Identification of cyanobacteria biomass in Baltic waters - comparative analysis of laboratory and remote methods

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MOTIVATION

In recent decades, an increase in the productivity and occurrence of cyanobacterial blooms has been observed in the coastal and open waters of the Baltic Sea and in Pomeranian lakes. Blooms of these organisms appear almost every summer, covering an area of up to 100,000 km2 in marine areas. Their biomass can account for up to 80% of the total algal biomass, and they can account for up to 50% of the primary production in the basin.

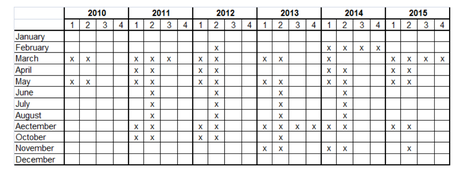
Determining the biomass of cyanobacteria present in a given body of water is an extremely important issue, not only for determining the productivity of a given body of water or the amount of solar energy absorbed by these organisms, but also for their ability to produce biologically active compounds with toxic properties.

AIM

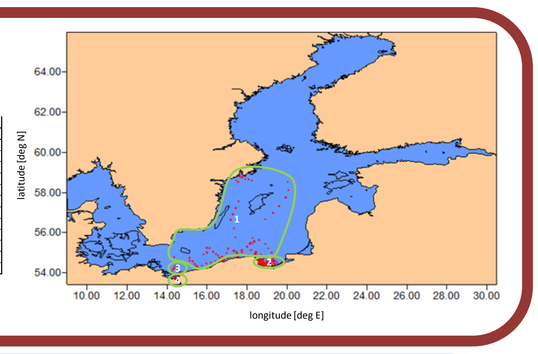
Comparison of methods for approximation of cyanobacteria biomass in Baltic Sea waters and evaluation of their accuracy

MATERIAL

• samples collected in 2010 -2015



1 – open Baltic 2 – Gulf of Gdańsk 3 – Pomeranian Bay 4 – Szczecin Lagoon



METHODS

Microscopic determinations

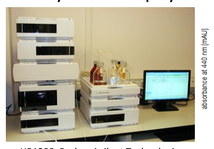
taxonomic composition, cell abundance and cyanobacteria biomass

photo M. Łotocka

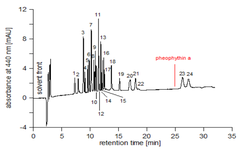
Liquid Chromatography HPLC

Identification of pigments characteristic for cyanobacteria

zeaxanthin, echinenone, β-carotene, canthaxanthin, astaxanthin, aphanizomenon, myxoxanthophyll



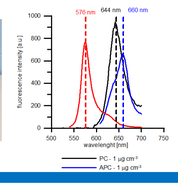
HP1200, Perlan, Agilent Technologies



Spectrofluorimetry

phycocyanin PC and phycoerythrin PE

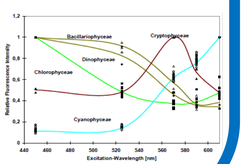
Cary Eclipse, Varian, Agilent Technologies



Fluorimetric measurements *in situ*

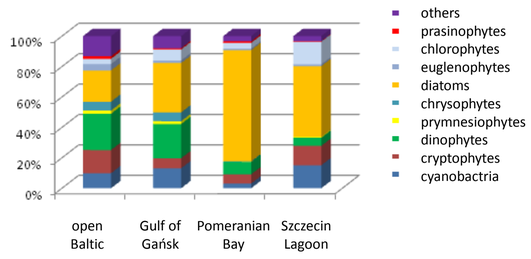
Identification of algae groups

FuoroProbe bbe Moldaenke

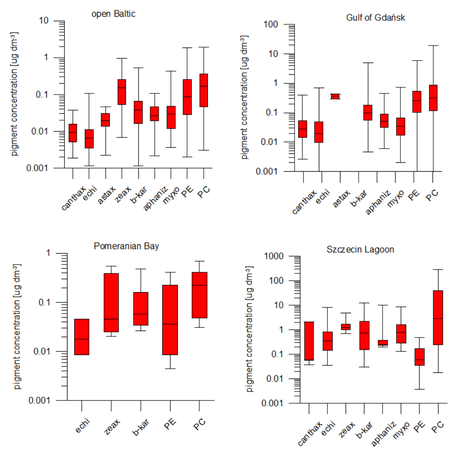


RESULTS

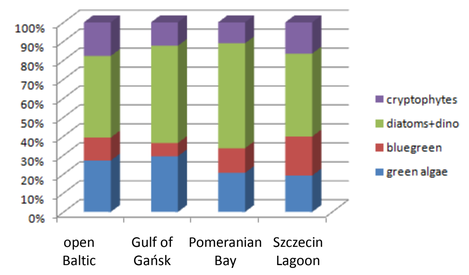
Mean percentage contribution of individual algal classes to total phytoplankton biomass



The ranges of variation in cyanobacteria-specific pigment concentrations identified in each region

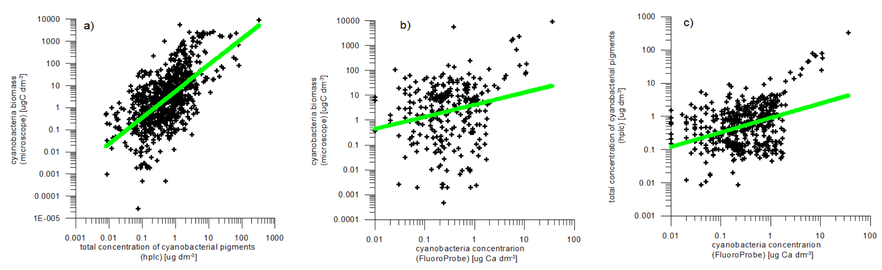


Relative proportions of identified algal groups determined from FluoroProbe bbe (Moldaenke) fluorimeter measurements in the waters of different ecosystems



CONCLUSIONS

The obtained relationships

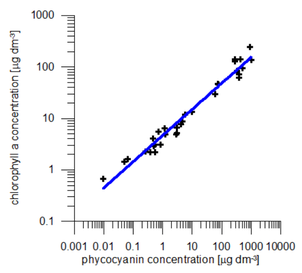


	Relatioships	N	r^2
1	$Biomass_{cyanobacteria}\ (microscope) = C_{cyanobacteria\ \ pigments\ (hplc)}^{1.182064922} * 5.505113756$	826	0.40
2	$Biomass_{cyanobacteria}\ (microscope) = biomass_{cyanobacteria\ \ (FluoroProbe\ )}^{0.4886483732} * 4.136885829$	270	0.05
3	$C_{cyanobacteria\ \ pigments\ (hplc)} = biomass_{cyanobacteria\ \ (FluoroProbe\ )}^{0.433813358} * 0.895817151$	457	0.13

• The best approximation accuracies were obtained when estimating cyanobacteria biomass on the basis of marker carotenoids characteristic of these organisms, i.e. zeaxanthin, echinenone, canthaxanthin, myxoxanthophyll and aphanizophyll (r^2=0.4, N=826).

The best relationship for satellite purposes

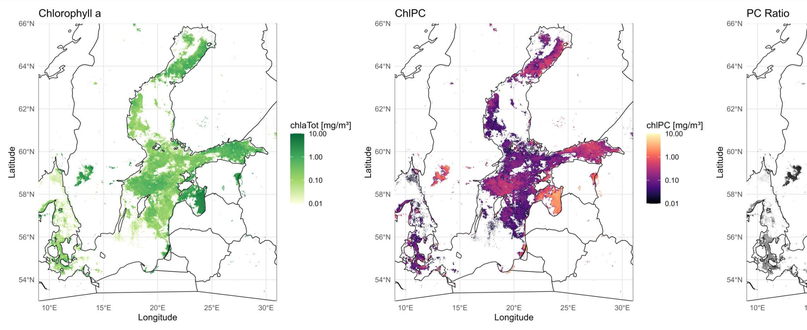
• For the selected subset of data in which cyanobacteria accounted for >75% of the occurring phytoplankton biomass, a relationship was established that allowed approximation of the biomass of this group of algae (represented by concentration of chlorophyll a) on the basis of phycocyanin concentration with a coefficient of determination of r^2=0.96.

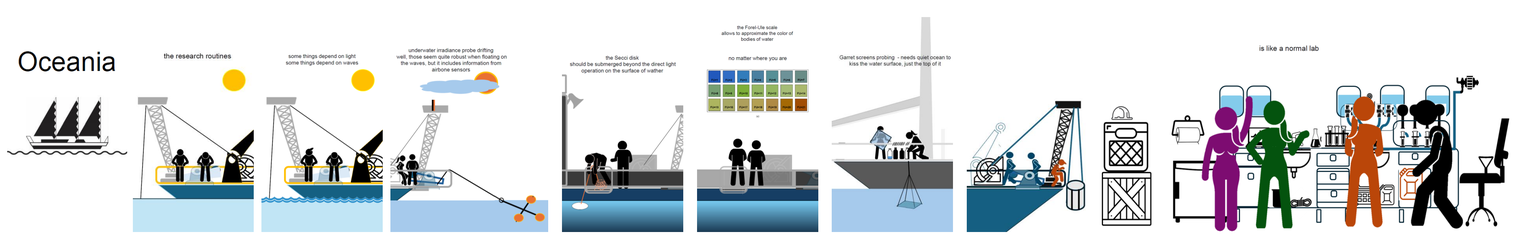


$C_{chl\,a\,-\,cyanobacteria} = 4.653 * C_{PC}^{0.505}$

$R^2 = 0.97$

N=32





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