Next generation algorithms based on PACE capabilities to obtain inherent optical properties of seawater associated with phytoplankton, nonalgal particles, and colored dissolved organic matter

Dariusz Stramski (PI)
Rick A. Reynolds (Co-I)
Matthew Kehrli (Graduate Student)
Ishan Joshi (Postdoctoral Researcher)

Scripps Institution of Oceanography
University of California San Diego

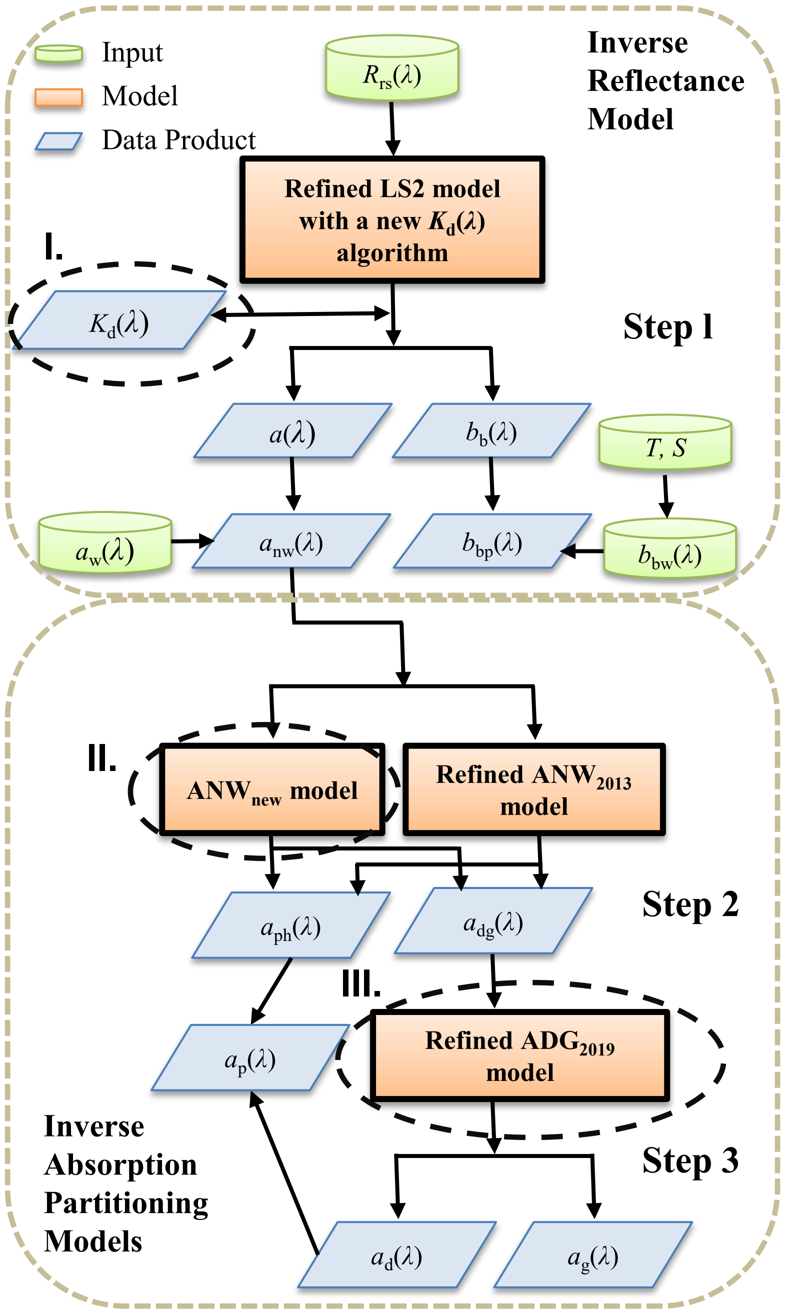
Contributors / collaborators in France

Hubert Loisel
Cédric Jamet
Daniel Jorge

Laboratoire d'Océanologie et de Géosciences, Wimereux, France

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

3-step Semi-Analytical Algorithm (3SAA)



- Input: $R_{rs}(\lambda)$ ⟶ Outputs: <K_d (λ)> + Nine IOPs
- Weakly restrictive assumptions (e.g., spectral shapes)
- Refine inverse reflectance model
- Refine and develop new absorption partitioning models
- Quantify uncertainties

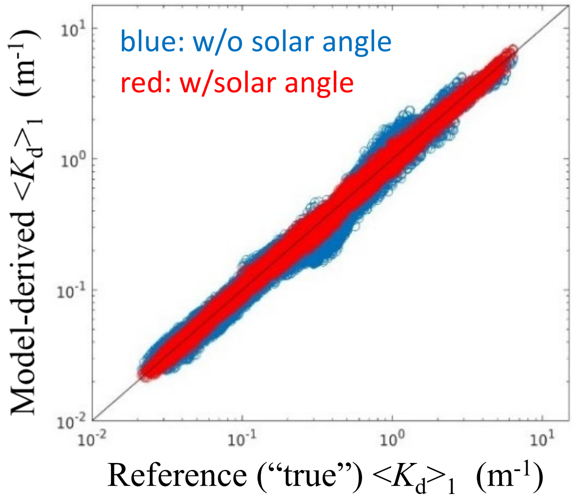
Task I. Refine K_d algorithm (French team)

- ☑ Effect of solar angle
- ☑ Synthetic IOP dataset
- ☑ Radiative-transfer synthetic dataset

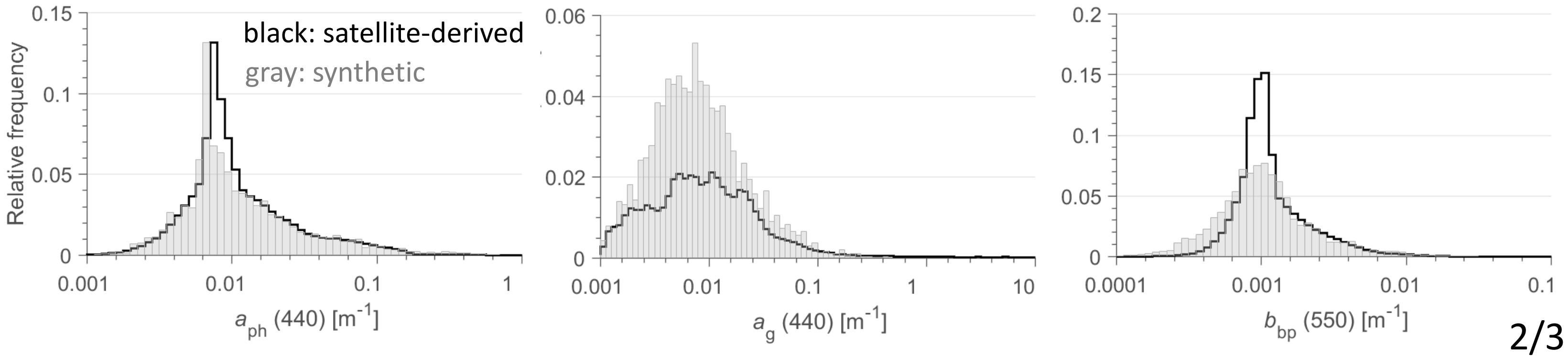
Next tasks:

- ☑ New Neural Network K_d algorithm
- ☑ Hyperspectral capabilities
- ☑ Extend to the UV

Improved K_d (VIS range)



Synthetic IOPs



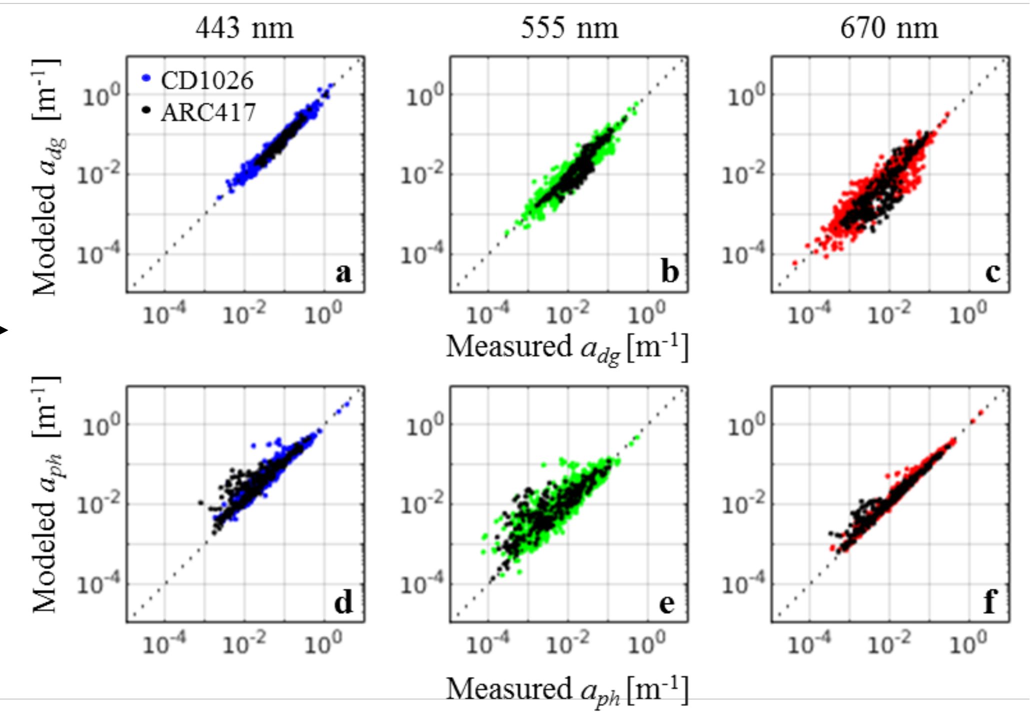
Task II. New ANW partitioning model

- ☑ ANW_{new} model formalism developed

$$a_{nw}(\lambda) = a_{ph}(\lambda) + a_{dg}(\lambda);\; a_{dg}(\lambda) = f[\hat{a}_{dg}(\lambda)];\; a_{ph}(\lambda) = a_{nw}(\lambda) - a_{dg}(\lambda)$$

Library of spectral shapes ($\hat{a}_{dg}$) and multiple inequality constraints

- ☑ Initial tests of ANW_{new} in the VIS range; good results (*MAPD* < 20%) →



Task III. Refine ADG_{2019} partitioning model (Stramski et al. 2019)

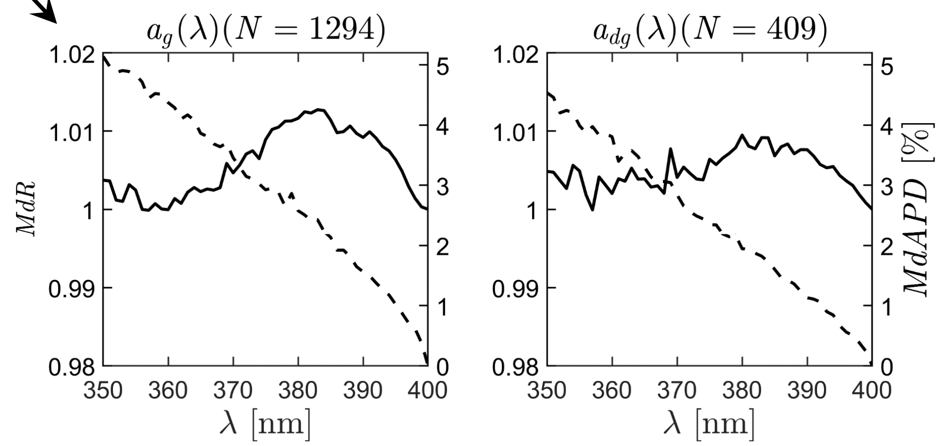
- ☑ Assemble UV-VIS absorption dataset (multiple inclusion/exclusion criteria)
- ☑ Extrapolation method for $a_g(\lambda)$, $a_{dg}(\lambda)$, and $a_d(\lambda)$ from the VIS to UV

Next tasks:

- ☑ Refine a library of spectral shapes for ADG and ANW models
- ☑ Integrate the UV extrapolation method with ADG and ANW models

Absorption dataset

Cruise(s)	Region	$N(a_g)$	$N(a_p, a_d, a_{ph})$	$N(a_g, a_p, a_d, a_{ph})$
BIOSOPE	S. Pacific	31	0	0
gp1-06-ka, gp5-05-ka, gp5-06-ka	Tropical Pacific - Hawaii	292	0	0
A16S, I8SI9N	S. Atlantic, Indian Ocean	91	0	0
HLY0803	Bering Sea	26	0	0
AMMA-RB-06	Equatorial Atlantic	12	0	0
MALINA	Beaufort Sea	60	65	53
CV1, CV2, CV4, CV5, CV7	U.S.A. E. Coast	357	115	93
HLY1001, HLY1101	Chukchi Sea	76	75	71
PC1301	U.S.A. E. Coast	25	35	24
GOMEX_2013	Gulf of Mexico	87	101	75
P16S	S. Pacific	44	43	31
BATS311a, BATS312	Bermuda	3	0	0
NAAMES NA1, NA2, NA3, NA4	N. Atlantic	37	0	0
Cyanate 2016	U.S.A. E. Coast	7	22	4
KR_2016	Korean Peninsula	61	57	40
Mirai17	Chukchi Sea	22	23	18
EXPORTS Process, Survey	N. Pacific	63	0	0
Total		1294	536	409



Evaluation results for extrapolated relative to measured values in the UV:

Median ratio (*MdR – solid line*) shows negligible aggregate bias

Median absolute percent difference (*MdAPD – dashed line)* < 5%