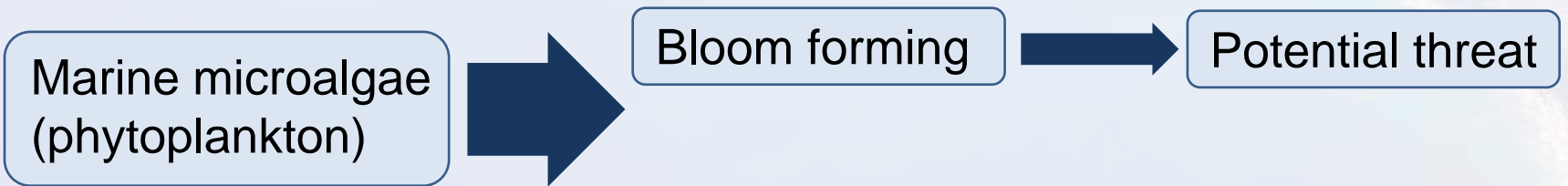# Molecular sensor based monitoring of harmful algae

**Johanna Hessel, Kerstin Oetjen and Dr. Katja Metfies
Young investigator group PLANKTOSENS**

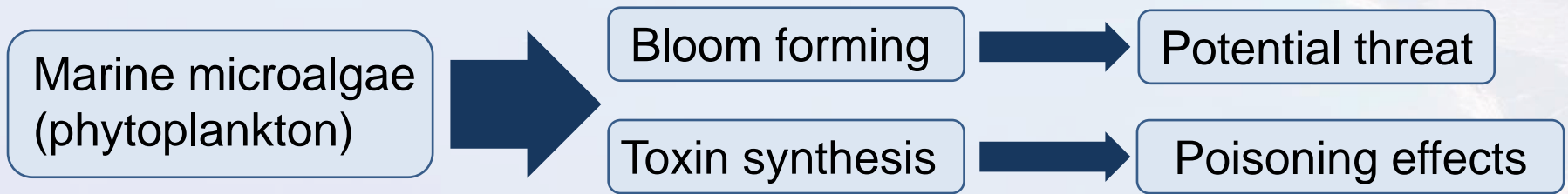**24.02.2015
Session 085**

How are harmful algae defined?

| Marine microalgae (phytoplankton) | → | Bloom forming | → | Potential threat |

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How are harmful algae defined?

Marine microalgae (phytoplankton) → Bloom forming → Potential threat

Toxin synthesis → Poisoning effects

Toxin group

Okadaic acid

Saxitoxins

Domoic acid

Dinophysis acuta
20 µm

Alexandrium sp.
20 µm

Pseudo-nitzschia sp.
20 µm
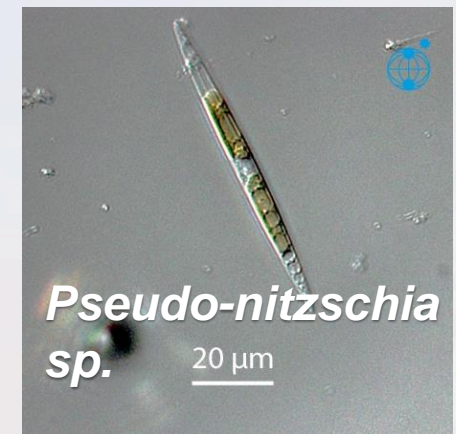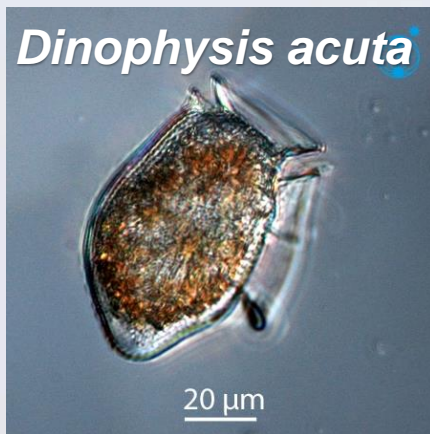
Syndromes

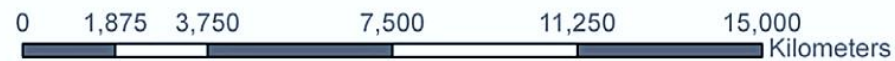**D**iarrheal **S**hellfish **P**oisoning

Amnestic **S**hellfish **P**oisoning

Paralytic **S**hellfish **P**oisoning
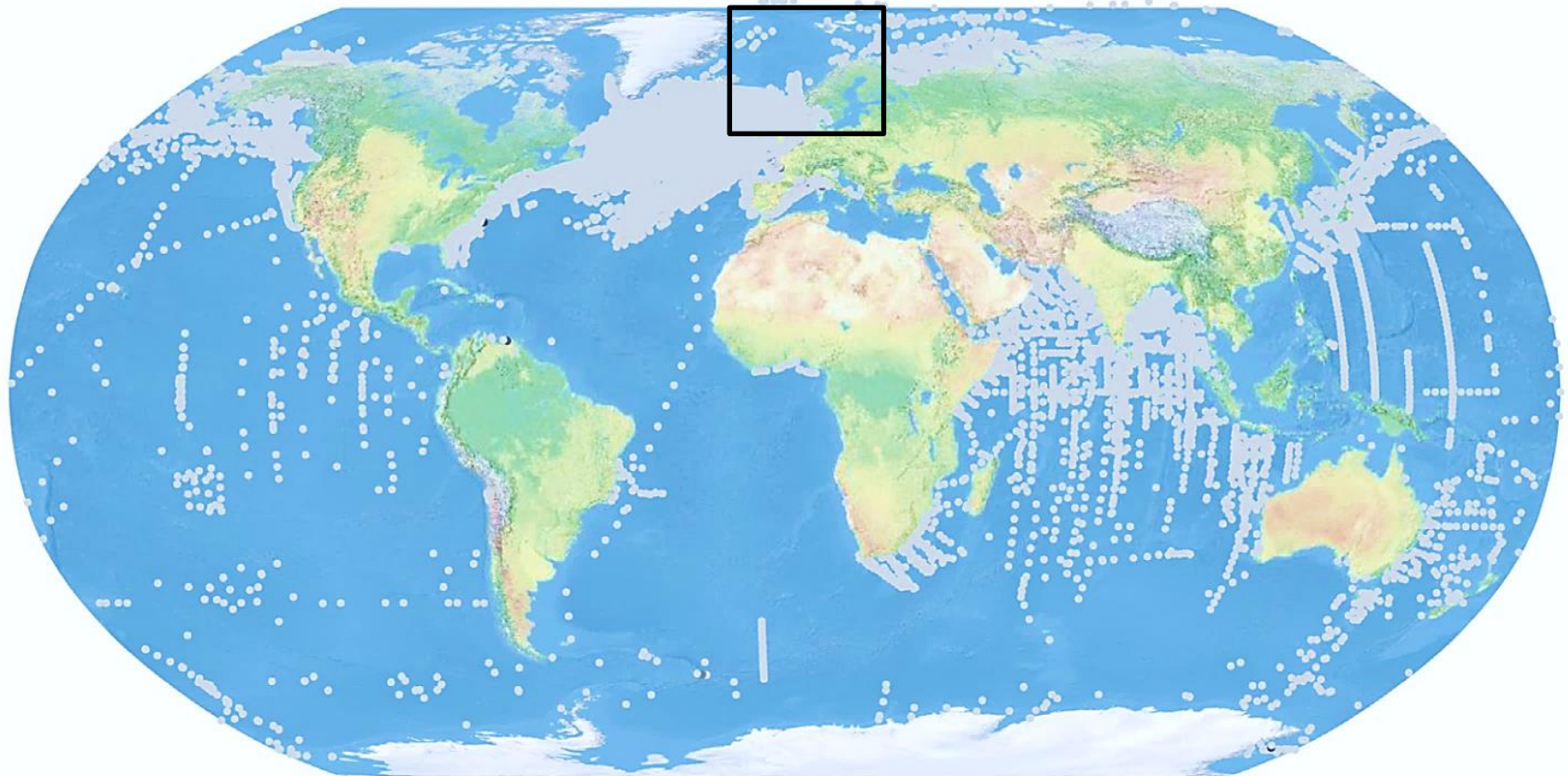
Number of records in OBIS of species that can potentially cause a HAB

0   1,875   3,750   7,500   11,250   15,000
Kilometers

N

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Detection and monitoring systems
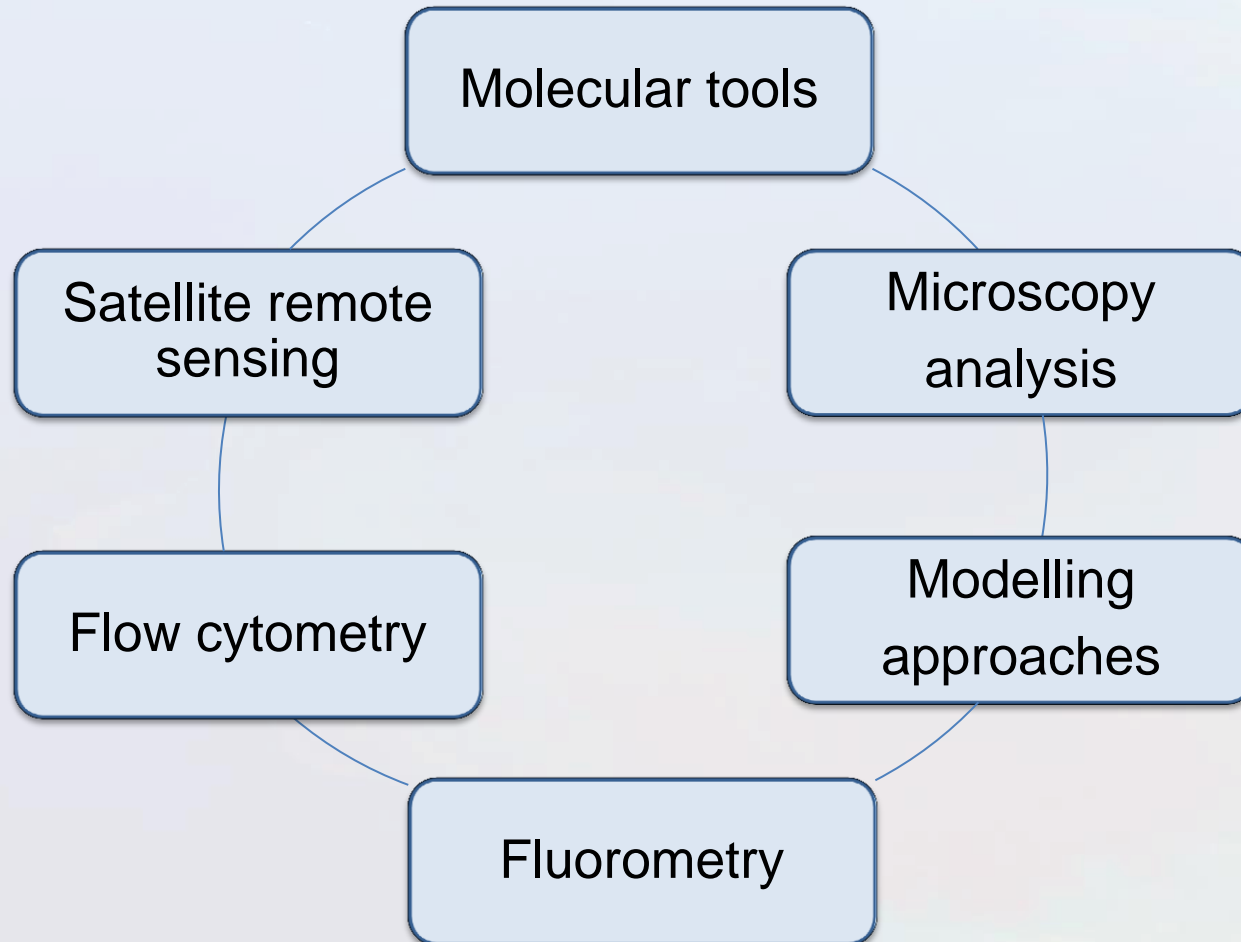
2. Technology approach

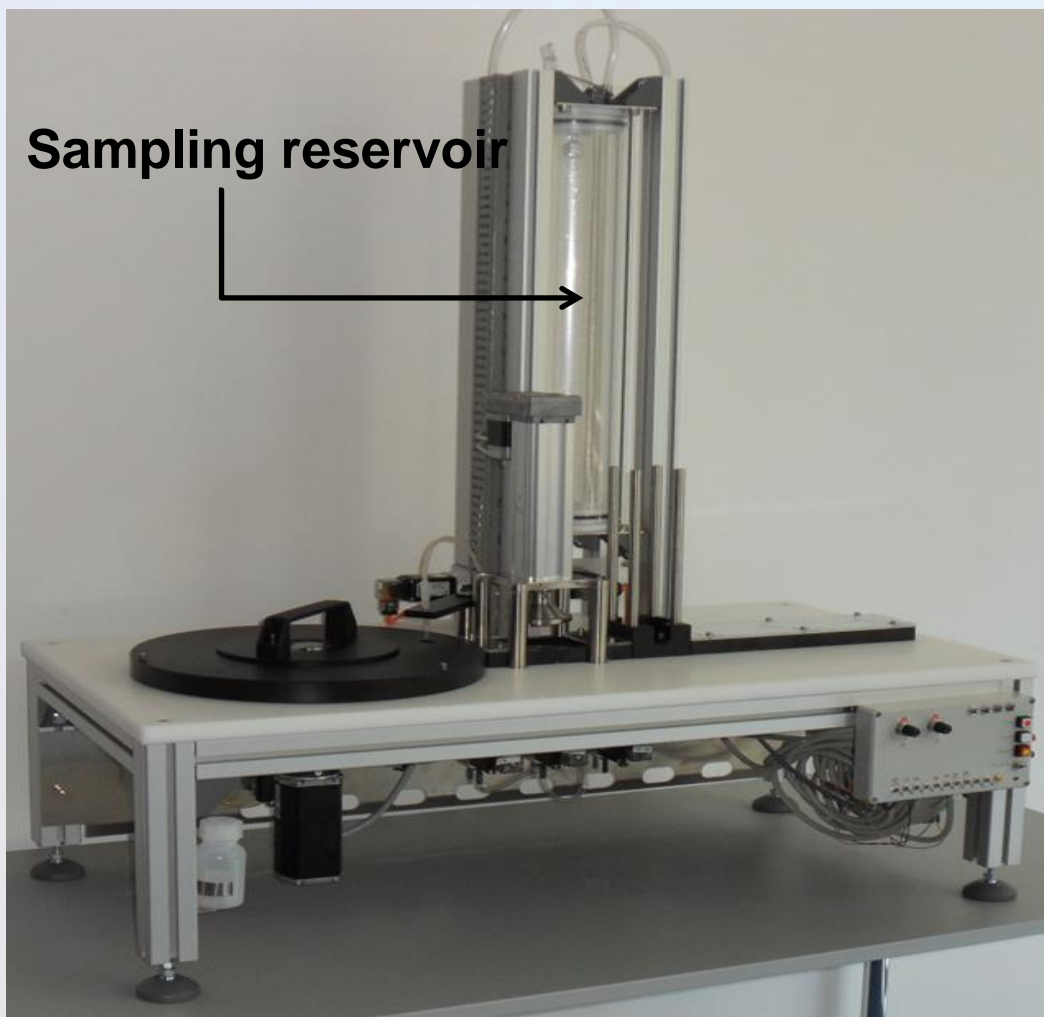| Sampling + Filtration	→	Cell lysis	→	Molecular quantification

Automatic filtration module

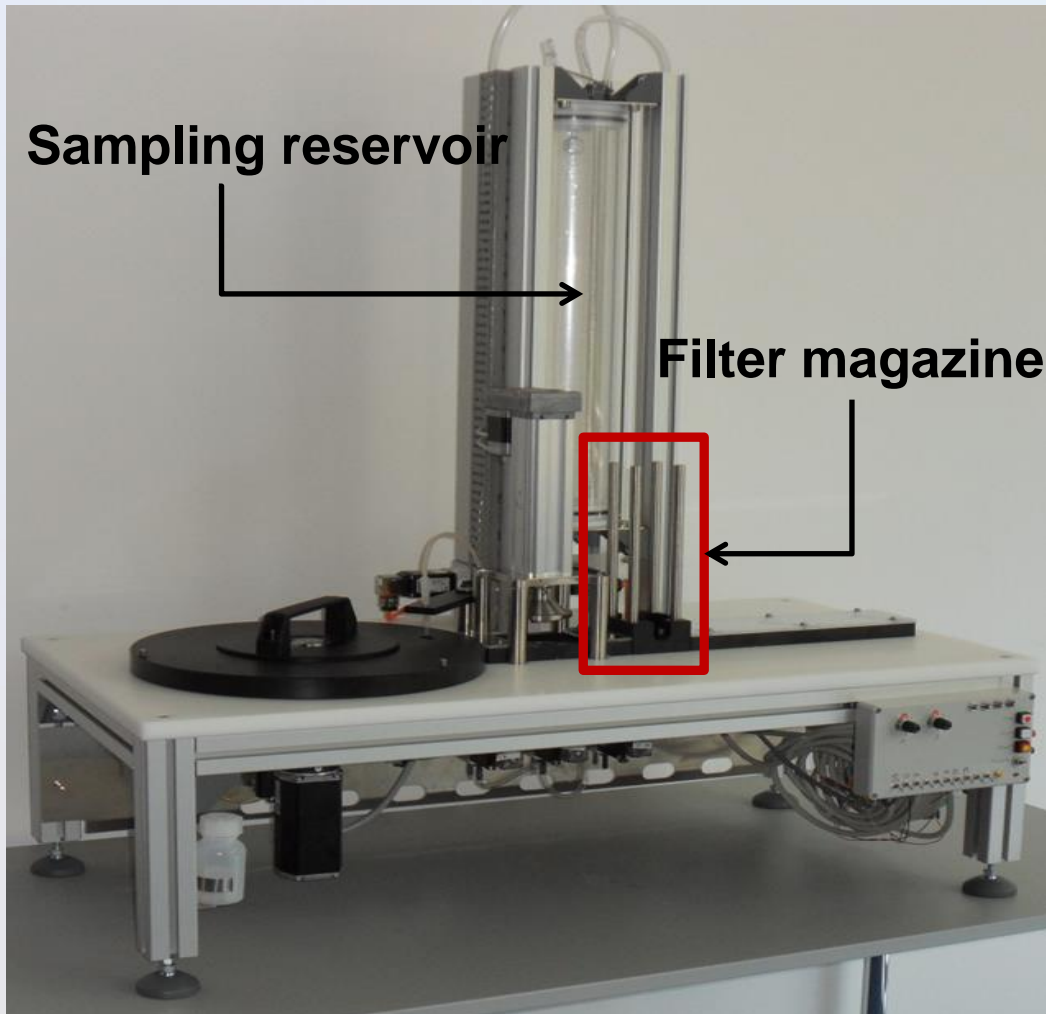

Ultrasound module

Nucleic acid biosensor

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Sampling reservoir

Automatic filtration module for marine microbes (AutoFiM)

• Sampling reservoir (up to 5 L)
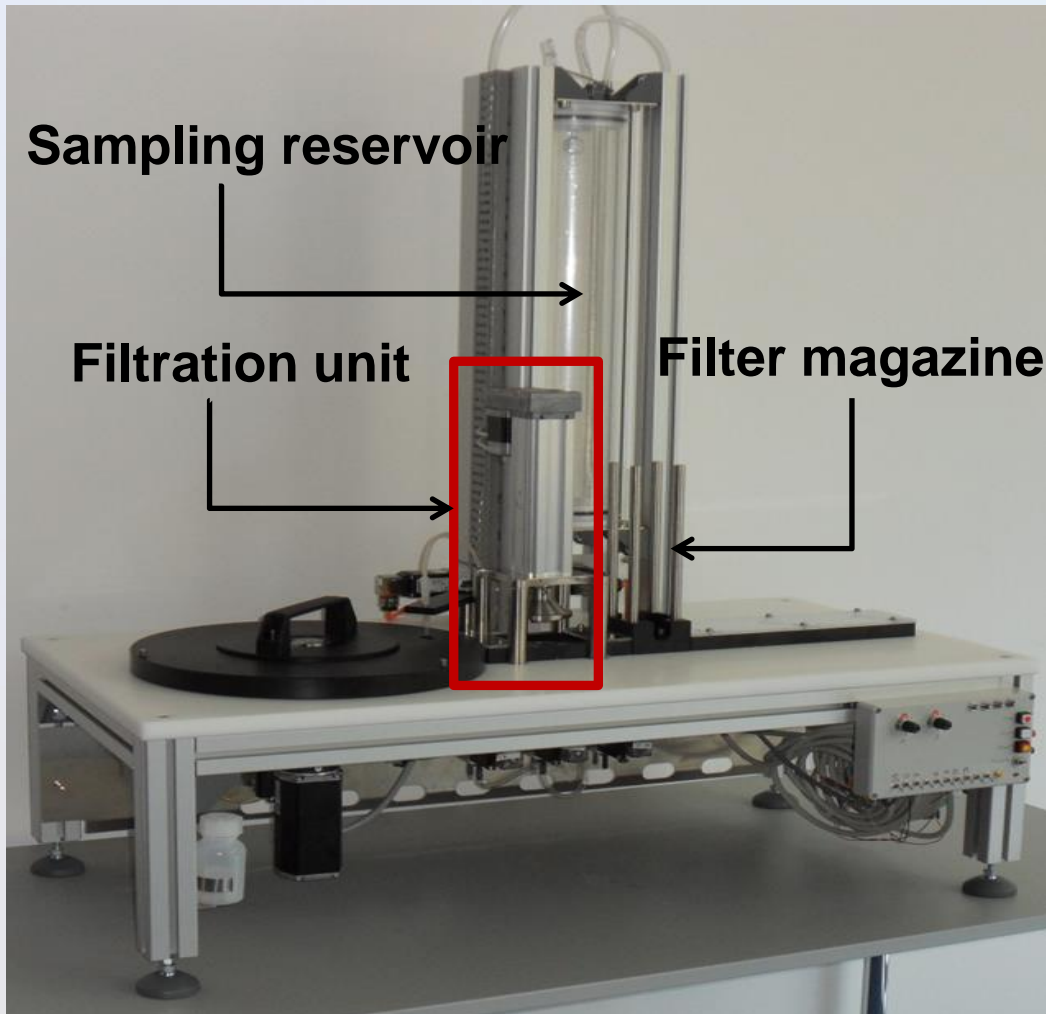
2.1 Sampling and filtration

Sampling reservoir

Filter magazine

Automatic filtration module for marine microbes (AutoFiM)

- Sampling reservoir (up to 5 L)

- Filter magazine

2.1 Sampling and filtration

Sampling reservoir
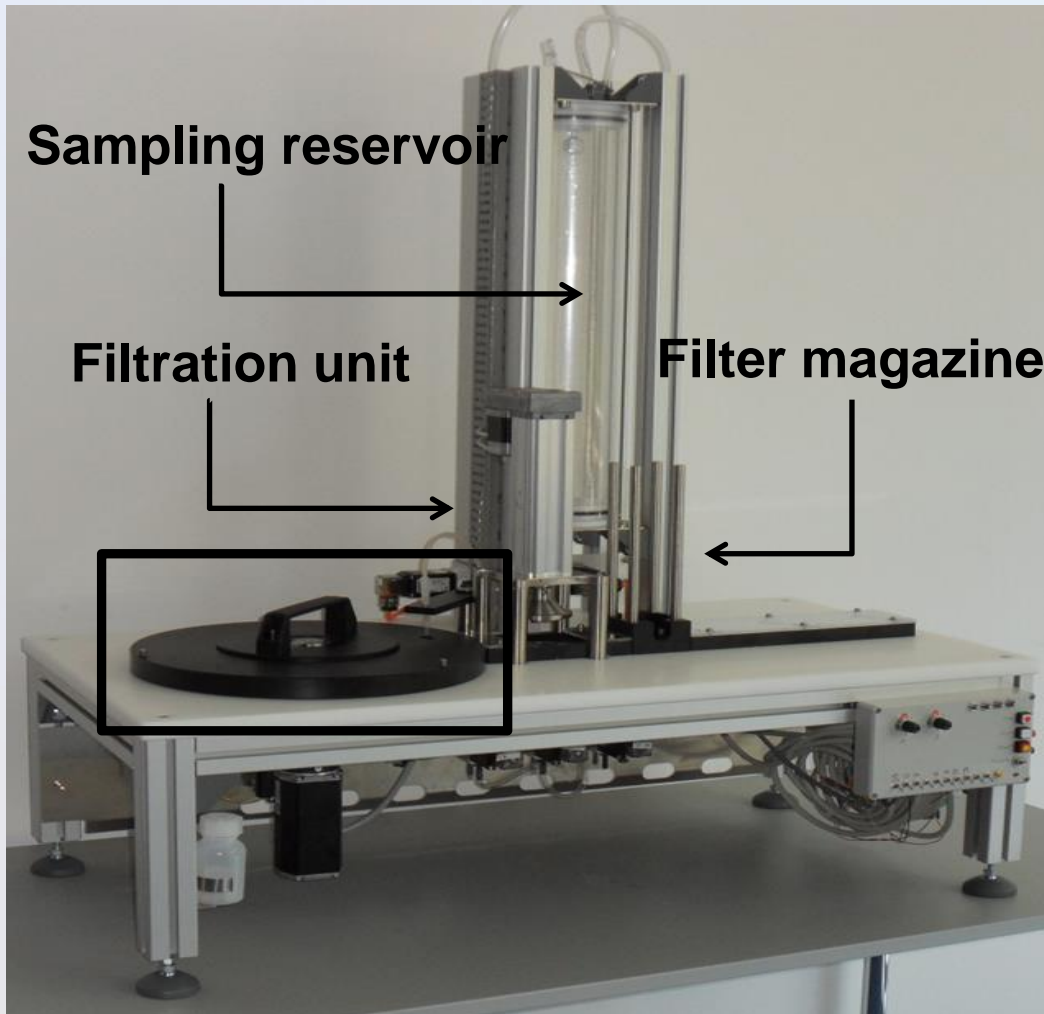
Filtration unit

Filter magazine

Automatic filtration module for marine microbes (AutoFiM)

- Sampling reservoir (up to 5 L)

- Filter magazine

- Filtration unit (vacuum pump)

2.2 Ultrasound unit

Sampling reservoir

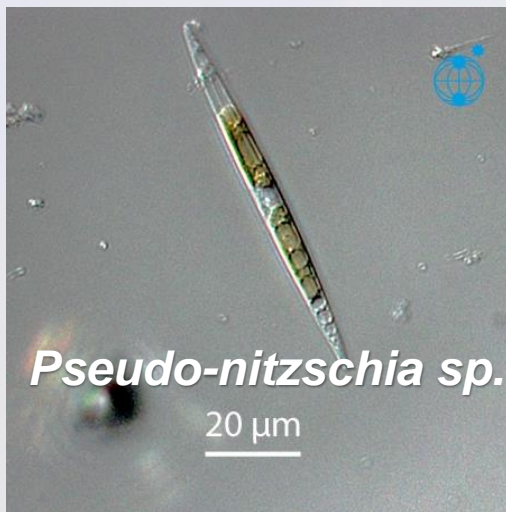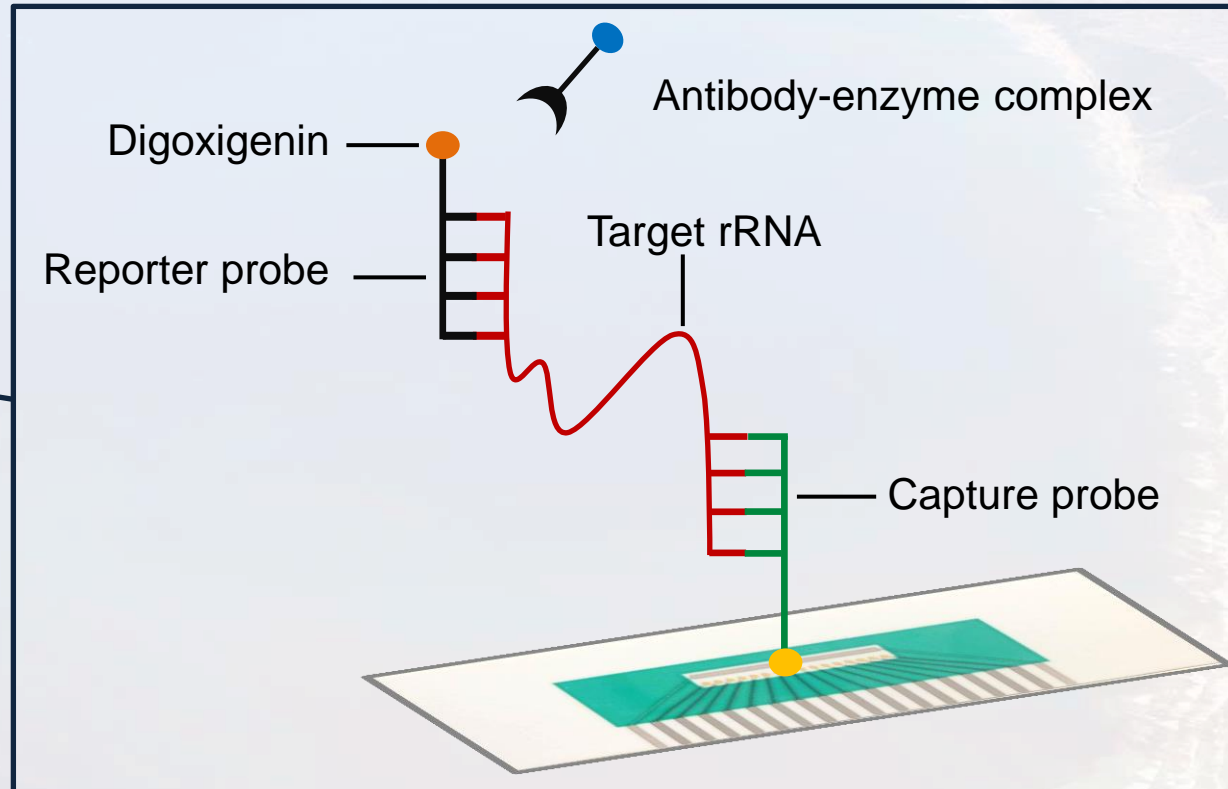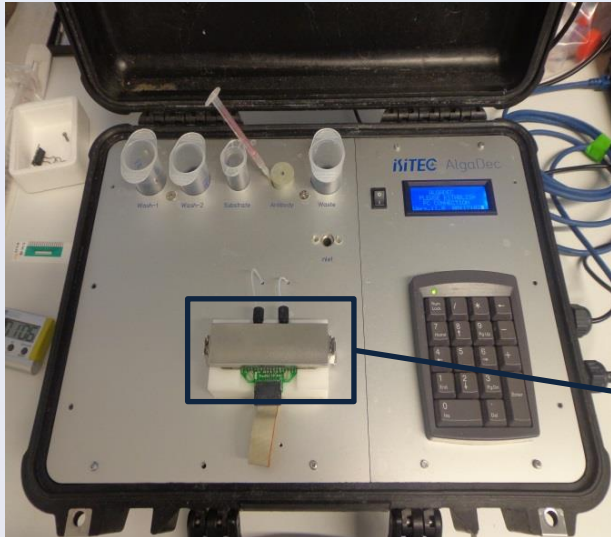**Filtration unit**

Filter magazine
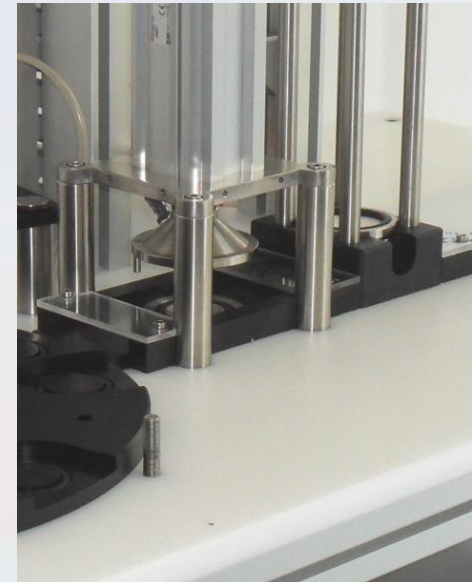
Further processing:

1. Filter storage (roundel)

2. Ultrasound unit generating cell extracts + free nucleic acids

Molecular detection and quantification: Sandwich Hybridisation

Antibody-enzyme complex
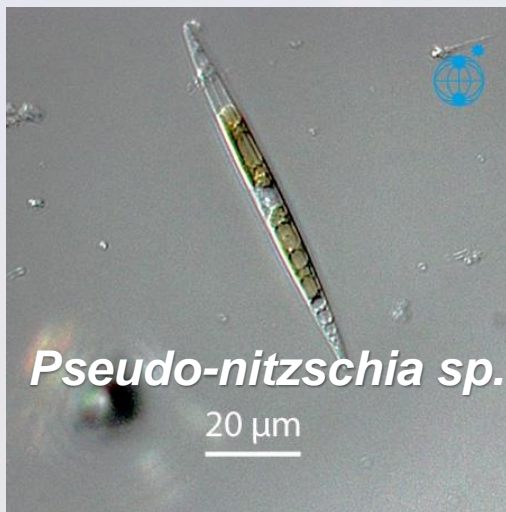
Digoxigenin

Target rRNA

Reporter probe

Capture probe

Pseudo-nitzschia sp.

20 μm

Molecular detection and quantification: Sandwich Hybridisation

Pseudo-nitzschia sp.

20 µm
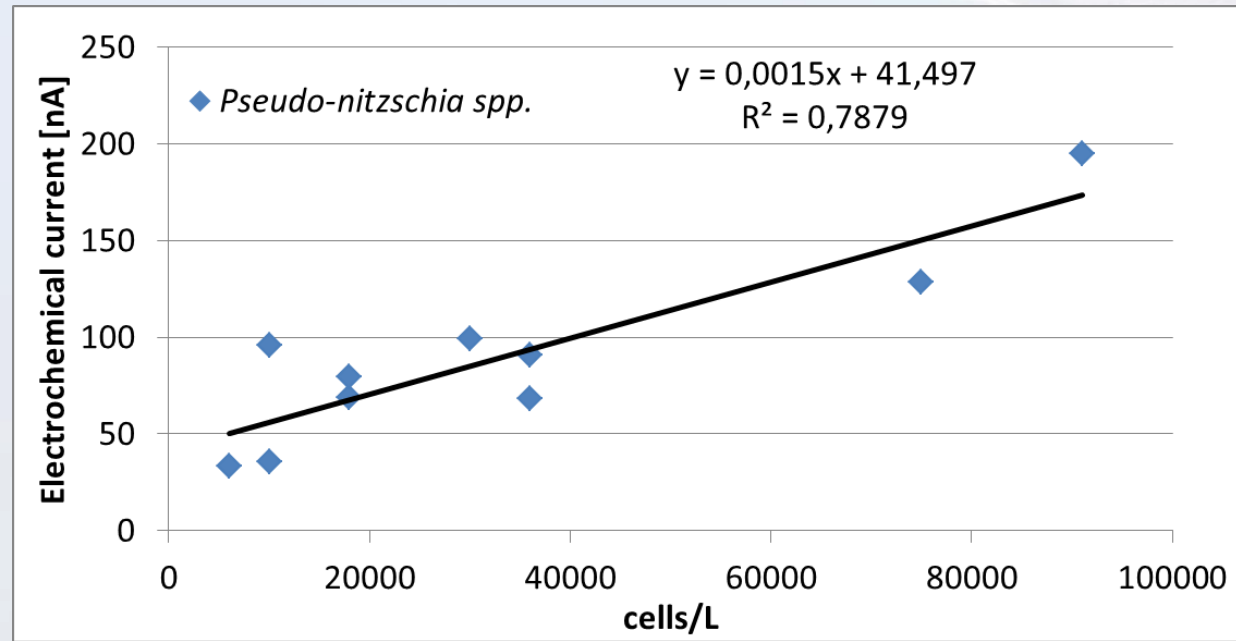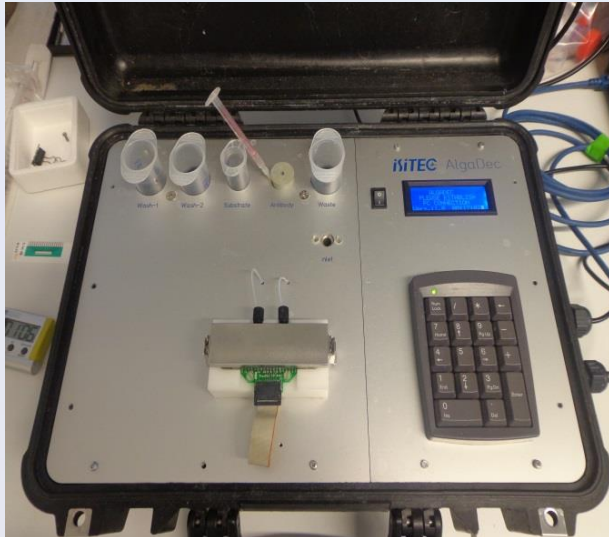
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- Redox-reaction measured as electrochemical signal

- Quantification of target species (calibration curves)

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3. Main Experiments and Objectives
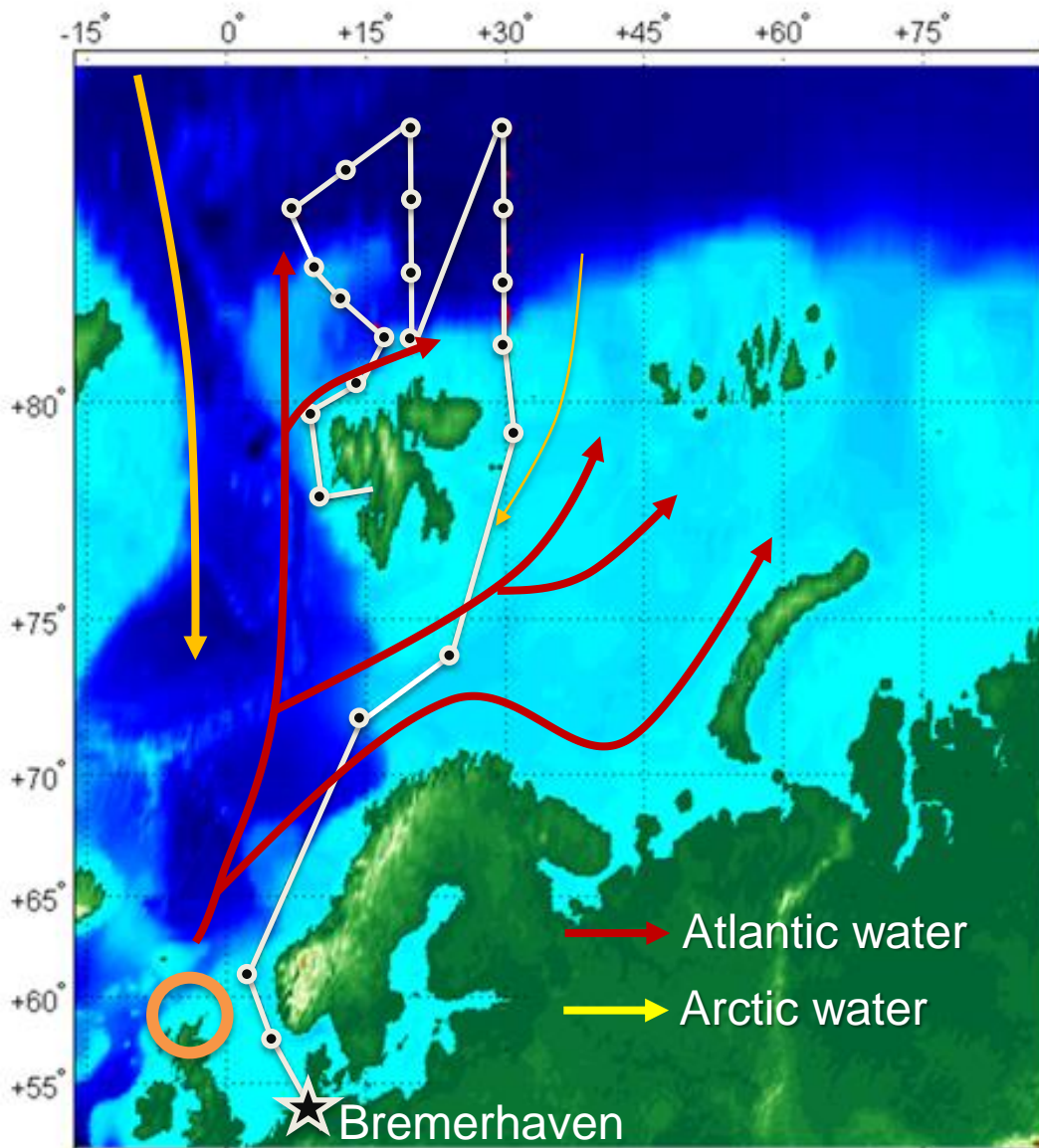
➢ **„Proof of Principle"**

(1) Autonomous workflow: combination of AutoFiM + us-unit and biosensor

(2) Evaluation and optimisation of

- Filtration procedure
- Sensor chip design
- Spotting performance
- Signal:noise-ratio
- Species-specific probes
- Calibration curves
- Detection chemicals
- Ultrasound intensity
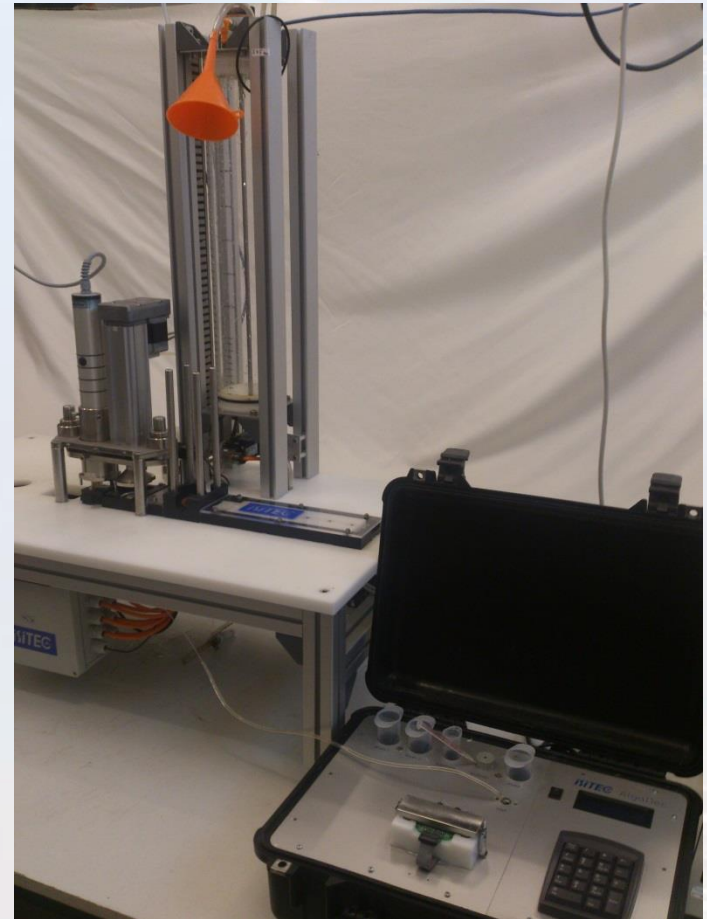
4. Application and field deployability

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(1) Cruise Sampling
(Polarstern May/June 2015)

- Identify abundance of potentially toxic dinoflagellates
- Do distribution ranges of HAB-species expand northwards?

(2) On-site field sampling (e.g. Orkney Islands)
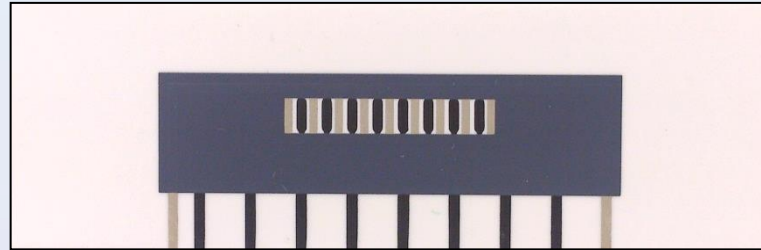

Polarstern © awi.de

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Many thanks to…

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Chipdesign and signal:noise-ratio

Multi(8)-carbonchip