A PREDICTIVE GROWTH MODEL FOR *NANNOCHLOROPSIS GADITANA* IN PHOTOBIOREACTORS

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Predicting algae growth

The aim of this study is to identify a model that predict how *Nannochloropsis gaditana* grows as function of external variables such as light, pH,… Algae have the capability to fixate and convert CO_2 into biomass by using solar energy, making them not only a promising tool to lower CO_2 emissions, but also a manufacturer of clean energy and sustainable bioproducts. However, predicting the growth of microalgae in photobioreactors in greenhouses in North-western Europe is still difficult. In order to better forecast this growth, *N. gaditana* was cultivated in the Sunbuilt installation at Thomas More in two photobioreactors. Limiting and/or driving factors for algae growth were identified, using a parametric model. This model was combined with an information criterion to optimize model complexity.

Setup

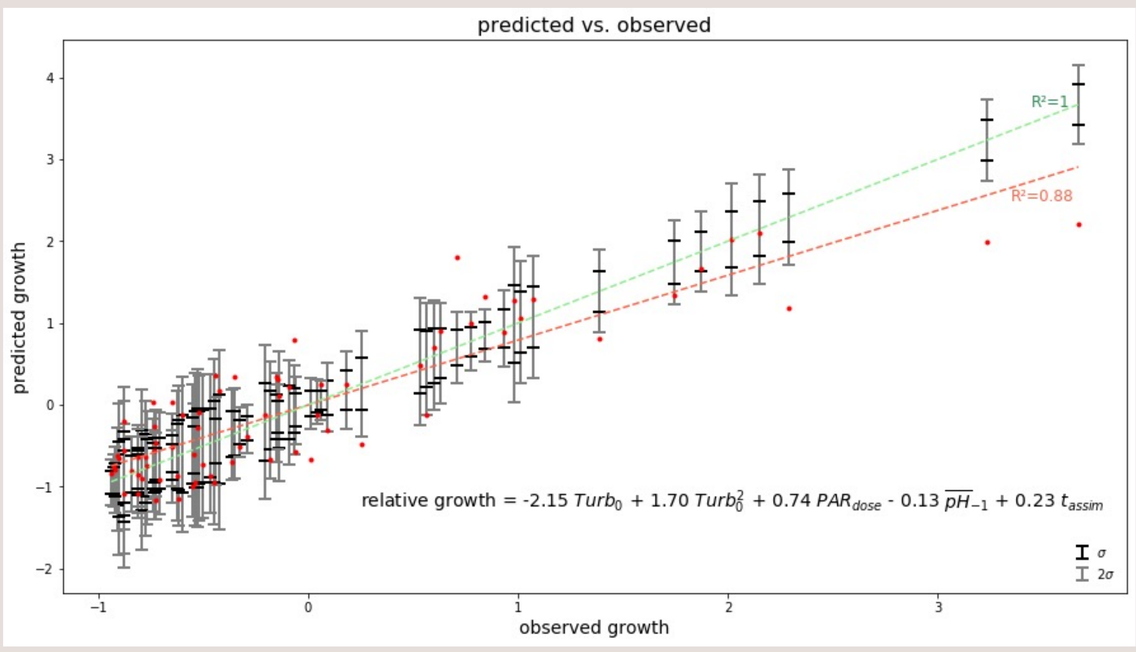
The growing conditions were artificially influenced and (more or less) controlled in the greenhouse, e.g. lighting was used to prolong the growing period and max. or min. temperature was controlled by cooling/heating. Multiple datasets from the two photobioreactors were logged for a five-month period and used as input for modelling (e.g. pH, turdibity, temperature). *N. gaditana* was kept in optimal conditions in a continuous set-up. A growth period was defined based on photosynthetically active radiation (PAR – µmol/s.m²) and the sunset and sunrise times. The relative growth during this period was calculated for predictive modelling.
Data were randomly split in training and validation sets in a Monte Carlo set up. Each iteration, different multi linear models were fitted using a least squares estimator. Model selection was done using a modified Akaike information criterion (AIC).

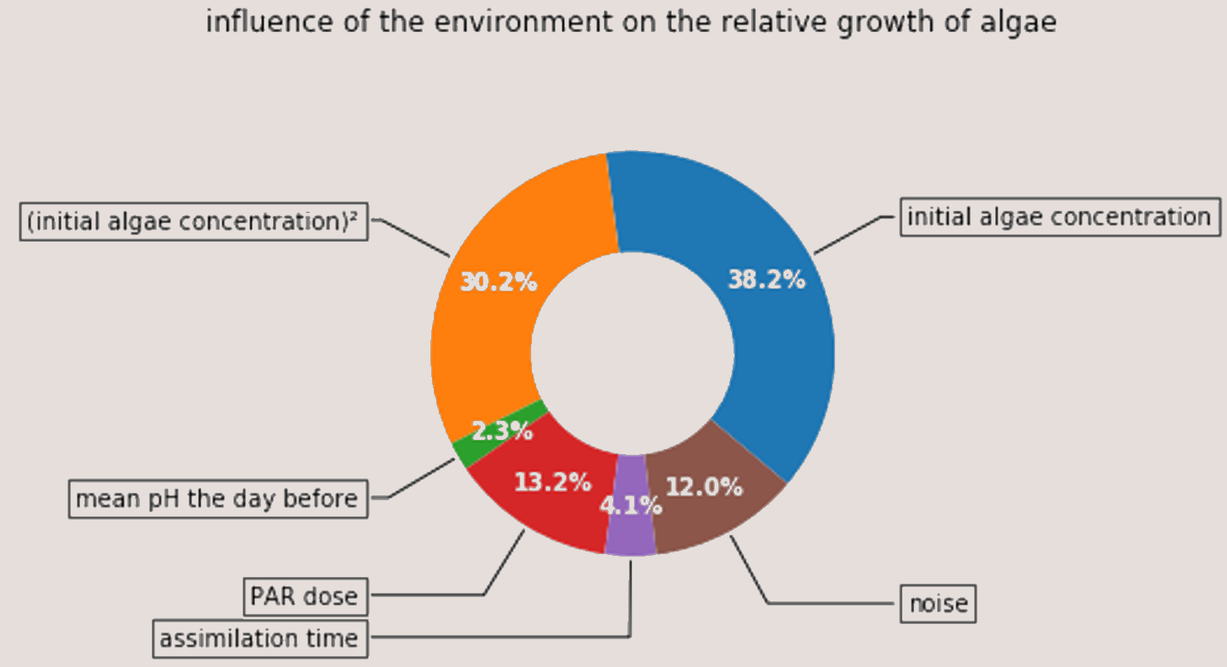
Results

88% of the observed relative growth of *N. gaditana* during this five-month growth period could be described with the following interplay of parameters:

$$Relative\ growth = -2.15\ Turb_0 + 1.70\ Turb_0^2 + 0.74\ PAR_{dose} - 0.13\ \overline{pH_{-1}} + 0.23\ t_{assim}$$

The algae concentration ($Turb_0$, measured as turbidity) showed to be the most important predicting factor, followed by the amount of PAR light during the defined growth period (PAR_{dose}). Other influencing parameters were the mean pH in the previous growth period ($\overline{pH_{-1}}$) and the time of extra (artificial) lighting during the night time before (t_{assim}). 12% of the variance in the algae growth could not be assigned to specific environmental factors, i.e. noise. The temperature was kept stable within a predefined range during cultivation, thus this parameter could not be linked to any variance in the algae growth.





Conclusion and Future Perspectives

This model can be incorporated in a ‘controller algorithm’ to optimize algae growth, where for example expected PAR dose shortage can be compensated through longer assimilation during the night before. Subsequently such a controller algorithm can be developed that optimizes profit.

IDEA - Implementation and development of economic viable algae-based value chains (NWE639)

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