IMOTOX
Identification and Monitoring of Toxic Cyanobacteria

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Summary

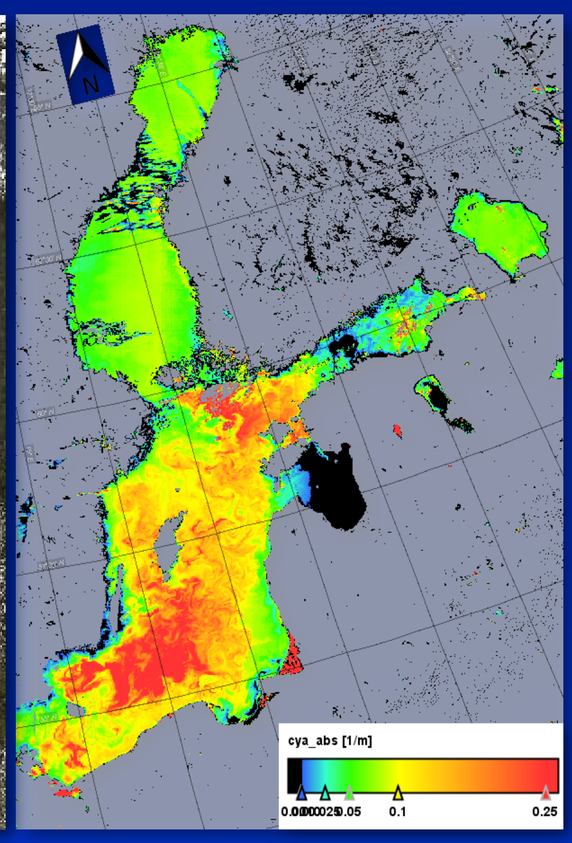
Blooms of harmful cyanobacteria have been shown to increase in both frequency and severity due to global warming, particularly through increased nutrient loads at extreme weather events with elevated winter/spring rainfall and flushing events followed by extended periods of summer drought. These blooms threaten our shrinking freshwater resources in several ways: By increasing turbidity and consequently depriving submerged plants of light they suppress invertebrate and fish habitats and can thus affect biodiversity. On the other hand, release of cyanotoxins during blooms can cause problems for fisheries, drinking water reservoirs as well as recreational water activities. This project aims to **develop a monitoring and early warning system for cyanobacterial blooms**, and study factors that influence bloom formation, toxicity and collapse. This will be achieved through a **close interaction of molecular microbiology, analytical chemistry and remote sensing technology**. The early detection of the rise of potentially harmful cyanobacteria in freshwater lakes will be achieved by remote sensing, followed by a targeted molecular, microbial and chemical verification which in turn will allow time for taking appropriate counter measures.

Aims

- Define the role of bacteriophage and protozoa in formation, toxicity and collapse of harmful algal blooms
- Modelling the optical properties of cyanobacteria
- Development of high-throughput screening assays for cyanotoxin measurements
- Monitoring of water quality using an octocopter
- Remote sensing of cyanobacteria in lakes

Cyanobacteria from satellite

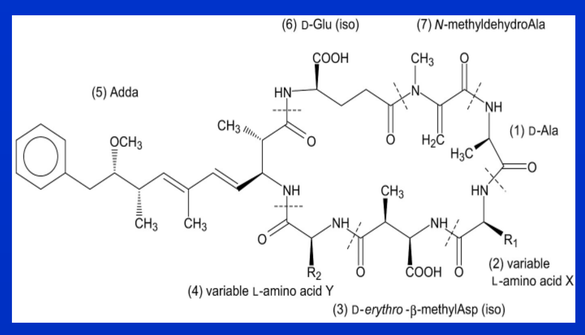
Baltic Sea, 2010-07-11
Truecolor image, MERIS RR



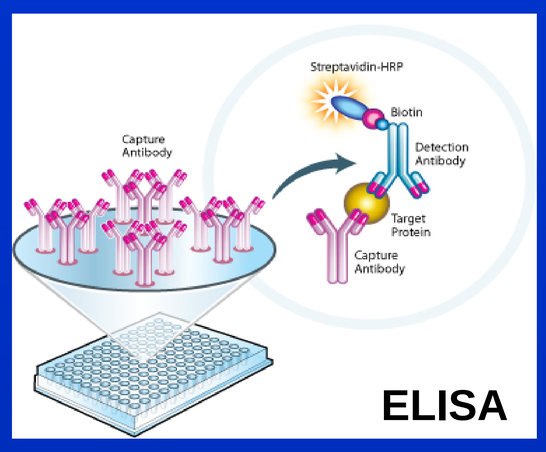
Cyanobacteria concentration
2 bloom centres

S. Riha, H. Krawczyk: Remote sensing of cyanobacteria and green algae in the Baltic Sea. ASPRS 2013 Annual Conference, Baltimore, Maryland, March 24-28, 2013.

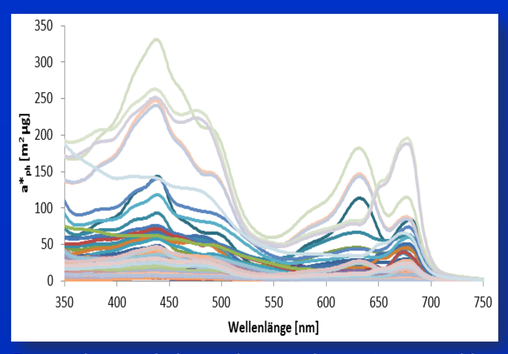
High throughput screening for cyanotoxins



General structure of microcystins. Variations in the structure are due to the methylation of the carboxylic acids (3) and (6), the demethylation of the amide (7) and the side chain of (3), methylation at the side chain of (7) and changes in the all-*trans* conformation of the conjugated double bonds of Adda.(Anne Zeck, Michael G. Weller, Don Bursillb and Reinhard Niessner, Analyst 2001, (126) 2002-2007)



Model the variability of optical properties



Dependency of absorption on pigment composition and growth conditions (light, nutrients)

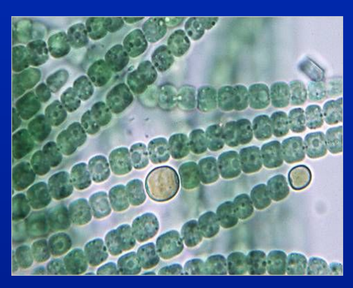
Courtesy S. Riha (unpublished results)

Prepare octocopter for monitoring of lakes

Goal: Cheap system operated by the end user

Harmful Algal Blooms

Anabaena sp.

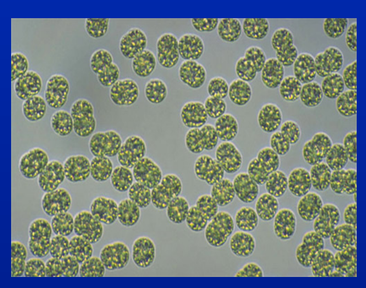


Anatoxin
Saxitoxin
Microcystin

Aphanizomenon flos-aquae

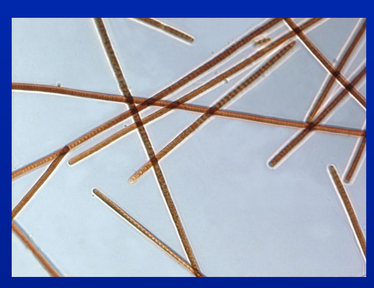
Cylindrospermopsin
Saxitoxin
Microcystin

Microcystis aeruginosa



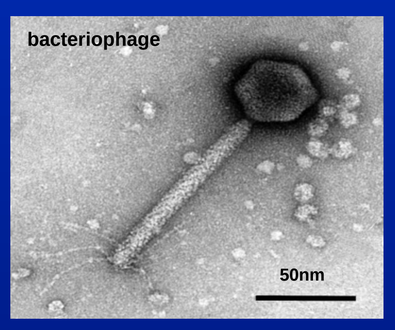
Microcystin

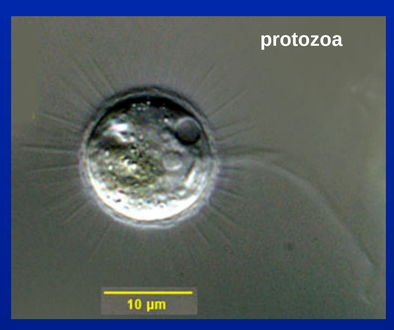
Planktothrix rubescens



Anatoxin
Saxitoxin
Microcystin
Aplysiatoxin

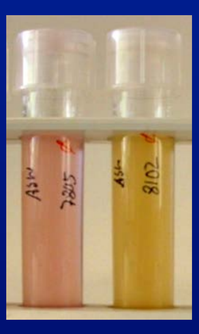
Effect of protozoa and bacteriophage on cyanobacteria





Healthy culture

lysed by phage



Healthy culture

lysed by protozoa

Limnologische Station

IGSSE

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.