

Development of datasets and algorithms for hyperspectral IOP products from the PACE ocean color measurements

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Objectives:

- a. **Development of a hyperspectral dataset.** Compile a hyperspectral (350 - 700 nm, 5 nm resolution) R_{rs} -IOPs dataset for the community to use. In particular, this dataset will ensure a closure between the measured R_{rs} and the modeled R_{rs} using *in situ* IOPs -- a hyperspectral R_{rs} -IOPs dataset with closure (HyRIDc).
- b. **Algorithm revision.** This will include
 - i) improve the determination of SS_{IOP} from remote sensing for different water bodies,
 - ii) extend the QAA and HOPE algorithms to include measurements in the UV (350-400 nm) and expanding IOP products to absorption coefficients of specific pigments (e.g., chlorophyll-a, -b, -c, and phycocyanin).
- c. **Test and evaluation of the revised algorithms with HICO measurements.**

Results from these efforts will provide desired tools and knowledge, and contribute to "*consensus and community-endorsed paths forward for the PACE sensor(s)*".

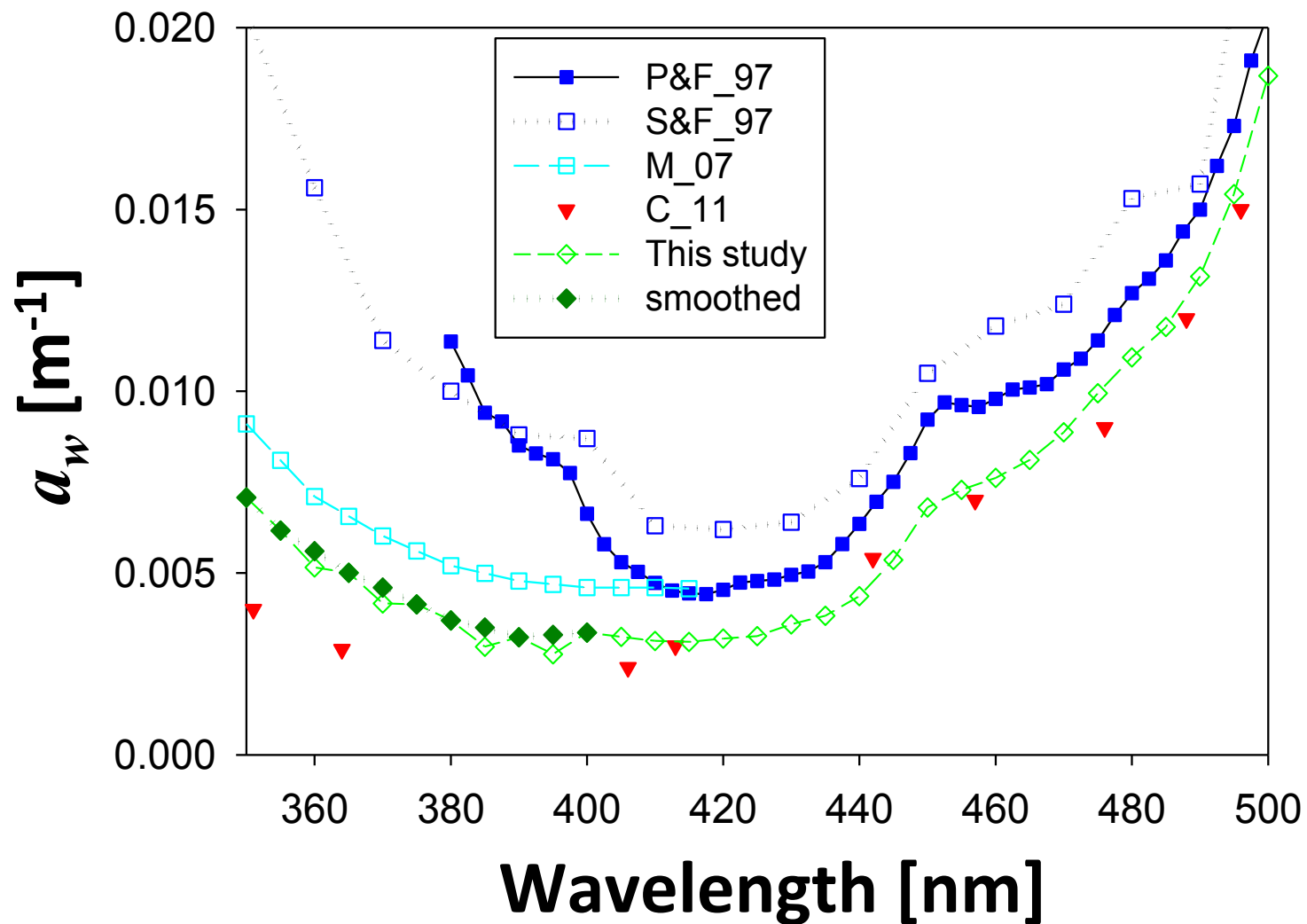


Accomplishments in 2016:

1. Impact of a_w on IOPs retrievals
2. IOPs derived from in situ AOPs
3. Inversion of a_{pig} from HICO

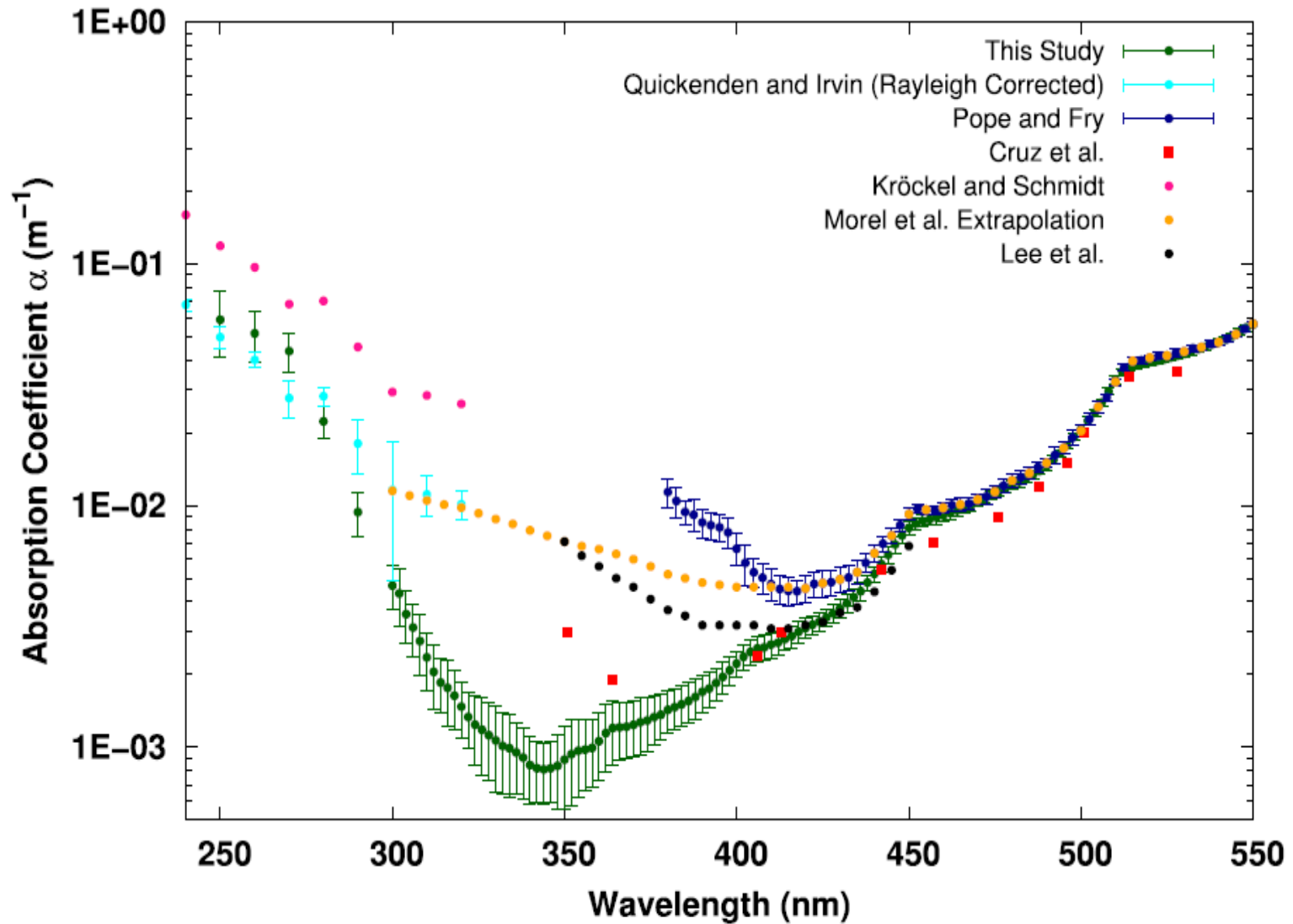


1. Impact of a_w on IOPs retrievals



(Lee et al 2015)



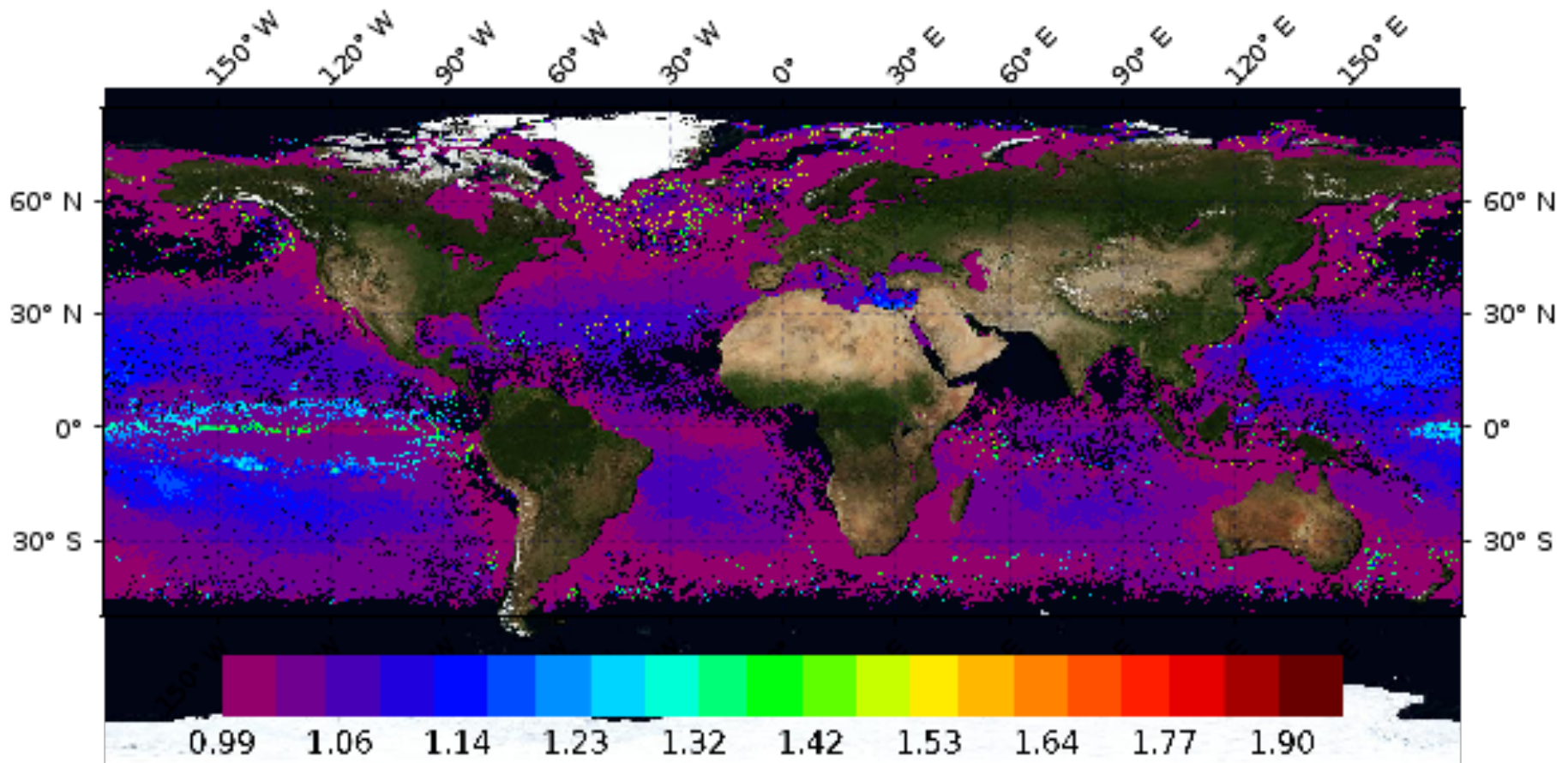


(Mason et al 2016)

Big difference in the 400 – 450 nm range compared to “standard” Pope&Fry 1997 aw.

What’s the impact on IOPs inversion?

$$a_{dg_412}(\text{new_a}_w)/a_{dg_412}(\text{Pope and Fry_a}_w)$$



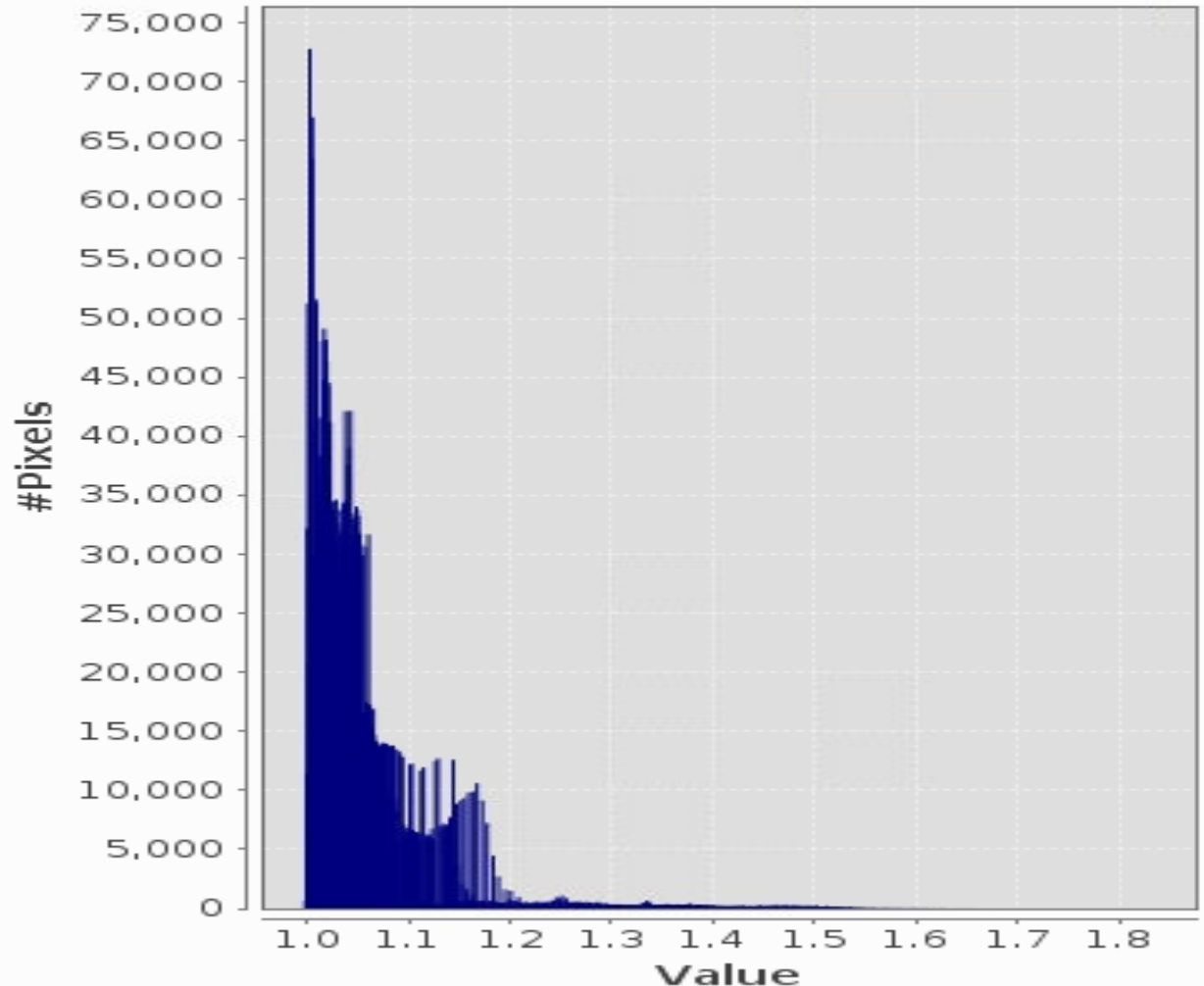
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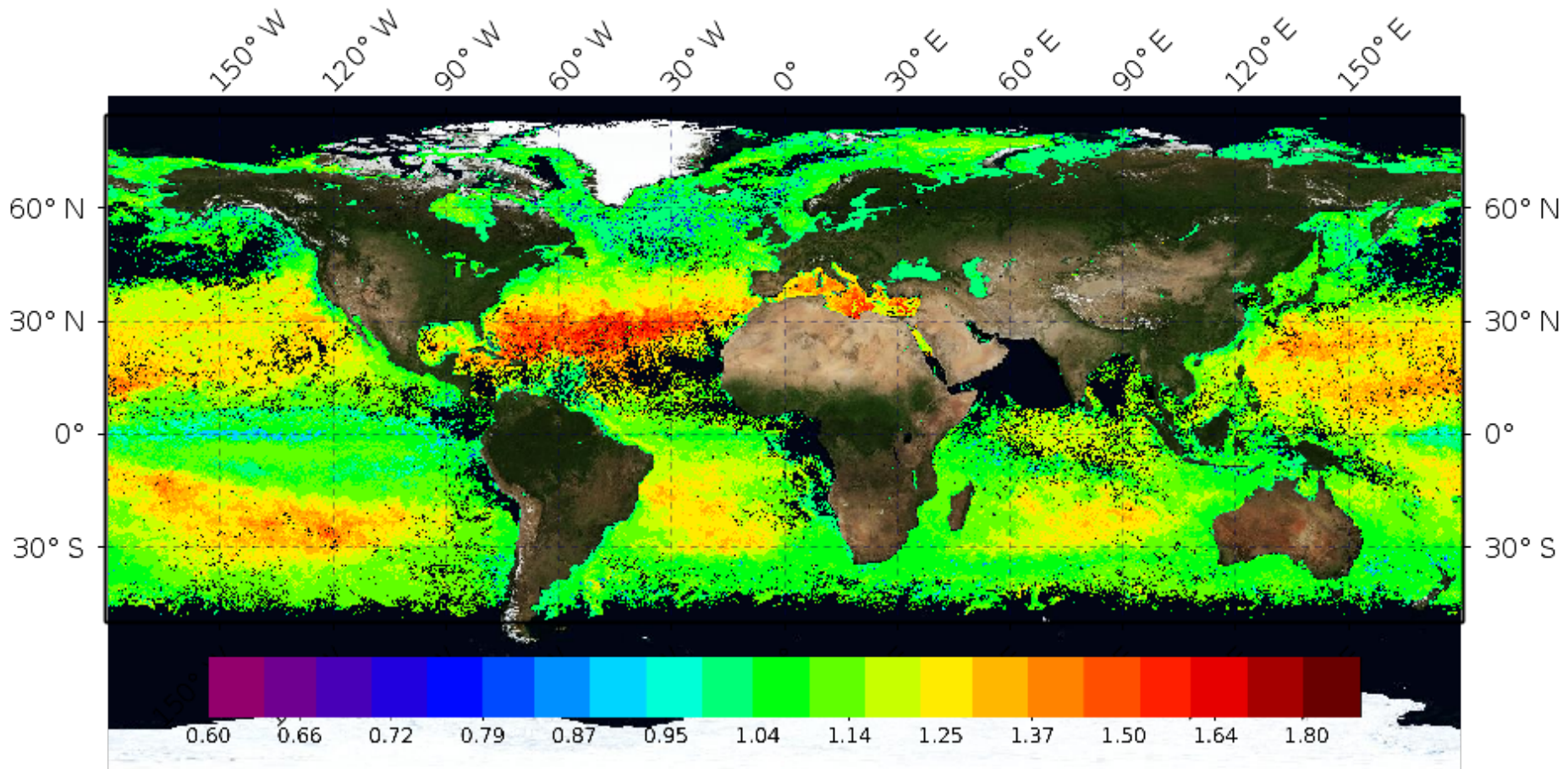
$$a_{dg_412}(\text{new_}a_w)/a_{dg_412}(\text{Pope and Fry_}a_w)$$

idg_412_new_old_ratio

#Pixels ...	3512136
Minimum:	0.9969
Maximum:	1.8333
Mean:	1.0529
Sigma:	0.0653
Median:	1.0362
<u>P75 thr...</u>	<u>1.0630</u>
P80 thr...	1.0739
P85 thr...	1.0889
P90 thr...	1.1148
Max error:	8.3642E-4



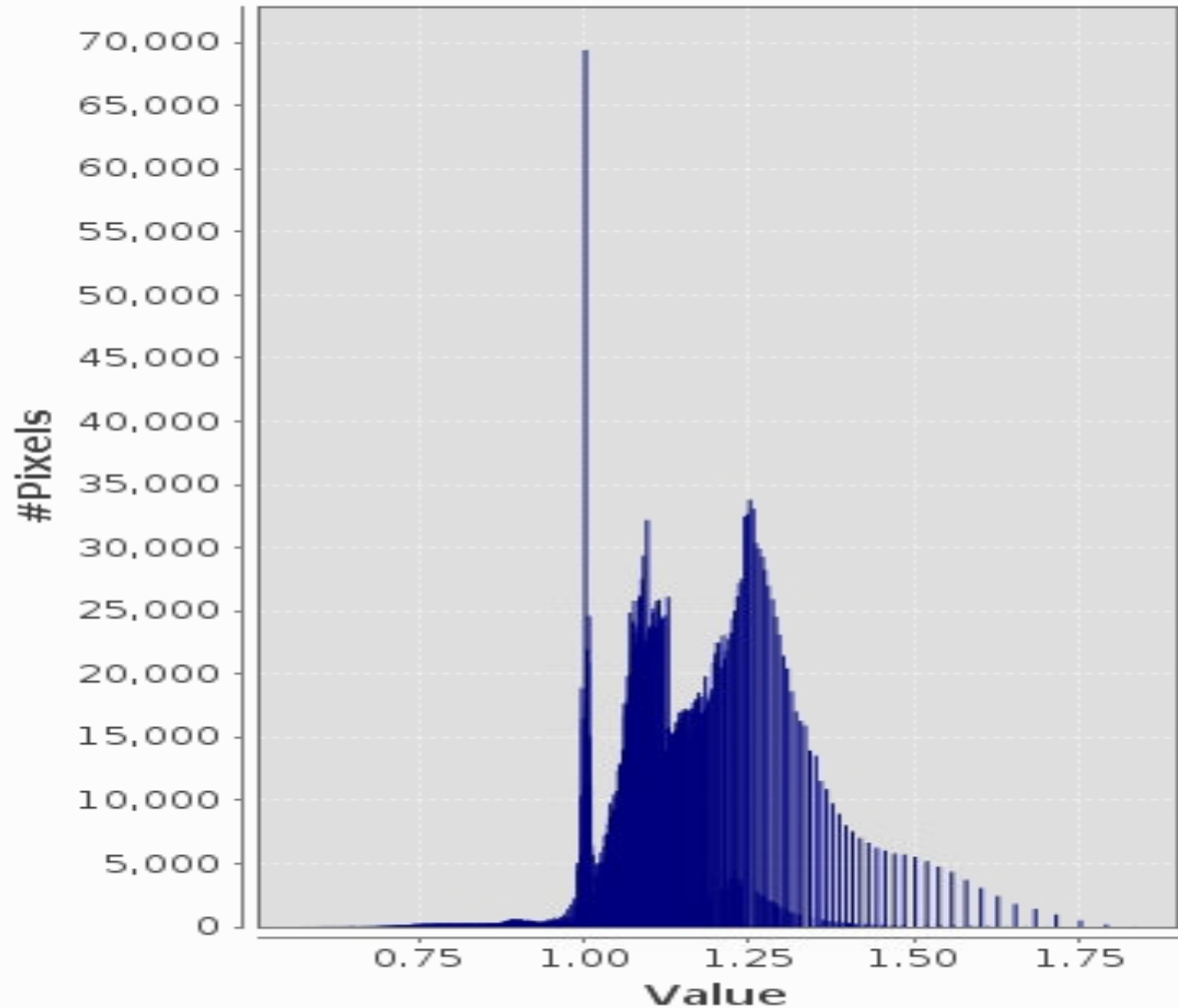
$a_{\text{ph}_443}(\text{new_a}_w)/a_{\text{ph}_443}(\text{Pope and Fry_a}_w)$



$$a_{\text{ph}_443}(\text{new_a}_w)/a_{\text{ph}_443}(\text{Pope and Fry_a}_w)$$

aph_443_new_old_ratio

#Pixels ...	3512784
Minimum:	0.5681
Maximum:	1.8333
Mean:	1.1436
Sigma:	0.1117
Median:	1.1248
P75 thr...	1.2108
P80 thr...	1.2336
P85 thr...	1.2538
P90 thr...	1.2829
Max error:	0.0013



Conclusion 1:

New a_w can cause, on average, ~10% increase in a_{dg} and a_{ph} retrievals.

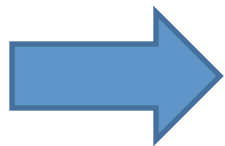
It is necessary to implement more appropriate a_w in IOP retrieval algorithms.



2. IOPs derived from in situ AOPs

In situ measurements $\rightarrow R_{rs}$ and K_d

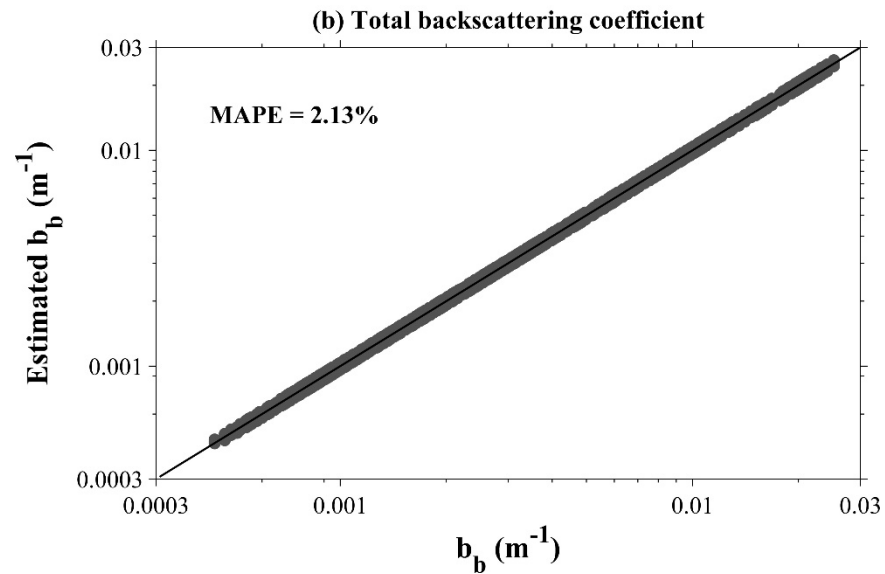
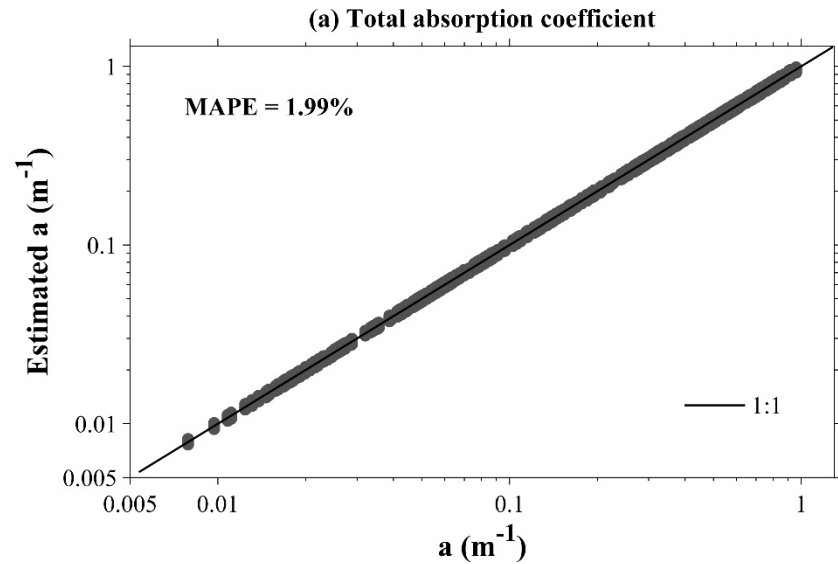
$$\begin{cases} R_{rs} = F_1 \{a, b_b\} \\ K_d = F_2 \{a, b_b\} \end{cases}$$



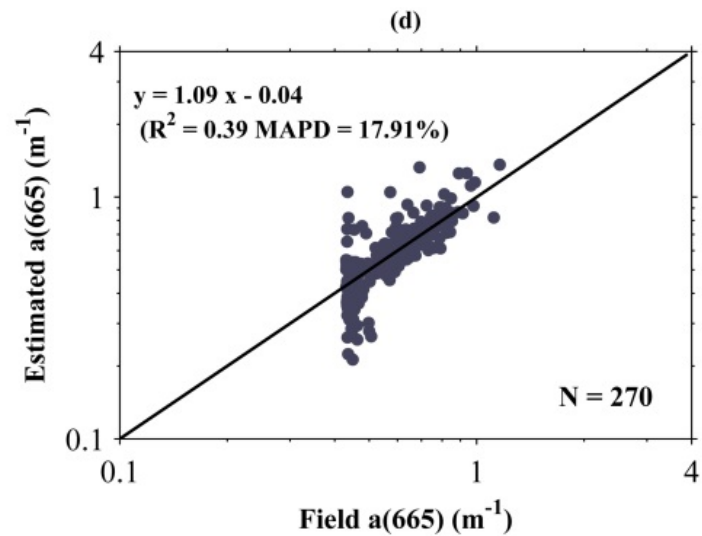
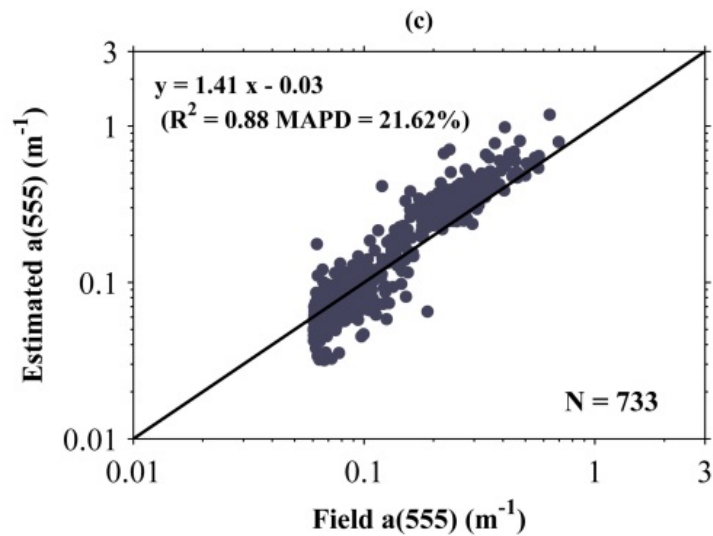
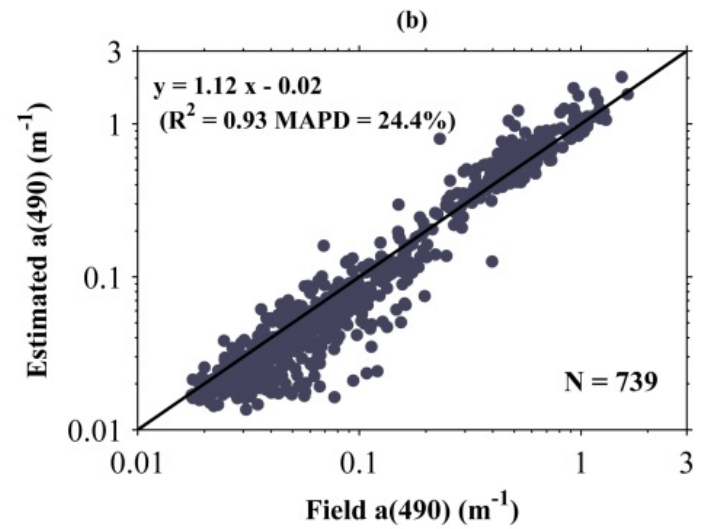
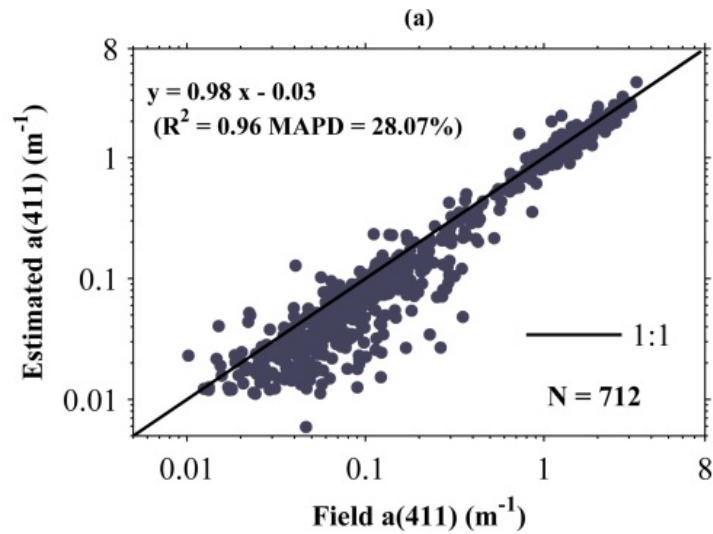
{spectra of a, b_b}



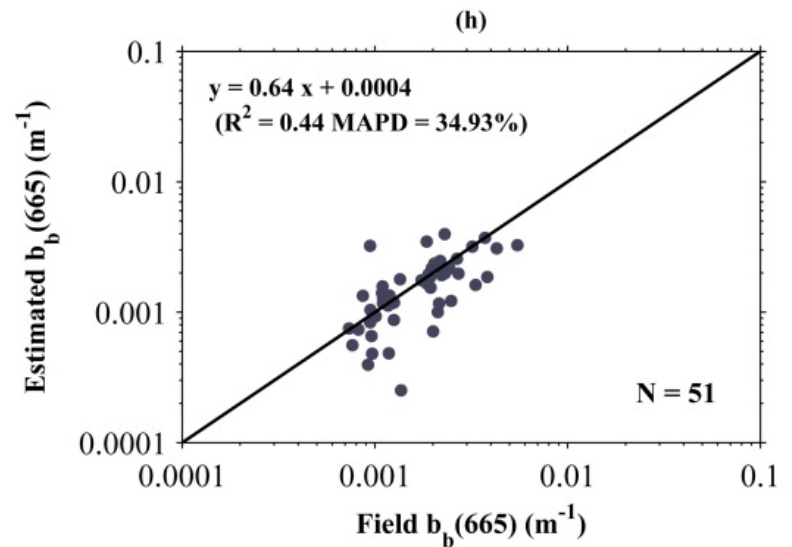
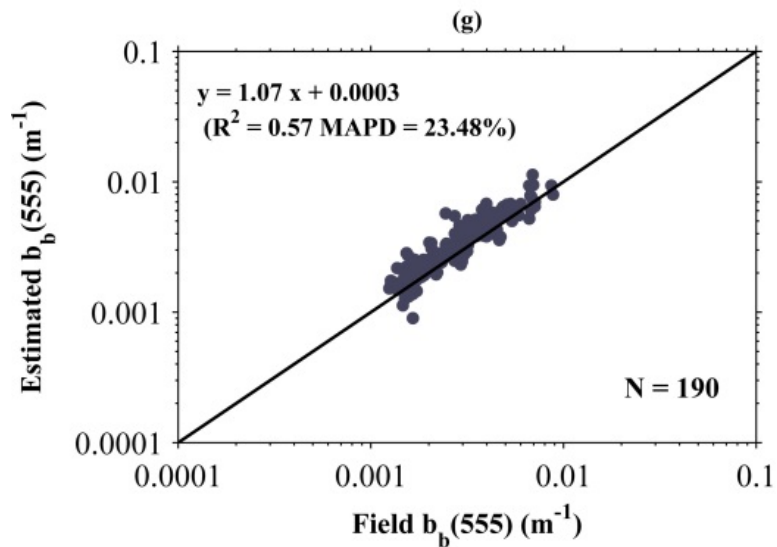
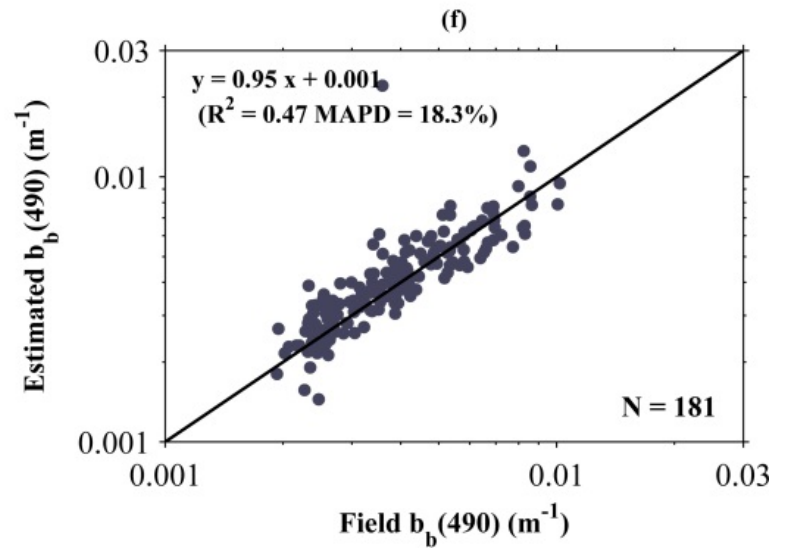
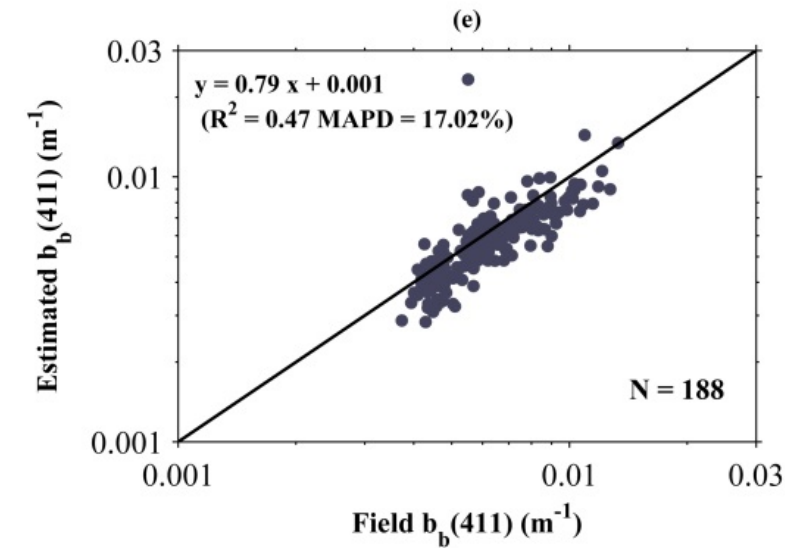
Self-consistency check with HL data



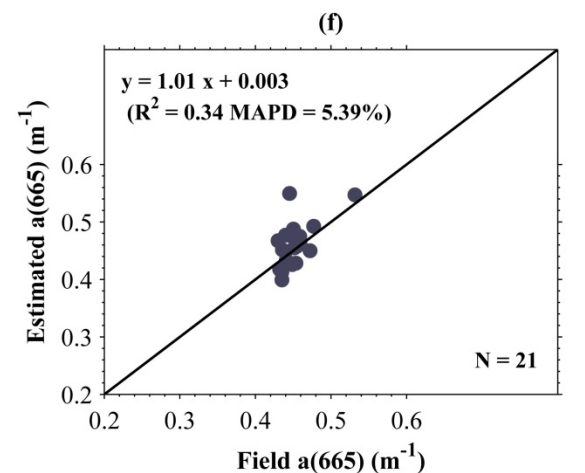
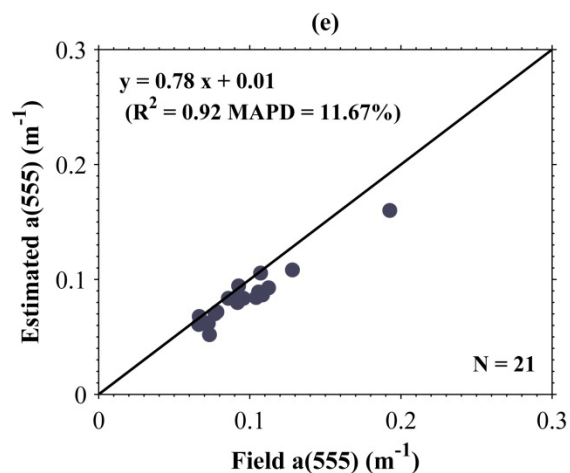
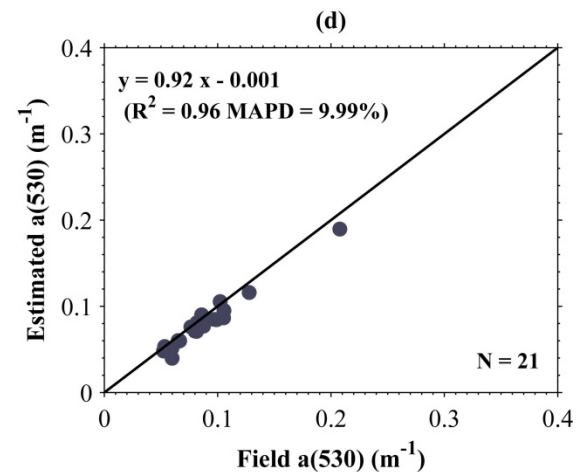
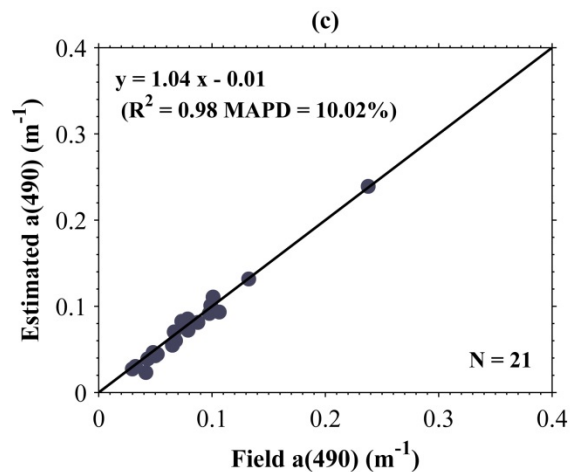
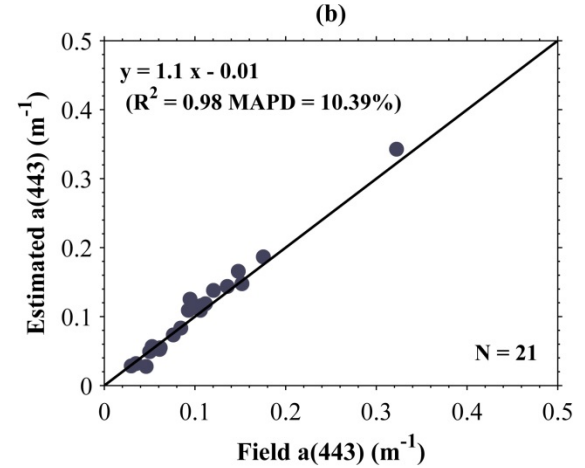
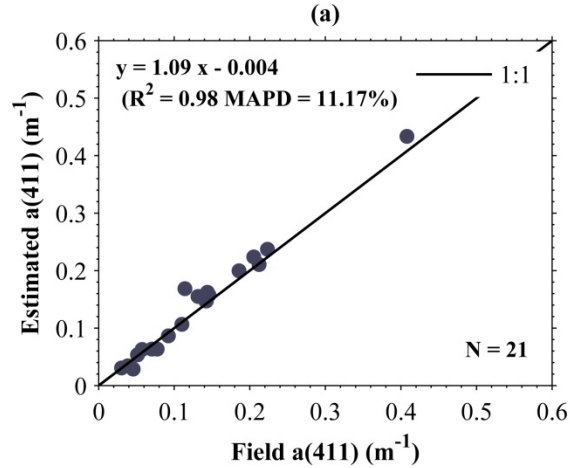
NOMAD



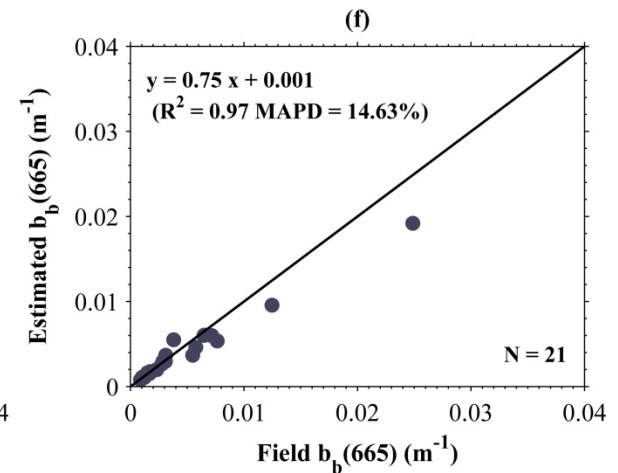
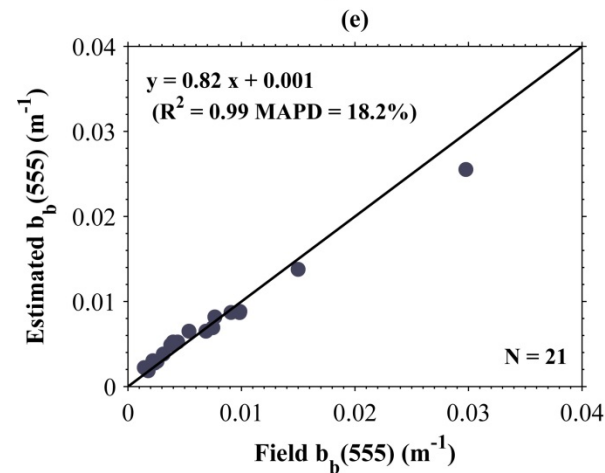
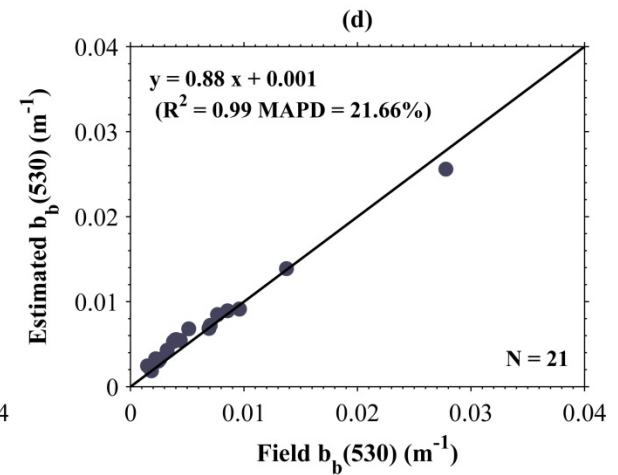
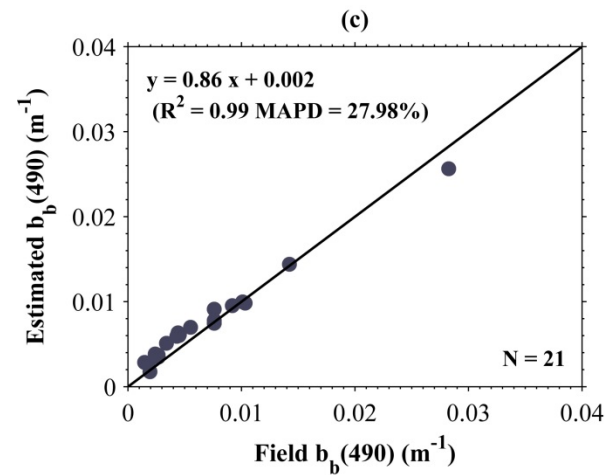
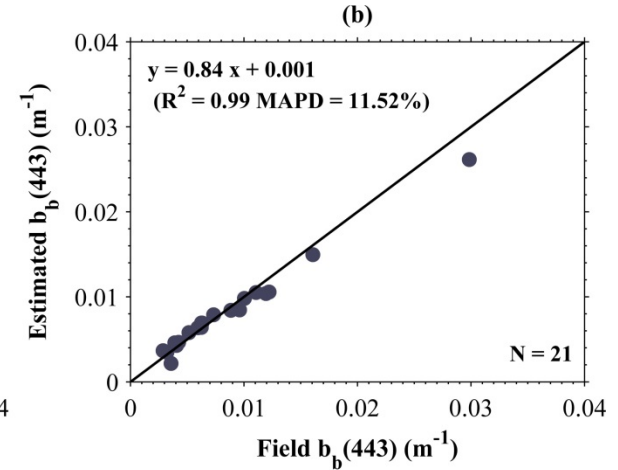
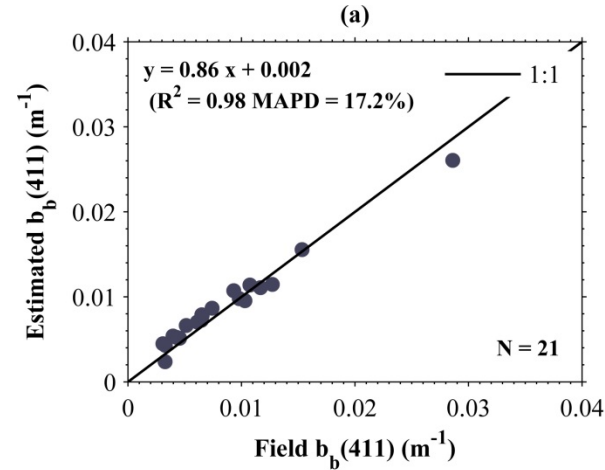
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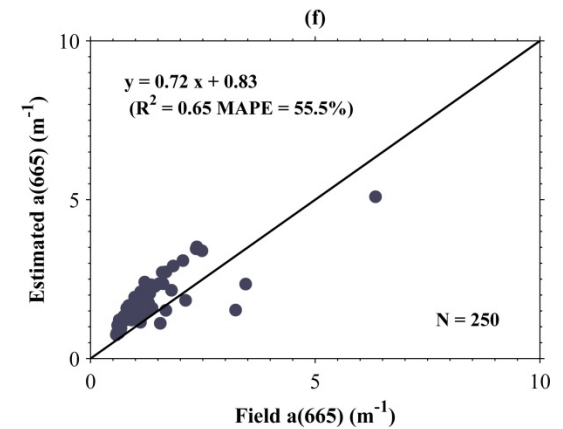
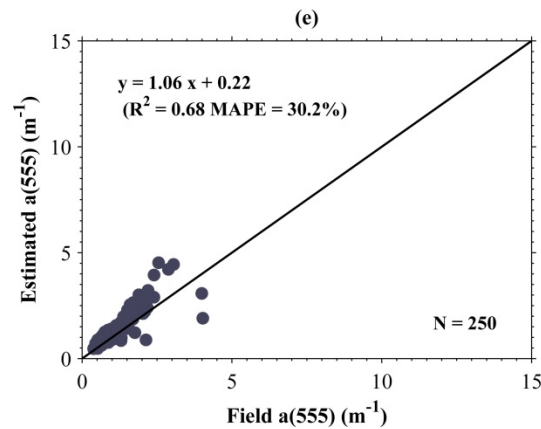
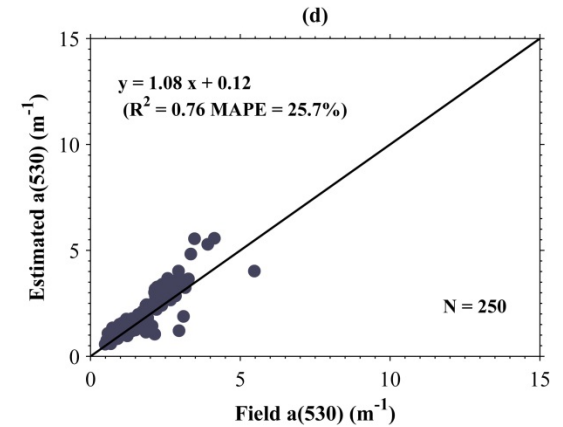
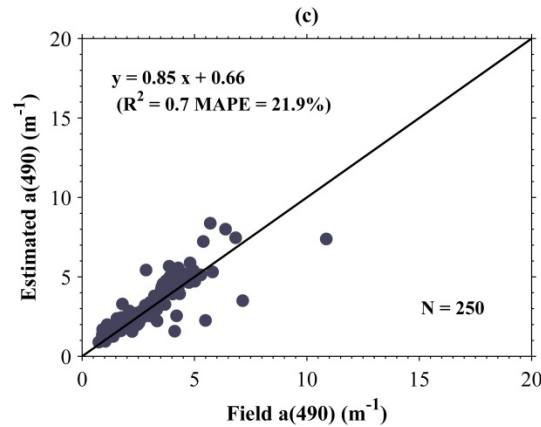
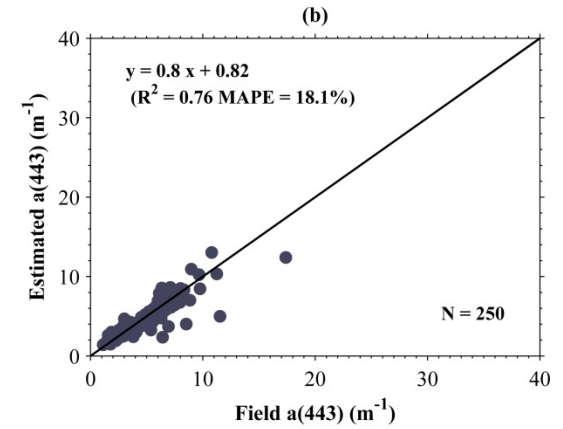
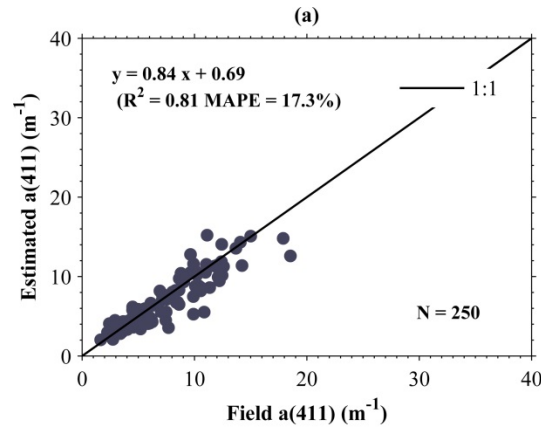
2014 VIIRS Cruise



2014 VIIRS Cruise



Lake Taihu (extreme water)



Conclusion 2:

Spectra of bulk IOPs (total a and total b_b) can be well retrieved from the combination of insitu R_{rs} & K_d spectra.

This scheme offers another (compared to data from instruments such as ac-9,bb-9, etc.), and reliable (at least with self-closure), IOPs data source to evaluate remote sensing algorithms.

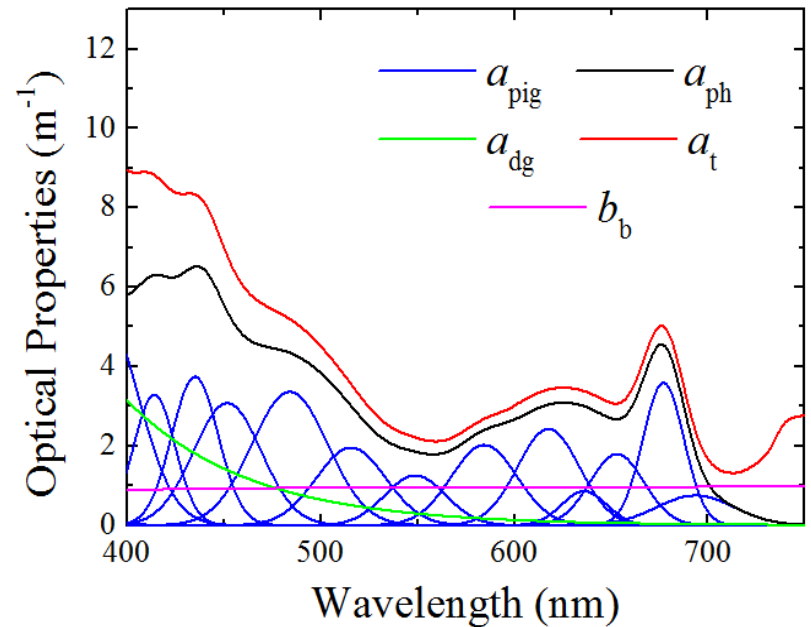
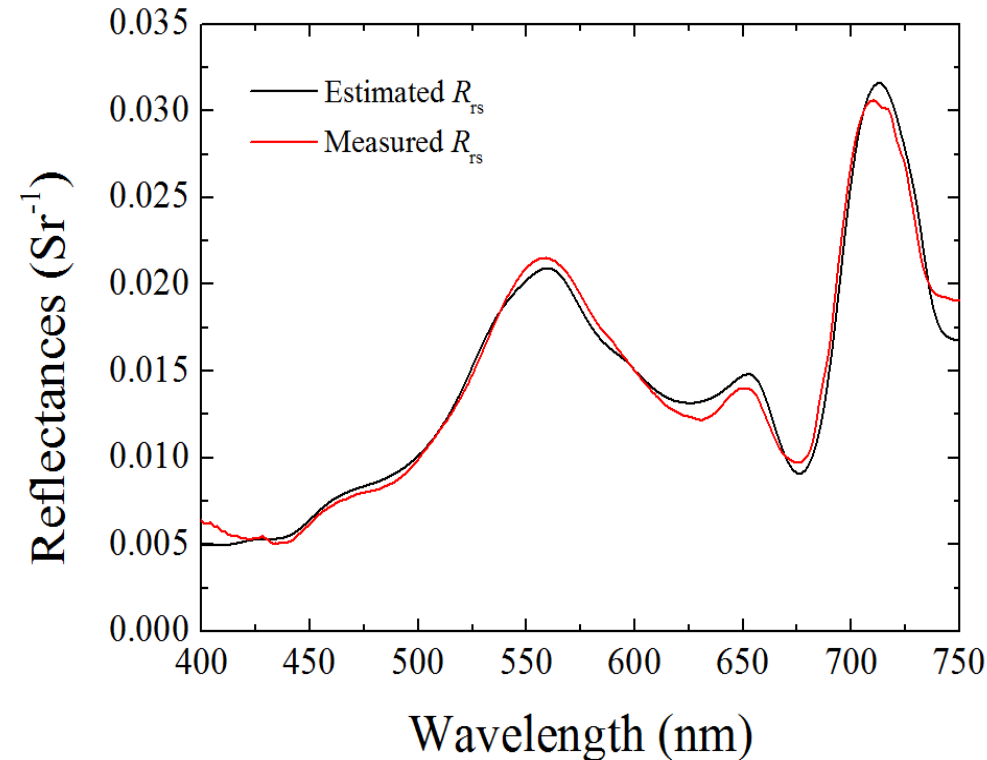
Available to be shared with the team.



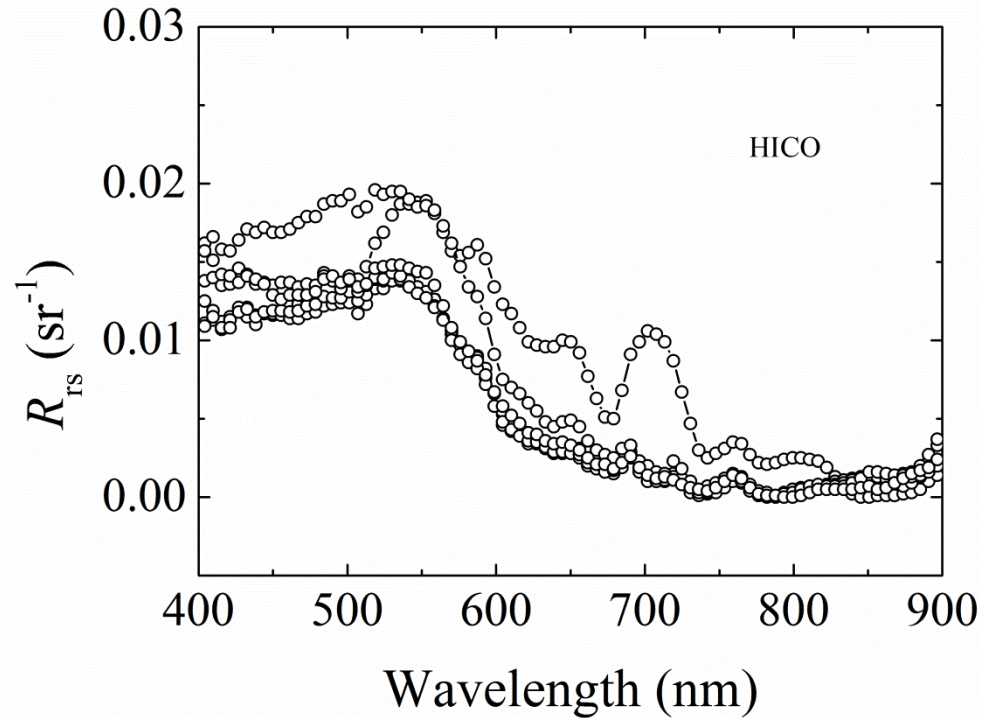
3. Inversion of a_{pig} from HICO

Hoepffner and Sathyendranath (1991):

$$a_{ph}(\lambda) = \sum_1^{13} a_{pig}(\lambda_i) Gau(i)$$

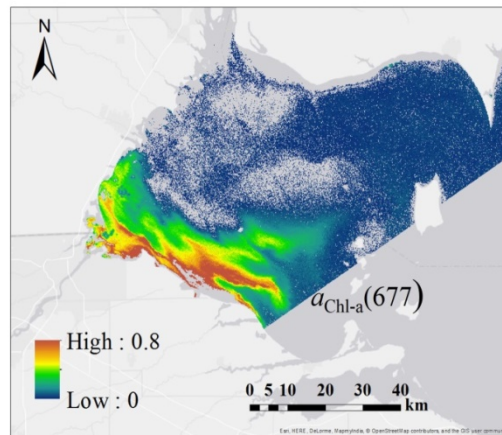
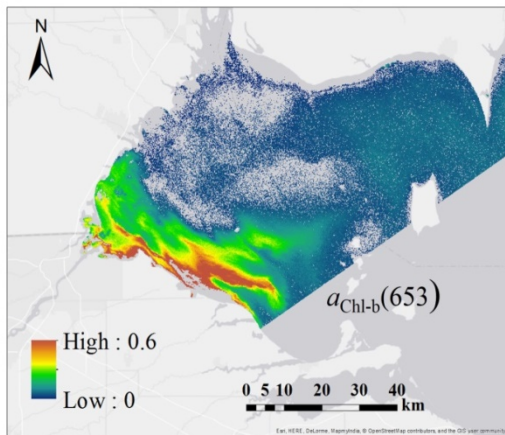
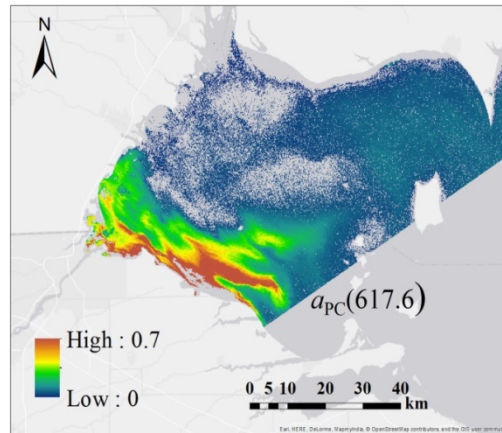
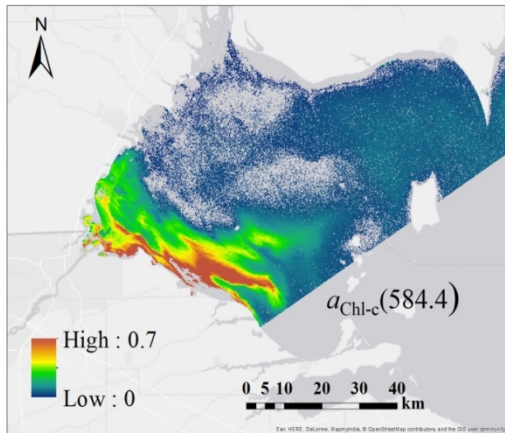
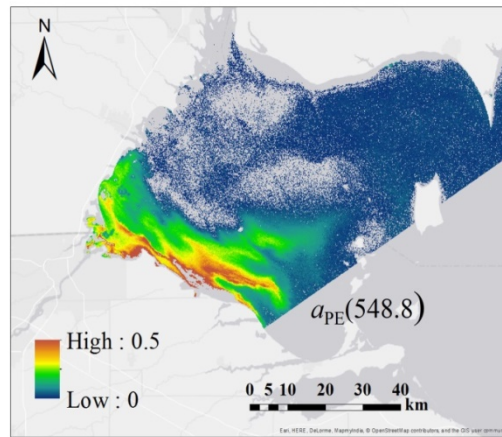
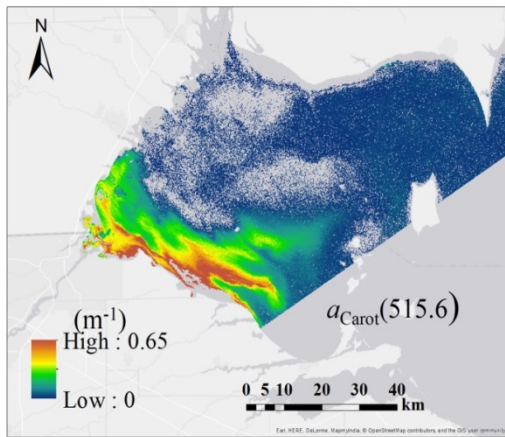


(Wang et al 2015)



True color HICO image of western basin of Lake Erie on August 15, 2014 and sample remote sensing reflectance spectra (after the standard atmospheric correction).





Pigment absorption coefficients (a_{pigs}) from HICO imagery for Western basin of Lake Erie on August 15th, 2014 during the cyanobacteria bloom time. The absorption coefficients of six pigments at their absorption peak wavelength are included: *carotenoids* at 515.6 nm, *phycoerythrin* at 548.8 nm, *chlorophyll c* at 584.4 nm, *phycocyanin* at 617.6 nm, *chlorophyll b* at 653 nm and *chlorophyll a* at 677 nm.



Conclusion 3:

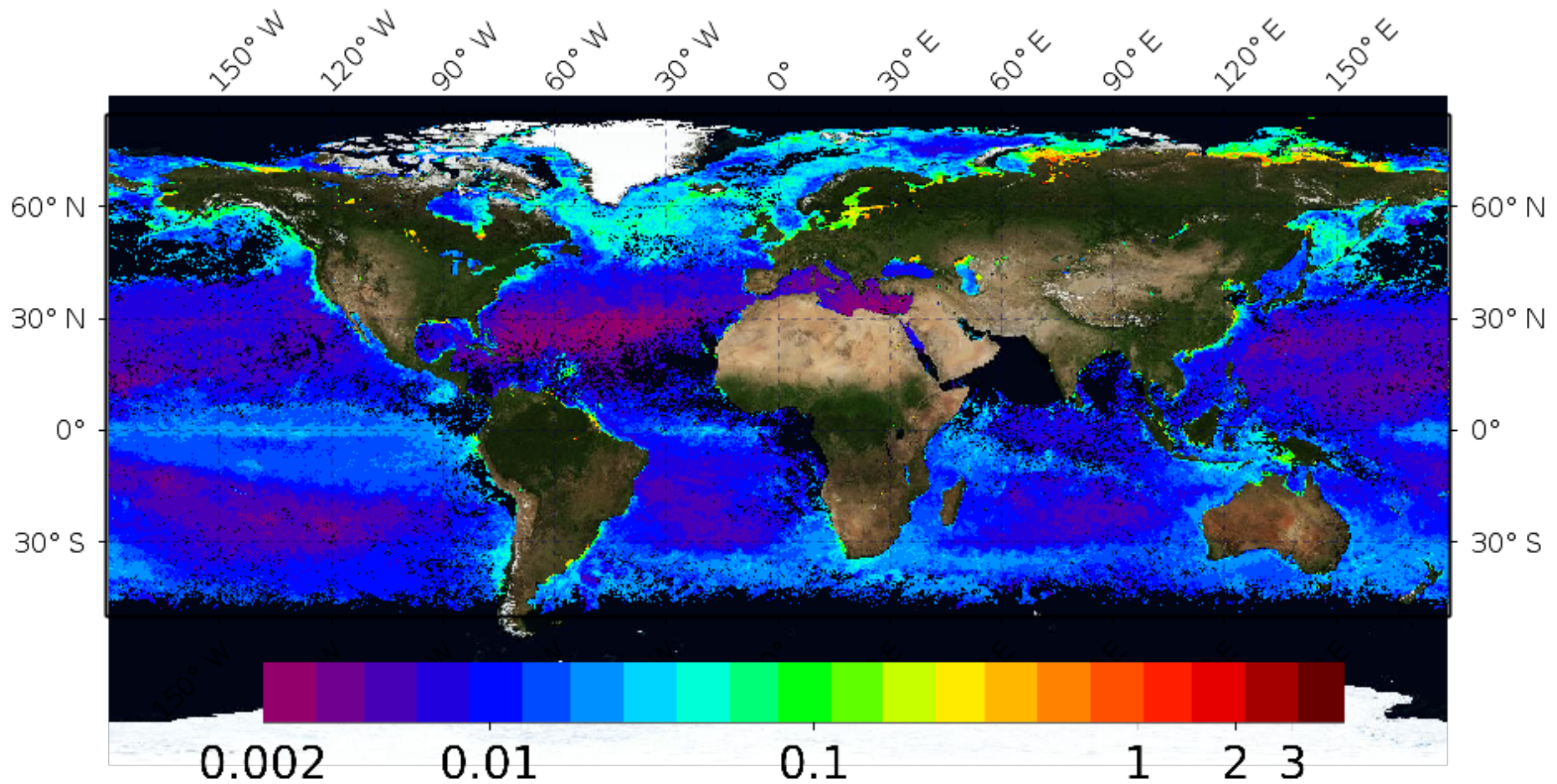
With hyperspectral remote sensing reflectance and the refined Gaussian decomposition model, absorption coefficients of multiple pigments were found reasonably retrieved for a bloom water in Lake Erie.



Thank you!



aph_443(Pope and Fry_aw)



Input file: A20071822007212.L3b_MO_RRS.nc, July 2007