IOP-AOP Models and Data Subgroup

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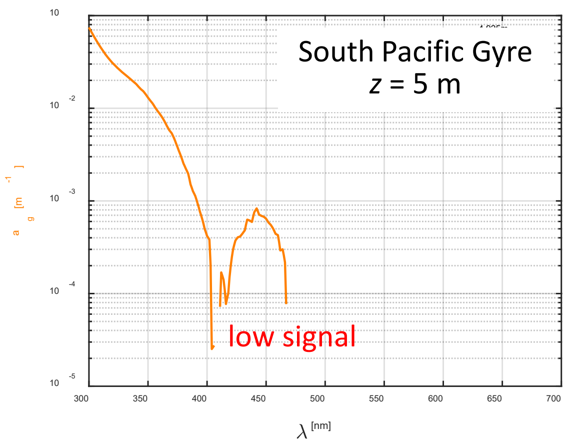
Apologies to anyone I may have missed (please send an email to me)

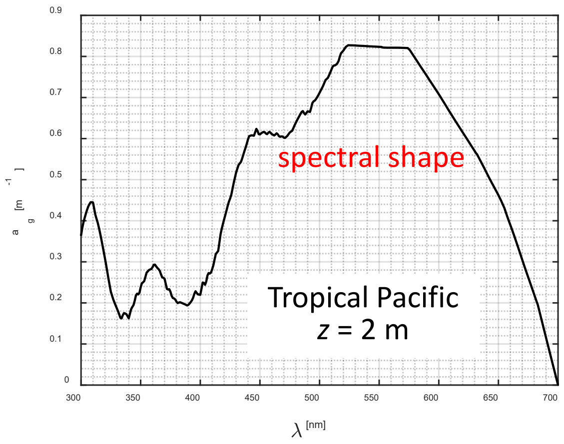
NASA PACE Science and Applications Team Meeting; 6 – 8 October 2021

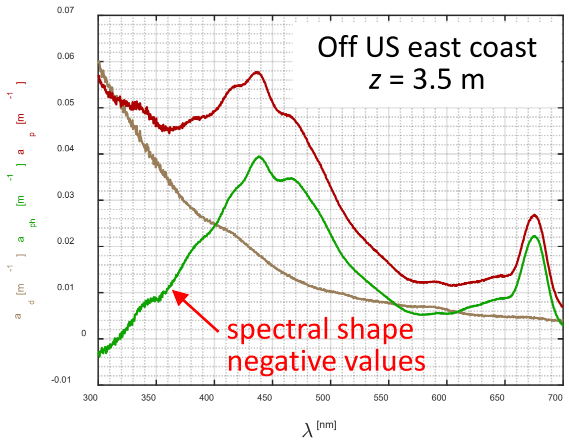
What are the main objectives of the IOP-AOP Subgroup and what do we want to accomplish?

- ❑ A round-robin evaluation of inverse reflectance models for estimating ocean optical properties (IOPs, K_d, and possibly others)

- ❑ Field datasets of ocean IOPs and AOPs used and/or needed in PACE projects (*meeting in March 2021*)
  - To what extent the same existing datasets, for example from SeaBASS, are used in individual PACE projects?
  - What data and model outputs can we share to minimize duplication of effort?
  - Data quality-control (QC) issues in the process of assembling project-specific datasets:
    - What are the QC challenges and what QC approaches, if any, are being used?
    - As an example, the QC challenges associated with the spectral absorption coefficients were demonstrated







❑ Field datasets of ocean IOPs and AOPs (*contd.*)

- Absorption data obtained with different measurement techniques are needed to address different scientific questions but are subject to different uncertainties and QC challenges
- Instrumental closure experiments and analysis are needed for absorption coefficients
- Ongoing QC efforts with SeaBASS and new NOMAD at NASA
- Open communication between the project investigators and NASA team (Violeta S., Ivona C., Lachlan M., Antonio M.) working on SeaBASS and new NOMAD has been encouraged, for example to inform the NASA team about SeaBASS data used in the projects and specific QC requirements

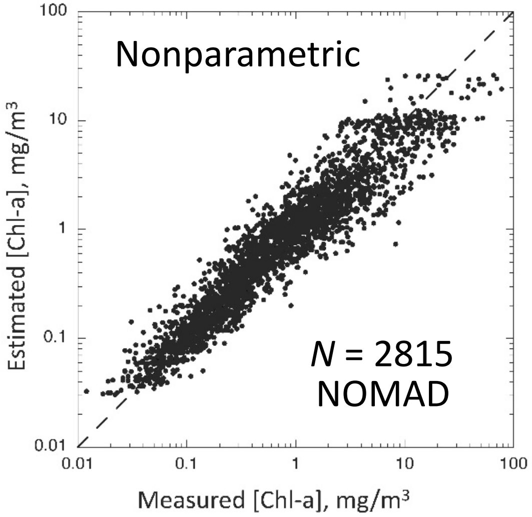
❑ Other topics *(not ordered according to any specific criteria)*

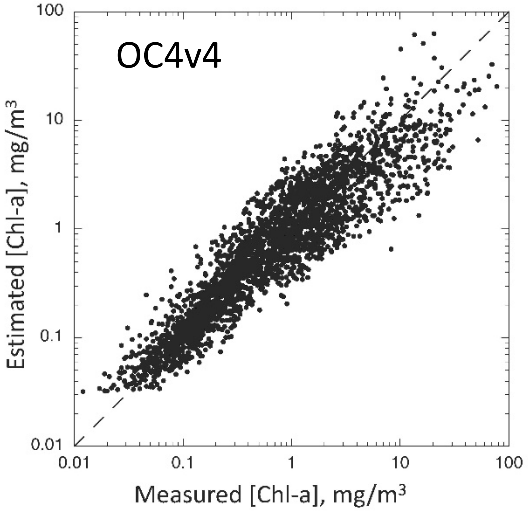
- The IOP data characterizing scattering properties (backscattering, VSF, scattering matrix)
- Approaches for validation of algorithms with satellite and field data
- Improvements in uniform terminology of ocean optical and bio-optical variables
- What are the required uncertainties of IOPs as prescribed by needed accuracy in higher level products?

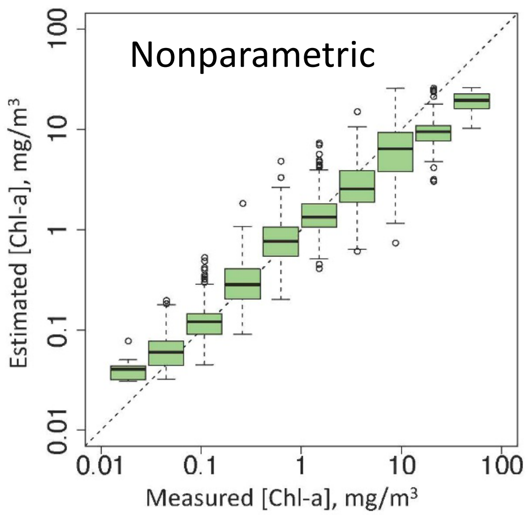
❑ Statistical modeling and nonparametric analysis of ocean reflectance

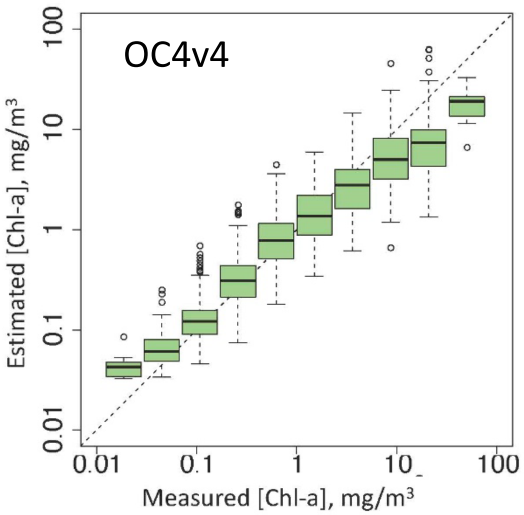
Robert Frouin, meeting in April 2021

- Statistical modeling allows realistic simulations of ocean reflectance spectra and a description of variability, correlations, etc., for example as a function of Chla.
- Nonparametric model based on conditional probability distributions describing the stochastic behavior of reflectance for fixed values of Chla was tested
- Nonparametric model improved the aggregate relative error of Chla retrieval (≈ 49%) compared to OC4v4 parametric model (≈ 60%) for the NOMAD dataset
- Other statistical models based on joint or conditional probability distributions may be considered









Plans for the near future discussions and meetings

- Instrumental closure experiment and analysis of absorption coefficients
  Mike Twardowski

- Identifying data-related synergies and data product collaboration
  Jacek Chowdhary

LIMNOLOGY and OCEANOGRAPHY: METHODS

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Hyperspectral optical absorption closure experiment in complex coastal waters

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Abstract

Accurate measurements of absorption data are required for the development and validation of inversion algorithms for upcoming hyperspectral ocean color imaging sensors, such as the NASA Phytoplankton, Aerosol, Cloud, and ocean Ecosystem mission. This study aims to provide uncertainty estimates associated with leading approaches to measure hyperspectral absorption coefficients in complex coastal waters. Absorption spectra were collected at 12 different stations, all located in the Indian River Lagoon, Florida, USA, between 09 January 2017 and 13 January 2017. Measurements included spectral absorption coefficients in the visible range (400–700 nm) associated with dissolved, a_{CDOM}, total particulate, a_p, and total nonwater, a_{nw}, fractions, and were made both in situ and from discrete samples. Discrete sample approaches included dual-beam spectrophotometer, liquid waveguide capillary cell, point-source integrating cavity absorption meter (PSICAM) for dissolved matter absorption samples, and quantitative filter technique ICAM measurements and the dual-beam spectrophotometer with center-mounted integrating sphere filter pad technique, while the Turner Designs ICAM, and WET Labs AC-s, and AC-9 instruments were used to determine absorption coefficients in situ. The Gershun approach, determining absorption from measurement of the irradiance quartet with respect to depth was also assessed in situ. Measurement uncertainties and relative accuracies were quantified for each of these approaches. Results showed generally strong agreements between different discrete sample methods, with average percent absolute error $\%\delta_{abs} < 7\%$ for a_{CDOM} and $< 9\%$ for a_p. In situ approaches showed higher variability and reduced accuracy. For a_{nw}, $\%\delta_{abs}$ deviation relative to PSICAM data was on average 12% to 20%. Results help identify remaining technological gaps and need for improvements in the different absorption measurement approaches.

Excerpt from Jacek's table "Collaboration products"

Aquatic products	Boss	Stramski	Twardowski	Zhang	Siegel	Westberry	Gaube	Barnes	Pahlevan	Rousseaux	Shuchman
	ocean body	ocean body	ocean body	ocean body	ocean body	ocean body	ocean body	ocean body	fresh water	ocean body	fresh water
Chl	ancillary: IOPs (from OCI)	retrieve (does not use pre-defined spectra for scattering and absorption)	retrieve (inverting ZTT model)	retrieve: implicit in a_{tot}	retrieve (GSM? anomalies)	ancillary	ancillary	not relevant (shallow ocean)	retrieve	retrieve (phytoplankton composition)	retrieve
a_{ph} (from IOCCG)							retrieve				
b_{bp}/b_p (from Chl)				retrieve (focus on β/b_b)	retrieve (Chl?)	not relevant	not relevant (a_{ph} only)		retrieve (Chl?)		
b_{bp} (440)					retrieve (GSM?)	ancillary			retrieve		
S_{bp}											
a_{cdm}(440)				retrieve: implicit in a_{tot}	retrieve: implicit in a_{tot}	not relevant (a_{ph} and bbp only)			retrieve	not relevant (phytoplankton composition only)	
S_{cdm}											
a_{NAP}(440)			retrieve: im/explicit						retrieve: (potential)		retrieve: implicit in cdm-cdom
S_c											