In-situ UV-Vis Probe to Monitor Algal Photobioreactors Treating Municipal Wastewater

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In-situ UV-Vis Probe to Monitor Algal Photobioreactors Treating Municipal Wastewater

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1. INTRODUCTION

End use of **green microalgae** [1]:
- Biofuels
- Organic fertilizers
- High value added products (e.g. pigments)

→ **Unsustainable if not coupled with used water treatment**

Monitoring systems for photobioreactors [2]:
- Usually focus on biomass or pH
- Mostly validated with synthetic media

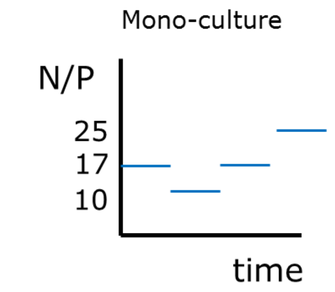
3. OBJECTIVE

Validate a **UV-Vis sensor** as a suitable monitoring tool for **algal photobioreactors** treating **municipal used water** for resource recovery

2. MATERIALS AND METHODS

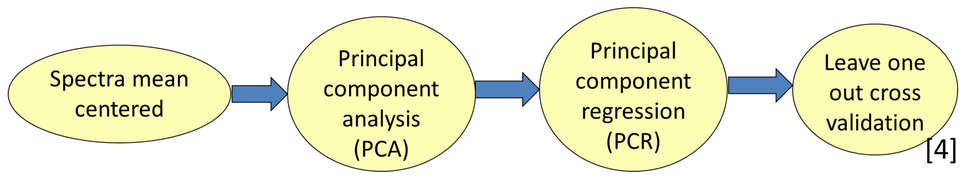
EXPERIMENTAL DESIGN

Two lab-scale photobioreactors [3]:
- 1.4 L reactor
- Hydraulic retention time of 3.5 days
- Fed with treated municipal used water
  - Variability in nutrient load

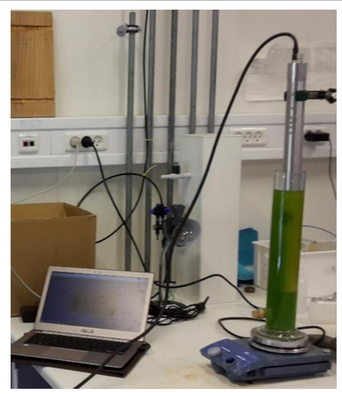


ANALYTICAL METHODS

Variables monitored:
- Nitrate
- Total suspended solids
- Total chlorophyll

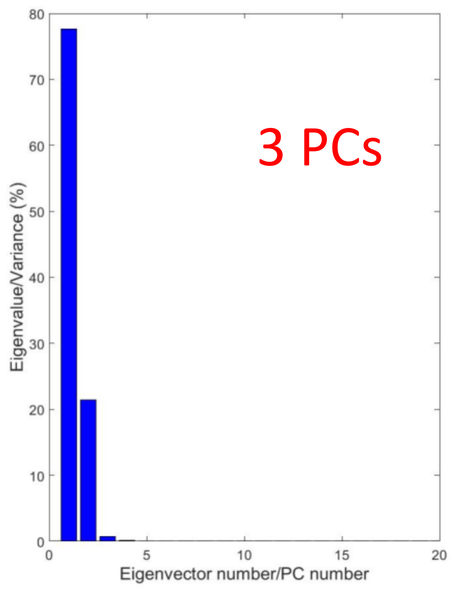


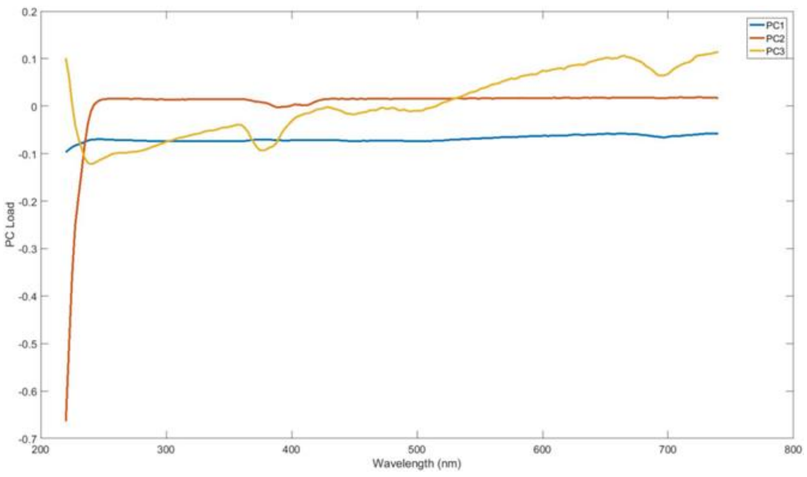
[4]



4. RESULTS AND DISCUSSION

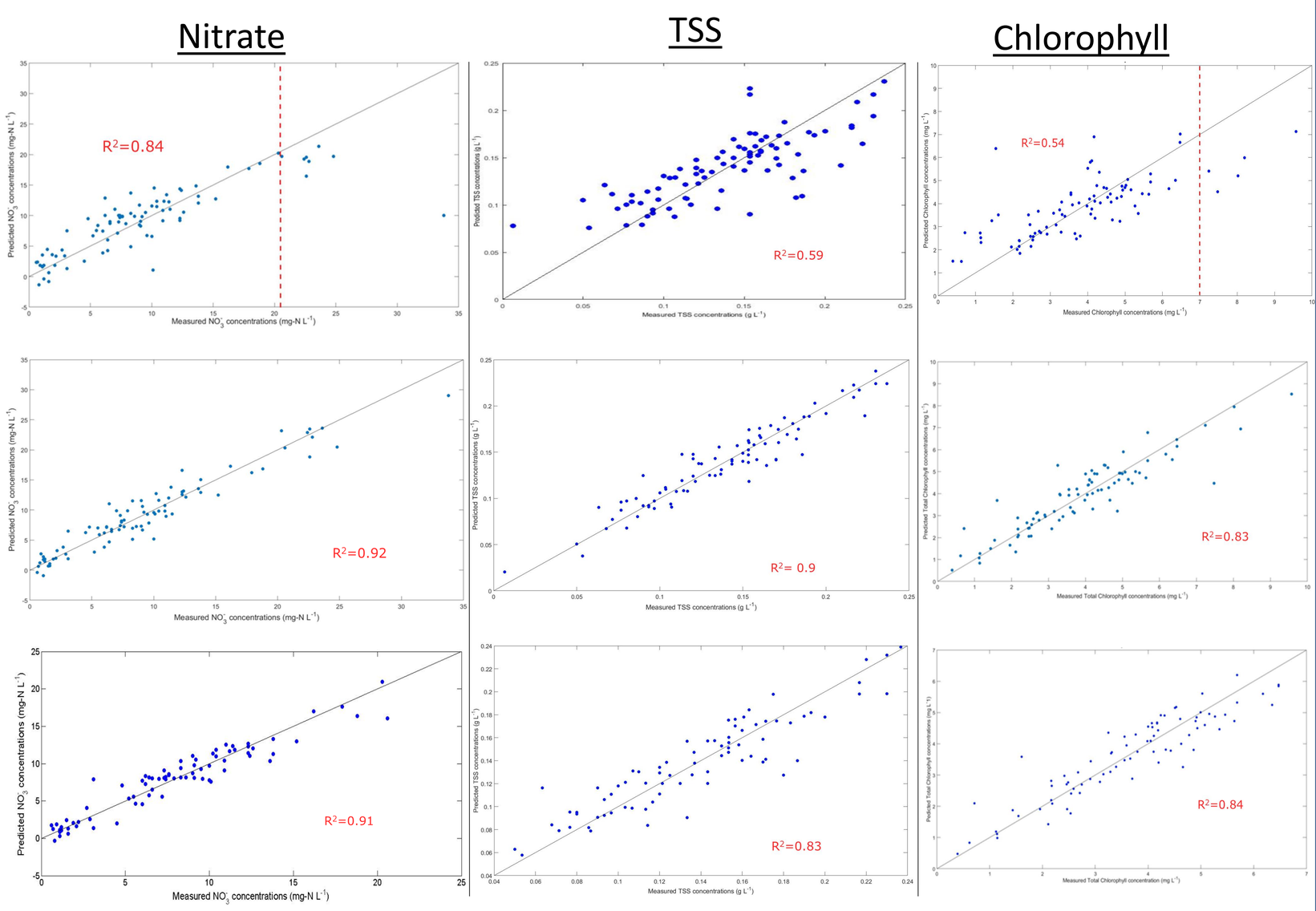
Principal component analysis





- **PC1** relates mainly to variability on **TSS** and **chlorophyll**
- **PC2** relates mainly to variability on **nitrate**

Principal component regression



- **First row:** models based on 3 first PCs
  - Only accurate for nitrate
- **Second row:** models based on the optimal model suggested by the leave one out cross validation method
  - Accurate, but over parametrized for TSS (40 PCs) and chlorophyll (27 PCs)
- **Third row:** models based on data after outlier removal (TSS) or saturation data removal (nitrate and chlorophyll)
  - **Nitrate:** only 10 PCs give comparable results as optimal after saturation removal
  - **TSS:** only 10 PCs give comparable results as optimal after outlier removal
  - **Chlorophyll:** only 24 PCs give comparable results after saturation removal

ACKNOWLEDGEMENTS

DTU INWATECH

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Economically and Ecologically Efficient Water Management in the European Chemical Industry

References:

[1] Cai and Park. *Renewable Sustainable Energy Reviews* 19 (2013): 360-369.

[2] Havlik et al. *Trends in Biotechnology* 31 (2013): 406-414.

[3] Wágner. *Used water resource recovery using green microalgae.* PhD thesis DTU Environment

[4] Masic et al. *Water Research* 85 (2015): 244-254.