FerryBox Workshop

Continuous integrating cavity absorption measurements – Extending the capability of the FerryBox to measure biological relevant parameters

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PROTOOL

COSYNA

Helmholtz-Zentrum Geesthacht
Centre for Materials and Coastal Research

Motivation

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- Comprehensive environmental monitoring requires reliable measurements in high spatiotemporal resolution
- Sensors mounted on mobile platforms (e.g FerryBox) can provide such data
- Many water constituents are optically active and can be detected by means of fluorescence, absorption, or scattering measurements
- Regarding *in situ* measurements, biological relevant information is mostly fluorescence-based
- Absorption measurements are probably less influenced by phytoplankton species composition, physiological state, and short term light acclimatization

Motivation

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Aims:

1. Obtaining hyperspectral absorption coefficients measurements in the visible spectrum
   - → *in situ*
   - → continuously

2. Using these data for the determination of
   - → important bulk parameters (chlorophyll-a, TSM)
   - → differences in phytoplankton composition

Absorption measurements

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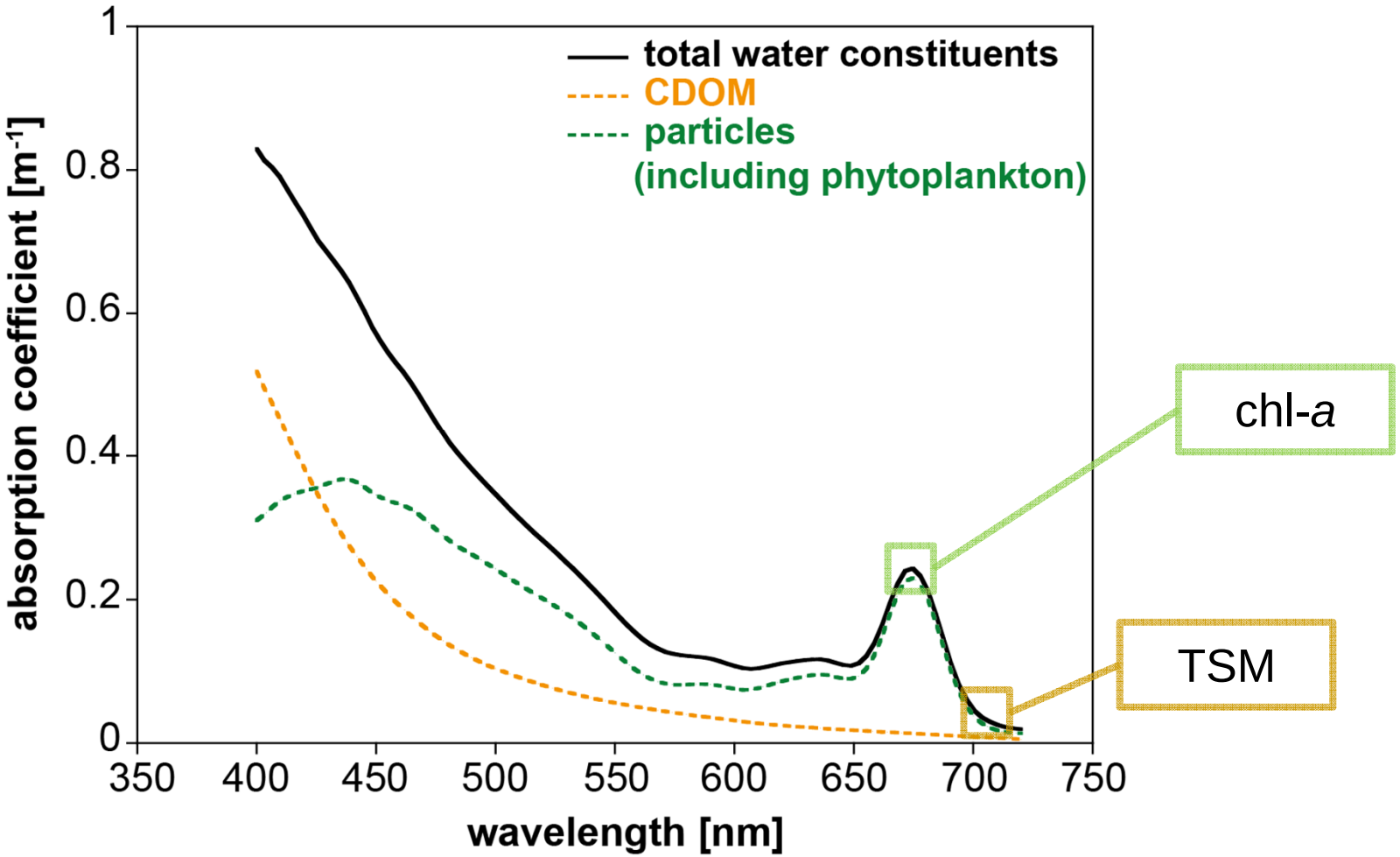

Hyperspectral absorption measurements can be used to estimate important bulk parameters

Absorption measurements

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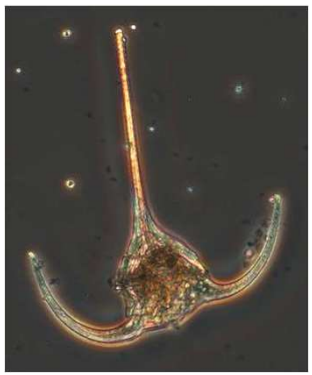

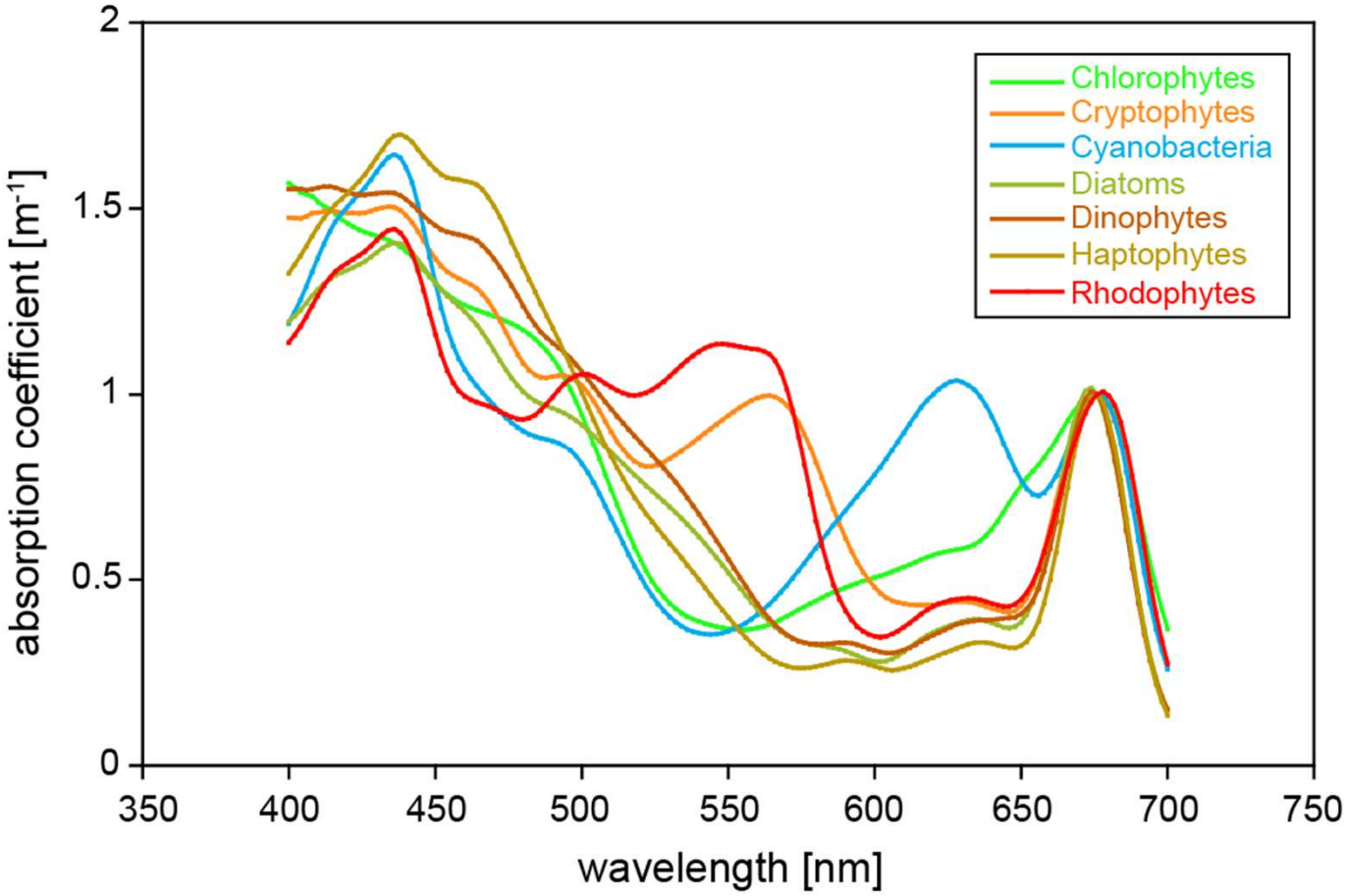

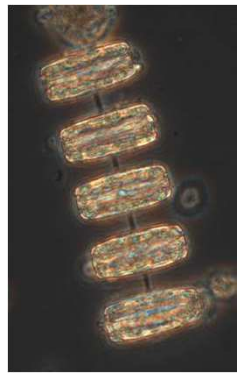

Shape of spectrum contains information for phytoplankton group identification

Obstacles in absorption measurements

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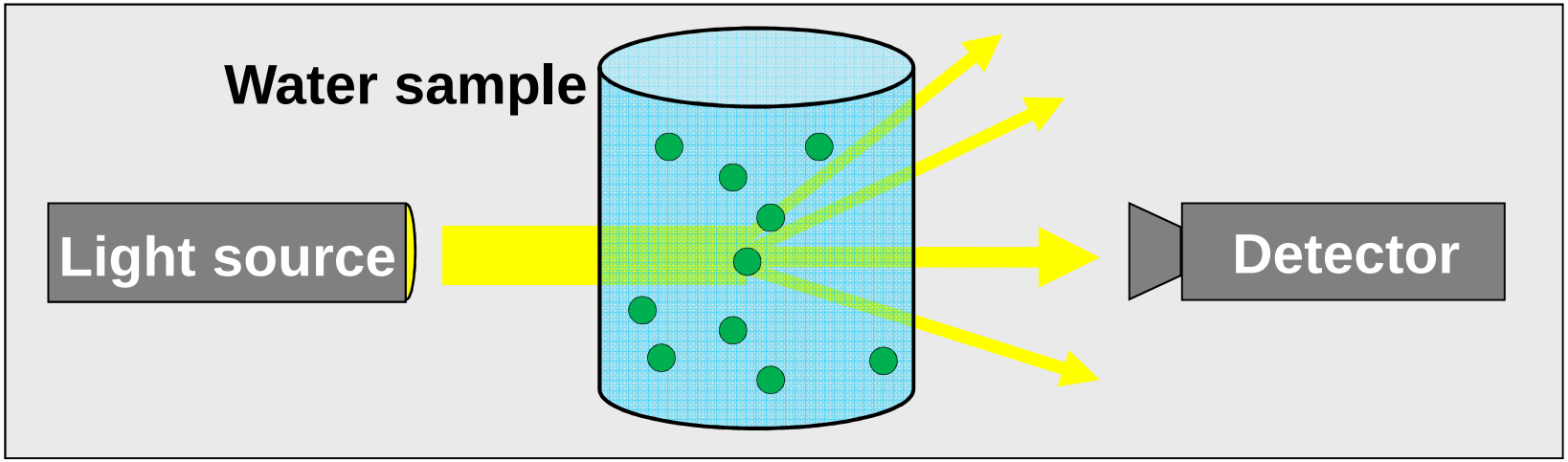
1. Low concentration of absorbing material:
   - ➢ Requires the concentration of samples by filtering
   - ➢ Requires large cuvettes for *in situ* measurements

2. Additional light loss due to scattering on particles
   - ➢ Can lead to overestimation of true absorption
   - ➢ Requires correction



Integrating cavities

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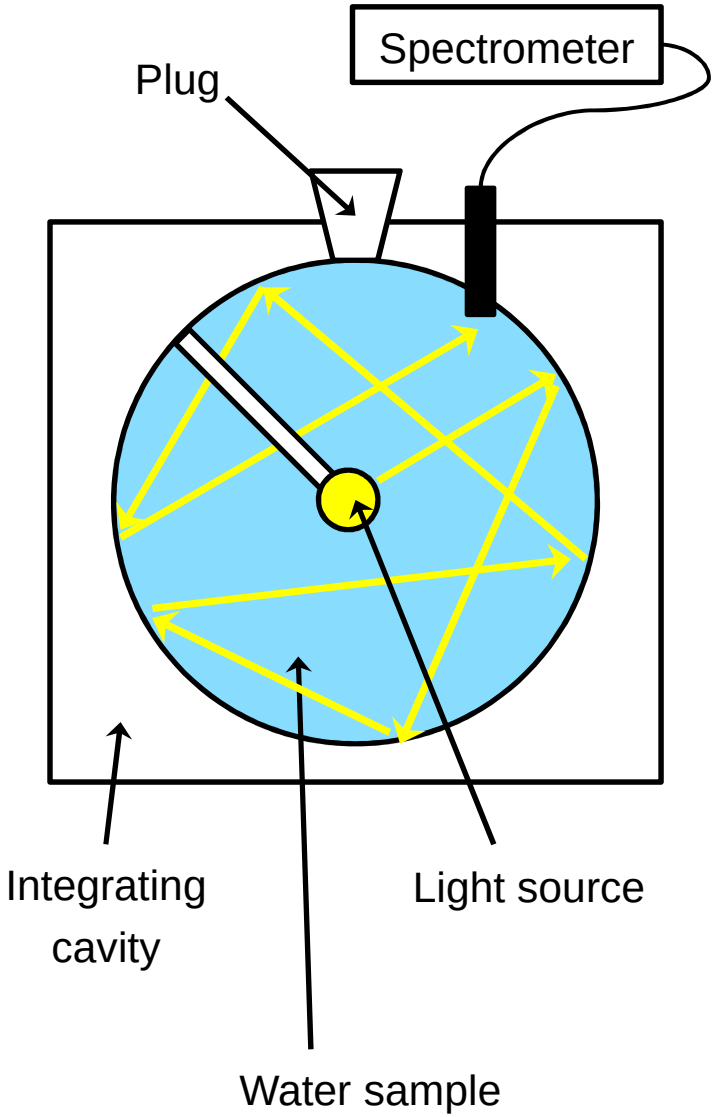
- Integrating cavities can overcome these problems
- **P**oint **s**ource **i**ntegrating **c**avity **a**bsorption **m**eter (**PSICAM**)
  - Compact design
  - A long optical path length (high sensitivity)
  - Diffuse light field (eliminates scattering error)
  - Whole visible light spectrum
- Accurate device for analysis of discrete samples
- Continuous measurements would be desirable



Flow-through-PSICAM

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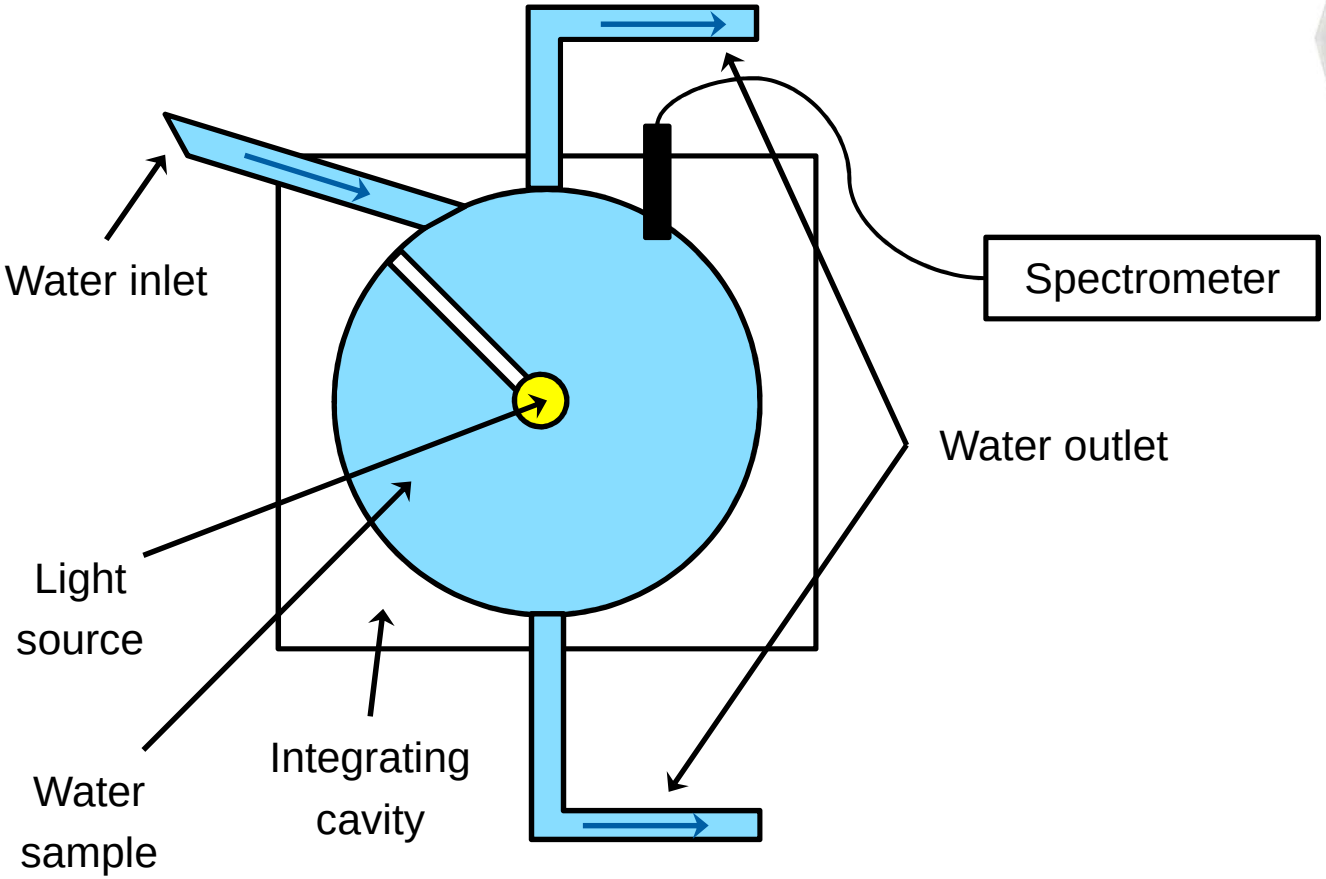

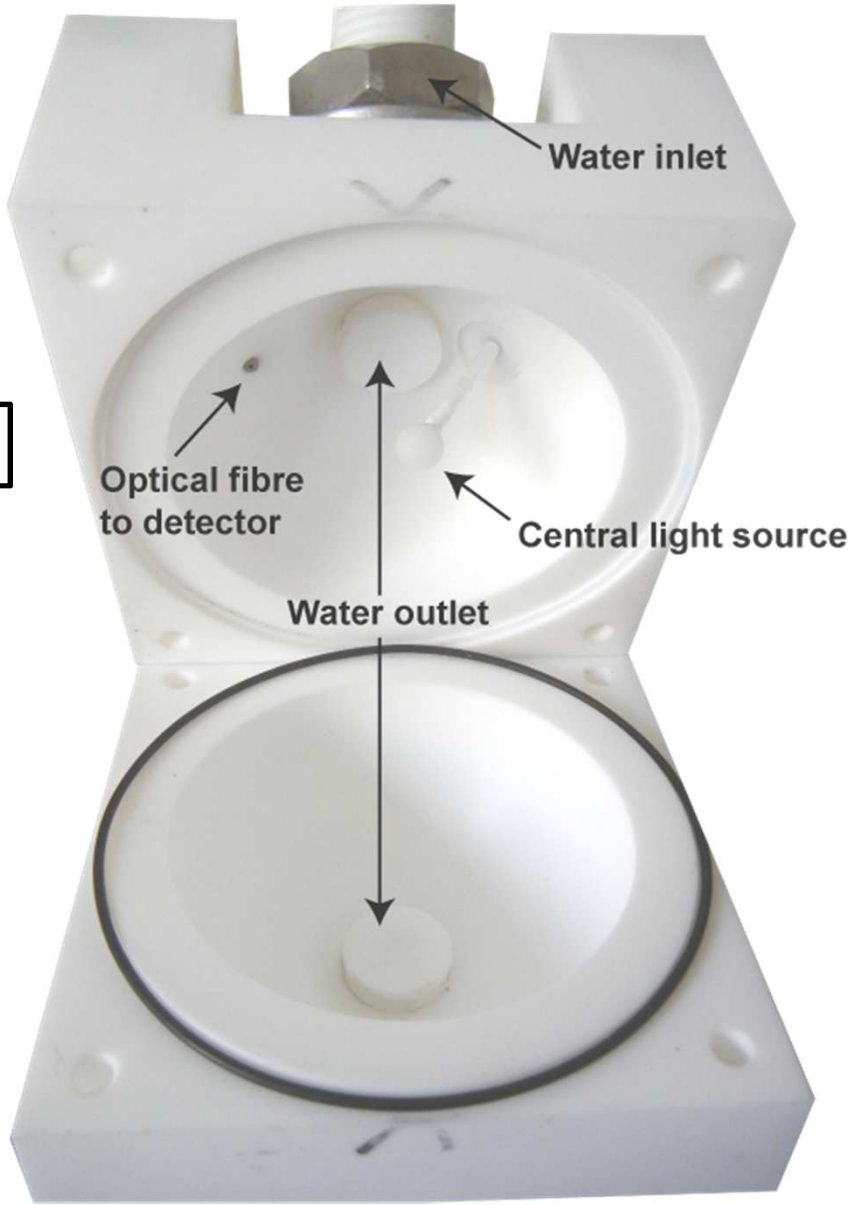

Flow-through-PSICAM

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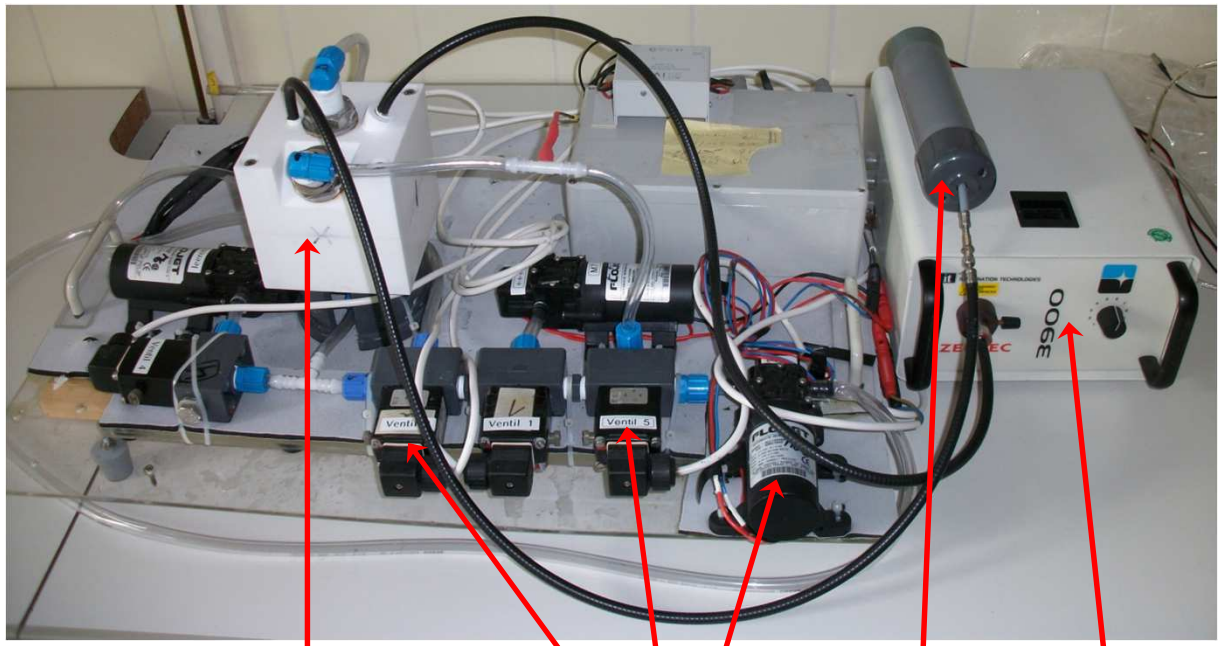

RV „Heincke“

Water

FerryBox

Field tests

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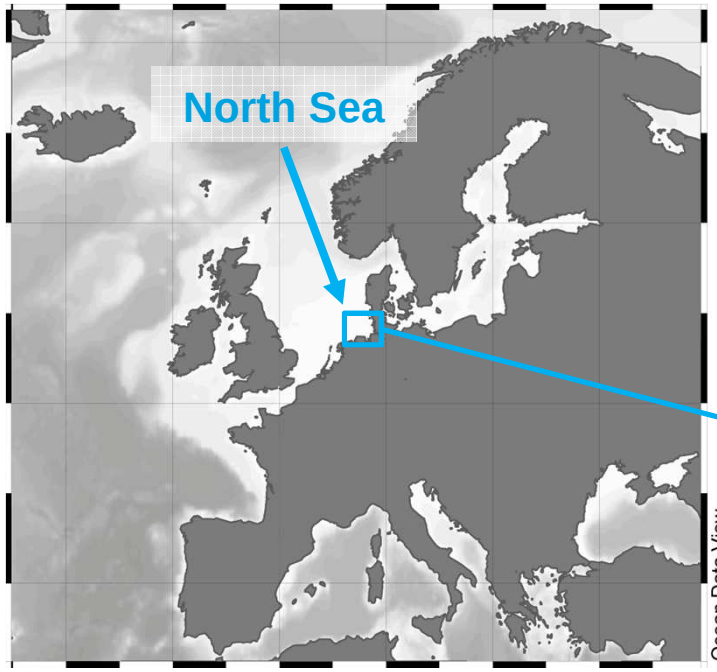
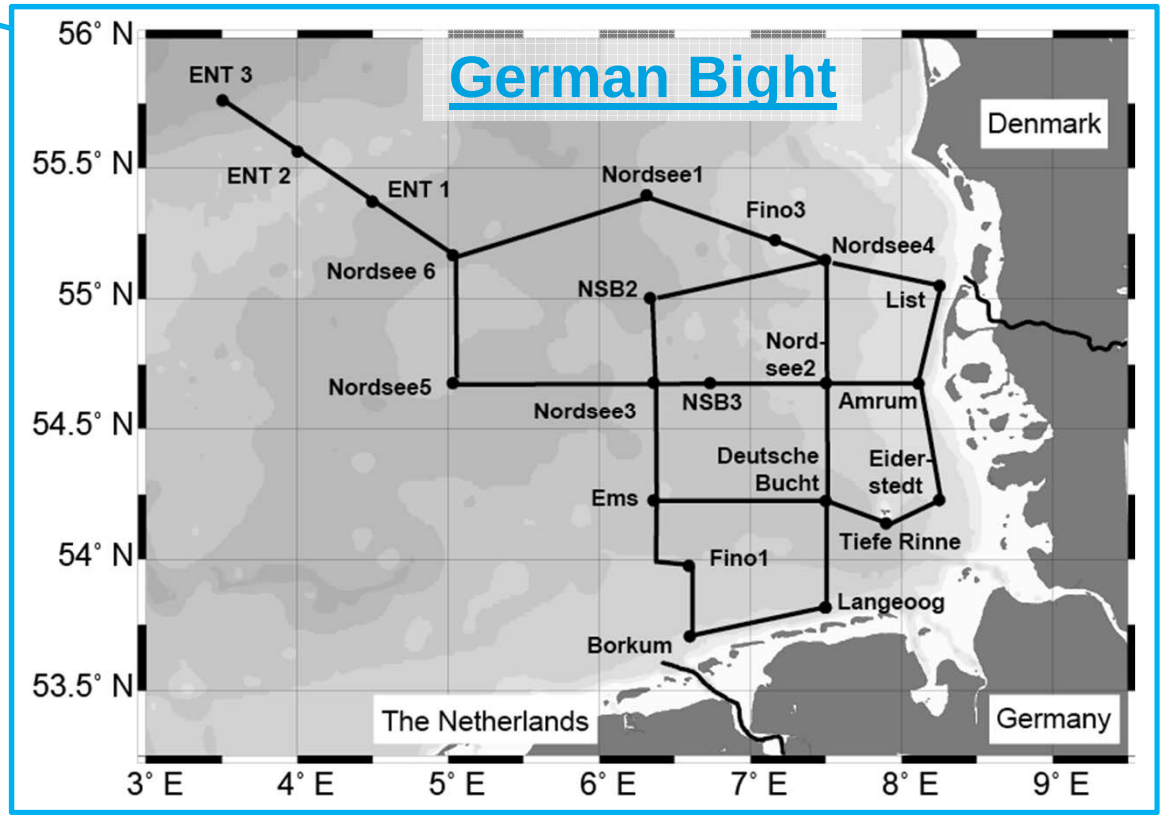


1. Comparison of PSICAM and flow-through-PSICAM

2. Evaluate absorption measurements for chl-*a* and TSM determination



Cruises:

April	2011
June	2011

Comparison of PSICAMs

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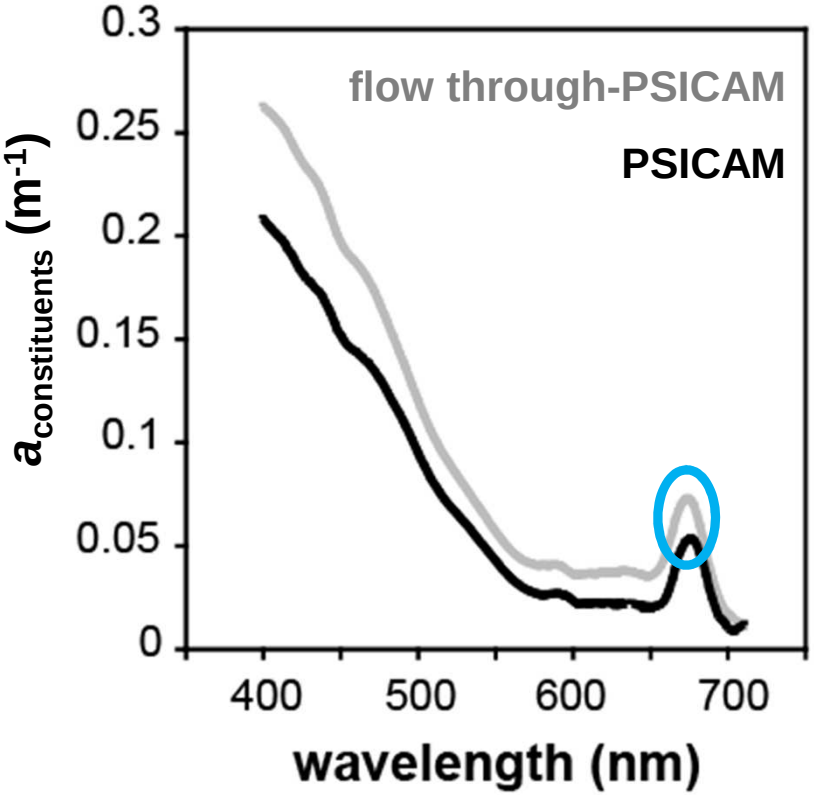

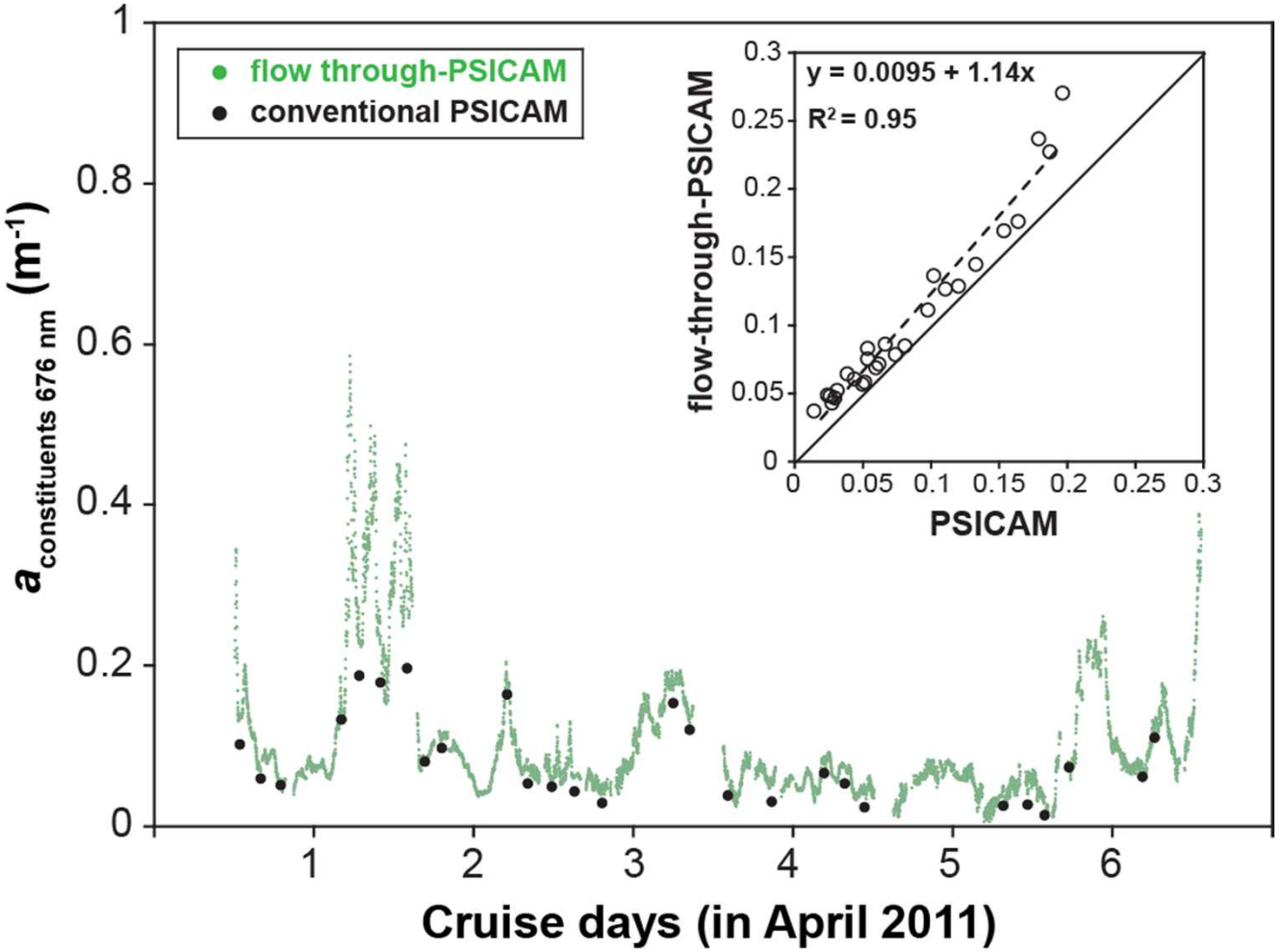

Main error source for deviation: → Contamination with particles

→ Less problematic in open ocean?

Determination of chl-*a* and TSM

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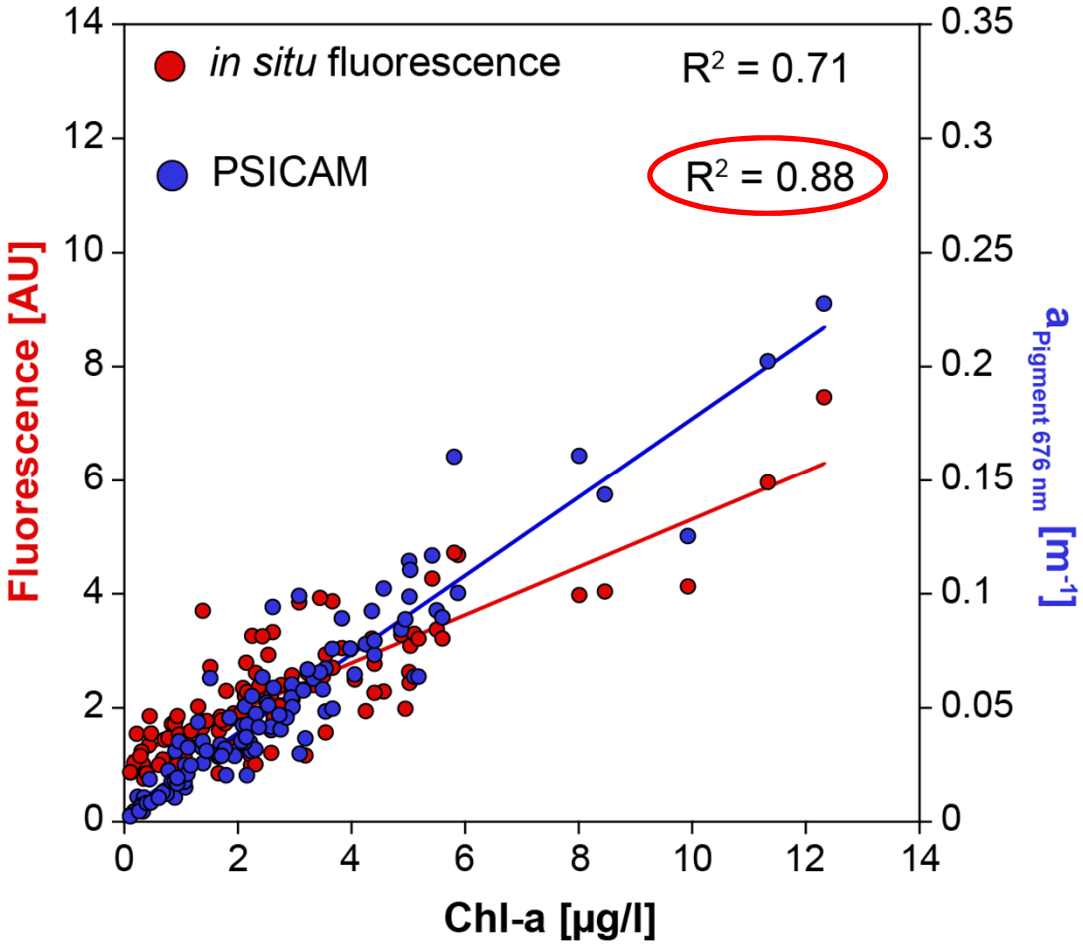
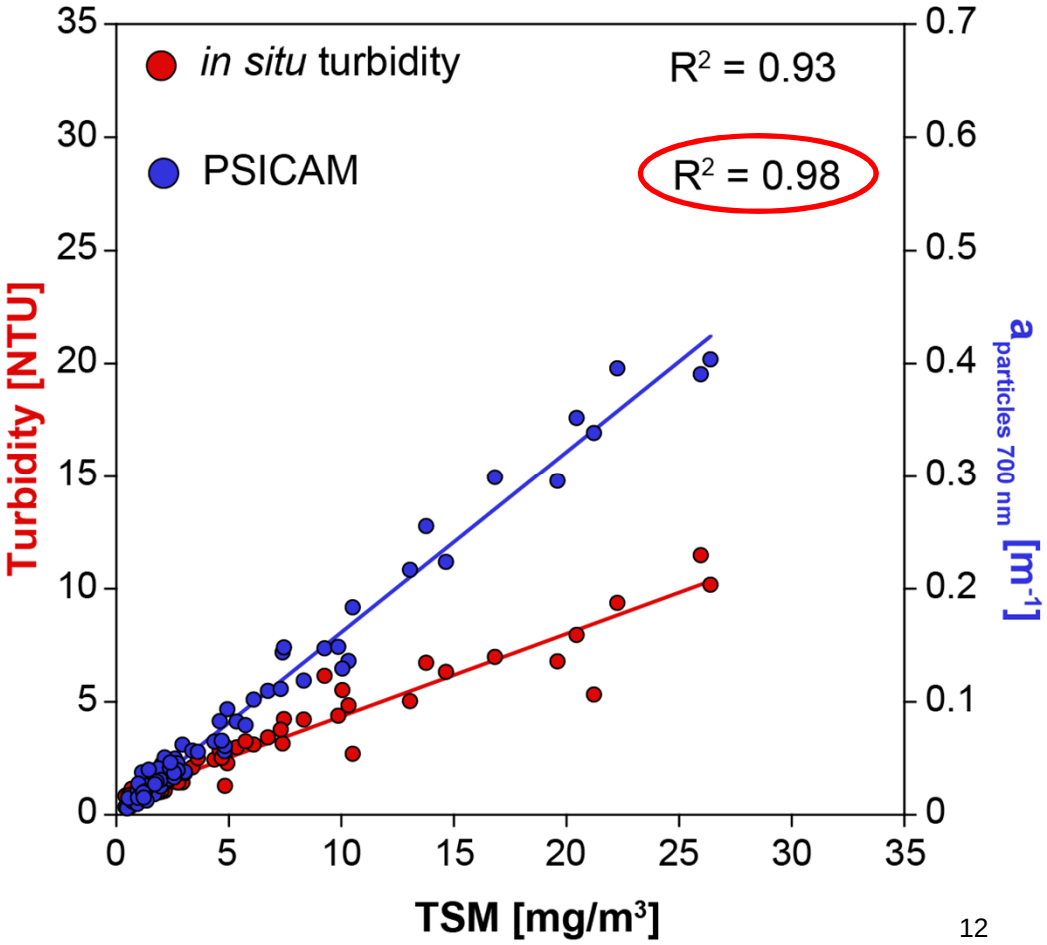
Traditional approaches vs. absorption coefficient measurements

Chlorophyll-a



Total suspended matter



Determination of chl-*a* and TSM

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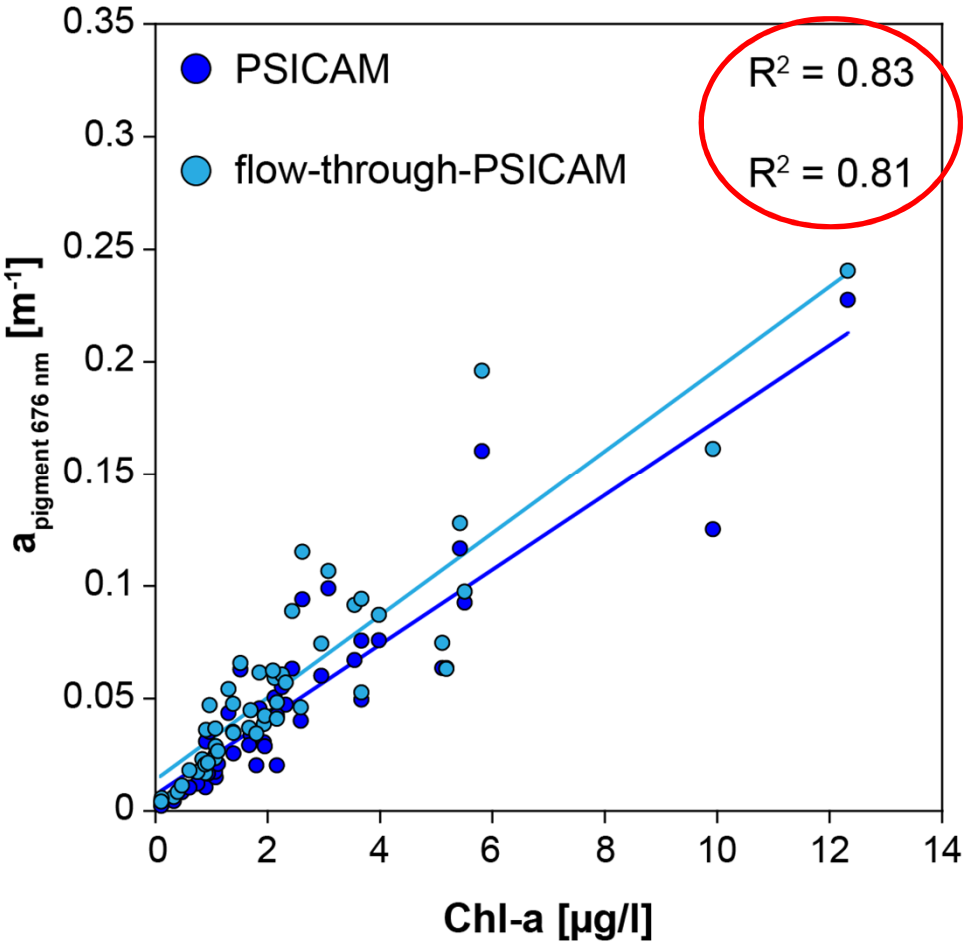
PSICAM vs. flow-through PSICAM

Chlorophyll-a



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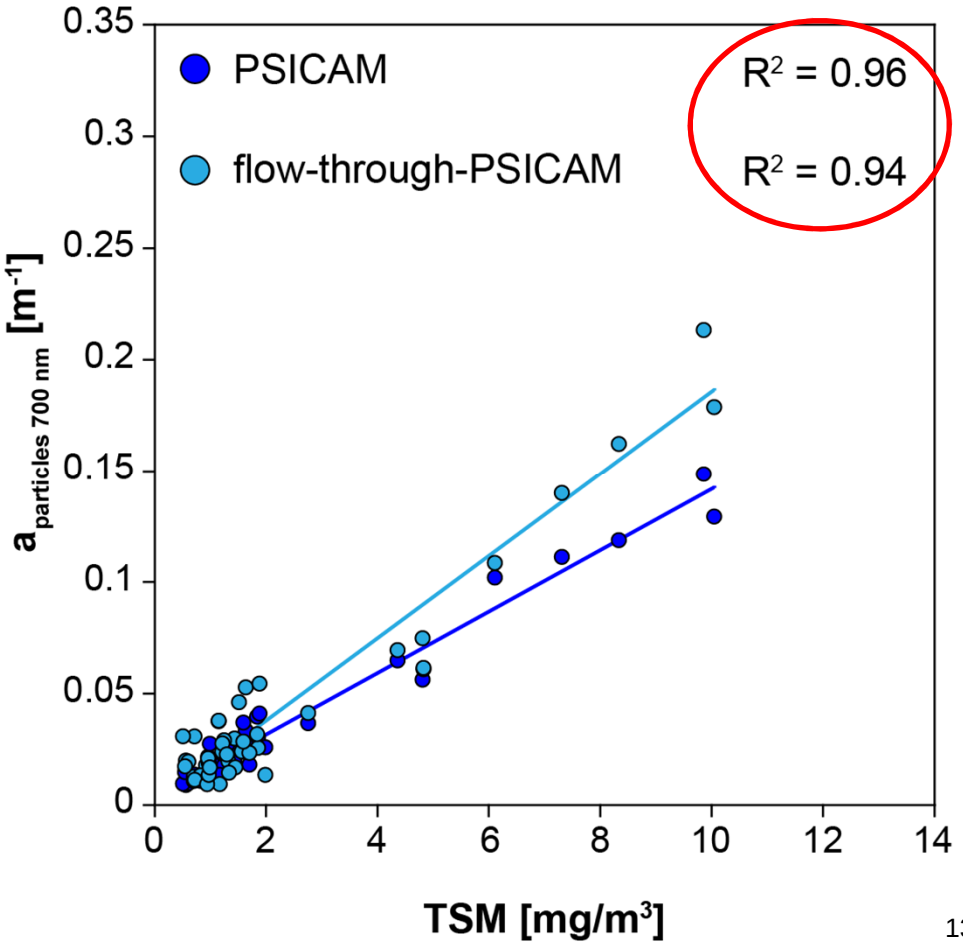

Summary

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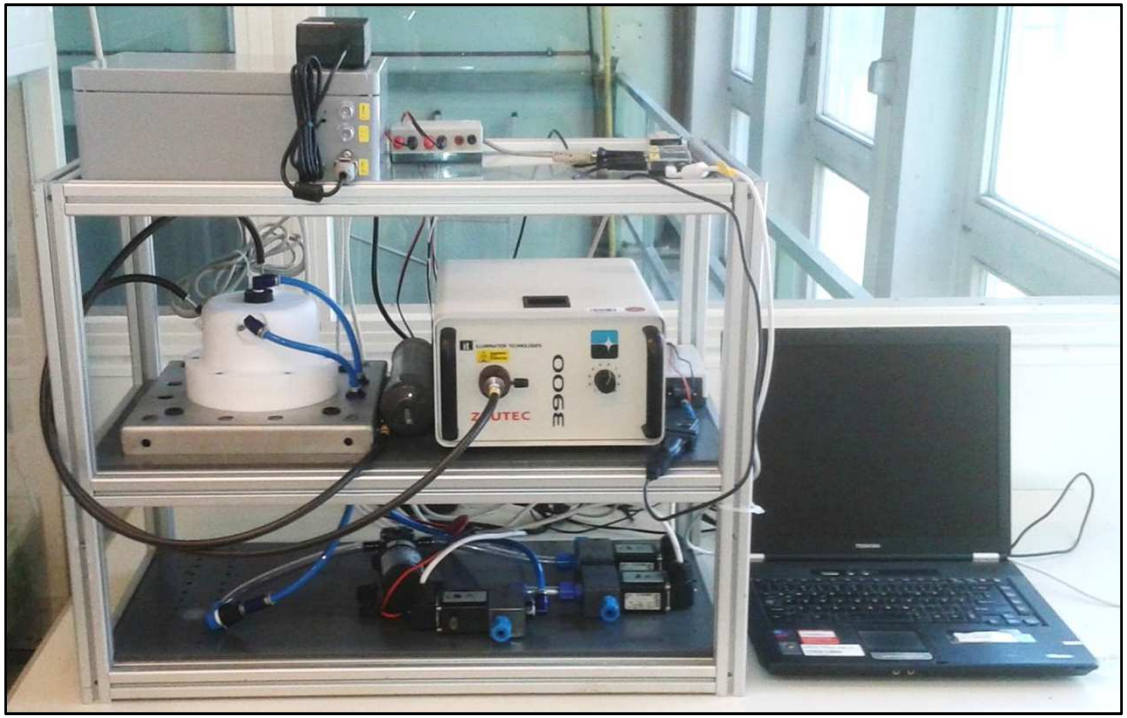
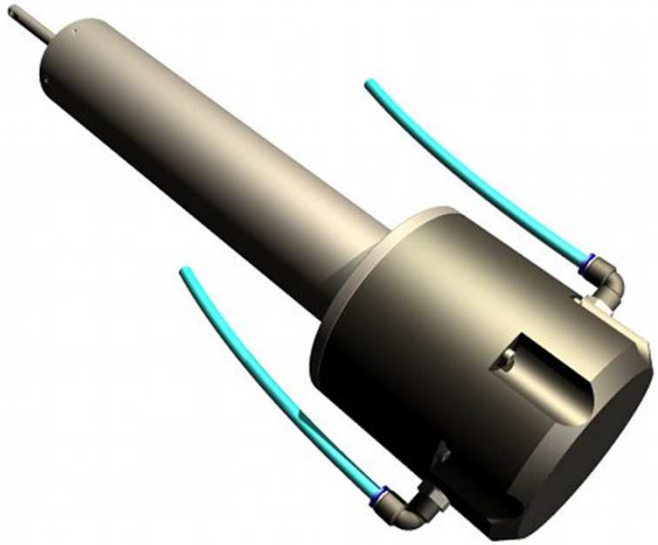
- Continuous hyperspectral *in situ* measurements of absorption coefficients were possible using the PSICAM approach
- Absolute values have to be corrected using point measurements
- Absorption measurements are less variable optical proxies for chlorophyll-a and TSM determination

Future work

- Automation of the system to enable unattended use

- Mounting the device´s components in a more user-friendly setup





- Testing of a commercial sensor based on the PSICAM principle manufactured by the company TriOS, Germany

Future work

- Establishing of an algorithm for automatic detection of the dominant phytoplankton group in the sample

- Based on fourt ta

Thank you for your attention