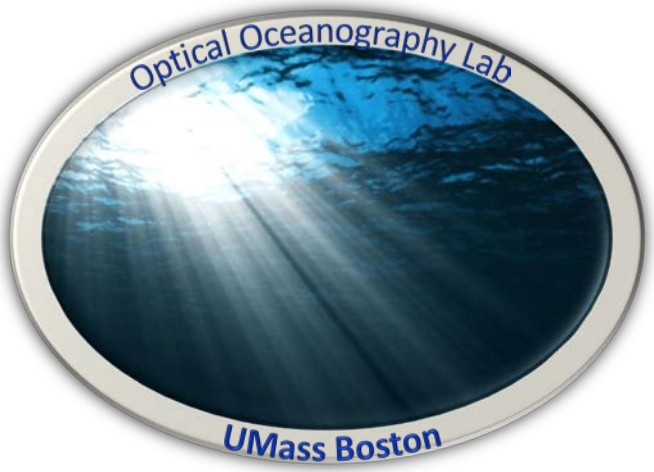
Towards consistent VIIRS AOP and IOP products

ZhongPing Lee, JunFang Lin, Laura Zoffoli, Jianwei Wei

University of Massachusetts Boston

UMASS BOSTON



Acknowledgements:

NOAA/STAR

UMB activities:

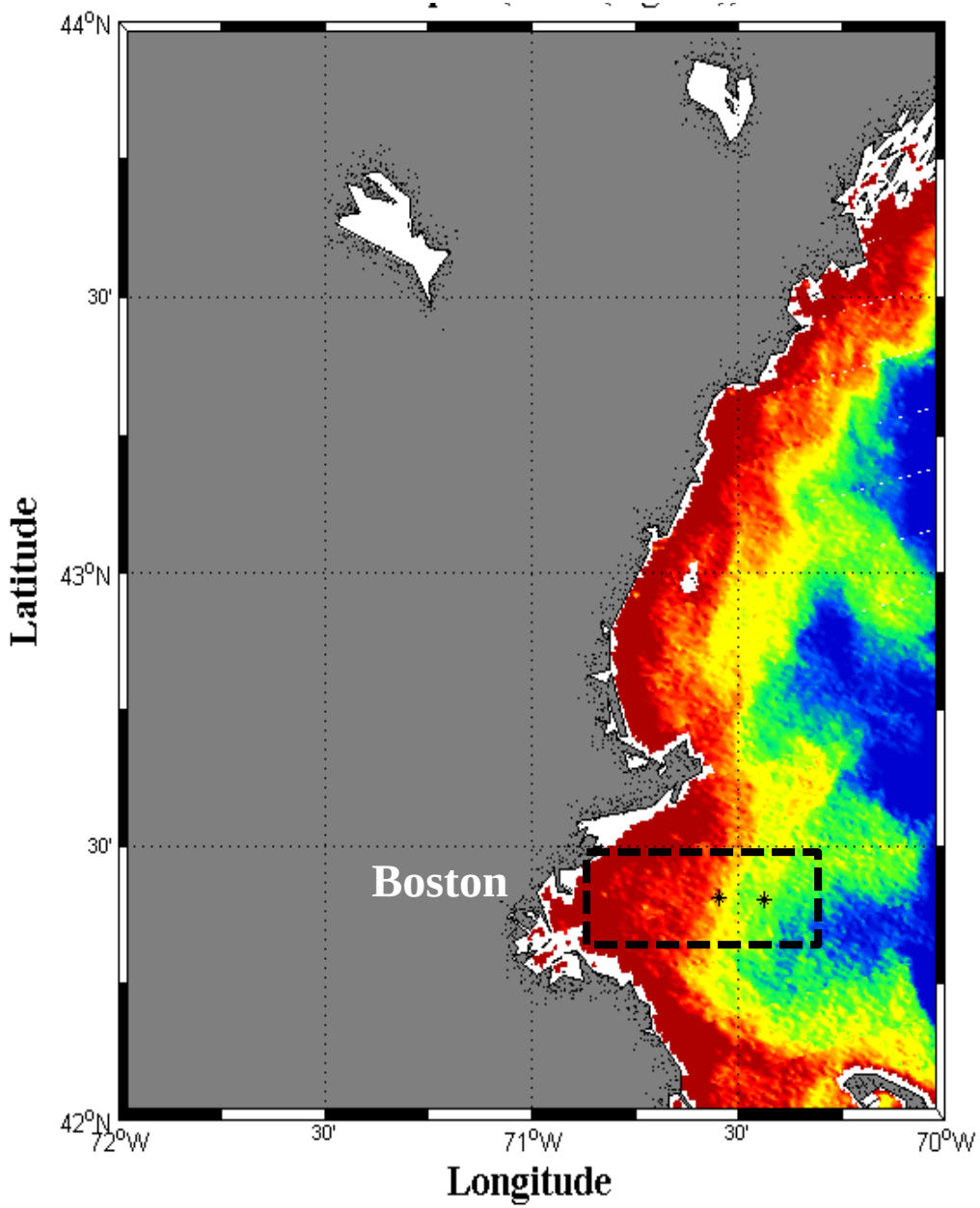
1. Evaluation of VIIRS Rrs products
2. Evaluation of VIIRS IOPs products
3. Some applications

1. Evaluation of VIIRS Rrs products

Data:
VIIRS CoastWatch L2, SBA Rrs

Measurements in Mass Bay:
Aug. 30, 2016 (1 match-up station);
Sep. 13, 2016 (2 match-up stations);
Sep. 15, 2016 (2 match-up stations);
Sep. 22, 2016 (5 match-up stations);
Feb. 2, 2017 (4 match-up stations);

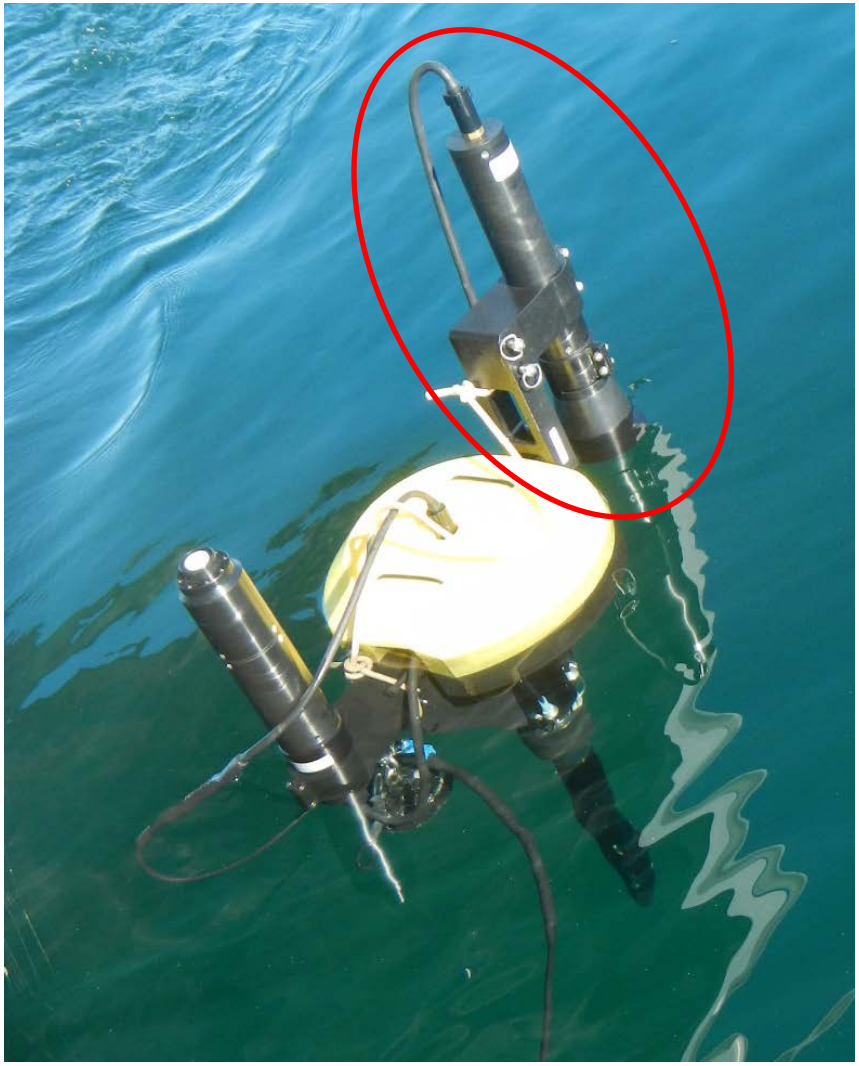
VIIRS cal/val cruise:
Oct. 13 – Oct. 18, 2016


44°N
30'
43°N
30'
42°N
72°W
30'
71°W
30'
70°W
Latitude
Longitude
Boston

SBA system to obtain accurate “ground truth” of Lw (Rrs)

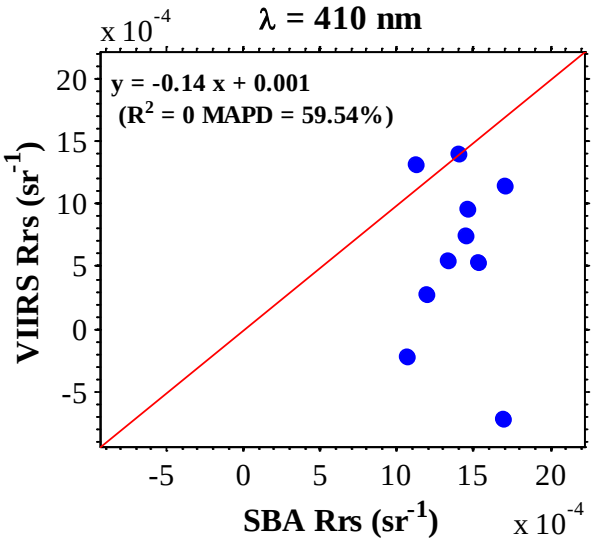


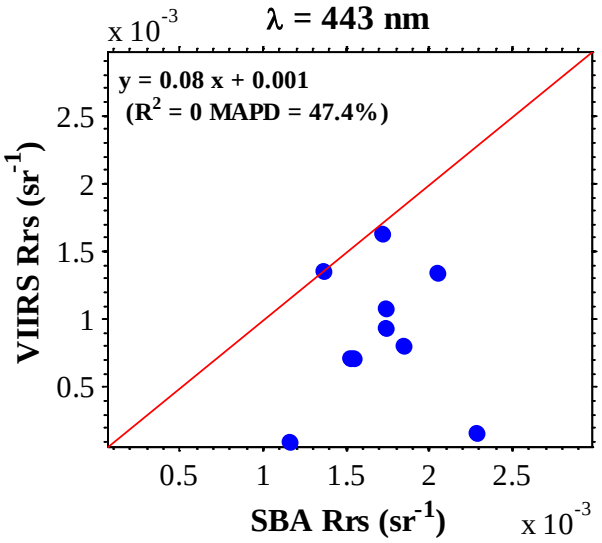


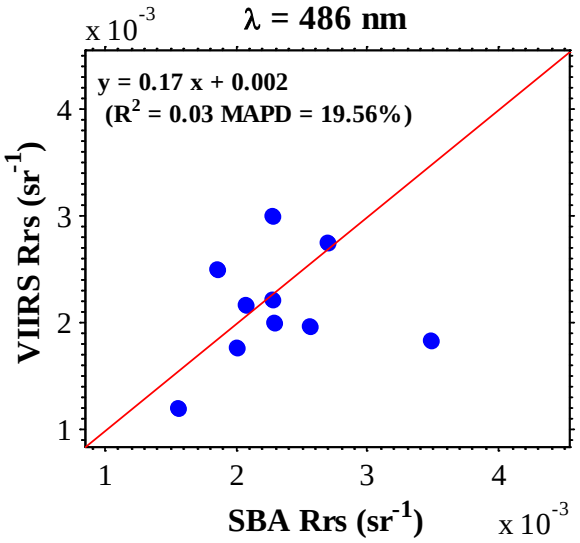


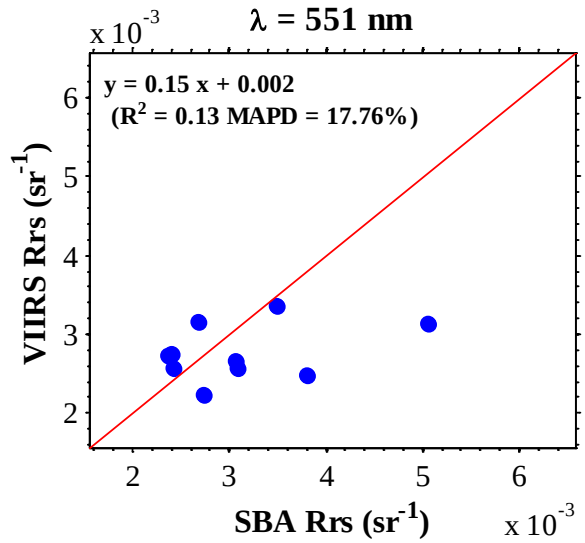
(Lee et al 2013)

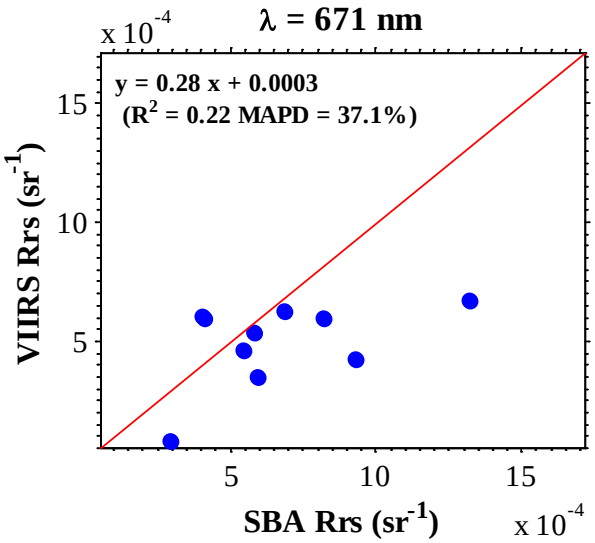
Comparison of Satellite Rrs data with Measurements in Mass Bay



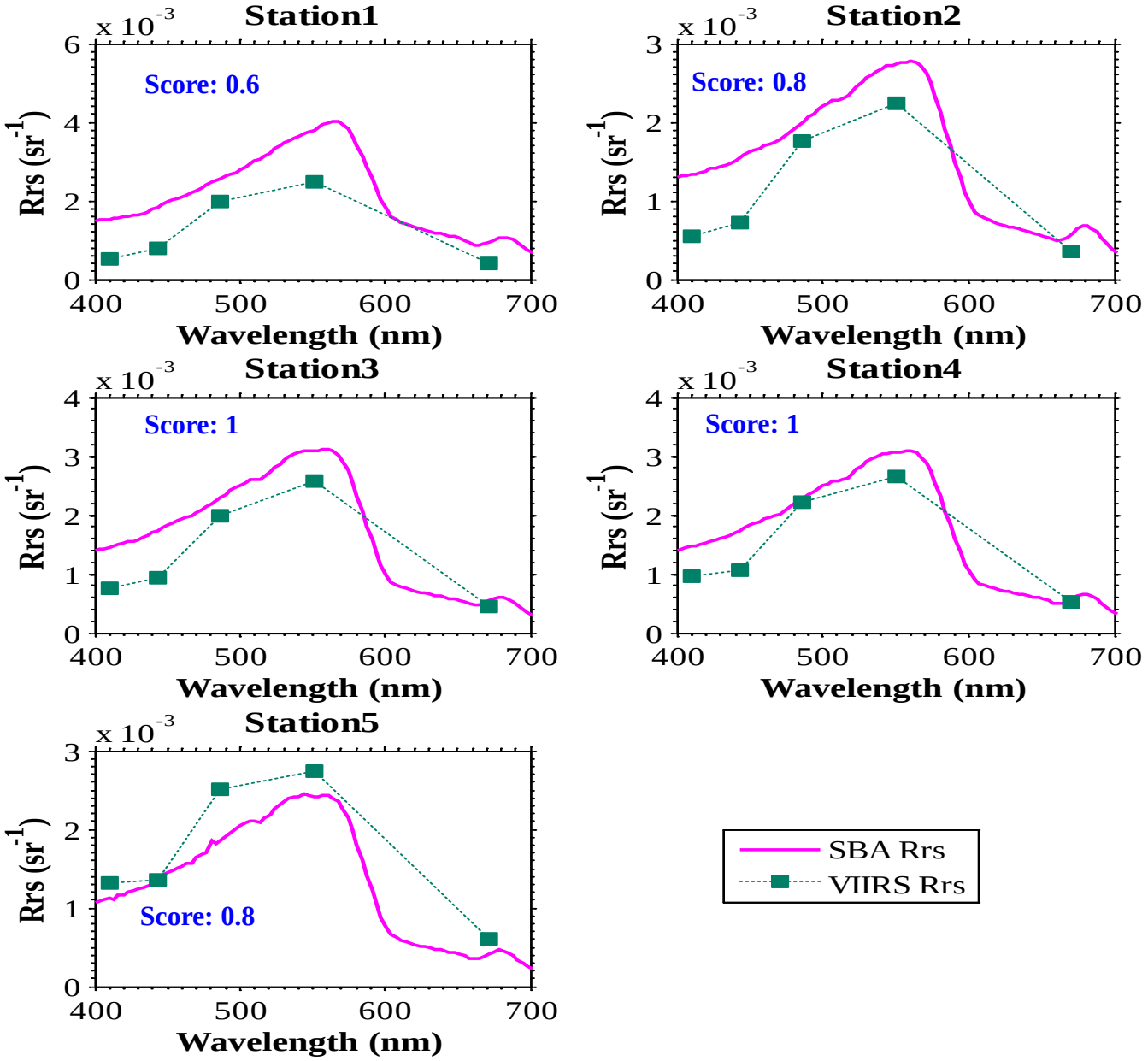




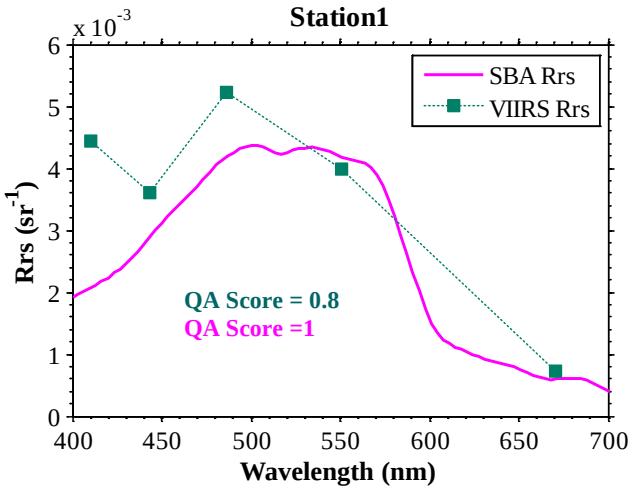


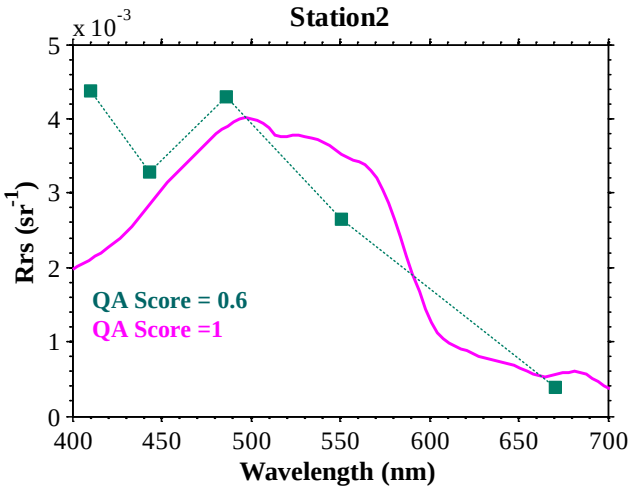


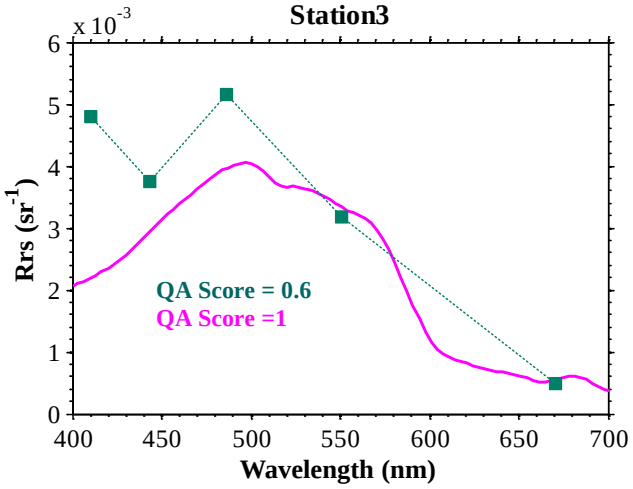
Examples of Rrs spectra

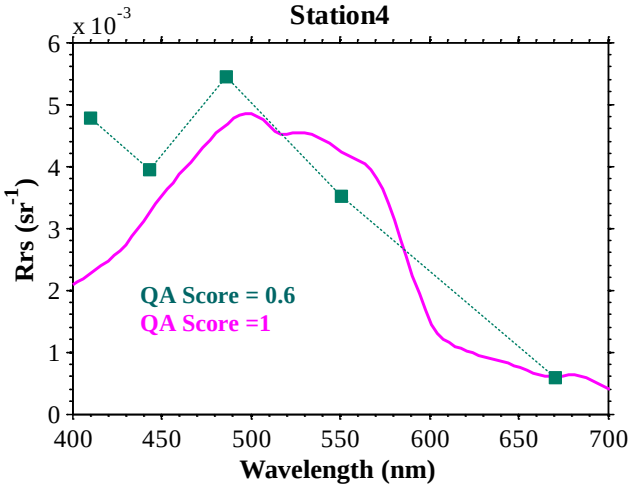


Examples of Rrs spectra (Feb. 2, 2017)

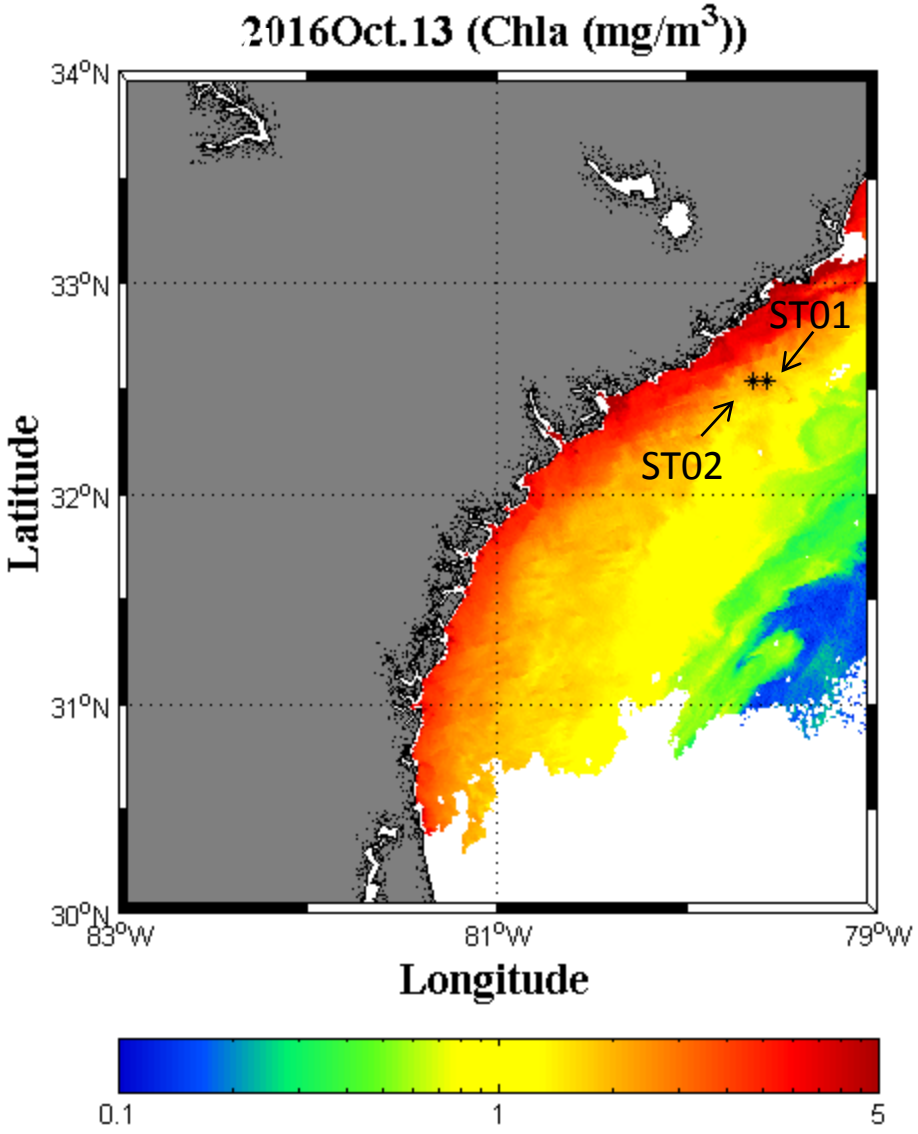


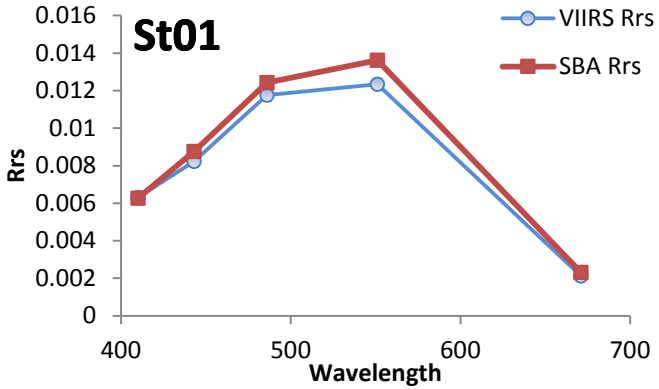


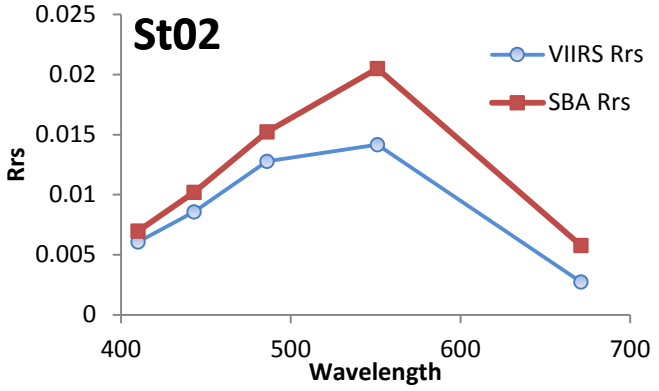




Examples of Rrs spectra (VIIRS cal/val cruise)







Part 1: Summary

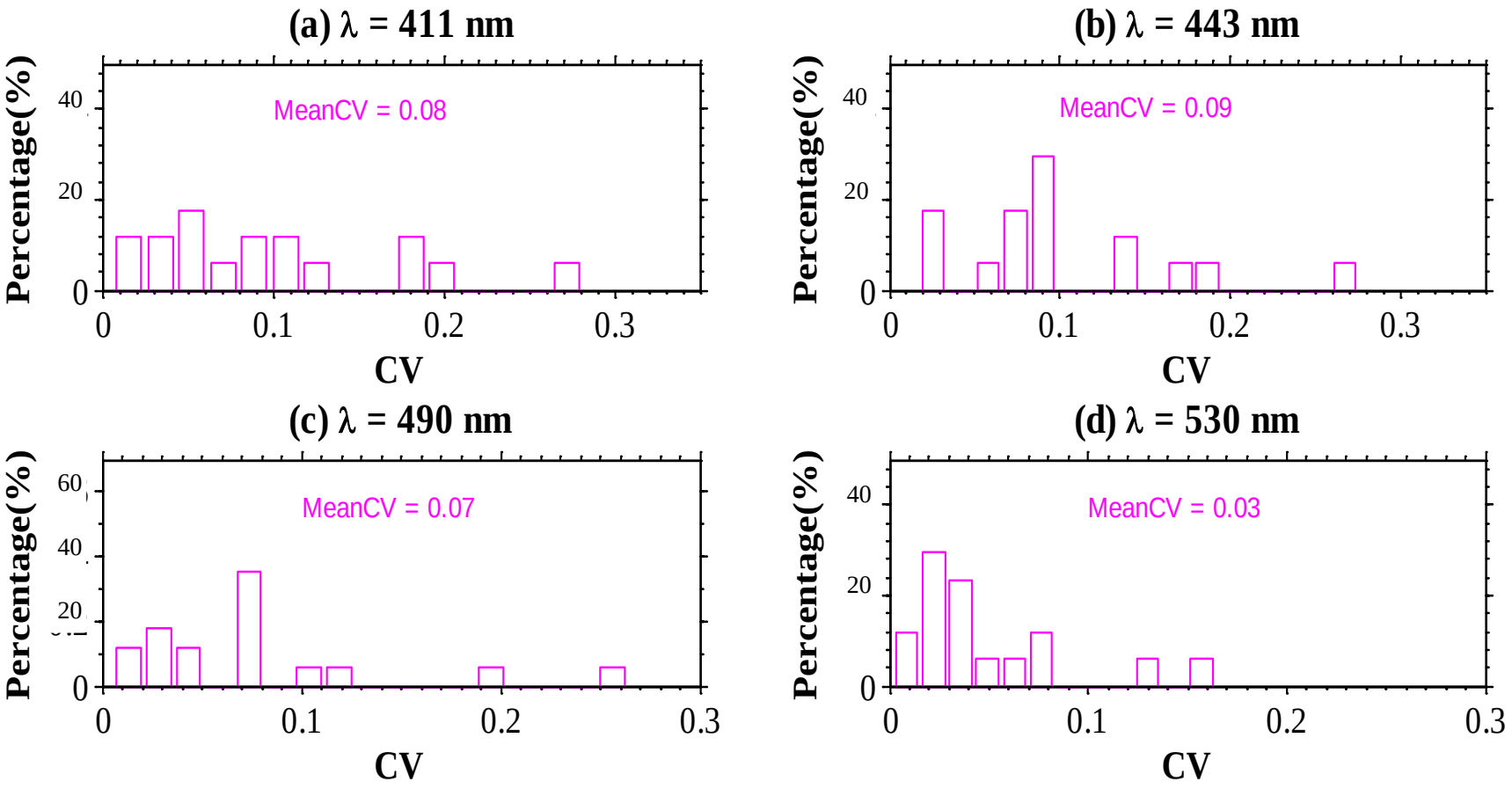
1. **For Massachusetts Bay, VIIRS Rrs data at shorter wavelengths (e.g. 410 nm) are always lower than field measurements.**
2. **QA score is a good indictor of the quality of satellite Rrs data. Satellite Rrs data with higher scores agree better with field measurements .**
3. **For most matchup stations during the 2016 VIIRS cruise, NOAA VIIRS Rrs data agree well with field measurements.**

2. Evaluation of VIIRS IOPs products

Commonly, measurements from ACS (or AC9) and BB9 (HS6) are considered the "ground truth" of IOPs in field.

How good are the "ground truth" of IOPs?

An example of uncertainties of ACS measurements from the 2014 VIIRS cruise (two ACSs for each station)



A scheme to obtain reliable IOPs in situ: R_{rs}&K_d

$$r_{rs}(\Omega) = \left(G_0^w(\Omega) + G_1^w(\Omega) \cdot \frac{b_{bw}}{a + b_b} \right) \frac{b_{bw}}{a + b_b} + \left(G_0^p(\Omega) + G_1^p(\Omega) \cdot \frac{b_{bp}}{a + b_b} \right) \frac{b_{bp}}{a + b_b}$$

(Lee et al 2004)

$$K_d = (1 + m_0 \cdot \theta_s) \cdot a + \left(1 - \gamma \cdot \frac{b_{bw}}{b_b}\right) \cdot m_1 \cdot \left(1 - m_2 \cdot e^{-m_3 \cdot a}\right) \cdot b_b$$

(Lee et al 2013)

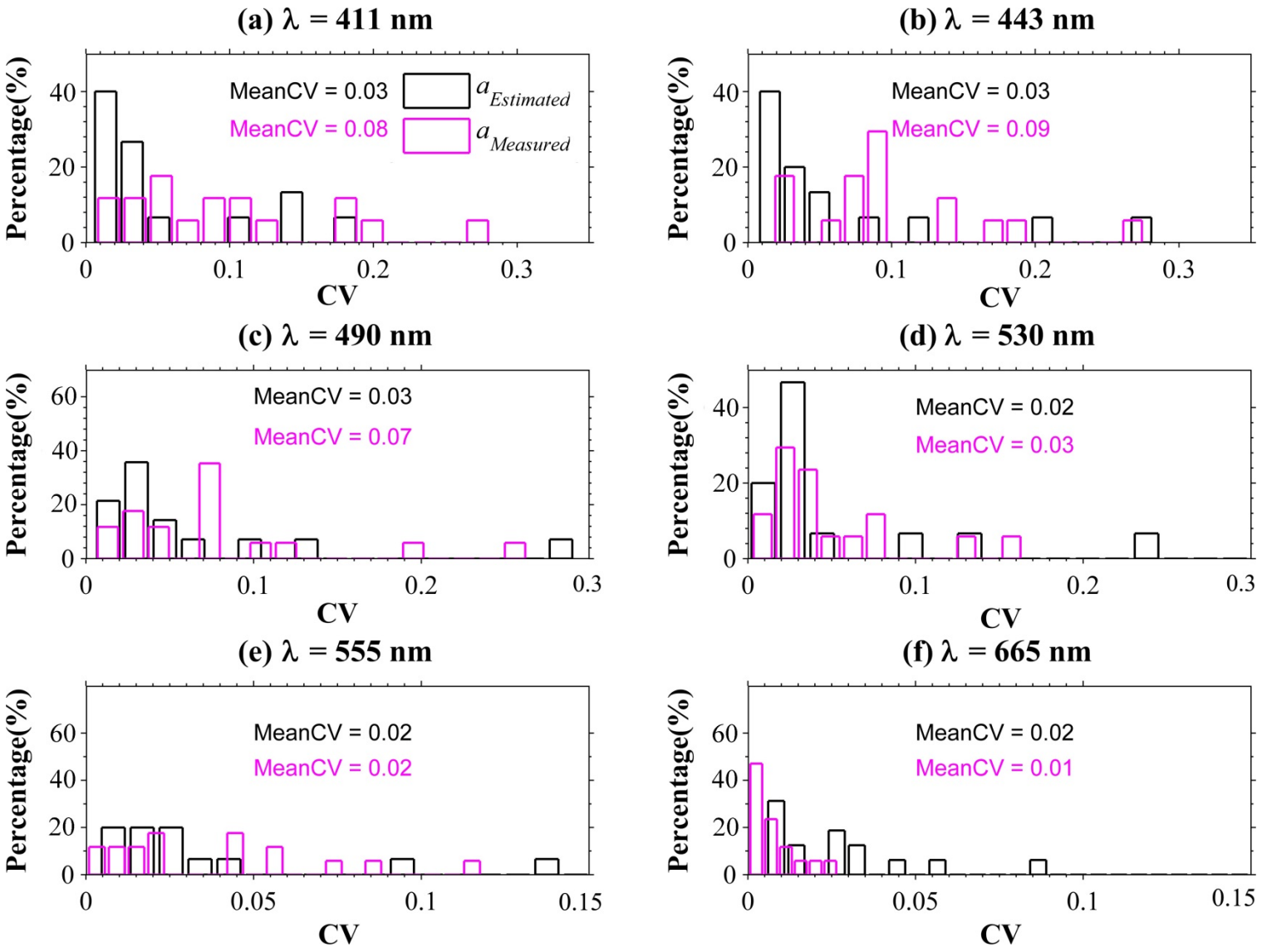
$$\Rightarrow \quad a(\lambda), b_b(\lambda)$$

Advantages:

(1). We can obtain hyperspectral absorption and backscattering coefficients;

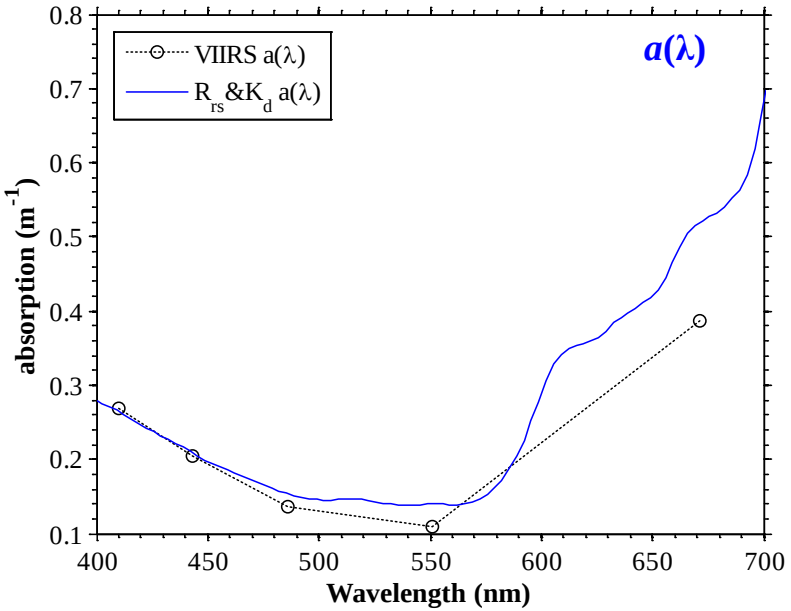
(2). With more casts (~5-15 casts for each station) of HyperPro, we can obtain more reliable absorption and backscattering coefficients of water.

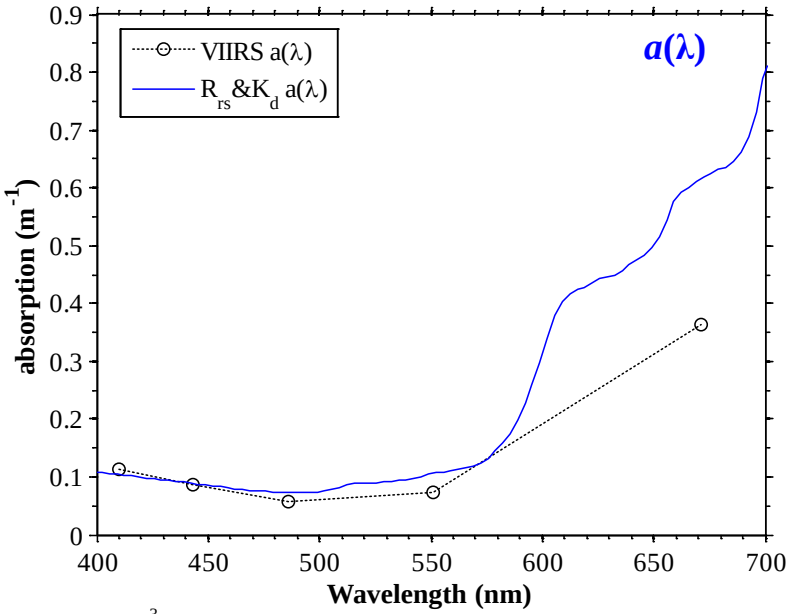
Comparison of uncertainties of absorption from Rrs&Kd and ACSs

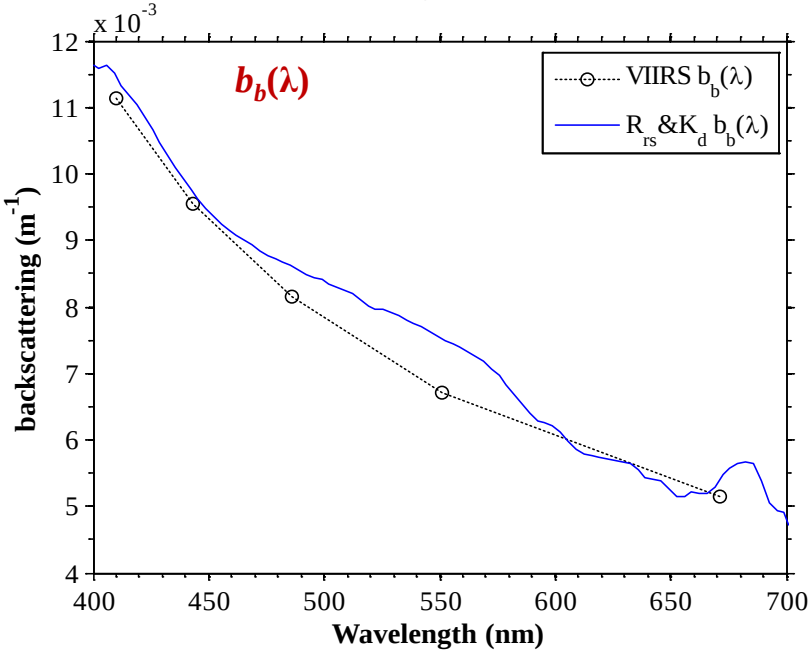


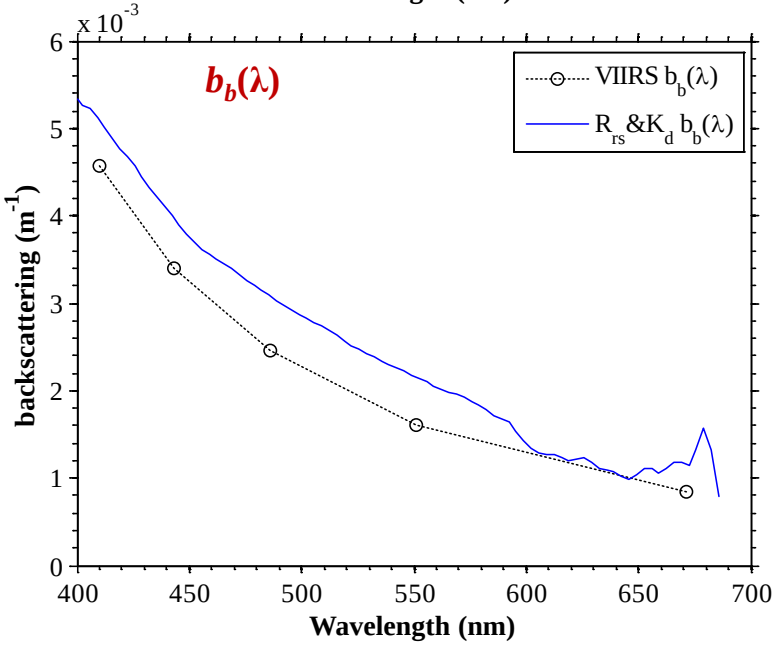
Validation of VIIRS IOPs products (VIIRS 2014 cruise)

Examples of IOPs spectra



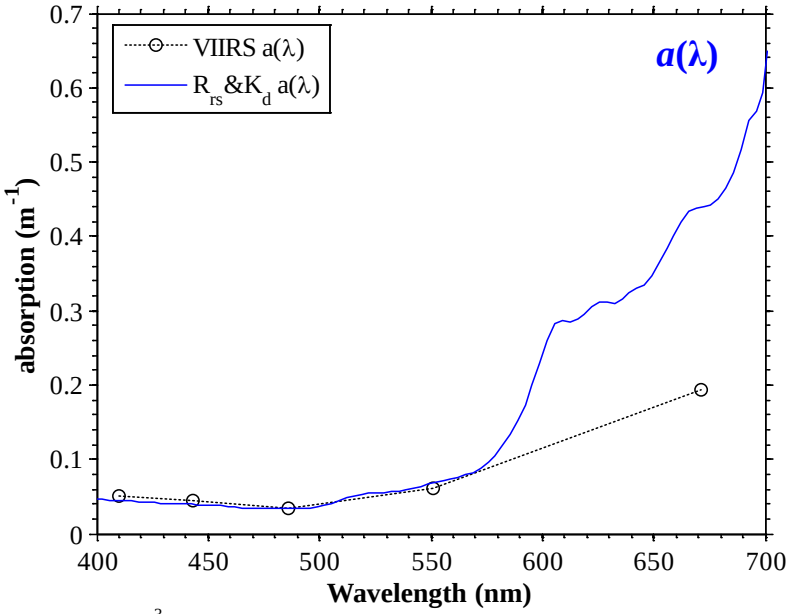


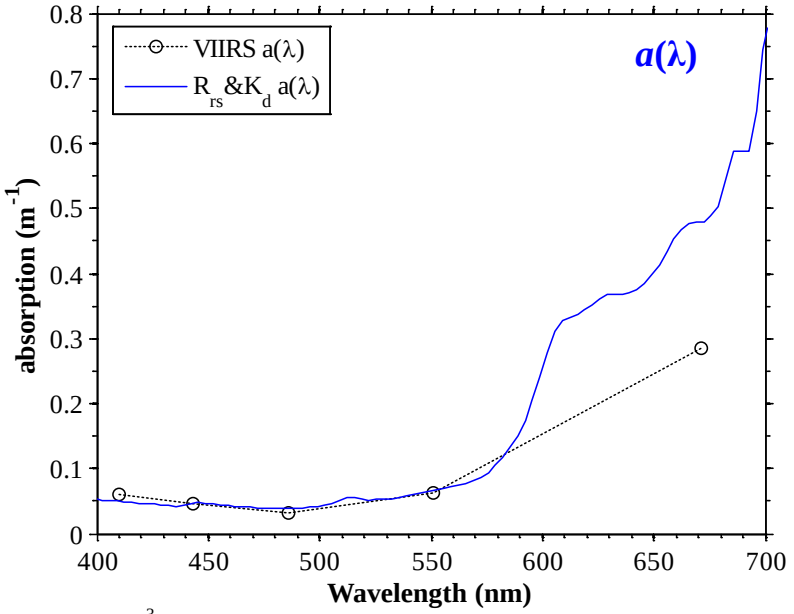


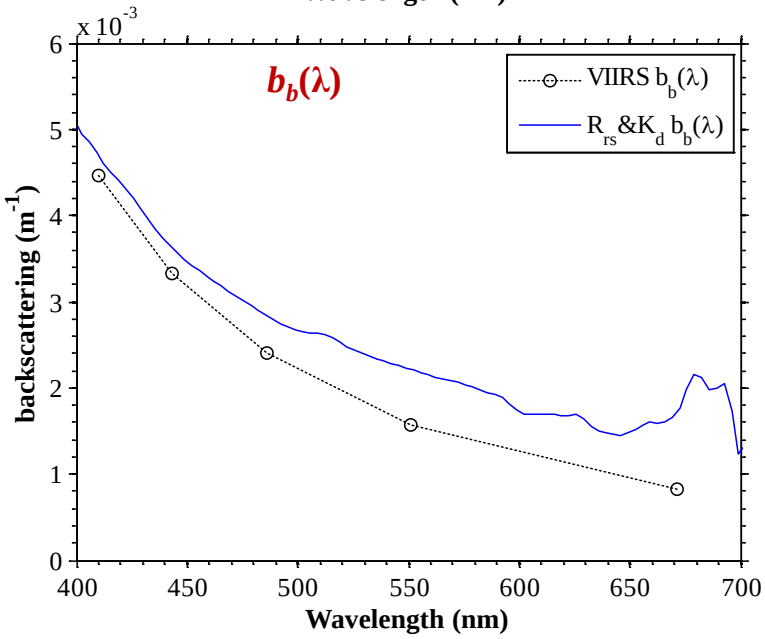


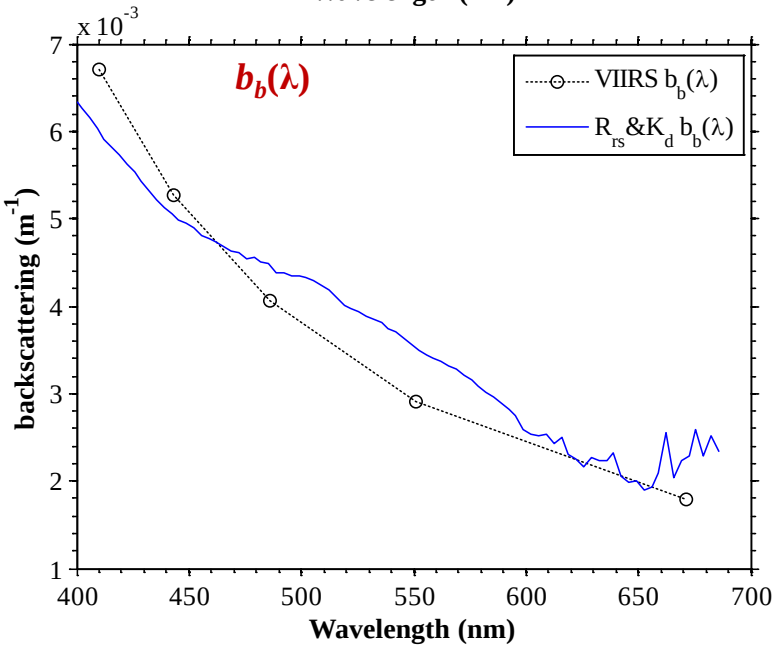
Validation of VIIRS IOPs products (VIIRS 2015 cruise)

Examples of IOPs spectra

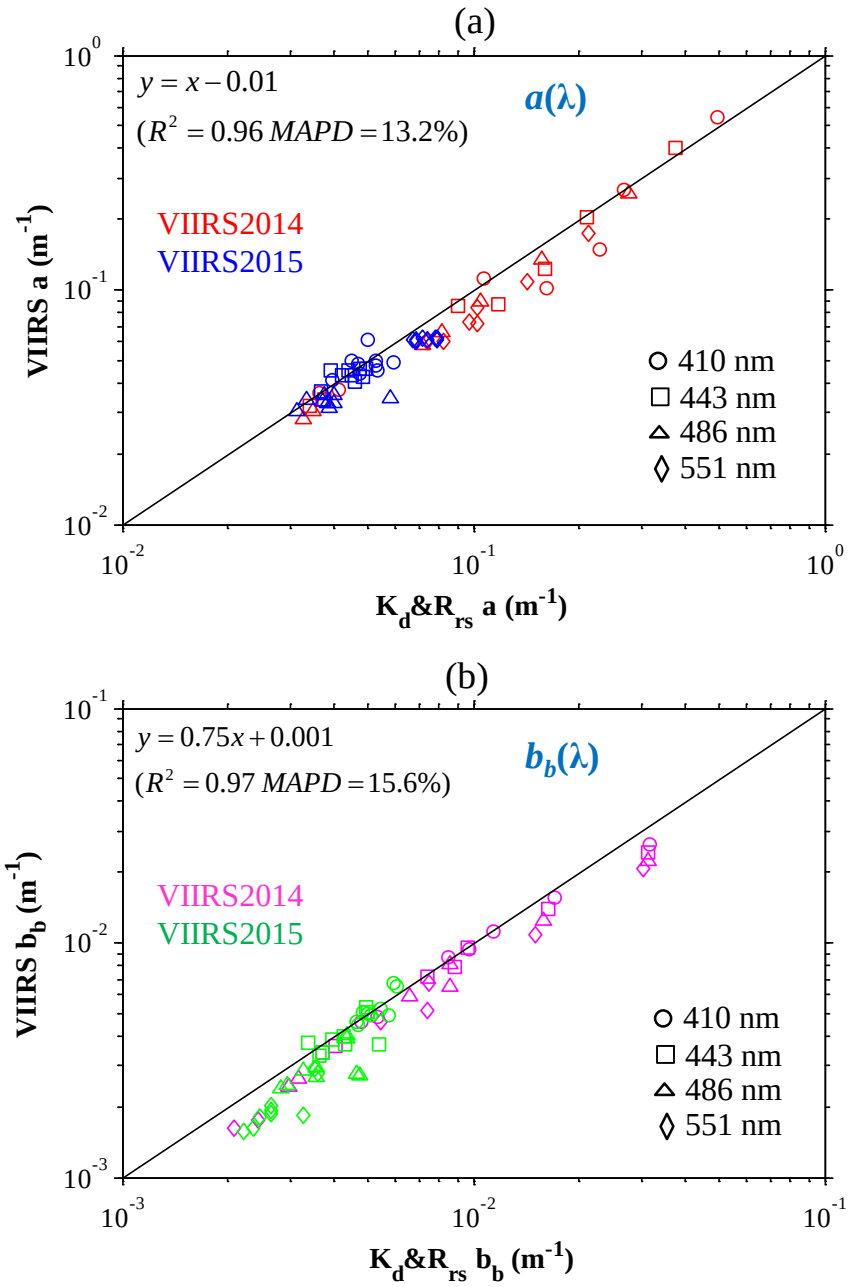








R_{rs}&K_d IOPs vs VIIRS IOPs (VIIRS cruises 2014&2015)



Part 2: Summary

(1). With multiple casts of ACS and HyperPro measurements, it is found that the derived hyperspectral a and b_b from R_{rs}&K_d are with lower uncertainties when compared with those from the presently used ACS system.

(2). Validation of IOPs during the VIIRS cruises (2014 and 2015) shows that the VIIRS IOPs by QAA are generally consistent with in-situ IOPs.

Phytoplankton and particles from IFCB



1) Submersible

2) Taking photos of phytoplankton cells

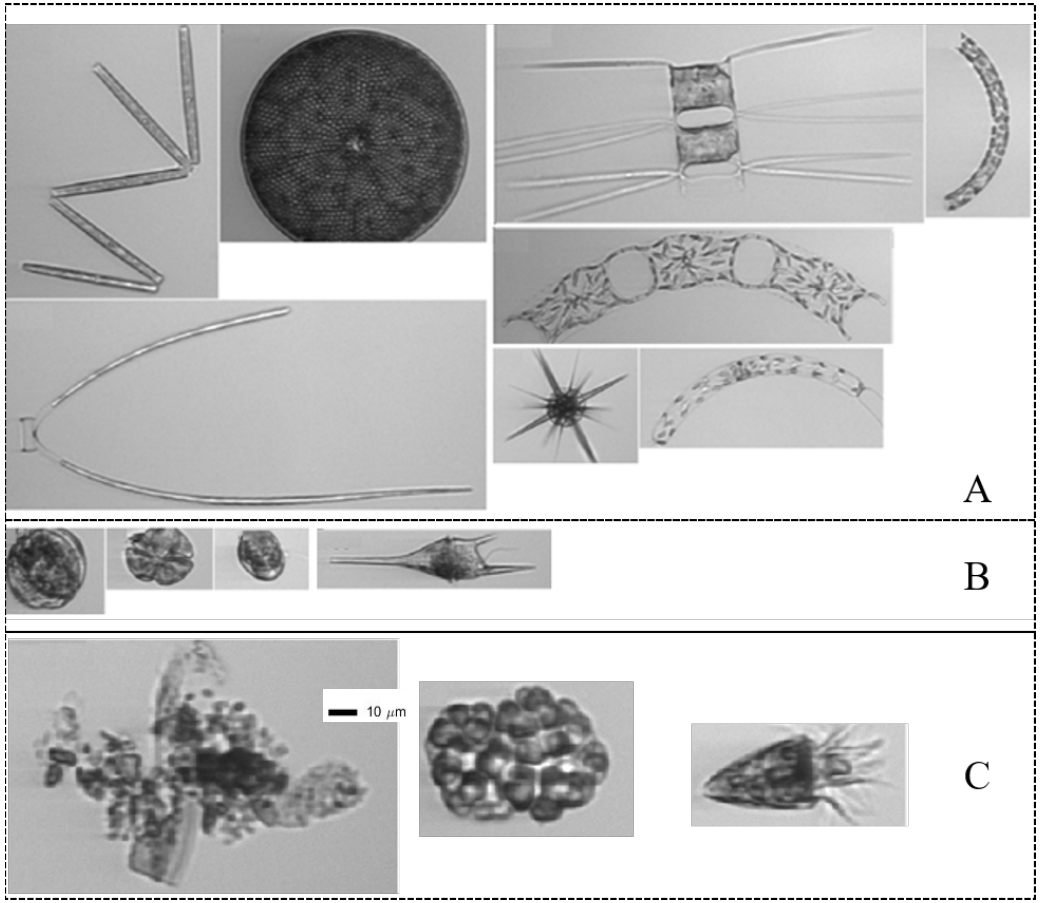
3) Sensible size range: <10 to 100 μm (~1 μm resolution)

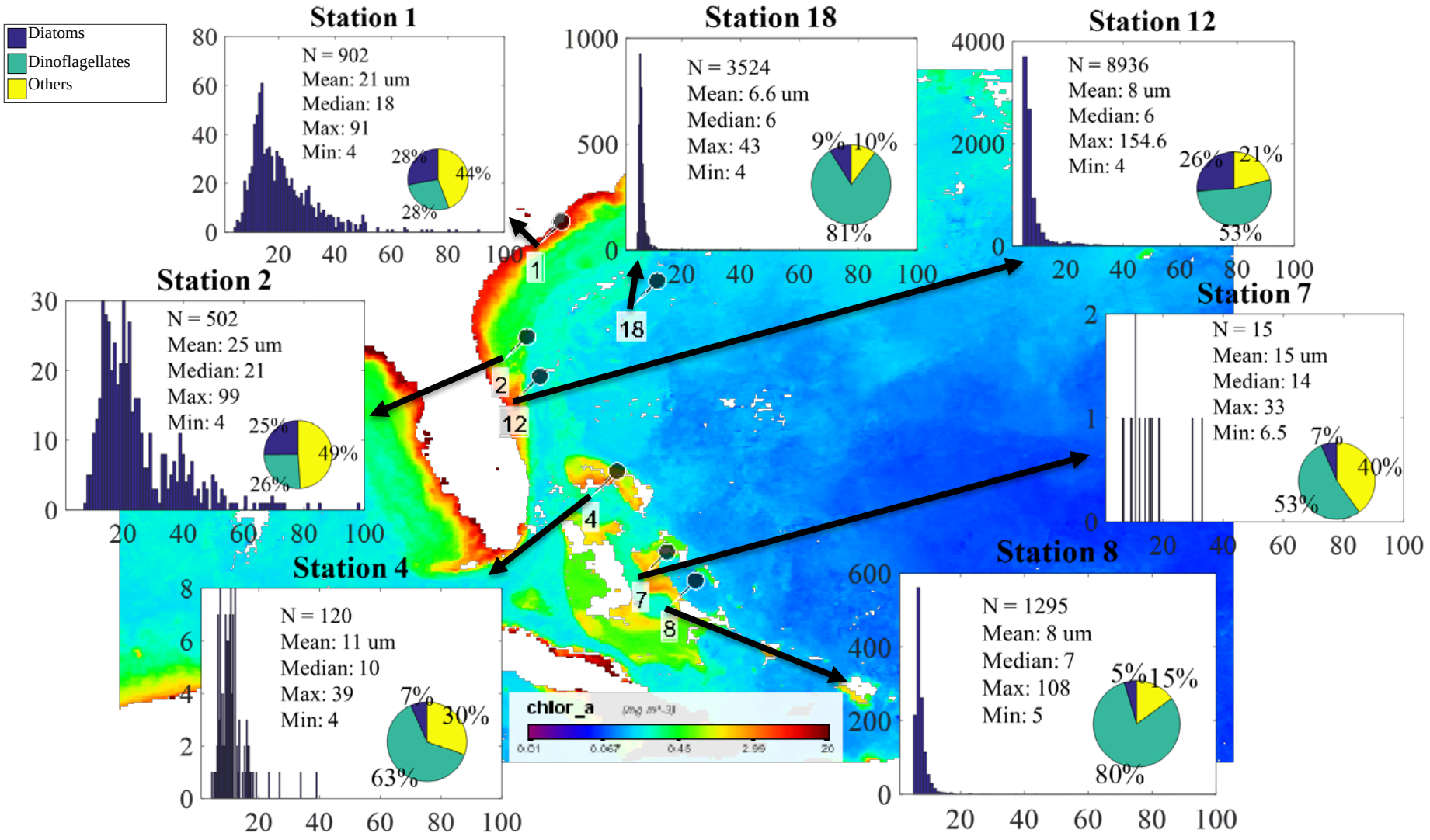
Different species recorded by IFCB for two dominant phytoplankton groups:

A: diatoms,

B: dinoflagellates,

C: others

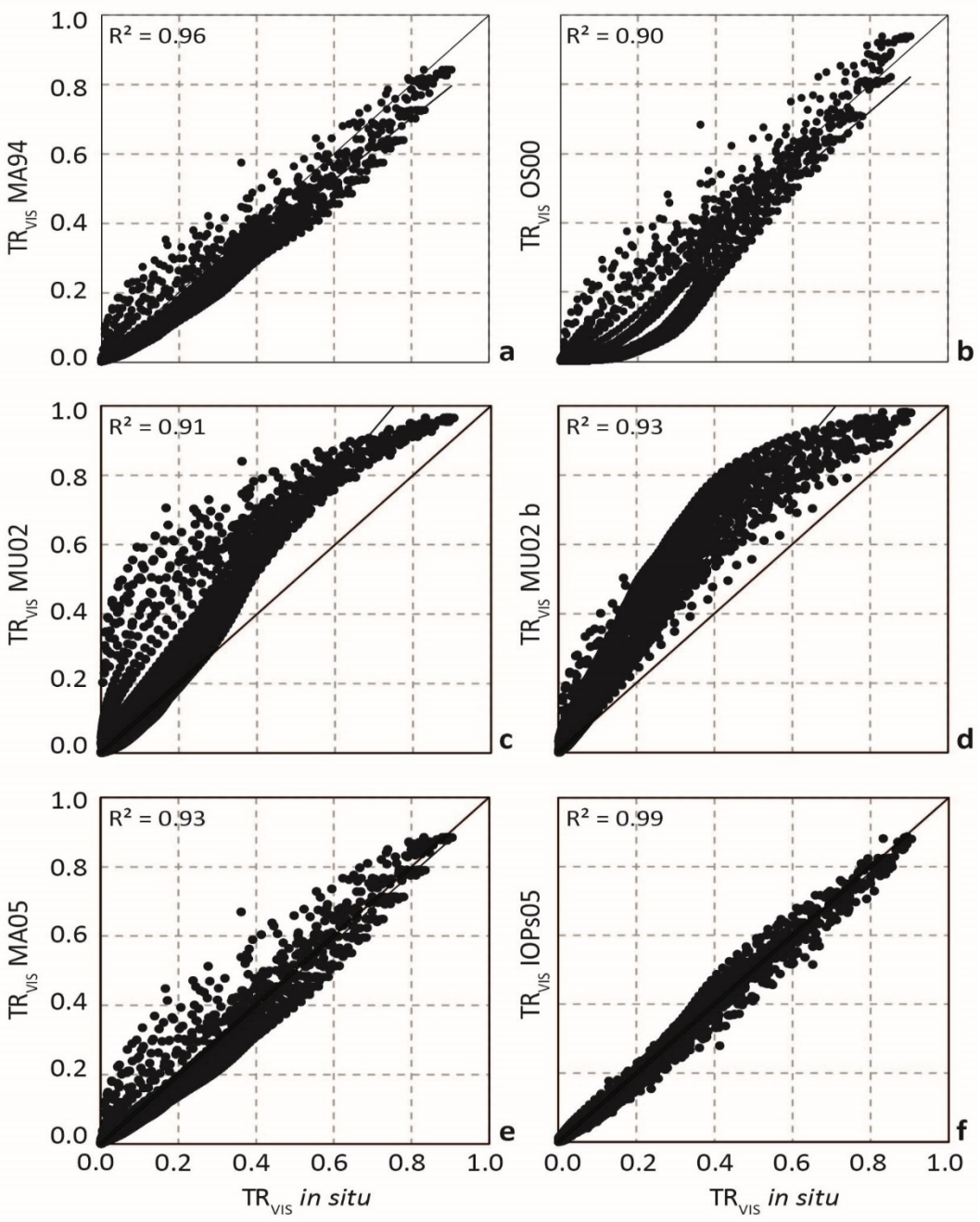



Diatoms
Dinoflagellates
Others
Station 1
N = 902
Mean: 21 um
Median: 18
Max: 91
Min: 4
28%
44%
28%
Station 18
N = 3524
Mean: 6.6 um
Median: 6
Max: 43
Min: 4
9%
10%
81%
Station 12
N = 8936
Mean: 8 um
Median: 6
Max: 154.6
Min: 4
26%
21%
53%
Station 2
N = 502
Mean: 25 um
Median: 21
Max: 99
Min: 4
25%
49%
26%
Station 7
N = 15
Mean: 15 um
Median: 14
Max: 33
Min: 6.5
7%
40%
53%
Station 4
N = 120
Mean: 11 um
Median: 10
Max: 39
Min: 4
7%
30%
63%
Station 8
N = 1295
Mean: 8 um
Median: 7
Max: 108
Min: 5
5%
15%
80%
chlor_a
1
18
2
12
4
7
8

3. Some applications

A. How good is solar transmission estimated from remote sensing?

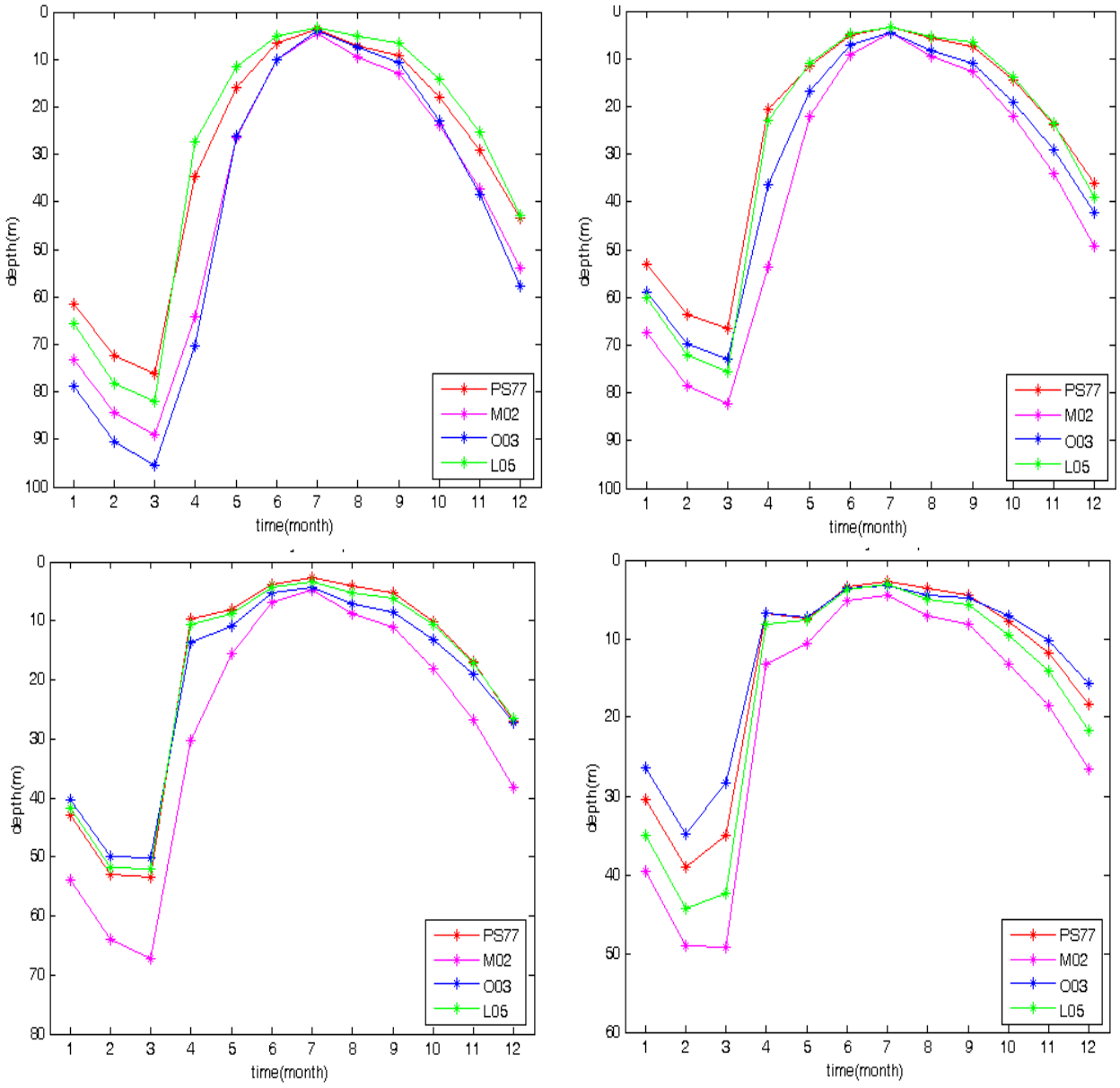
B. How big is the impact of modeled solar transmission based on remote sensing on upper column T and MLD?



A. How good is solar transmission estimated from remote sensing?

(see Laura's poster)

Mixed-layer depth with the different trans. models (all from the same Rrs)



B. How big is the impact of modeled solar transmission based on remote sensing on upper column T and MLD?

(see Liu's poster)

Thank you!