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UAV monitoring of blue-green aglae blooms in freshwater ecosystems

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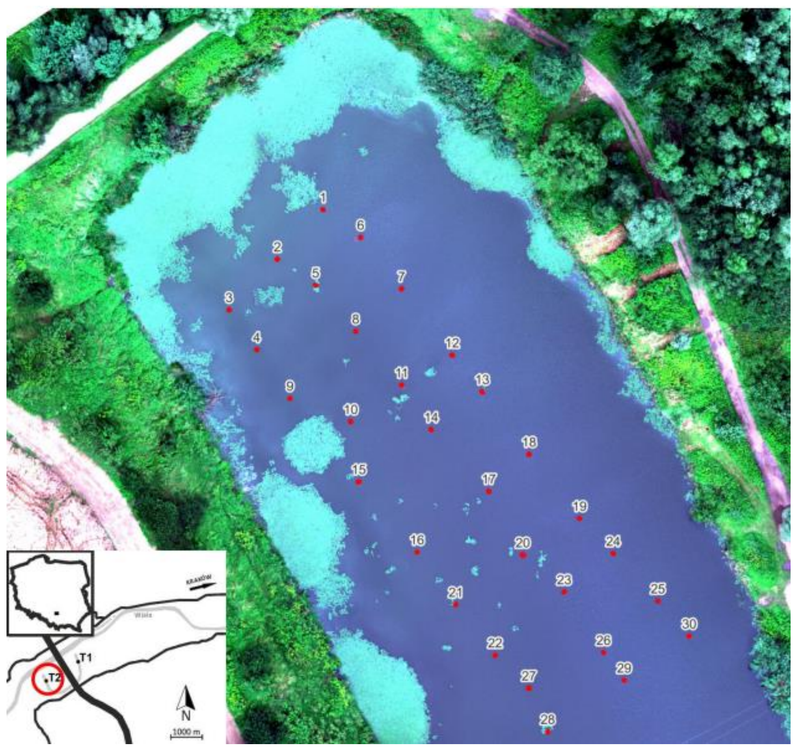

Fig. 1. Localization of styrofoam frames on surface of water

Cyanobacterial blooms are a widespread phenomenon naturally occurring in different types of water bodies. Recently observed climatic changes and increasing human impact lead to the intensification and proliferation of cyanobacterial blooms, and as a consequence – severe reduction in water quality and changes in functioning of freshwater ecosystems.

A common indicator of a cyanobacterial bloom is a change in water colour to blue-green, due to pigments of the growing cyanobacteria. Remote-sensing technologies used in satellite imagery or unmanned aerial vehicles (UAVs) can be used for detection and monitoring cyanobacterial blooms in water bodies.

The aim of our study was to develop an index for cyanobacterial blooms detection using UAVs.

Analyses showed that key spectral bands for identifying cyanobactrial blooms are: Near-Infrared (NIR; 842 nm); Red Edge (RE; 740 nm); Red Edge (RE; 717 nm); Blue (B; 475 nm) and Red (R; 668 nm). We designed 4 remote sensing indexes and tested their correlation with data from **Chla** and **PC** measurement in water (Tab.1).

The analyses showed the strongest correlation for indexes based on in situ Chla and PC measurements. This provides a solid basis for the application of the developed indexes in broad-scale studies. The indexes can be used to detect cyanobacterial blooms over a large geographical area by using satellite imagery provided, for example by the Copernicus Sentinel constellation (European Space Agency).

We settled 30 frames floating on the surface of an oxbow lake (Tyniec oxbow lake, S Poland, Fig.2). We measured the concentrations of chlorophyll-a (chla) and phycocyanin (PC) using multiparameter probe with simultaneous measurements of reflectances performed with UAV

Fig. 1. Field works: deploying styrofoam frames on the surface of water (left)
Fig 2. UAV used for remote mictispectral analyses (right)

Index	Description	Corelation with measurement data
$I_{chl\text{-}s} = RE_{717nm} - 4\ NIR_{842nm}$	In situ Chla measurement based index	+75%
$I_{chl\text{-}W} = R_{668nm} - NIR_{842nm}$	Densed material Chla measurement based index	+54%
$I_{pc\text{-}s} = RE_{740nm} - 3\ RE_{717nm} - 6NIR_{842nm}$	In s itu PC m easurement based index	+70%
$I_{pc\text{-}w} = B_{475nm} + 2NIR_{842nm} - 2RE_{740nm}$	Densed material PC measurement based index	+59%

Tab. 1 Remote sensing indexes designed on basis of key spectral bands

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