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Personal profile Publication

Fluorescence-based in situ measurement of cyanobacteria: state of the art, potential, limitations, compensation methods and further development of an optical sensor system

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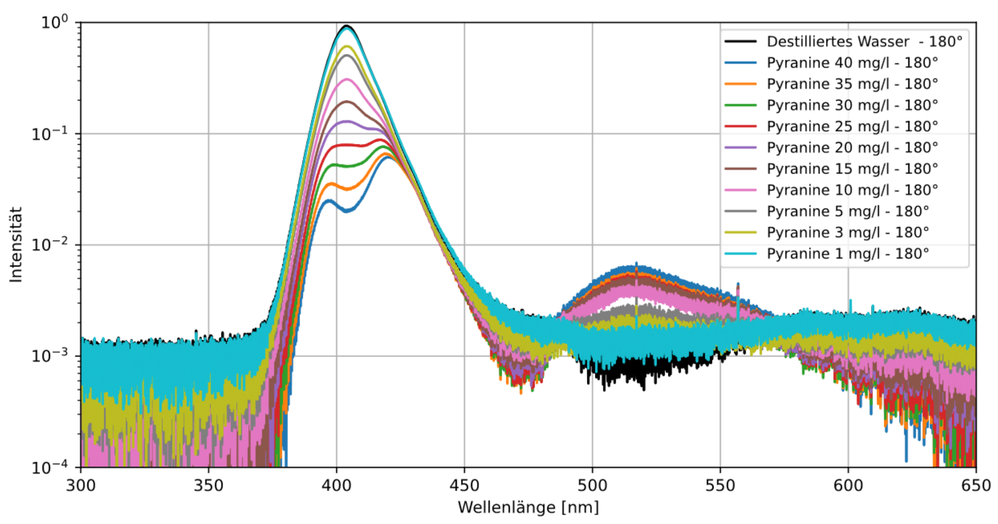
Motivation

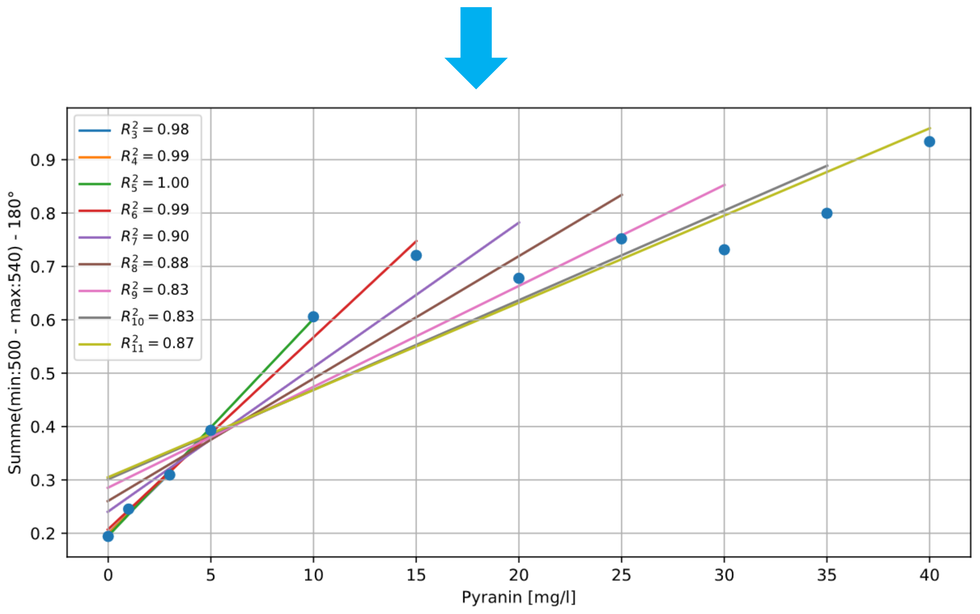
- Cyanobacteria can produce algae blooms, cyanotoxins, as well as taste and odour compounds
  - This leads to ecological, health and economic risks
  - Effective high-frequency monitoring is essential for risk management
  - In situ fluorescence measurements (isFM) are widely used for monitoring purposes around the world
- Objectives:
  - The state of the art, limitations and potential of isFM
  - Analysis of the potential for further development of two existing optical sensor systems towards isFM

Methodology

- Systematic literature review in Scopus using specific keyword combinations with Boolean operators
- Measurements of spectra in the laboratory using different configurations
- Sensor 1:
  - 3 fluorophores: Rhodamine WT, Pyranine, Uranine
  - Configuration: Internal lamp (180° geometry) and torch (90° geometry)
- Sensor 2:
  - 1 fluorophore: Pyranine
  - Configuration: Internal LED + Thorlabs spectrometer (90° and 180° geometry)

180° Geometry Sensor 2





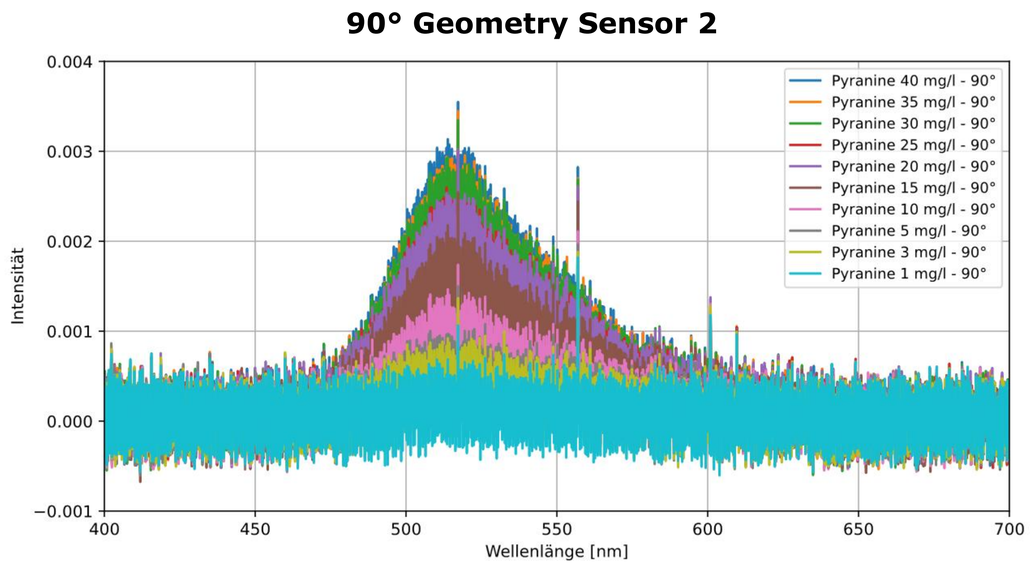
Pyranine spectrum and linear regression for 180° geometry

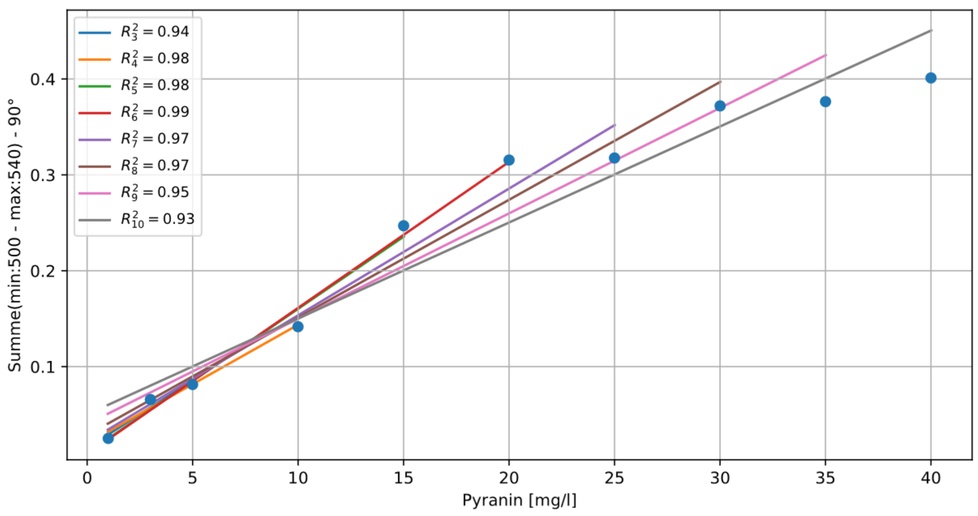
Results

- Application areas for isFM:
  - Monitoring (real-time data)
  - Risk management
  - Predictive models
- Limitations:
  - Numerous sources of interference (e.g. species, light exposure, chl a, turbidity, temperature)

    → Measurement is often an estimate
  - Compensation is available for certain conditions, but there is a lack of holistic approaches
  - It is not possible to differentiate between cyanobacterial species using isFM
- Sensor 1: Not suitable in the current configuration
- Sensor 2: Suitable for exciting and detecting fluorescence

90° Geometry Sensor 2





Pyranine spectrum and linear regression for 90° geometry

Conclusion

- Sensor 2 has great potential for further development
  →combination of absorption and fluorescence spectroscopy
  →wide range of parameters with a single sensor
- Interferences in the isFM cannot be ranked quantitatively
  →variations between and within species, as well as variations in time and location
- Future goal: Optimising the robustness and selectivity of this technology and developing holistic compensation methods