IOP-AOP Models and Data Subgroup

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Frouin, Robert  McKinna, Lachlan  Zhai, Pengwang
Ibrahim, Amir  Moore, Tim  Zhang, Xiaodong

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

![Graphs showing spectral shape and data from different locations: South Pacific Gyre ($z = 5$ m), Tropical Pacific ($z = 2$ m), and Off US east coast ($z = 3.5$ m) with different signal levels and spectral shapes with and without negative values.](image)
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.

![Graphs comparing Nonparametric and OC4v4 models](image-url)
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**

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**Excerpt from Jacek’s table “Collaboration products”**

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**LIMNOLOGY and OCEANOGRAPHY: METHODS**

*Ina Kostakis, Michael Twardowski, Collin Roessler, Rüdiger Röttgers, Darlusz Stramski, David McKee, Alberto Tornblom, Susan Drakeau*

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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 Phytolab, Aerosol, Cloud, and Ocean and Sea-Eye 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, $a_{bbp}$ total particulate, $a_{bb}$, and total non-water, $a_{bbp}$, fractions, and were made both in situ and from discrete samples. Discrete sample approaches included dual-beam spectrophotometer, liquid waveguide capillary, point-source integrating cavity absorption meter (PSCAM) 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-4, and AC-9 instruments were used to do 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 percent absolute error $\%$ for $a_{bbp}$, $a_{bb}$, and $a_{bbp}$ for $a_{bbp}$, $a_{bb}$, and $a_{bbp}$ for $a_{bbp}$ in situ approaches showed higher variability and reduced accuracy. For $a_{bbp}$, $a_{bb}$, and $a_{bbp}$ deviations relative to PSCAM data was on average 12% to 20%. Results help identify remaining technological gaps and need for improvements in the different absorption measurement approaches.