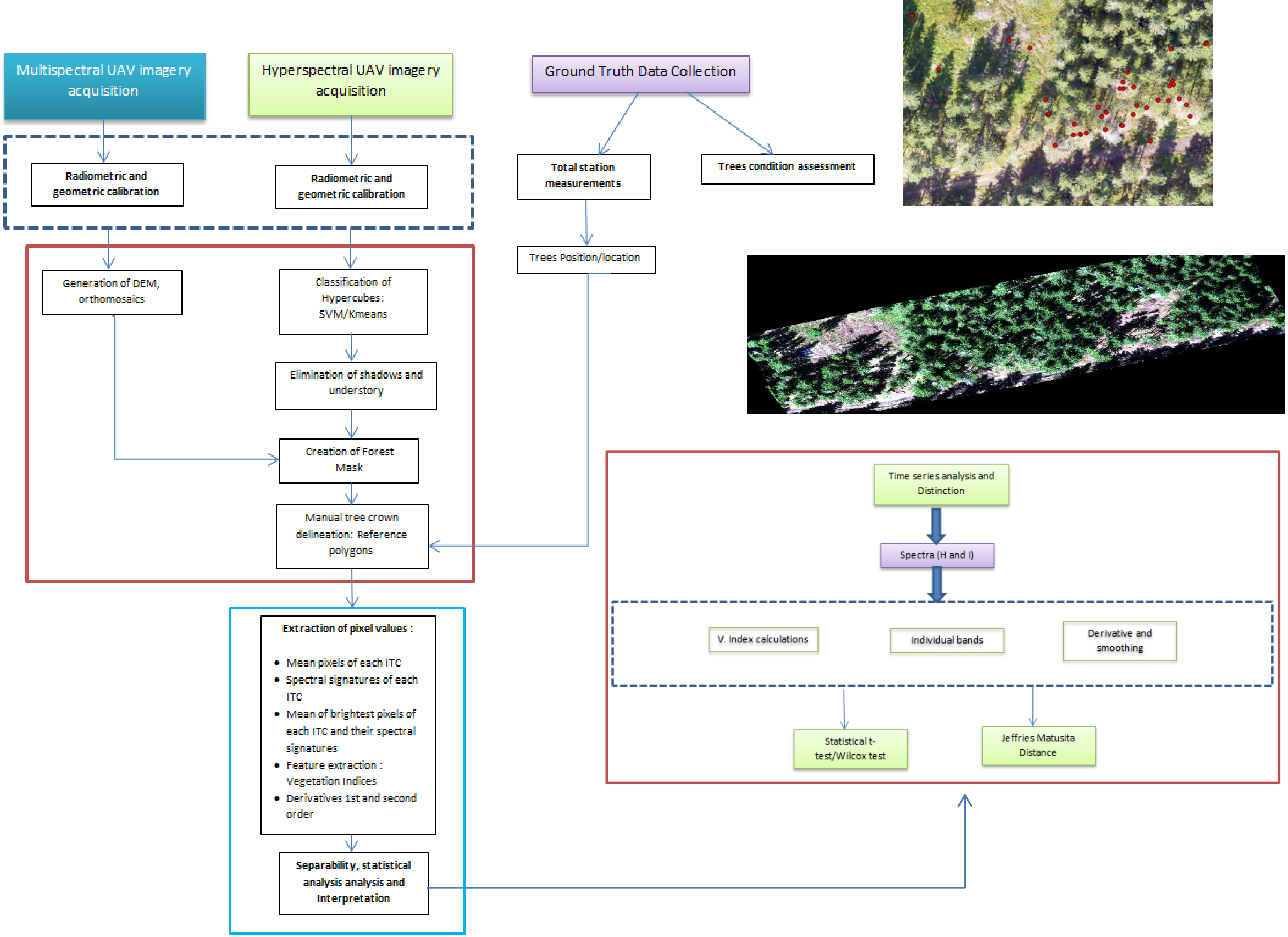


Dates of the data acquisition

9 flight campaigns	16/05/2022
	03/06/2022
	08/06/2022
	15/06/2022
	24/06/2022
	01/07/2022
	19/07/2022
	04/08/2022
	25/08/2022

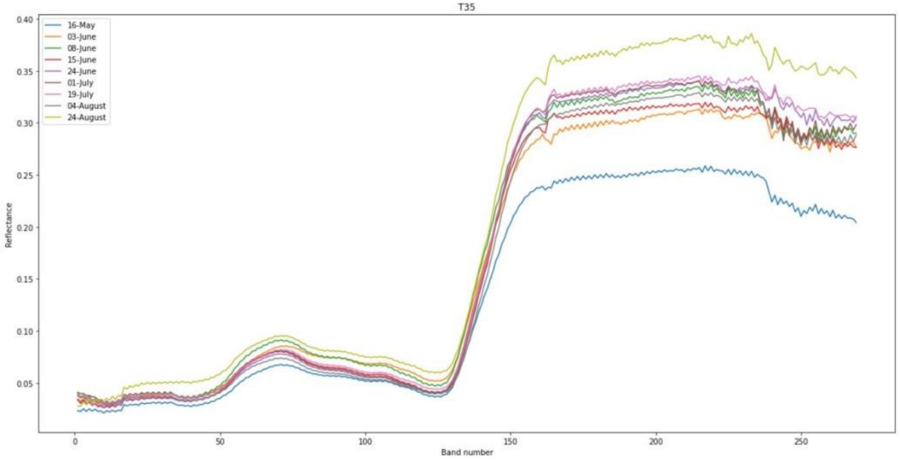
Ground truth collection

WORKFLOW

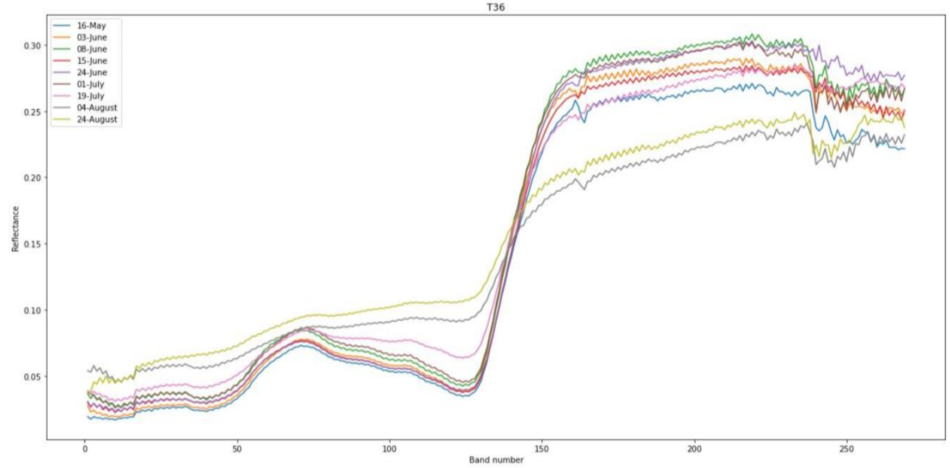


Multispectral UAV imagery acquisition
Hyperspectral UAV imagery acquisition
Ground Truth Data Collection
Radiometric and geometric calibration
Radiometric and geometric calibration
Total station measurements
Trees condition assessment
Trees Position/location
Generation of DEM, orthomosaics
Classification of Hypercubes: SVM/Kmeans
Elimination of shadows and understory
Creation of Forest Mask
Manual tree crown delineation: Reference polygons
Extraction of pixel values :
Mean pixels of each ITC
Spectral signatures of each ITC
Mean of brightest pixels of each ITC and their spectral signatures
Feature extraction : Vegetation Indices
Derivatives 1st and second order
Separability, statistical analysis analysis and Interpretation
Time series analysis and Distinction
Spectra (H and I)
V. Index calculations
Individual bands
Derivative and smoothing
Statistical t-test/Wilcox test
Jeffries Matusita Distance

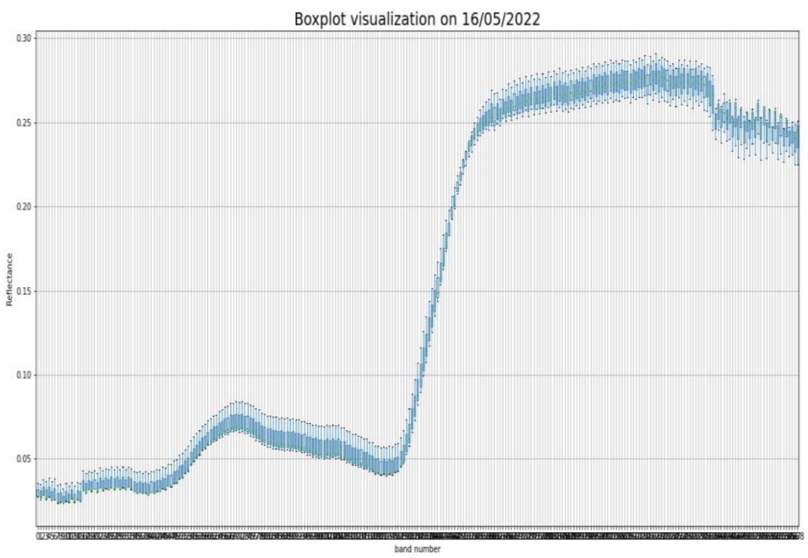
Multitemporal spectral signature extraction of infested trees

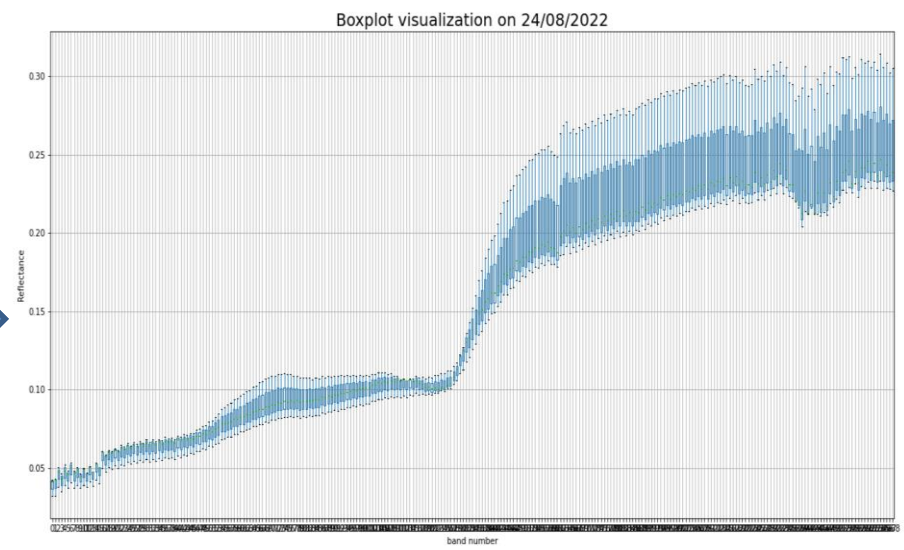


Infested tree with no visual symptoms in the last date

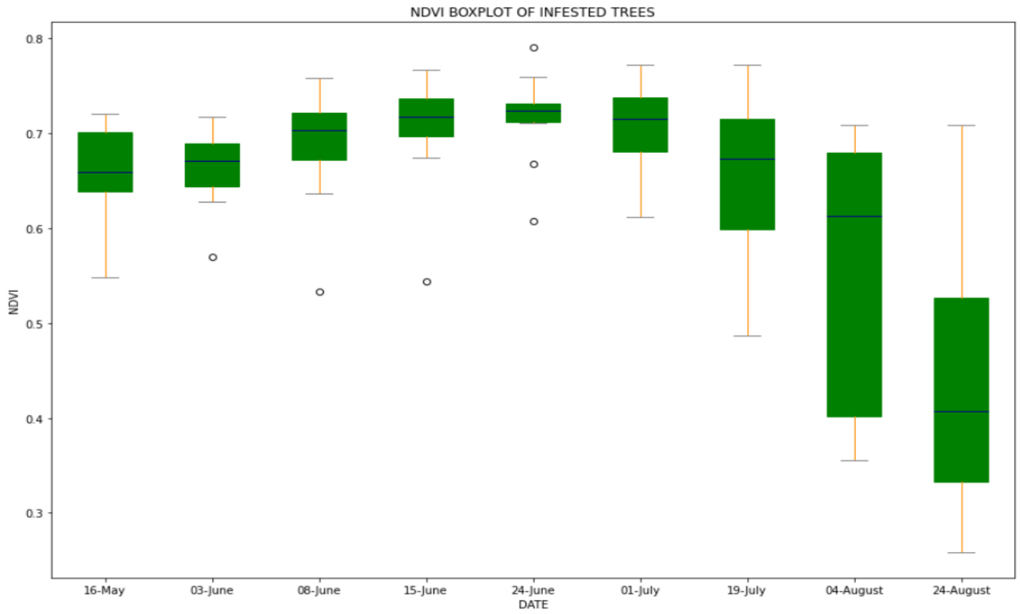


Infested tree : Dead in the last date

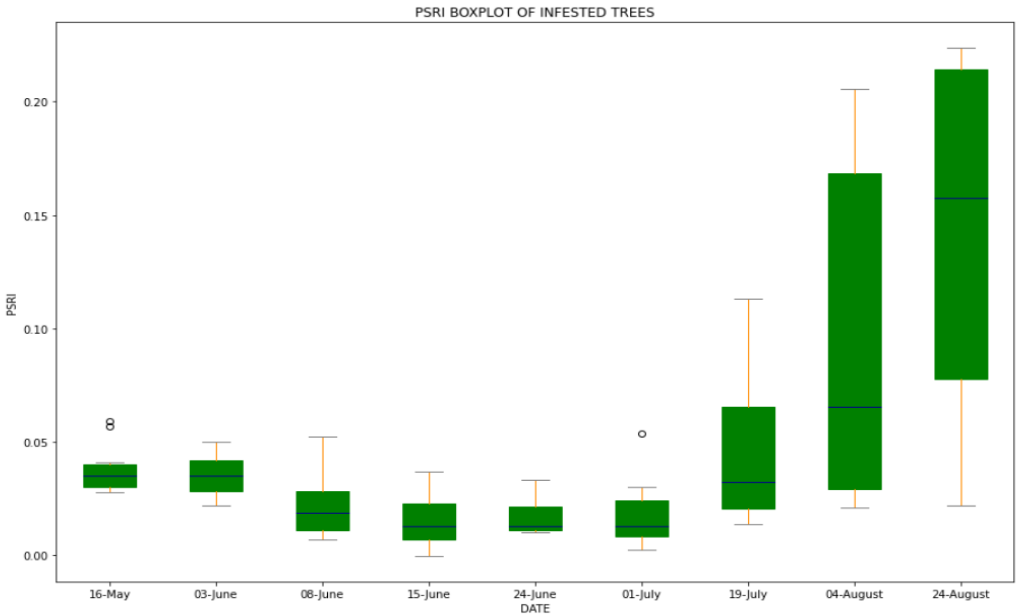




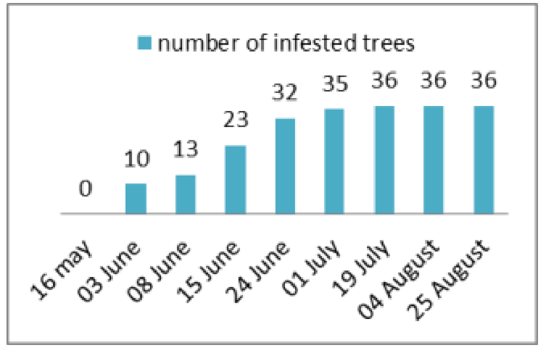
NDVI


NDVI BOXPLOT OF INFESTED TREES
NDVI
0.8
0.7
0.6
0.5
0.4
0.3
16-May
03-June
08-June
15-June
24-June
01-July
19-July
04-August
24-August
DATE

PSRI


PSRI BOXPLOT OF INFESTED TREES
PSRI
0.20
0.15
0.10
0.05
0.00
16-May
03-June
08-June
15-June
24-June
01-July
19-July
04-August
24-August
DATE

Statistical Analysis



P-value > 0.05
P-value < 0.05

G1: 11 trees

Group 1	BLUE	GREEN	RED	REDEDGE	NIR
16/05					
03/06					
08/06					
15/06					
24/06					
01/07					
19/07					
04/08					
25/08					

G2: 6 trees

Group 2	BLUE	GREEN	RED	REDEDGE	NIR
15/06					
24/06					
01/07					
19/07					
04/08					
25/08					

G3: 6 trees

Group 2	BLUE	GREEN	RED	REDEDGE	NIR
24/06					
01/07					
19/07					
04/08					
25/08					

Next steps

- Finishing the analysis for the different groups in different infestation stages
- Statistical multitemporal analysis of infested trees
- Use of other statistical methods and Jeffries Matusita distance
- Extraction of relevant Vegetation indices + statistical analysis
- Extraction of derivatives + statistical analysis

Thank you for your attention!

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