Analysis of the information capability of spectral indices in remote sensing of mistletoe (Viscum album ssp. austriacum L.) in pine stands, acquired using unmanned aerial platforms (BSP)
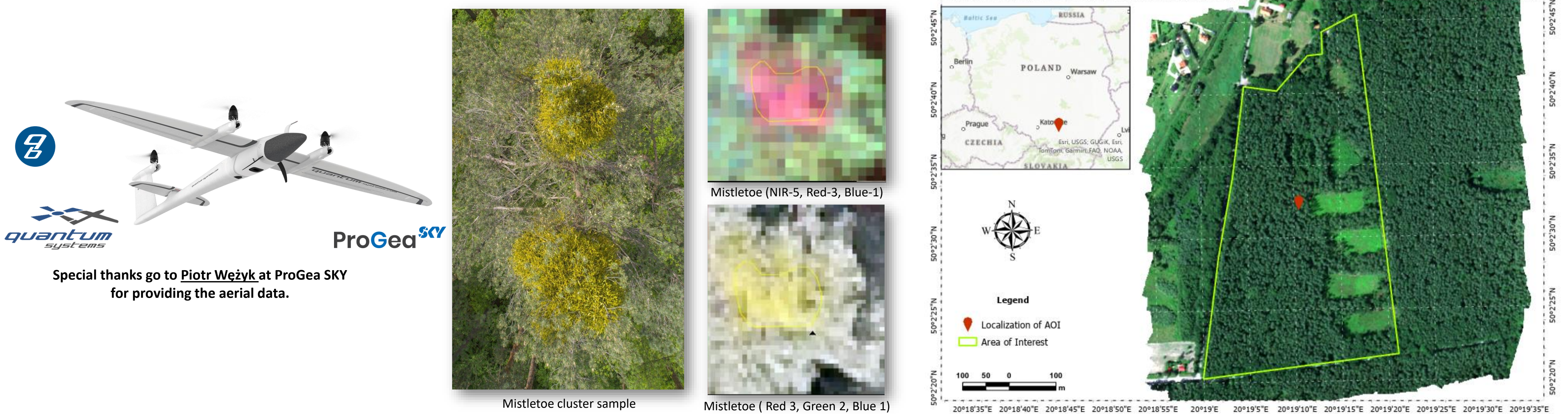
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PHOTOGRAMMETRY SURVEY BACKGROUND

The study was carried out on a fragment of a stand located in the area of the Niepołomice Forest District, in department number 83 (dominant species - Scots pine (Pinus sylvestris L.), age 108 years; average tree height 28 m; average breast height 36 cm; according to BDL 2022). A photogrammetric survey was performed (ProGea SKY; Trinity F90+; dual-payload: Sony UMC and Micasense RedEdge-M).

Special thanks go to Piotr Wężyk at ProGea SKY for providing the aerial data.

Mistletoe cluster sample

Mistletoe (NIR-5, Red-3, Blue-1)

Mistletoe (Red 3, Green 2, Blue 1)

Legend
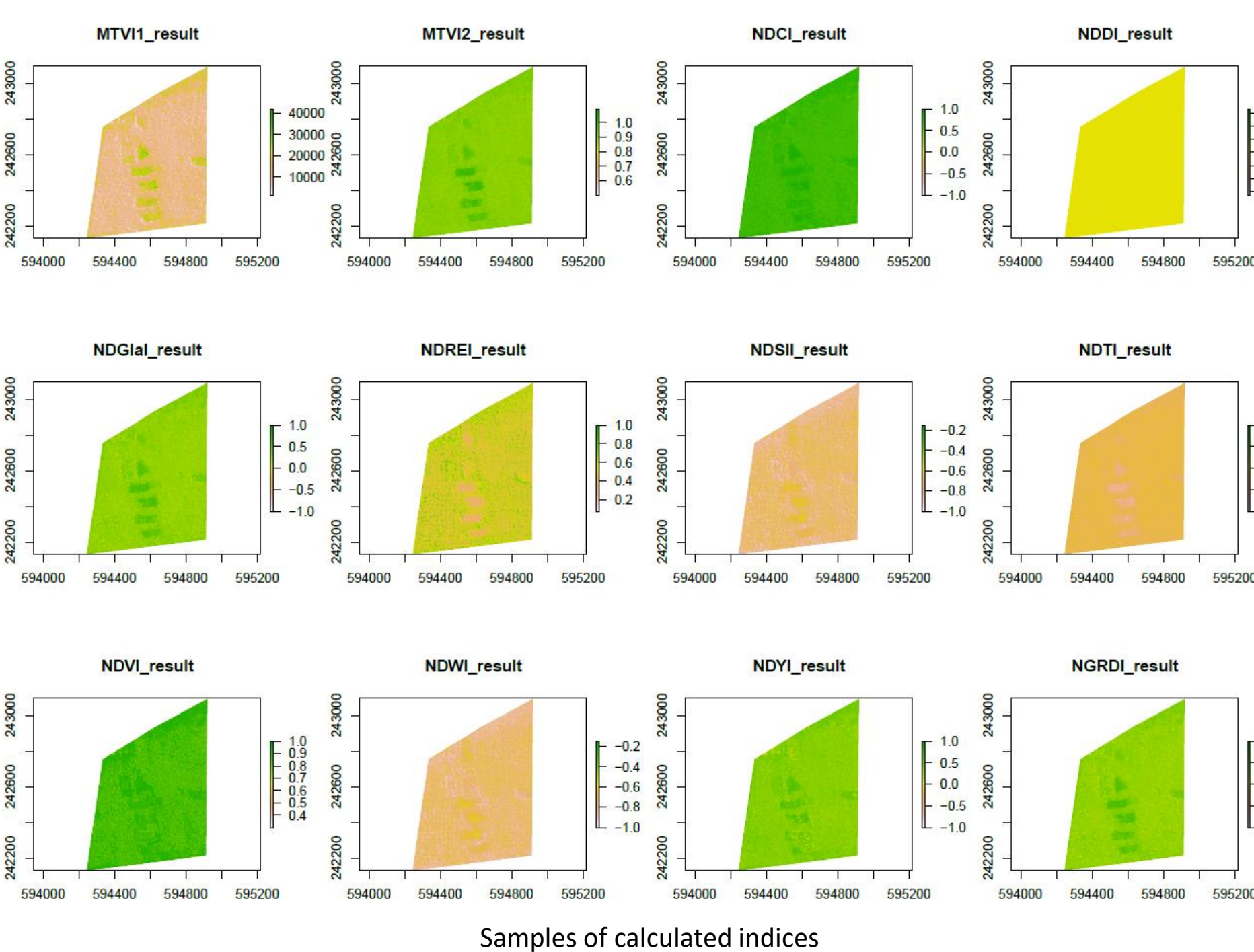- Localization of AOI
- Area of Interest

The aim of this study is to determine the information potential of spectral indices calculated from a true multispectral orthophoto, acquired using BSP, in the detection of mistletoe clusters in pine stands.

METHODS

A total of 820 training fields were vectorised, representing 6 classes: clearcuts-70, gaps-100, dead trees-50, deciduous trees-100, coniferous trees-100, mistletoe cluster-400. For each training field, statistics of individual spectral indices were calculated.

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Samples of calculated indices

Class: Mistletoe

Class: Coniferous tree

Class: Deciduous tree

Class: Dead tree

Class: Ground

Correlationos between indices

Machine learning algorithms including decision trees, k-nearest neighbours, support vector machines and random forests were then used to evaluate the potential of the spectral indices in mistletoe cluster detection based on the classification performed.

RESULTS

	CART	KNN	SVM	RF
Mean Kappa value	0,70	0,71	0,85	0,88

Mean Kappa value of learning algorithms

	SVM	RF	Total Kappa value
MTVI1	0,9411	0,9207	1,8618
VgNIRBI	0,9406	0,921	1,8616
GBNDVI	0,927	0,9338	1,8608
NormG	0,9406	0,9199	1,8605
GOSAVI	0,9236	0,9343	1,8579
GRNDVI	0,9308	0,9213	1,8521
TDVI	0,9193	0,9313	1,8506
BITM	0,9311	0,9174	1,8485
GNDVI	0,9267	0,9143	1,841

Total Kappa value of indices

No.	RGB	Total Kappa value	MS	Total Kappa value
1	BITM	1,8485	MTVI1	1,8618
2	VIG	1,8264	VARI700	1,8616
3	SI	1,8102	GBNDVI	1,8608
4	NGRDI	1,8026	NormG	1,8605
5	TGI	1,7978	GOSAVI	1,8579
6	NDTI	1,7537	GRNDVI	1,8521
7	RGRI	1,7513	TCI	1,8506
8	MGRVI	1,7489	GNDVI	1,841
9	RI	1,7443	RDVI	1,8361
10	ExGR	1,7442	NDSII	1,8306

Top 10 indices accord to RGB and MS imaginery

Index	Mean correlation
RI4XS	0,10
GARI	0,31
TCARI	0,37
VARI700	0,38
NDDI	0,38
TCARIOSAVI	0,39
BCC	0,41
BNDVI	0,44
NDYI	0,45
SR	0,45

Set of the lowest mean correlation

CONCLUSIONS

- Classification of mistletoe clusters using infrared and rededge channels has on average better results than classification based on spectral channels of visible light.
- The indicators with the highest information potential are MTVI1, VgNIRBI, GBNDVI.
- When only RGB images are available, the best indicators are BITM, VIG, SI.
- The indices are highly correlated with each other. The least correlated of all are RI4XS, GARI, TCARI, VARI700.
- The results obtained can form the basis for further research, which will create a multichannel raster built from the least correlated indicators and subjected to classification using SVM or RF.
- The data obtained provide a good database for use in training a convolutional neural network CCNN).

CONTACT

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