Searching for Hyperspectral Fingerprints of Diatoms

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Abstract

What?
Ecologically significant diatoms were grown in culture for spectral analysis. Diel cycles were monitored to see temporal variation. These diatoms exhibit unique frustules and intracellular structures.

How?
Hyperspectral **absorption, attenuation, and backscatter** were measured using an inline system every 3 hours for 24 hours. Quantitative analyses were used to differentiate between the spectral signatures of these species.

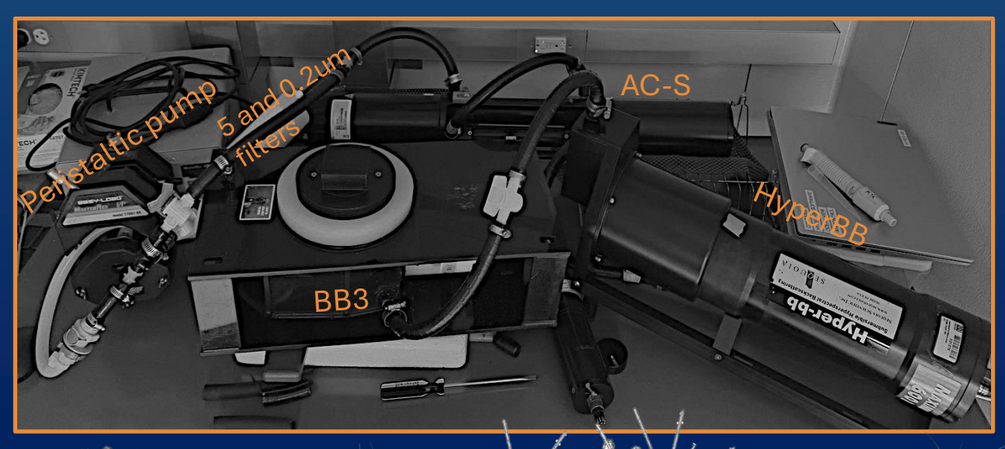
Why?
Changes in the optical properties of phytoplankton over diel cycles are closely linked to physiological shifts. Investigation of photoacclimation's contribution to uncertainties in taxa-specific spectral signatures provides insights for addressing similar challenges using PACE mission observations.

Methods

Triplicate cultures were grown semi-continuously in nutrient-replete conditions under a sinusoidal irradiance cycle.

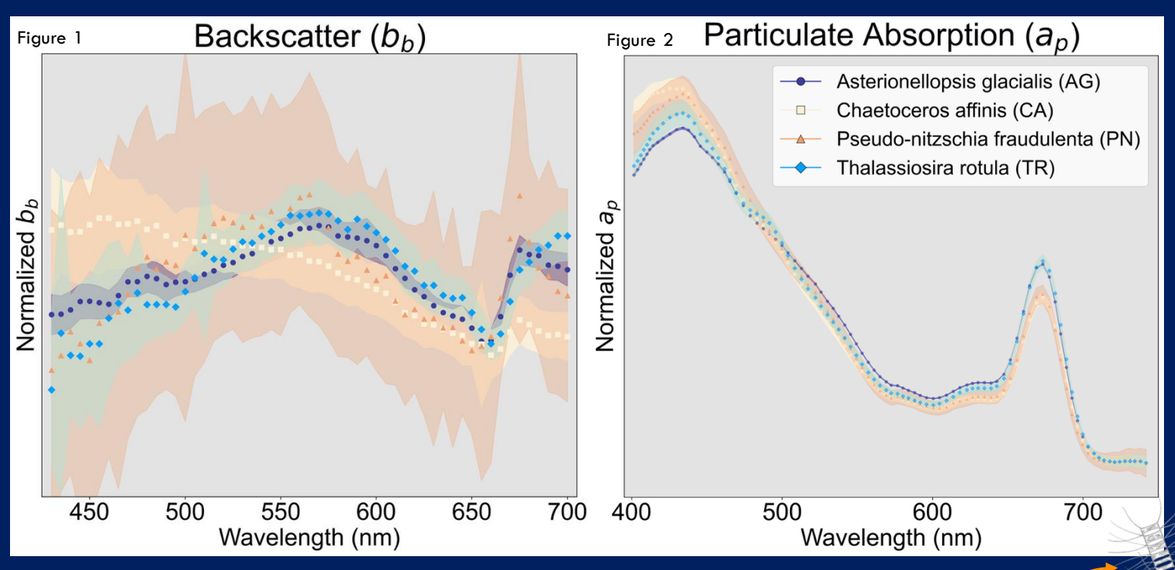
Bio-optical signatures were measured using an in-line system (below). Data was logged using Inlinino.

Cell counts, size, and shape were obtained with an Imaging FlowCytobot. Fast repetition rate fluorometry provided estimates of cell health. Discrete samples were filtered for TOC/N and pigments. For *Pseudo-nitzschia*, samples were also taken for microscopy and analysis of domoic acid.



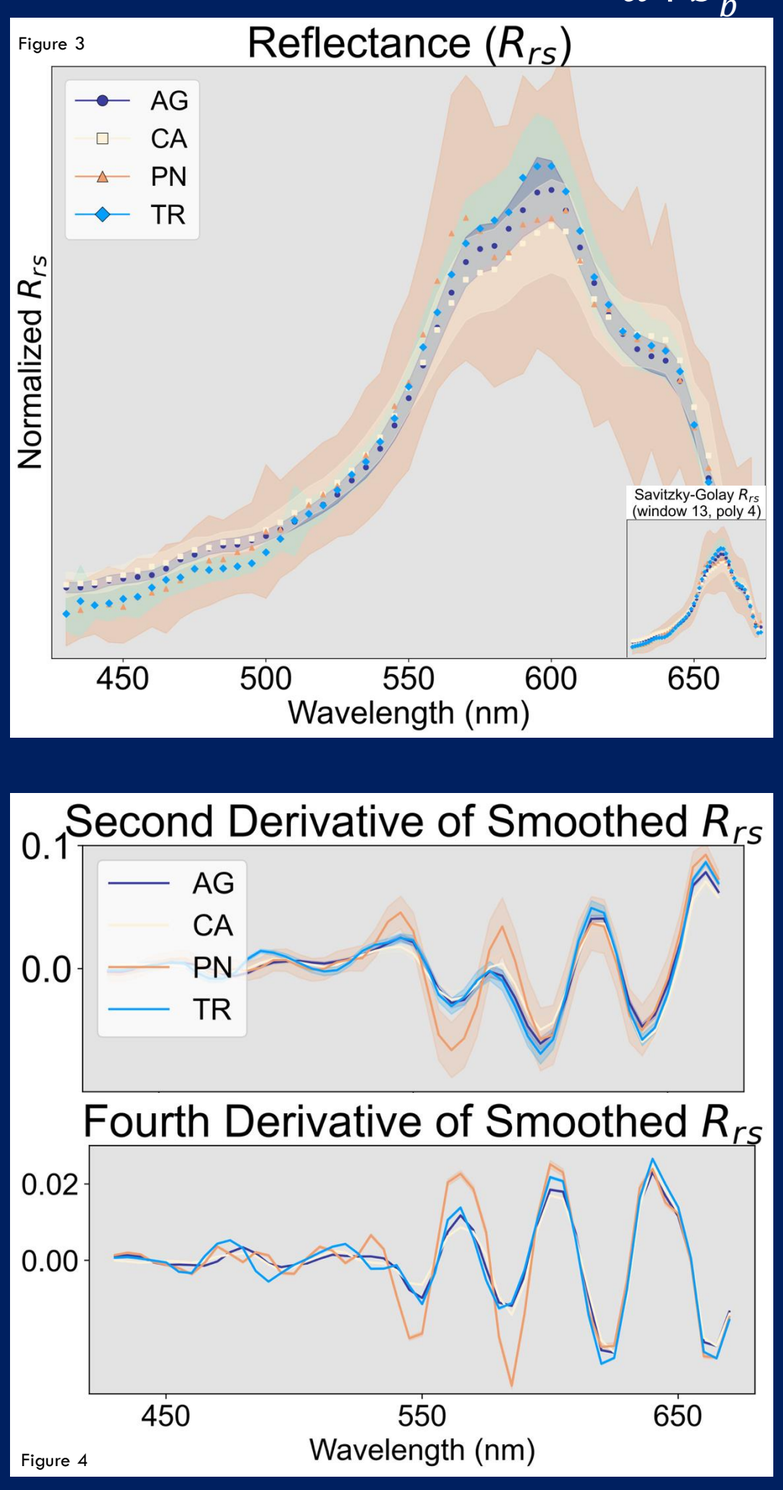
Results

Spectral Analysis

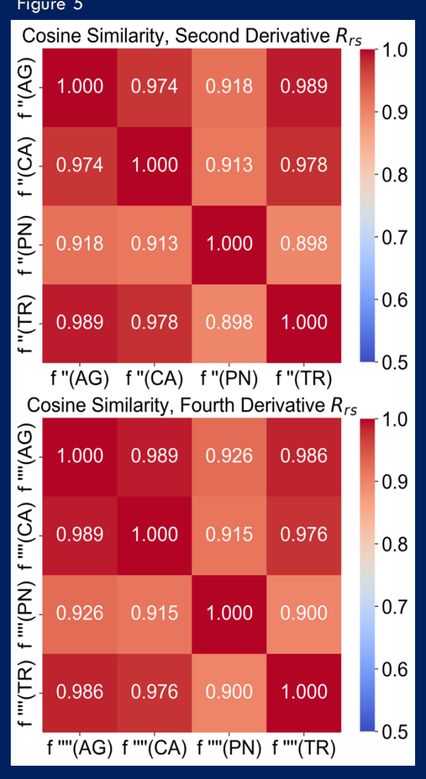


- Largest differences in backscatter, especially for *Chaetoceros affinis*
- Variability in *Pseudo-nitzschia* backscatter, potentially from apical vs transapical axis views

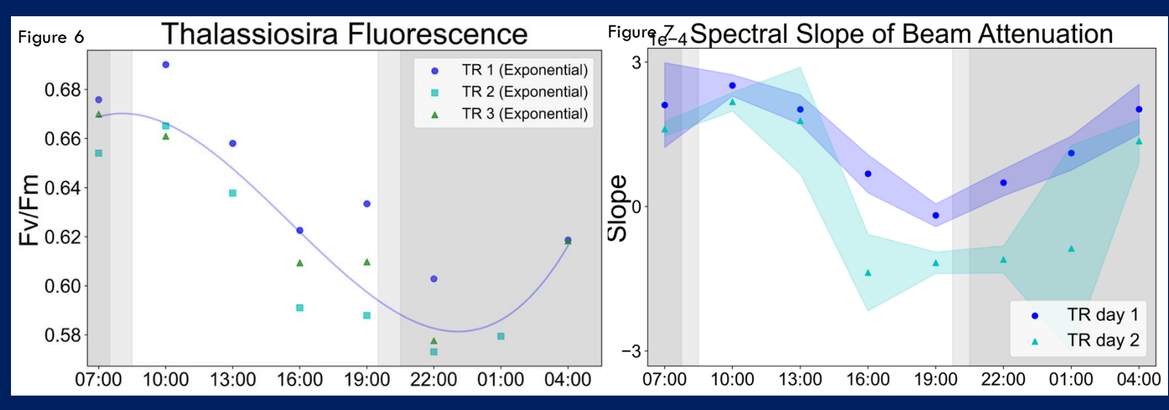
$$R_{rs} \approx \frac{b_b}{a+b_b}$$



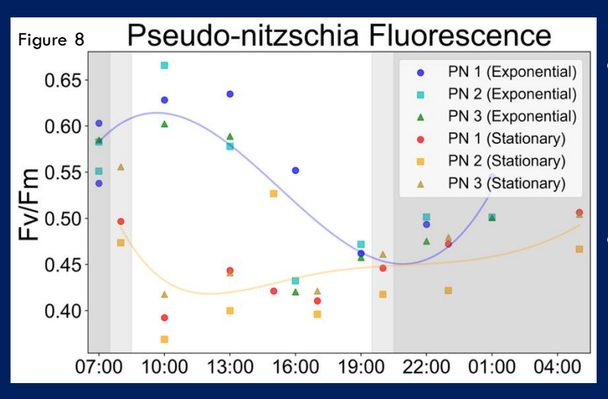
- Greatest difference is ~10% in Rrs spectra between *Thalassiosira* & *Pseudo-nitzschia*



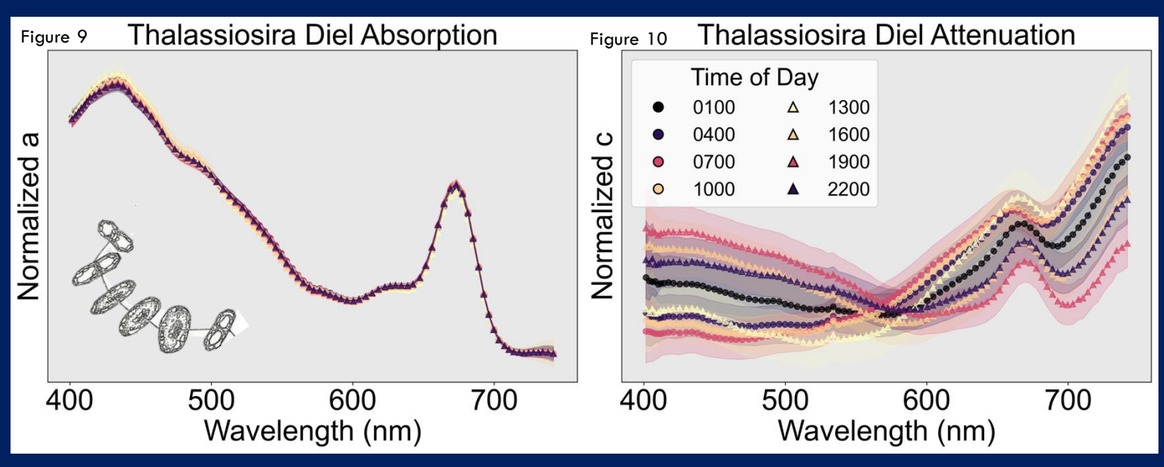
Diel Experiments



We observed cellular division just before sunrise. Changes in spectral slope of beam c follow the pattern of cell division. Positive values are associated with a relative increase of larger cell sizes and likely, chains.



- *Pseudo-nitzschia* in stationary growth appear to be more sensitive to photoinhibition
- Fv/Fm is lowest after dawn and remains depressed during the light period



Future Work

- Investigate other methods to quantify differences in spectra
- Process TOC/N and domoic acid discrete samples
- Use an instrument with high resolution and narrow bandpass (e.g. HyperNAV) to look at Rrs of cultures

Acknowledgments

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