PACE Hyperspectral *in situ* Data Archive

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Objective of Science Team:

Diverse group of investigators who cumulatively bring end-to end knowledge and will pursue theoretical and analytical studies associated with **Inherent Optical Properties and Atmospheric Correction**.

End-to-end knowledge encompasses laboratory and field measurement protocols and quality assurance, radiative transfer modeling, remote sensing theory in the UV-to-SWIR spectral range, and ocean color, aerosol, and cloud algorithms

Subgroups:
IOP Inversion
Datasets
IOP Methodologies
Environmental methodologies
Synthetic database
Atmospheric Correction
Applications
Uncertainties

Objectives Database Subgroup:

1. Create a high quality, diverse and complete database of existing multi- and hyperspectral IOP and Rrs data for the validation of remote sensing products and the development of algorithms for the PACE mission.

2. Create a database of existing polarized IOP and polarized radiometric quantities using data from various sources.

Why a database?

Objective of PACE: "To understand and quantify ocean biogeochemical cycling and ecosystem function in response to anthropogenic and natural environmental variability and change"

- Total chlorophyll from Ocean Color is well validated

  -> variations in IOPS are clear indication of changes in water mass or water constituents
- Currently no database that have all the current data available (nomad was last updated in 2008)
- Most database currently have only multispectral resolution
- Data collected as part of the PACE effort have to be publicly available by the end of the proposed work

How will this database be create and what has been achieved so far?

- Decided on the priorities: coincident AOP and IOP, covering a range of water types
- Decided on the variables needed in the database
- Advertised the need for data
    - Replies from several institutions (e.g. EPA, Michigan Technological University, University of South Florida , Environment Canada, Bedford Institute of Oceanography)
    - Biosope database will be included in the data used for the PACE effort
    - Use of SeaBASS and NOMAD data
- Established an ftp for the ST member to share information and data
- ftp site also used as a pre-database
- Conditions of the database (publicly available in 2017, contributors are authors)

Location of data	
Latitude	
Longitude	
sst	Sea Surface Temperature
t_mld	Temperature MLD
wt	Water Temperature
sal	Salinity
depth	Depth of measurment
Rrs	Radiometry
a	Total absorption coefficient (aw+ap+ag)
a_p	Absorption coefficient of particles
ad	Absorption coefficient of non algal detritus
a_ph	Absorption coefficient of phytoplankton
agp	Absorption coefficient of Gelbstoff + particles
a_g	Absorption coefficient of Gelbstoff
bb	Total Backscattering Coefficient
bbp	Backscattering coefficient of particles
c_p	Beam attenuation coefficient of particles (ap+bb)
c	Beam attenuation coefficient
cgp (or cnw)	Attenuation coefficient of Gelbstoff+particles
VSF	Volume Scattering Function
cdmf	Fluorescence of CDOM
F_chl	Fluorescence of Chlorophyll

Synthetic hyperspectral IOP-AOP dataset for PACE

(Slide courtesy of ZhongPing Lee)

Objectives:

Create a free-of-measurement-error hyperspectral (350-800 nm, 5 nm resolution) dataset for algorithm test and evaluation

General rules:

1. Representative to commonly encountered waters
2. Consistent with up-to-date knowledge

Approach:

Create an IOP dataset, and feed it to Hydrolight to generate corresponding AOP spectra

$$b_b(\lambda) = b_{bw}(\lambda) + b_{b-ph}(\lambda) + b_{b-dm}(\lambda)$$

$$a(\lambda) = a_w(\lambda) + a_{ph}(\lambda) + a_y(\lambda) + a_d(\lambda)$$

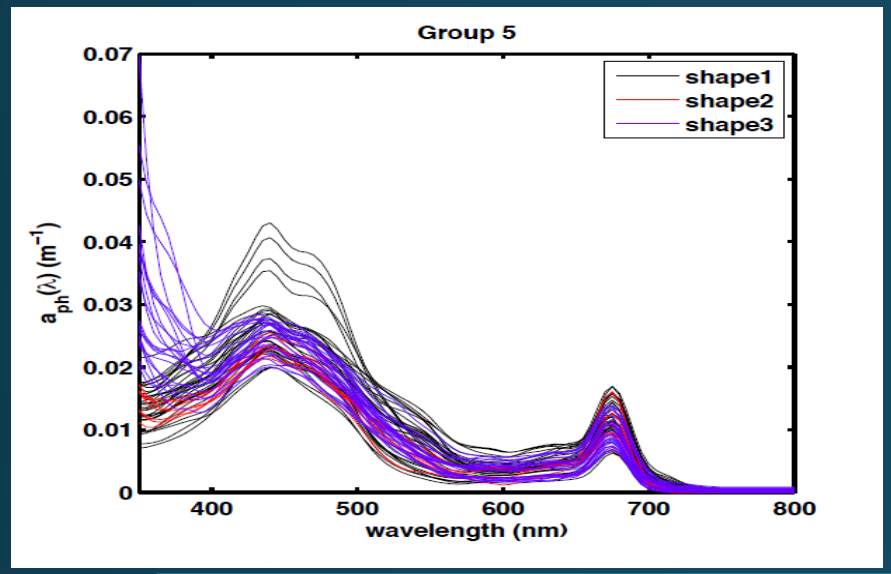
synthesized

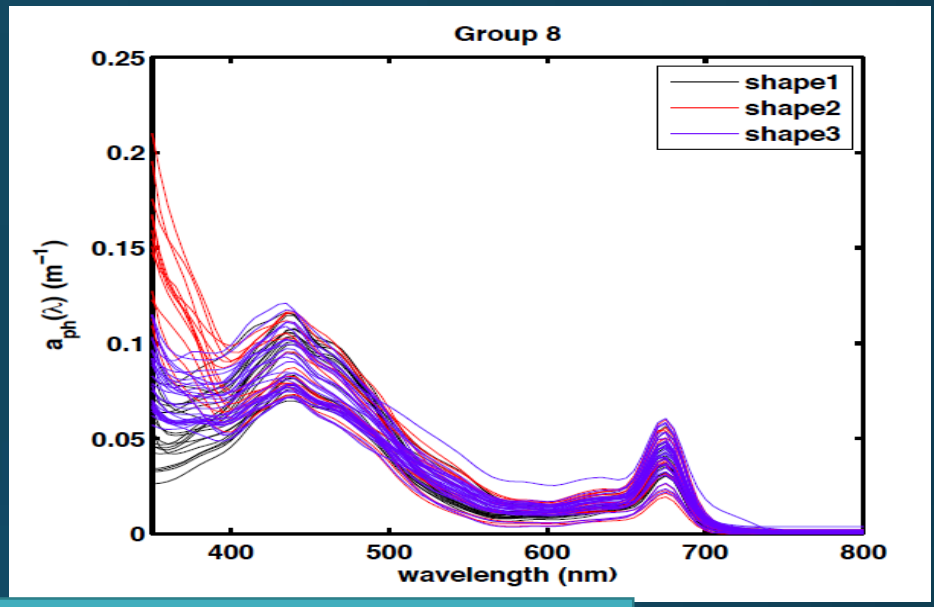
constants

From measurements

720 a_{ph} spectra (from >4000 SeaBASS spectra): 12 "groups" (separated by $a_{ph}(440)$ value), and ~3 a_{ph} shapes within each "group", e.g.

(Slide courtesy of ZhongPing Lee)





$$a_y(\lambda) = a_y(440)e^{-S_y(\lambda-440)}; \quad a_y(440) = p_1 \times a_{ph}(440)$$

$$a_d(\lambda) = a_d(440)e^{-S_d(\lambda-440)}; \quad a_d(440) = p_2 \times a_{ph}(440)$$

$$b_{b-ph}(\lambda) = 0.01 \times \left(c_{ph}(\lambda) - a_{ph}(\lambda)\right) \qquad c_{ph}(\lambda) = p_3 \times a_{ph}(440) \times \left(\frac{440}{\lambda}\right)^{p_4}$$

$$b_{b-dm}(\lambda) = p_5 \times a_{ph}(440) \times \left(\frac{440}{\lambda}\right)^{p_6}$$

Value of p_1, S_y, p_2, S_d, p_3, p_4, p_5, and p_6 are determined semi-randomly (within ranges from field observations) as in IOCCG Report #5.

What's the next step?

- Separated or combined multi- and hyper-spectral database?
- Exact format of the database is under discussion (modified, NOMAD-like being considered)
- How will the uncertainties be conveyed
- Several PIs have been funded to develop datasets as well
- Use the database!

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In situ Inherent Optical Properties and Apparent Optical Properties Data for the PACE Mission

NASA's Pre-Aerosol, Clouds, and Ecosystem (PACE) satellite mission is intended to be a hyperspectral ocean color mission that provides extended data record on ocean ecology and biogeochemistry. Recently, a competitively selected PACE Science Team was assembled to address science challenges pertaining to the PACE mission. One of the objectives of the PACE Science Team is to create a high quality, diverse and extensive database of existing multi- and hyperspectral inherent and apparent optical properties (IOP/AOP) data for the validation of remote sensing products and the development of algorithms for the PACE mission. Both polarized and non-polarized datasets are sought. This is a call to the community to contribute **well-documented, quality controlled data sets consisting of synchronous IOP/AOP profiles and above-water radiometry that could be of interest in a global effort to build a database that would ultimately be published and made available to the public (estimated date of publication is 2017).** All contributors to this database will actively take part in the quality assessment of the data and participate as co-authors on a publication that is expected to arise from this effort. Please direct any questions, recommendations or comments to Cecile S. Rousseaux (Cecile.S.Rousseaux@nasa.gov) and Emmanuel Boss (Emmanuel.Boss@maine.edu).