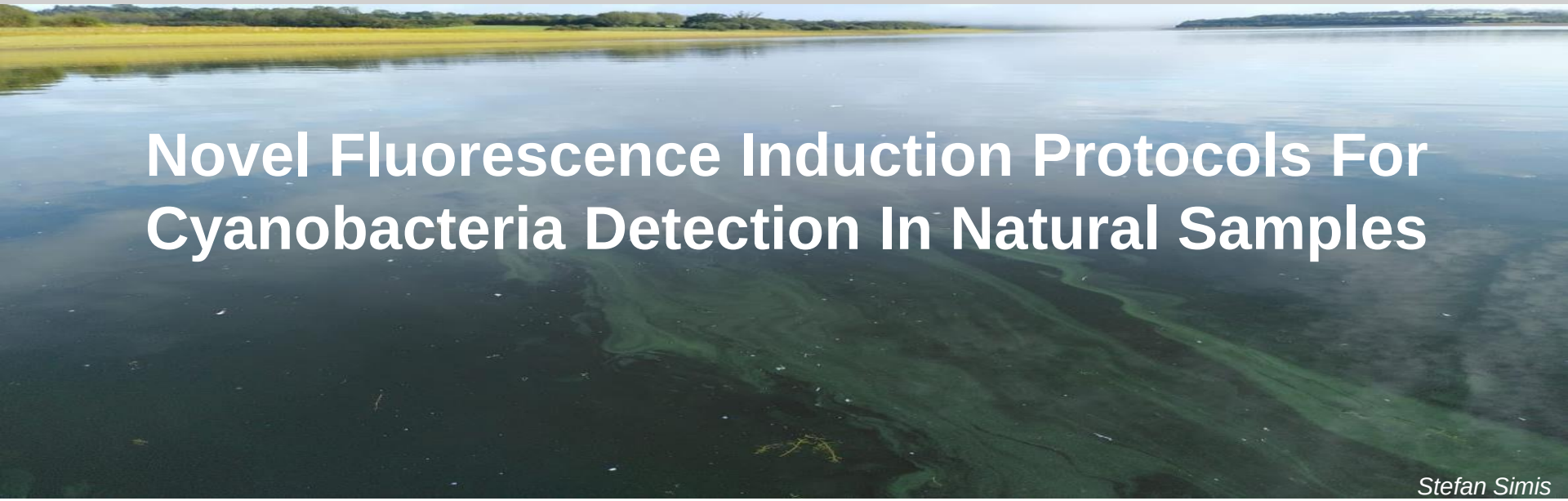
PML | Plymouth Marine Laboratory

Research excellence supporting a sustainable ocean



Novel Fluorescence Induction Protocols For Cyanobacteria Detection In Natural Samples

Stefan Simis

Emilie Courtecuisse[1], Peter Hunter[2], Kevin Oxborough[3], Gavin Tilstone[1], Evangelos Spyrakos[2], Stefan Simis[1]

[1]Plymouth Marine Laboratory, United Kingdom; [2]University of Stirling, Scotland, United Kingdom; [3]Chelsea Technologies Ltd, United Kingdom

PML | Plymouth Marine Laboratory

UNIVERSITY of STIRLING

Chelsea Technologies Group Ltd

LabSTAF : new active fluorometer

https://chelsea.co.uk/

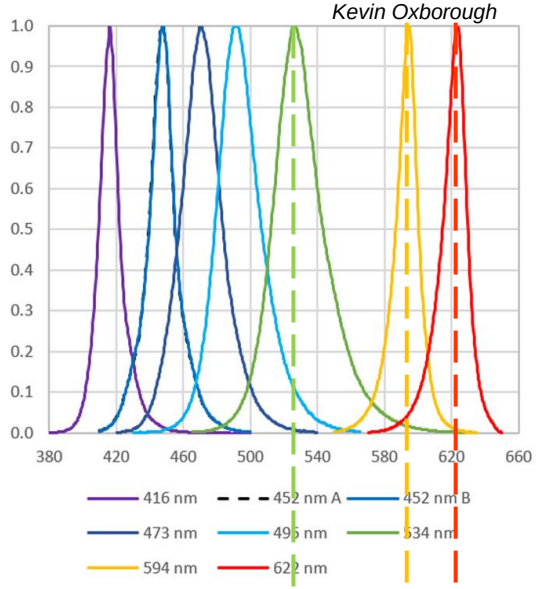
Optical properties

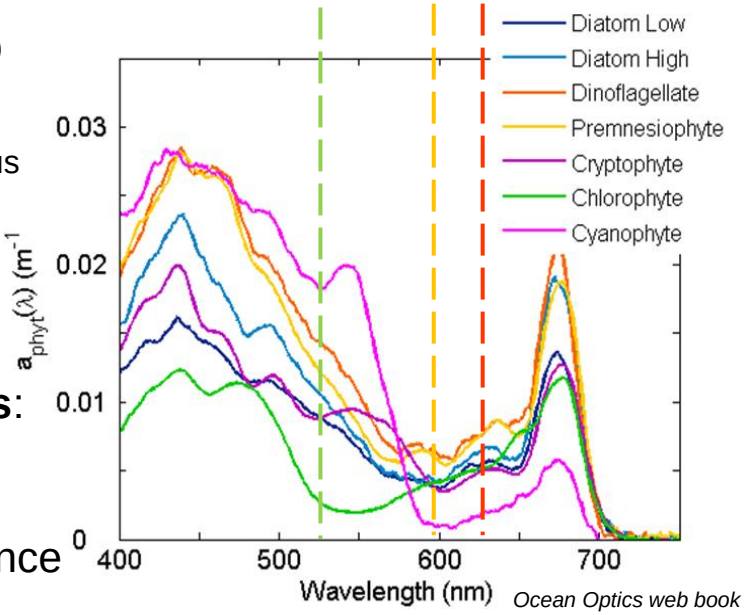
- **2 emission wavebands**: 685 and 730 nm
- **7 Excitation LEDs channels**, used alone or combined
- **1 actinic light**
- **high sensitivity** to low fluorescence signals
- **ST (Single turnovers)** measurements

Measurements

- **Fluorescence Light Curves** (FLCs)
- **Excitation spectra** using the excitation LEDs
- **Flow-through system** for continuous measurements or **punctual measurements**
- **T° C** measured

Kevin Oxborough





Ocean Optics web book

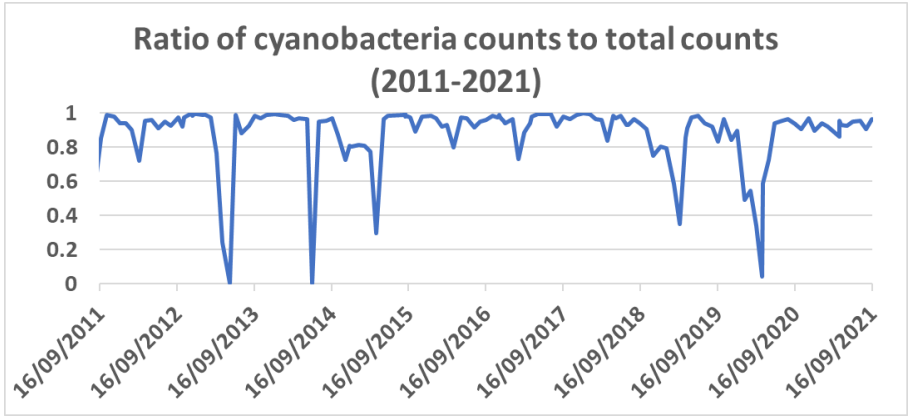
→ **Advantages to target cyanobacteria in natural samples**:

- LEDs targeting phycobilipigments (Phycocyanin and Phycoerythrin)
- Determination of physiology and productivity from fluorescence parameters
- Excitation spectra

Study site: *Roadford* lake

Sampling site (50.690424, -4.2300678)

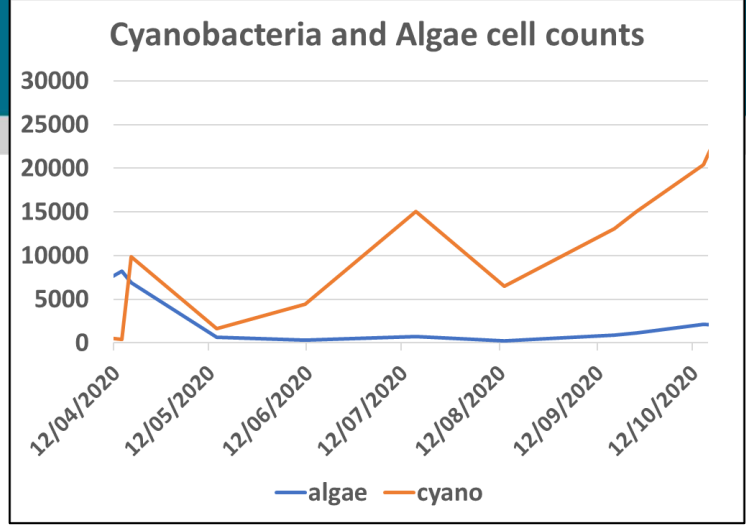
Presence of cyanobacterial blooms since at least a decade

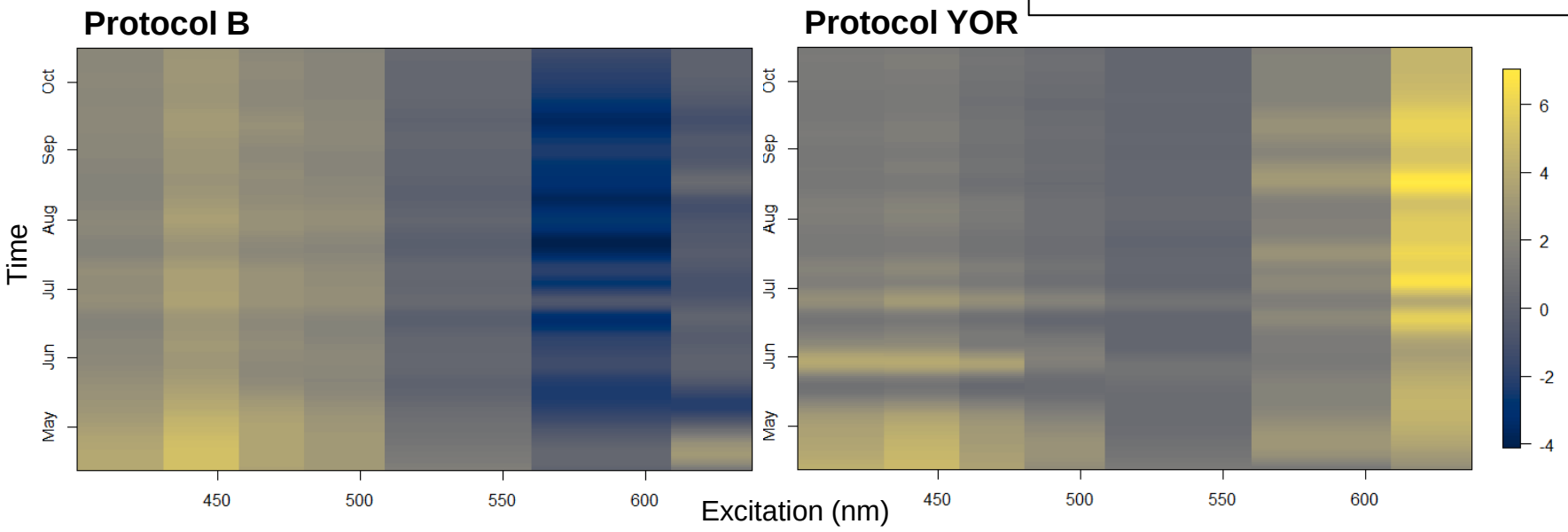


- Weekly sampling of sub-surface water between April and October 2020
- Measurements in the laboratory: fluorescence, chlorophyll a (Chla), nutrients concentration
- Data from *South West Water*: nutrients concentration/ phytoplankton counts and identification
- **LabSTAF:** Determination of 5 protocols with different LEDs combination to target different phytoplanktonic groups: **B:** 452 nm (*2)
  YORB: 452 nm(*2),534 nm, 594 nm, 622 nm,
  YOB: 452 nm(*2), 534 nm, 594 nm
  YOR: 534nm, 594 nm. 622 nm
  YO: 534 nm, 594 nm

Excitation spectra:
σPSII absorption cross section of photosystem II (PSII)

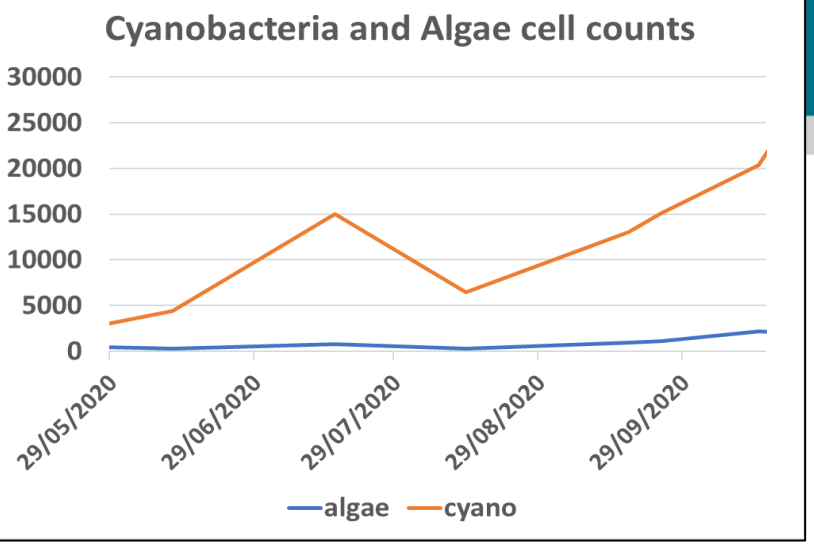
σPSII

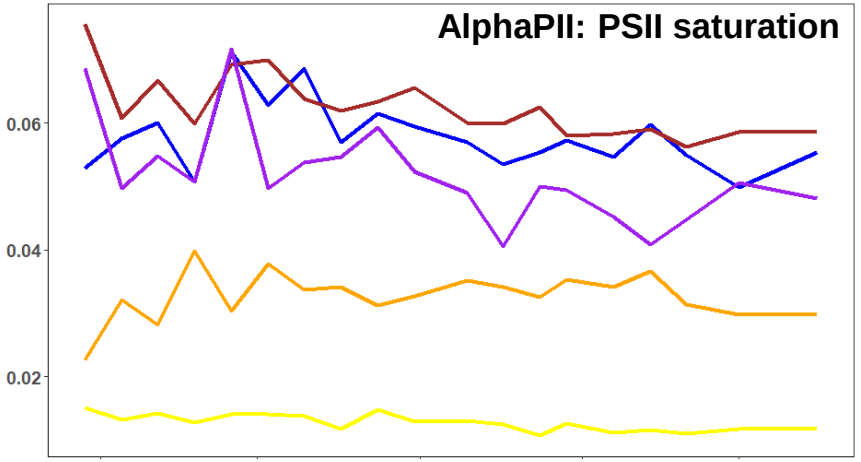


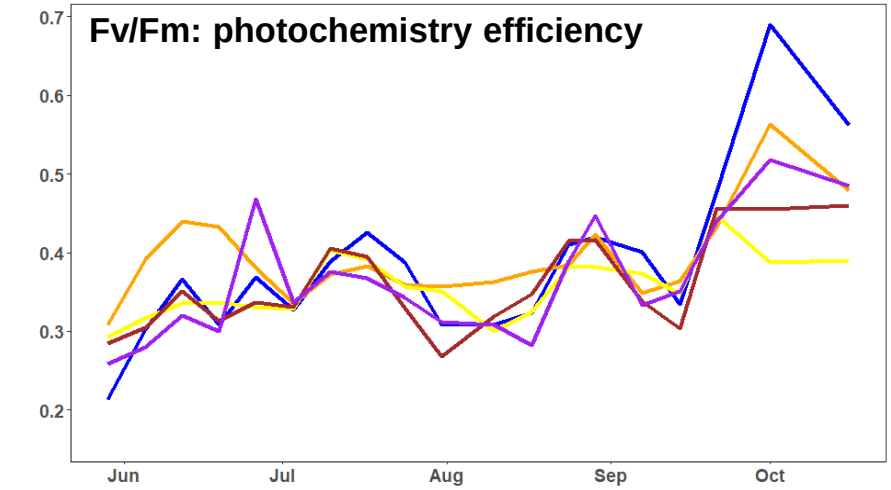


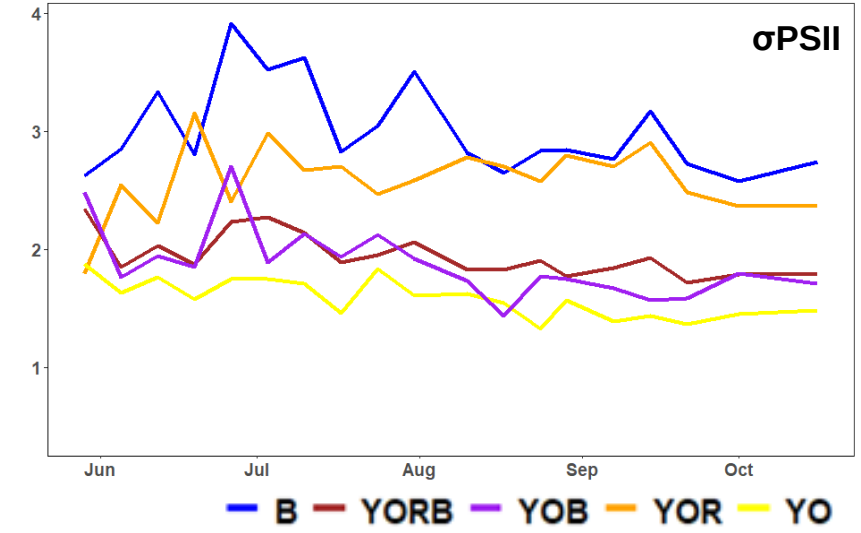
- Higher σPSII values in shorter wavelengths at the beginning of the sampling period in YOR and B protocols
- Higher σPSII values in longer wavelengths in the YOR protocol only towards the end of the sampling period
    - **YOR and B protocol target different community responses and seems to follow the trends of algae vs cyanobacteria abundance**

PSII saturation and productivity parameters









- **Saturation obtained** (AlphaPII between 0.05 and 0.07) **with three protocols only**
- **Fv/Fm increase over the sampling period**, protocols give similar results, **but small differences are observed in B and YOR protocols**
- σPSII show an increase at the beginning of the sampling period, **YOR and B protocols have higher values than with other protocols**

Conclusion

- **YOR and B protocols target different communities responses** but…
- YOR protocol is not able to fully saturate PSII
- B protocol is also susceptible to induce a fluorescence signal by cyanobacteria with the 452 nm excitation LEDs

- **Those results are preliminary** and the fluorescence parameters should be compared to Chla concentration

- To correctly assess the presence of cyanobacteria vs. algae**, efficient Y, O and R LEDs (534, 594 an 622 nm respectively)** should be added to the LabSTAF to allow the saturation of cyanobacteria with YOR and YO protocols

- **Ratio of fluorescence recorded at 685 nm to fluorescence recorded at 730 nm** (under YOR and B protocols) should be compared to Chla concentration and phytoplankton counts

Challenge and priorities for next steps

Challenge: Accurate estimation of biomass and physiology of cyanobacteria in natural samples

Next steps to achieve the challenge:

- **in 1 year:** Measurements of fluorescence emission at 685 nm and 730 nm *(LabSTAF),* measurements with the ameliorated version of the *LabSTAF* (new excitation LEDs)- ***My work until the end of the PhD***

- **in 5 years:** Continuous measurements with the *LabSTAF* during blooms periods in the field, measurements of fluorescence in oceanic and freshwater environments to test the sensitivity range of the instrument

- **in 10 years:** Determination of optical properties able to discriminate cyanobacteria in mixed communities, and consequently, modification of *LabSTAF* optical features