

Updates on the OCI Chl algorithm

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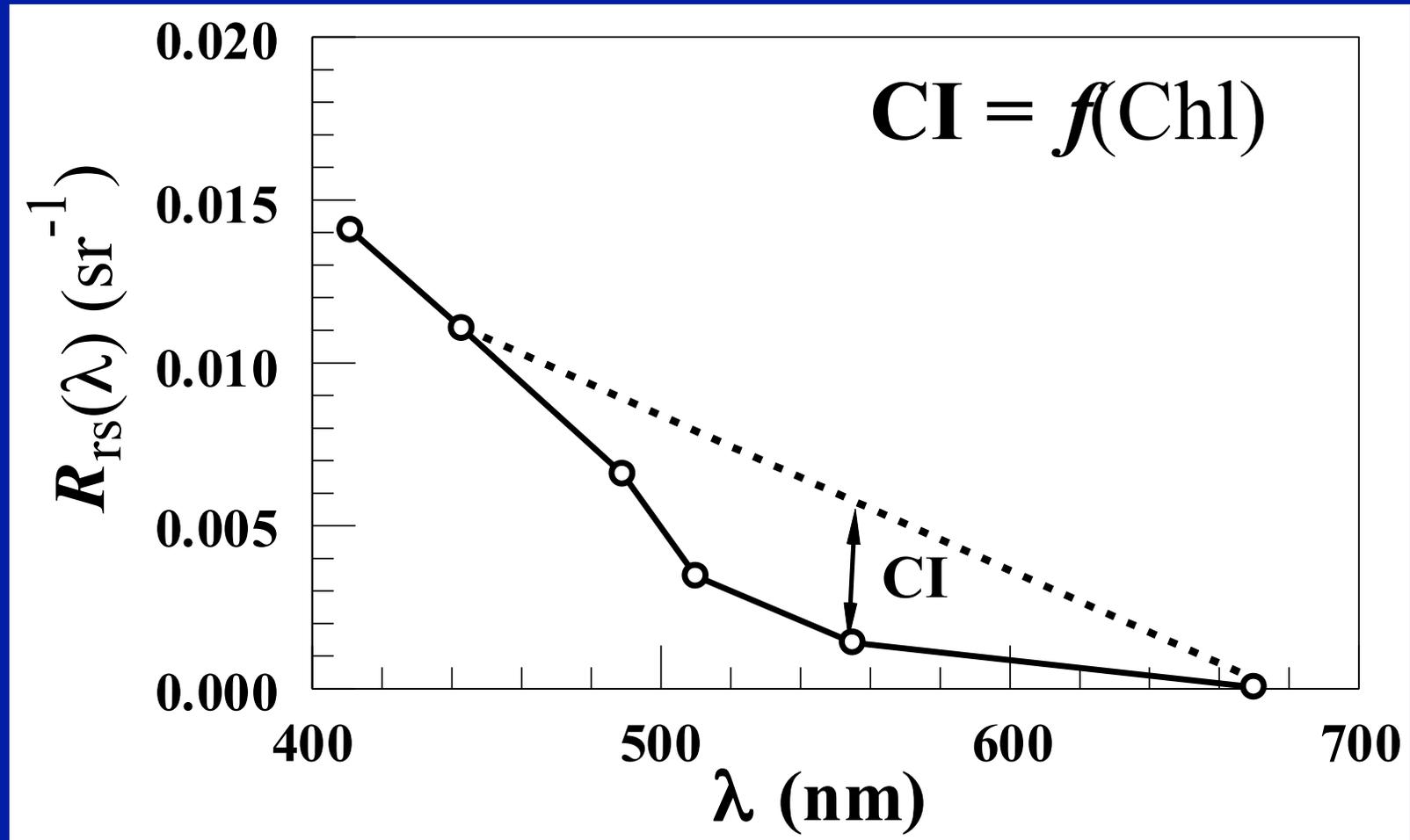
³NASA OBPG

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MODIS/VIIRS Science Team meeting, 6 – 10 June 2016, Silver Spring, MD

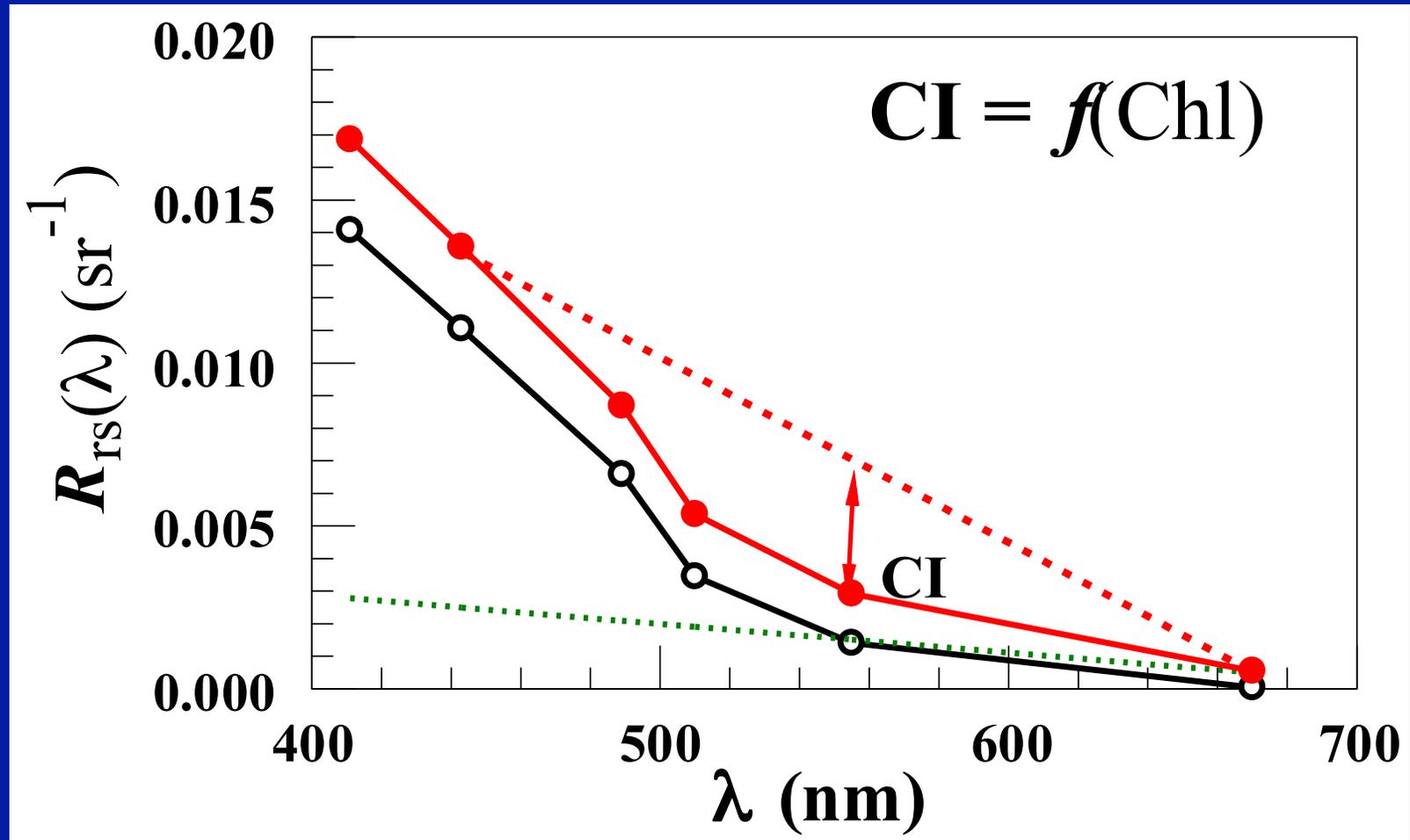
A new concept to derive Chl...

$$CI = Rrs_{555} - [Rrs_{443} + (555-443)/(670-443)*(Rrs_{670}-Rrs_{443})]$$

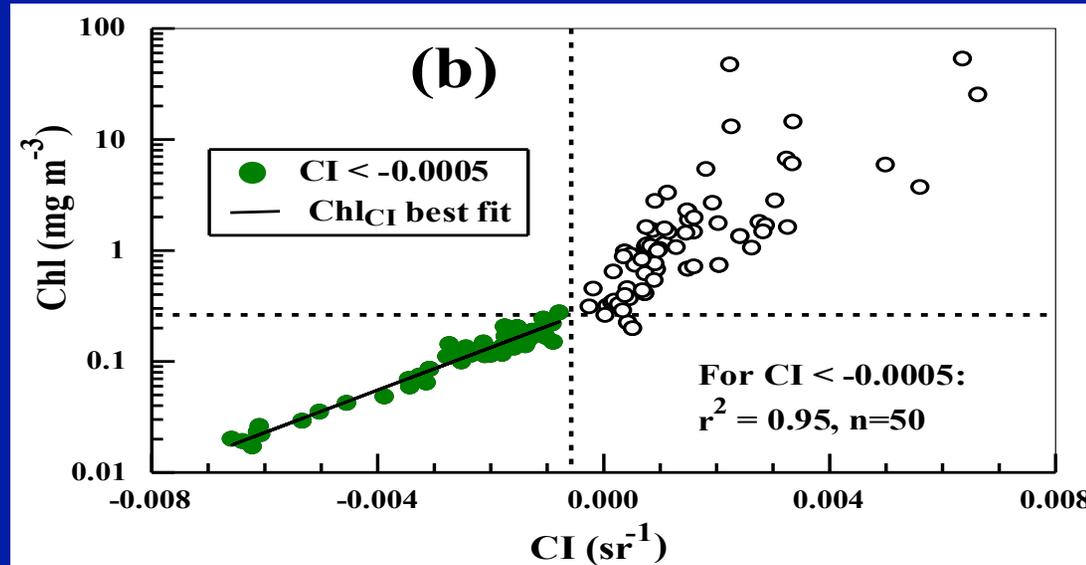


A new concept to derive Chl...

$$CI = Rrs_{555} - [Rrs_{443} + (555-443)/(670-443)*(Rrs_{670}-Rrs_{443})]$$



A new concept to derive Chl...



From:
NOMAD
dataset

Hu et al.
(2012, JGR)

$$CI = Rrs_{555} - [Rrs_{443} + (555-443)/(670-443)*(Rrs_{670}-Rrs_{443})]$$

$$Chl_{CI} = 10^{-0.4909 + 191.6590 * CI} \quad [CI \leq -0.0005 \text{ sr}^{-1}]$$

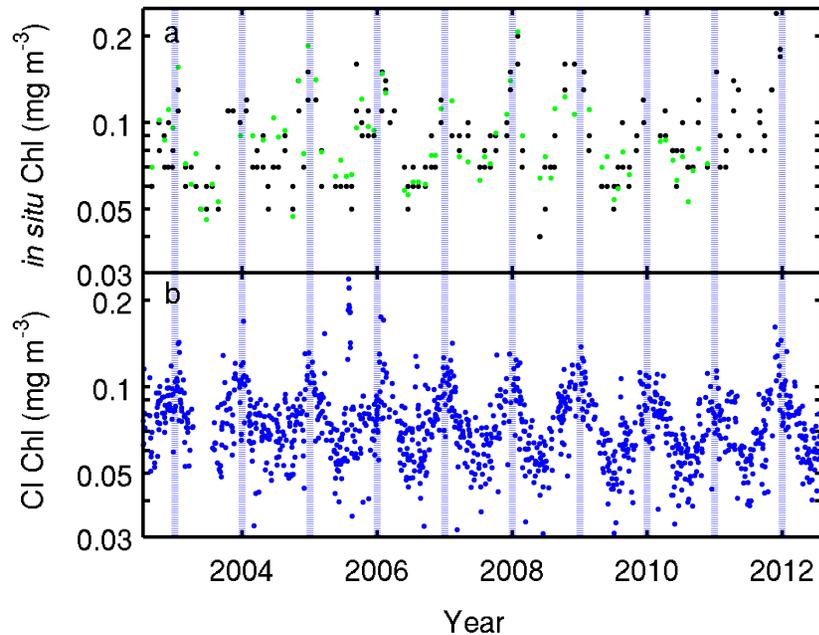
$$Chl_{OC1} = Chl_{CI} \quad [\text{for } Chl_{CI} \leq 0.25 \text{ mg m}^{-3}]$$

$$Chl_{OC4} \quad [\text{for } Chl_{CI} > 0.30 \text{ mg m}^{-3}]$$

$$\alpha \times Chl_{OC4} + \beta \times Chl_{CI} \quad [\text{for } 0.25 < Chl_{CI} \leq 0.30 \text{ mg m}^{-3}],$$

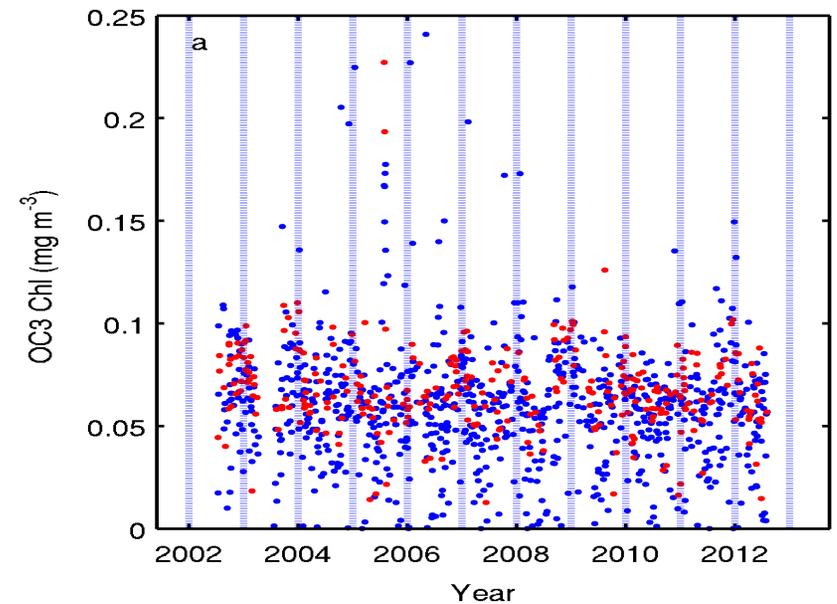
$$\alpha = (Chl_{CI} - 0.25)/(0.3 - 0.25), \quad \beta = (0.3 - Chl_{CI})/(0.3 - 0.25)$$

MODIS comparison with HOTS measurements



in situ

- HPLC
- fluorometric



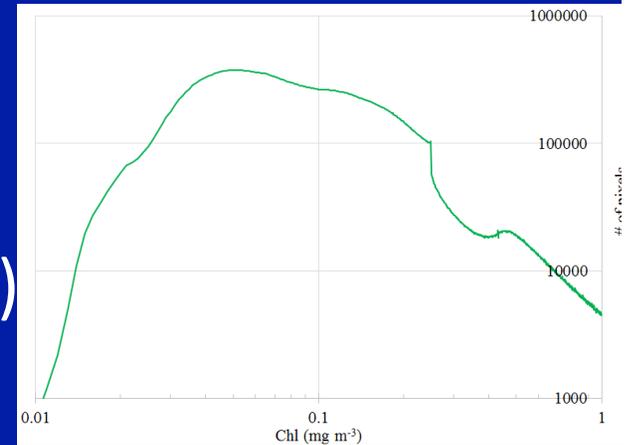
satellite

- no flags (n=1171)
- standard flags (n=319)

Slide from Jasmine Nahorniak, Oregon State Univ.

What's the problem?

- Only 50 HPLC data points from NOMAD were used to relate to Chl for $\text{Chl} < 0.25 \text{ mg m}^{-3}$
- Discontinuity in the algorithm transition zone
- Uncertainties in gyres ($< 0.05 \text{ mg m}^{-3}$)



Temporary solution

Instead of using the $0.25 - 0.30 \text{ mg m}^{-3}$ transition zone, use $0.175 - 0.25$ transition zone. Results are good (see Franz report), but the full-advantage of band subtraction is compromised.

What's the approach?

- Revisit regressions
- Develop a sensor-independent OCI algorithm with more data and fine-tuned regression coefficients;
- Raise the algorithm transition zone and to take full advantage of the band-subtraction design

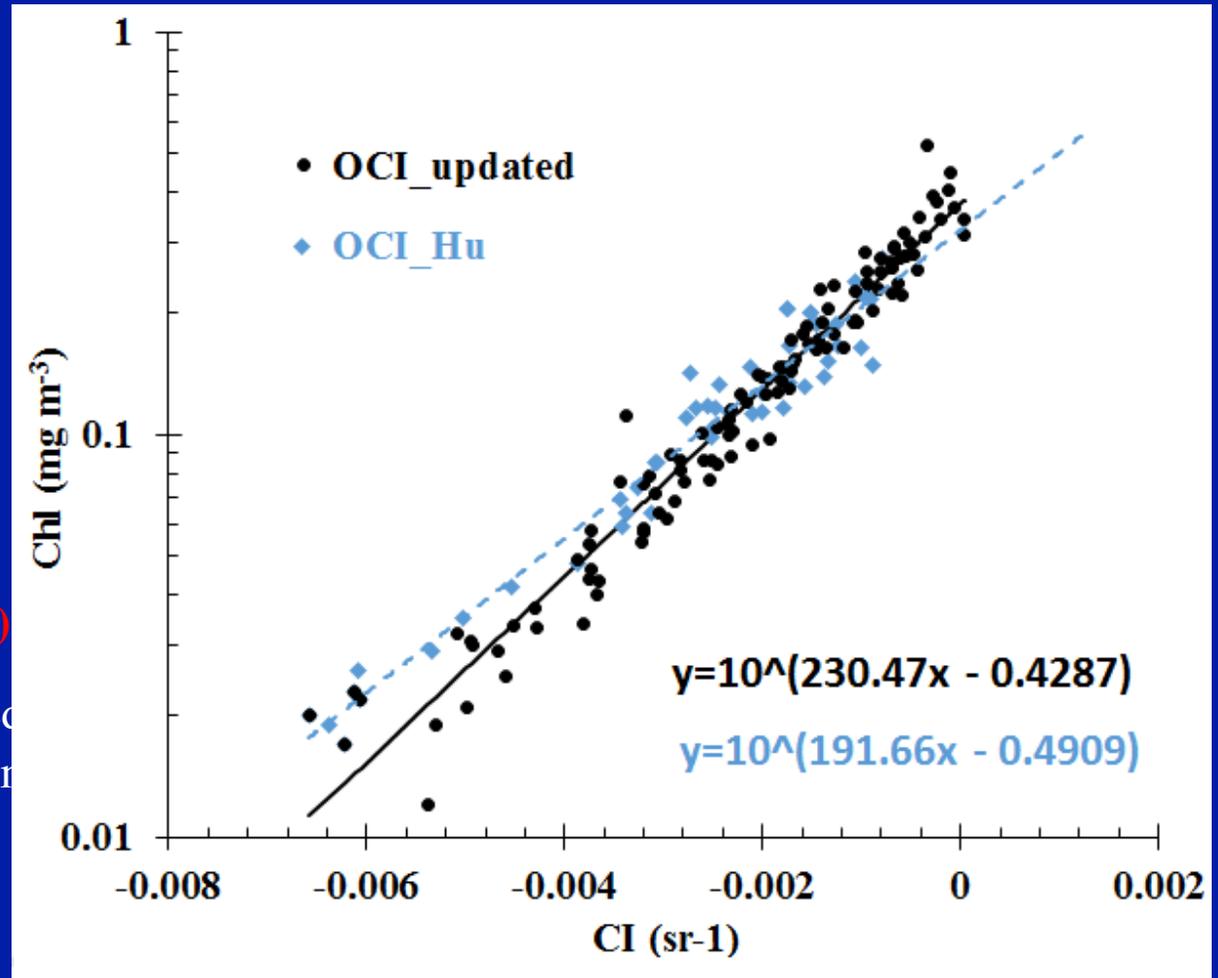
Data and Method

Dataset

- Fluorometric and HPLC of NOMAD
- Region: [60S~60N]

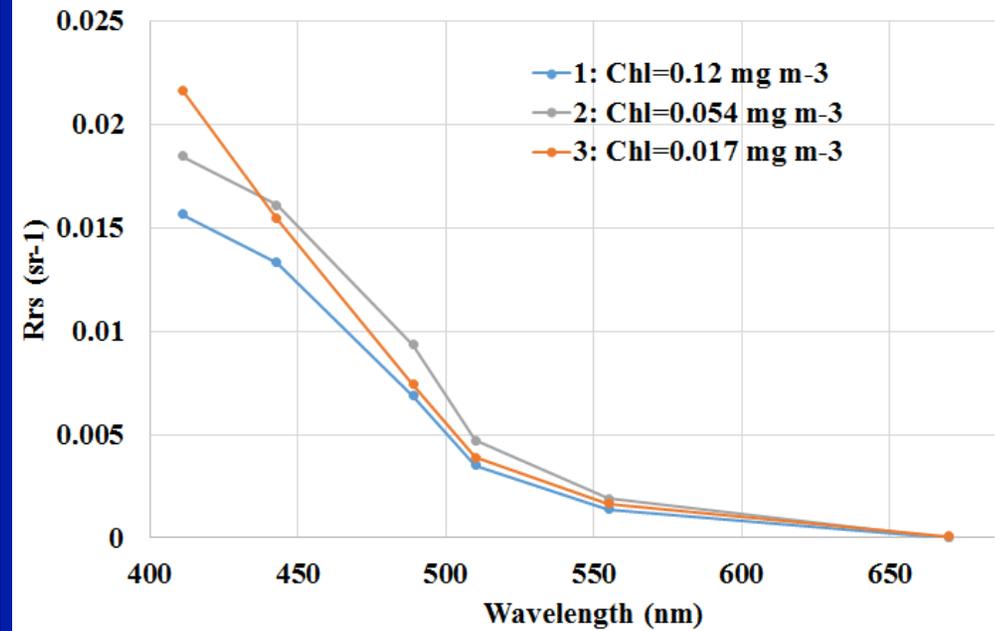
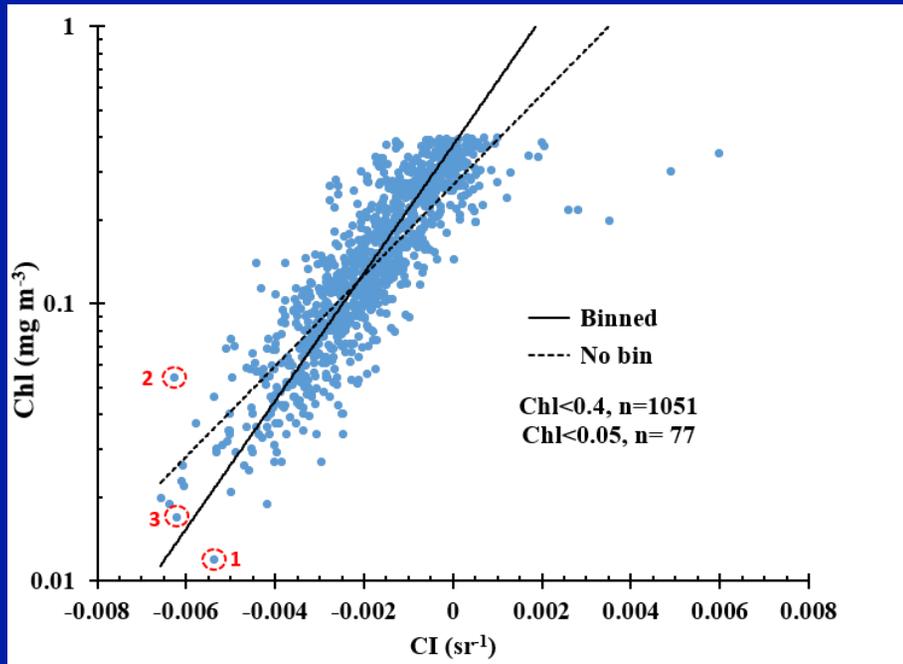
Methods

- Criteria: Valid Rrs at 443, 490, 510 and 555 nm
- Chl < 0.4 mg m⁻³ (**1051 points**)
- Valid in situ points were gridded into log space for both maximum ratio and Chl
- Merge zone: **0.25~0.4 mg m⁻³**



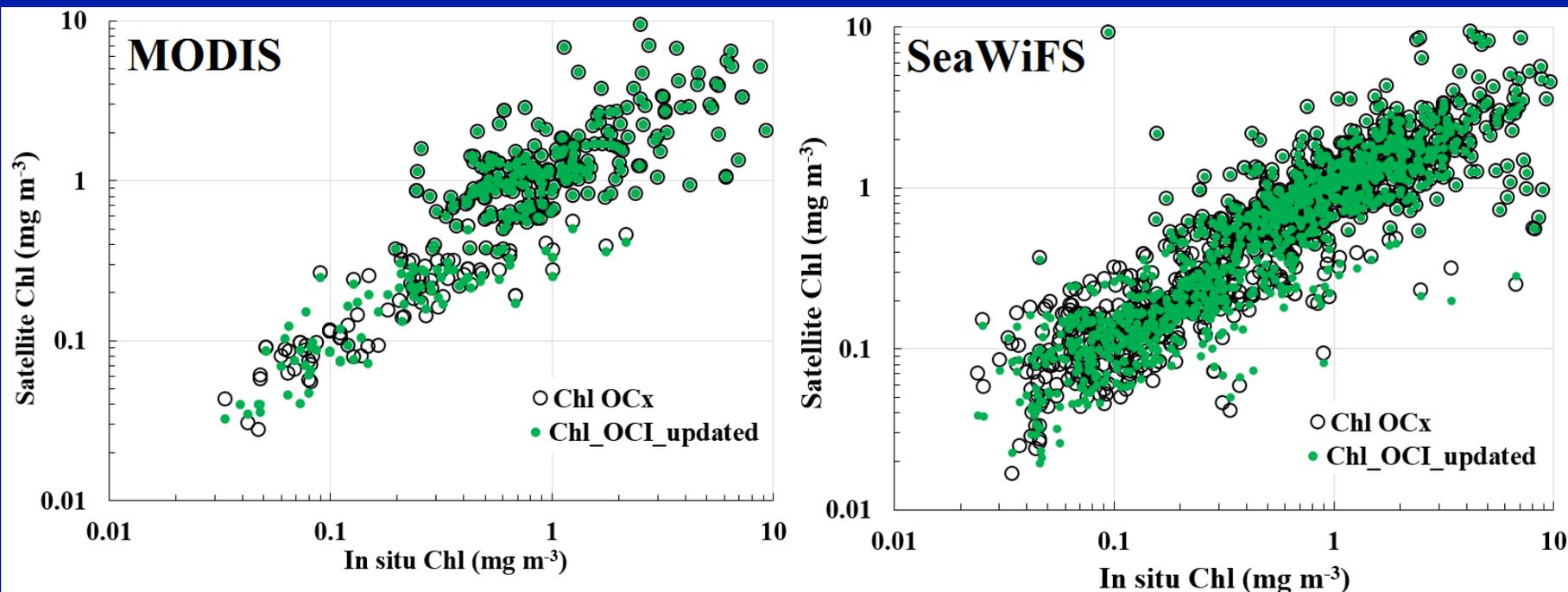
Data and Method

Are all these field data valid, even outliers?



Results

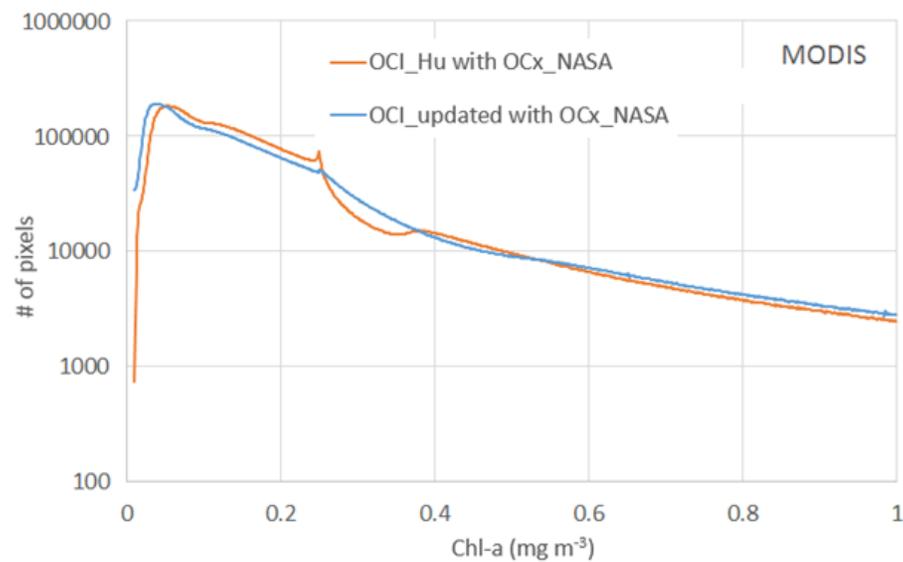
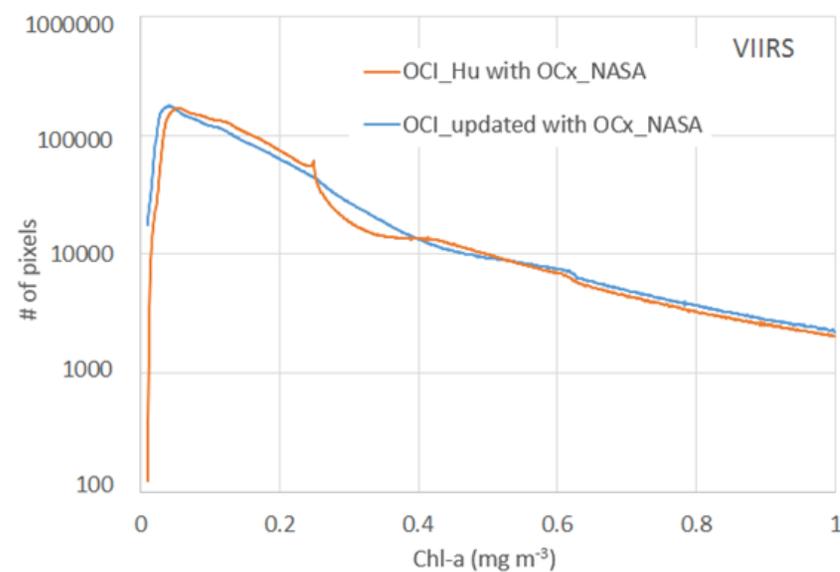
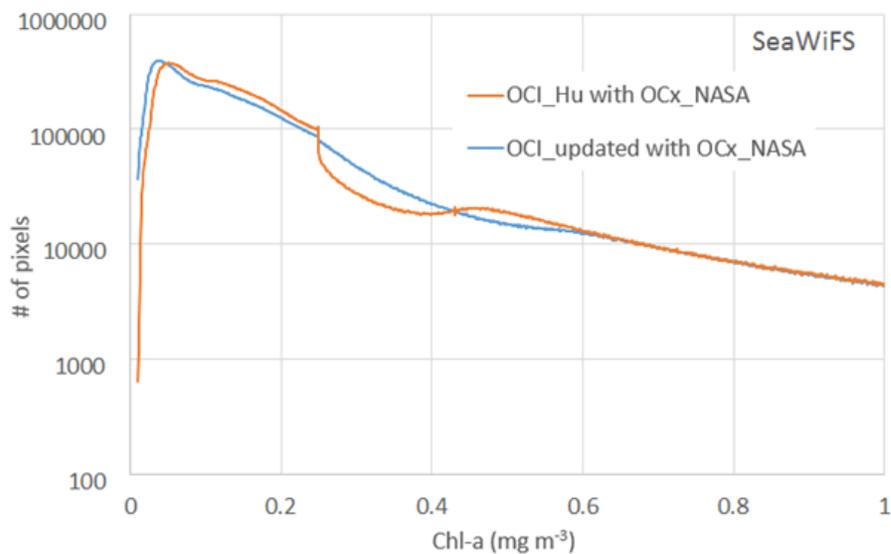
SeaBASS VALIDATION



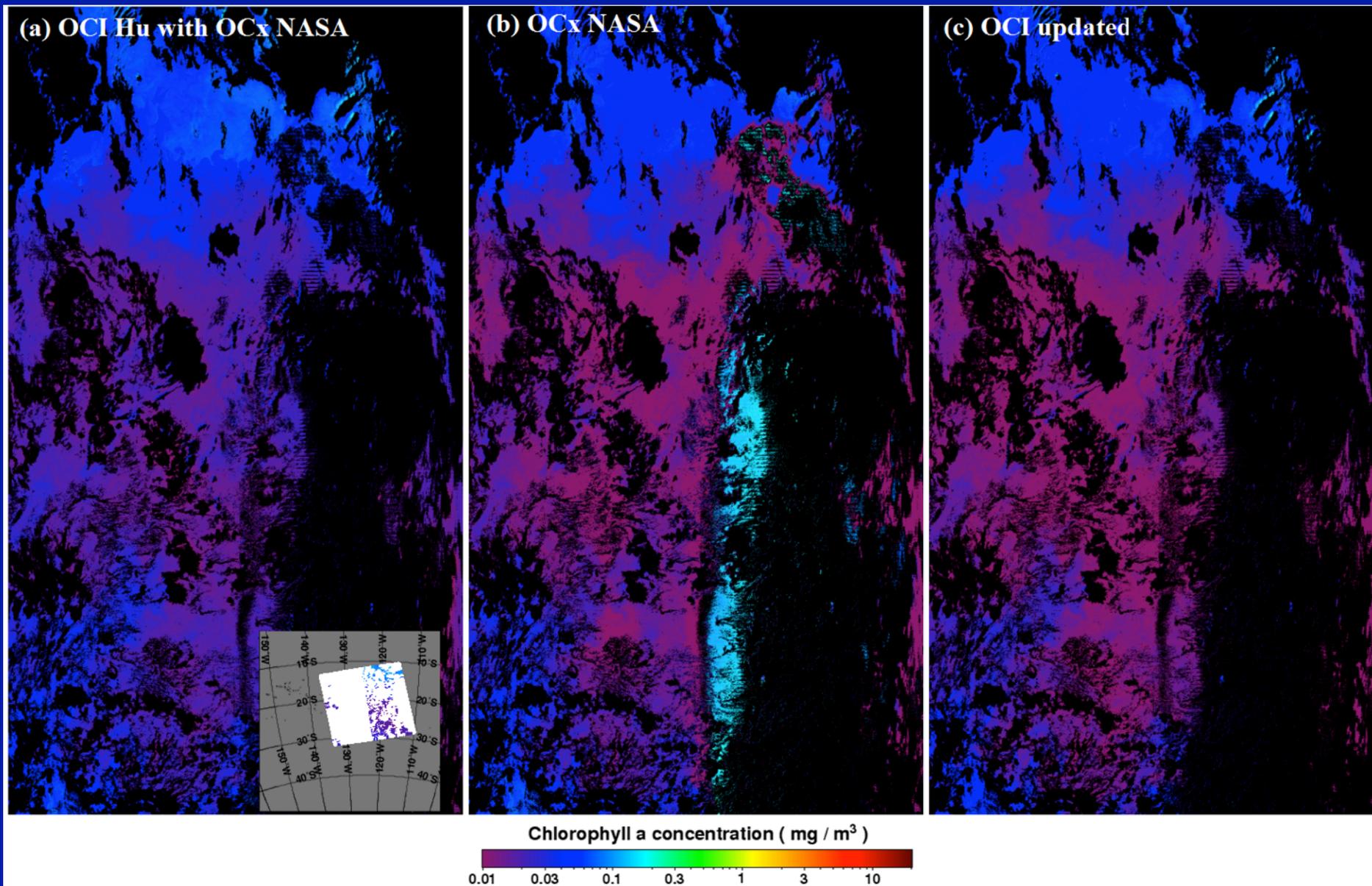
| MODIS | RMSE | URMSE | Mean Ratio | Median ratio | MRE | R2 | logR2 | N |
|---------|---------|--------|------------|--------------|--------|------|-------|-----|
| OCX | 77.70% | 44.20% | 1.24 | 1.05 | 32.00% | 0.42 | 0.66 | 63 |
| OCI_hu | 43.90% | 32.70% | 1.15 | 1.04 | 25.40% | 0.62 | 0.71 | 63 |
| OCI_new | 51.20% | 37.60% | 1.12 | 0.94 | 35.20% | 0.59 | 0.71 | 63 |
| SeaWiFS | RMSE | URMSE | Mean Ratio | Median ratio | MRE | R2 | logR2 | N |
| OCX | 535.80% | 54.20% | 1.79 | 1.19 | 41.50% | 0.01 | 0.33 | 357 |
| OCI_hu | 91.80% | 47.20% | 1.4 | 1.16 | 36.80% | 0.31 | 0.39 | 357 |
| OCI_new | 102.00% | 49.60% | 1.38 | 1.14 | 39.40% | 0.28 | 0.39 | 357 |

Results

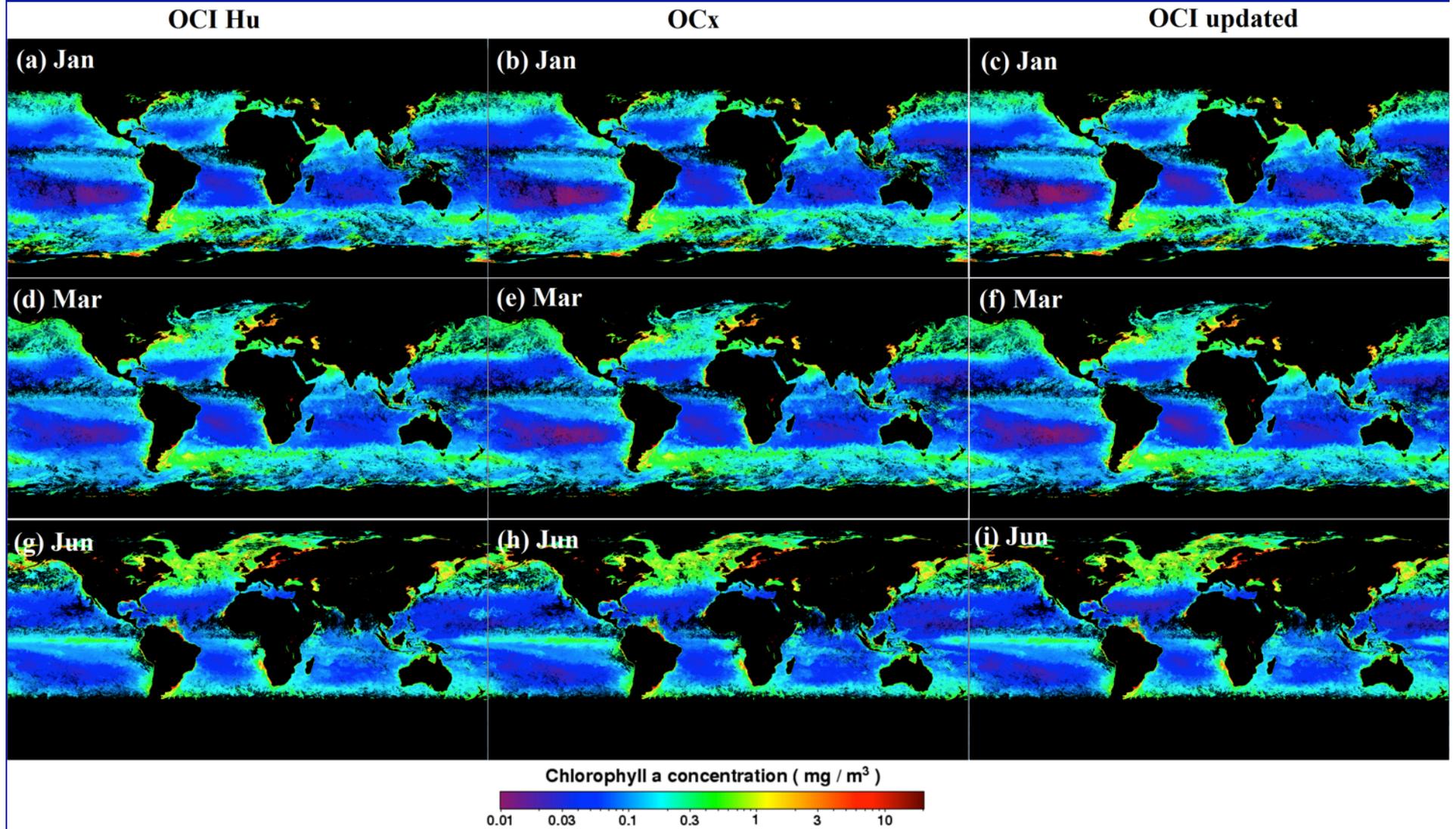
Improvement in transition zone



Results single image comparison (MODISA 10/24/2004)



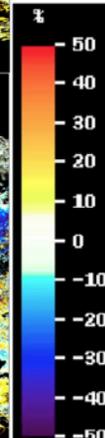
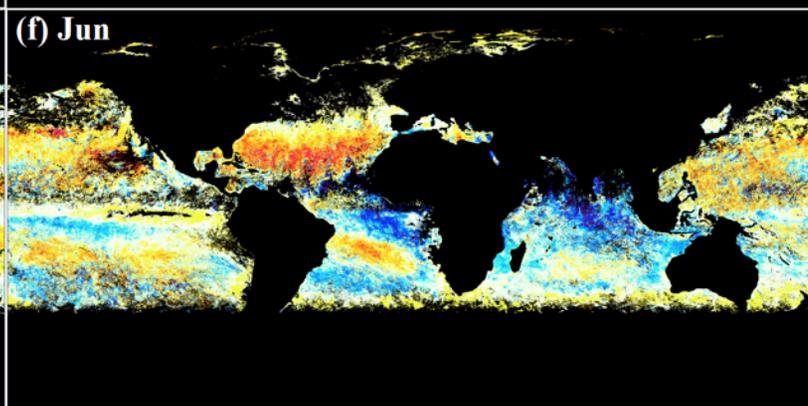
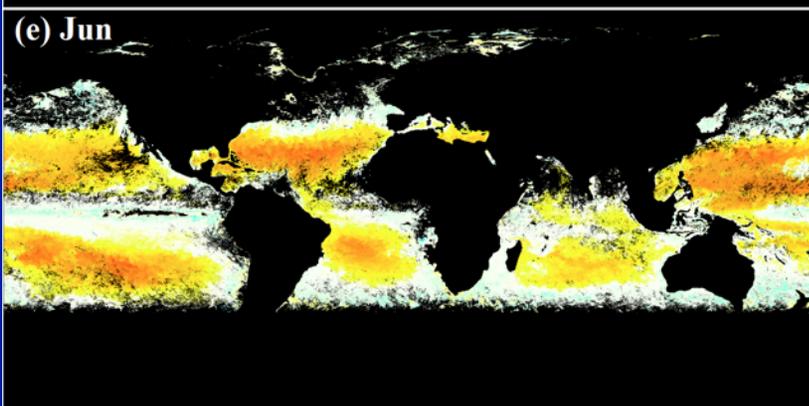
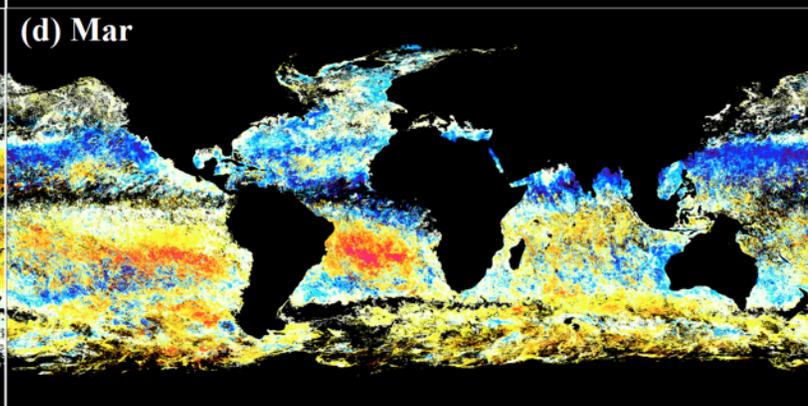
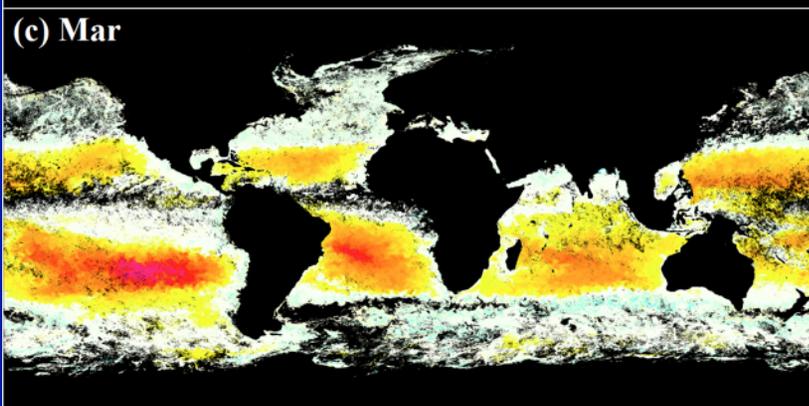
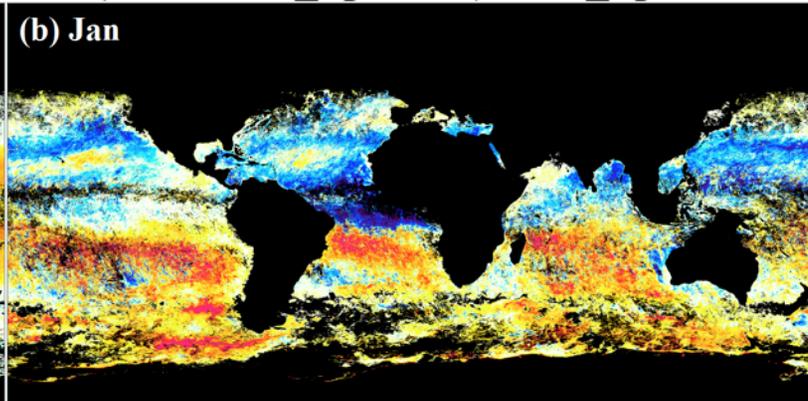
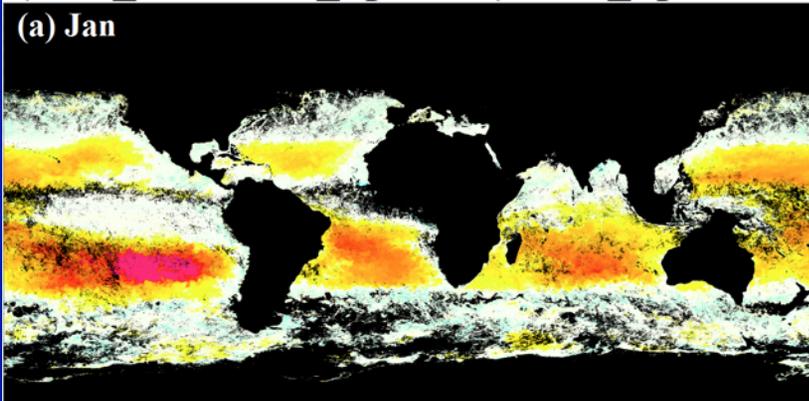
Results Global comparison (MODISA in 2010)



Results Global comparison (MODISA in 2010)

$(OCI_Hu - OCI_updated)/OCI_updated$

$(OCx-OCI_updated)/OCI_updated$



Results

Cross-sensor consistency

- aqua seawifs:

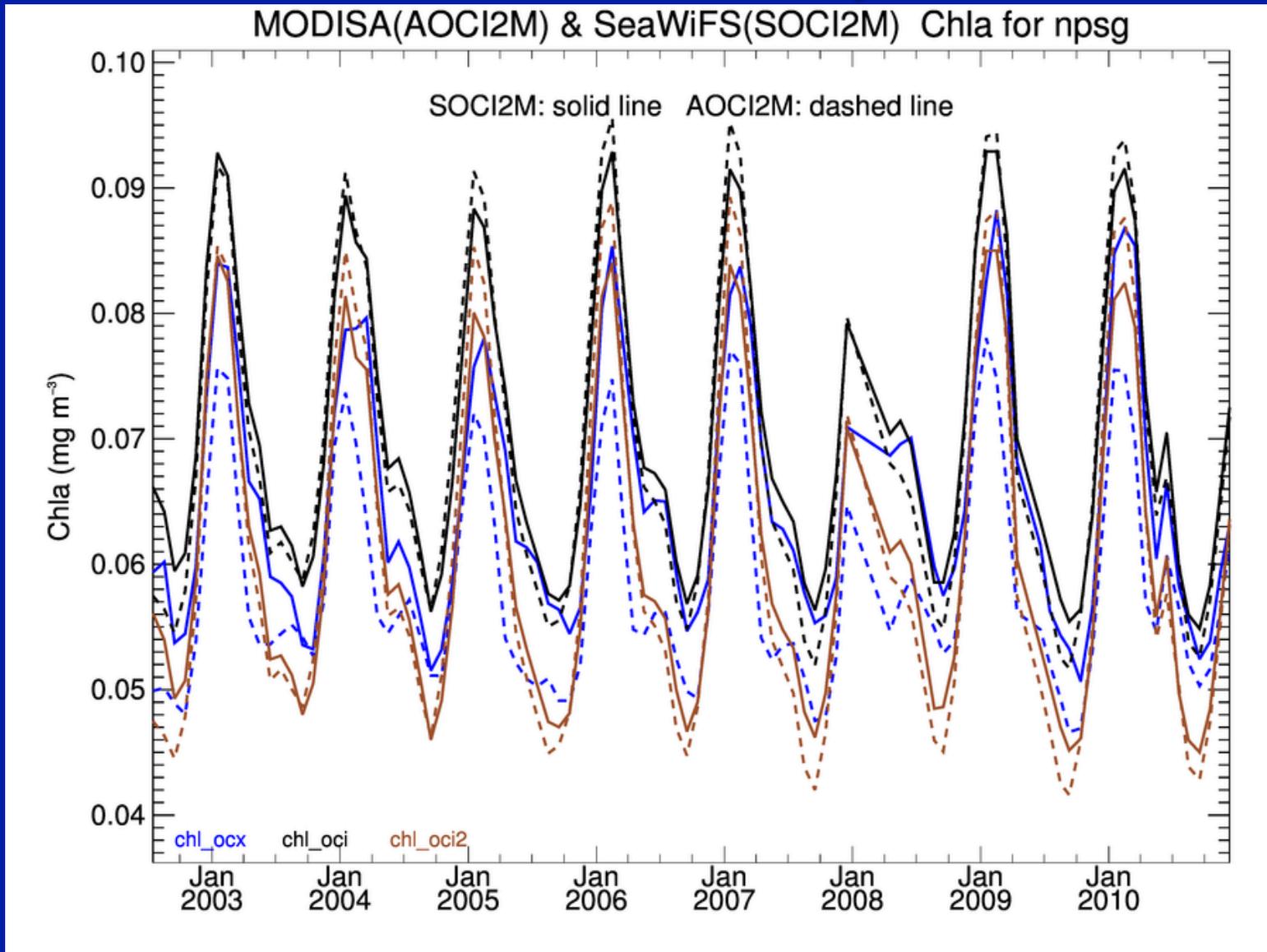
http://oceancolor.gsfc.nasa.gov/ANALYSIS/PROCTEST/aOCI2m_sOCI2m/

viirs aqua:

http://oceancolor.gsfc.nasa.gov/ANALYSIS/PROCTEST/vOCI2m_aOCI2m/

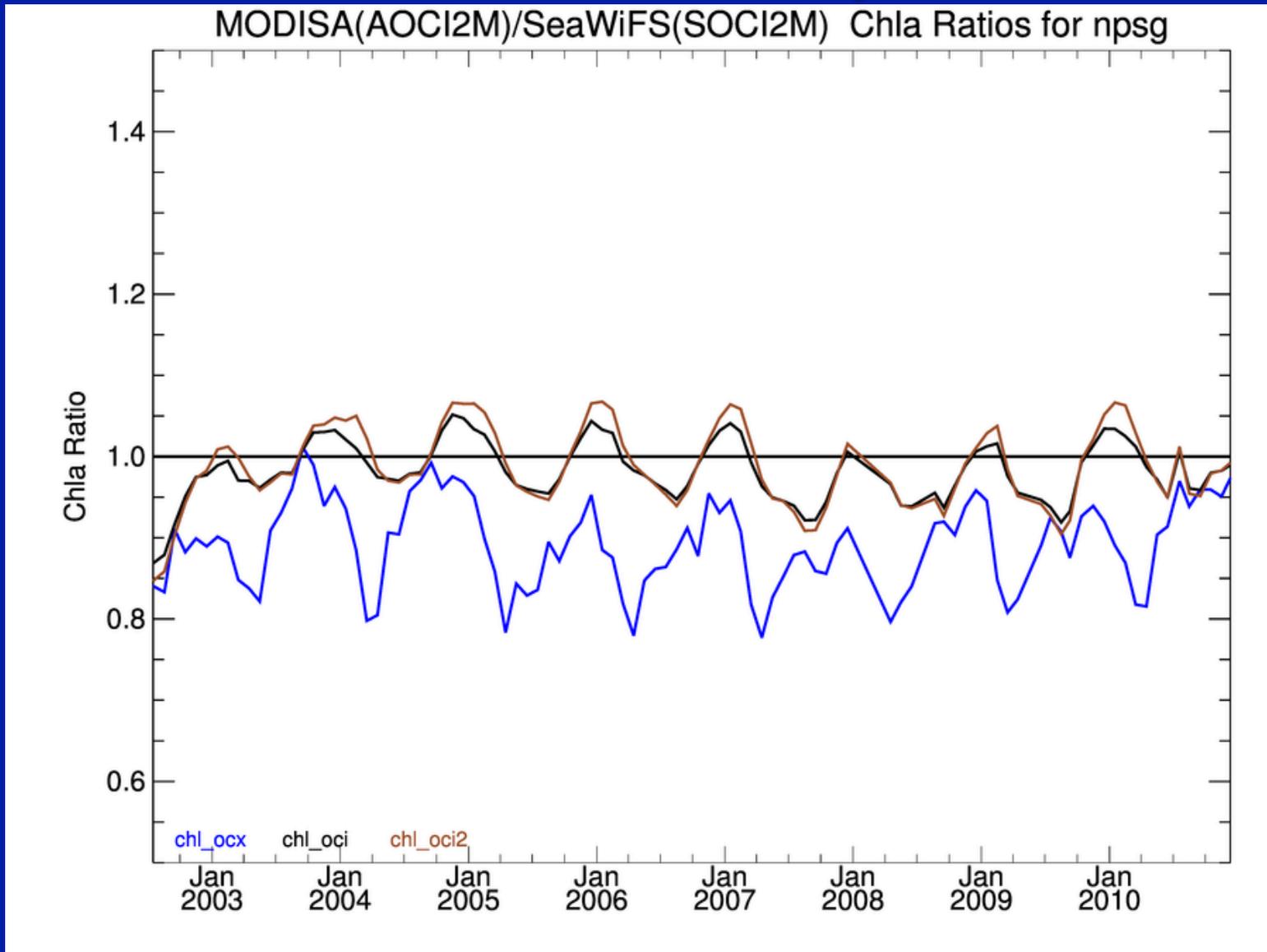
Results

Cross-sensor consistency



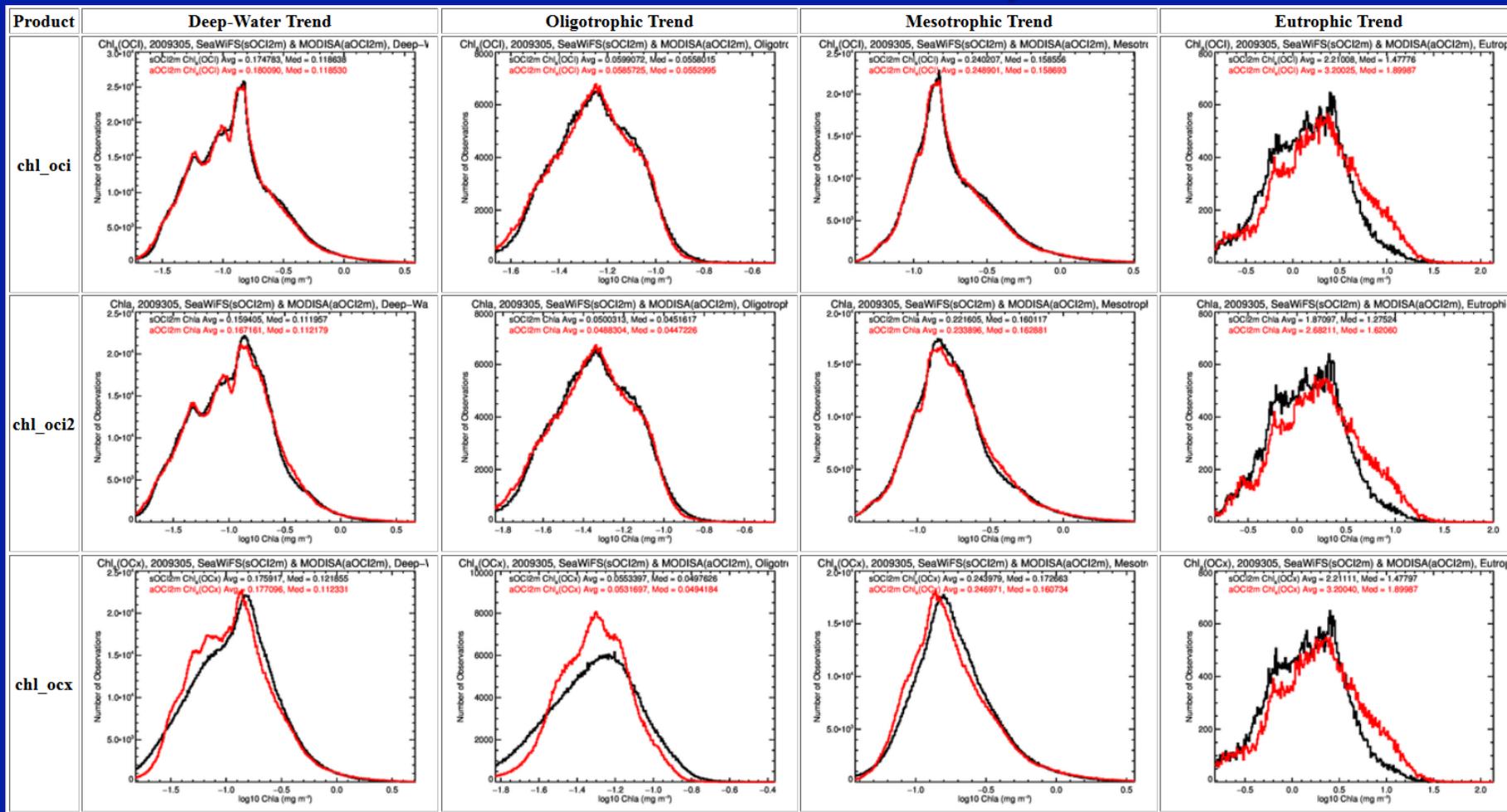
Results

Cross-sensor consistency



Results

Cross-sensor consistency



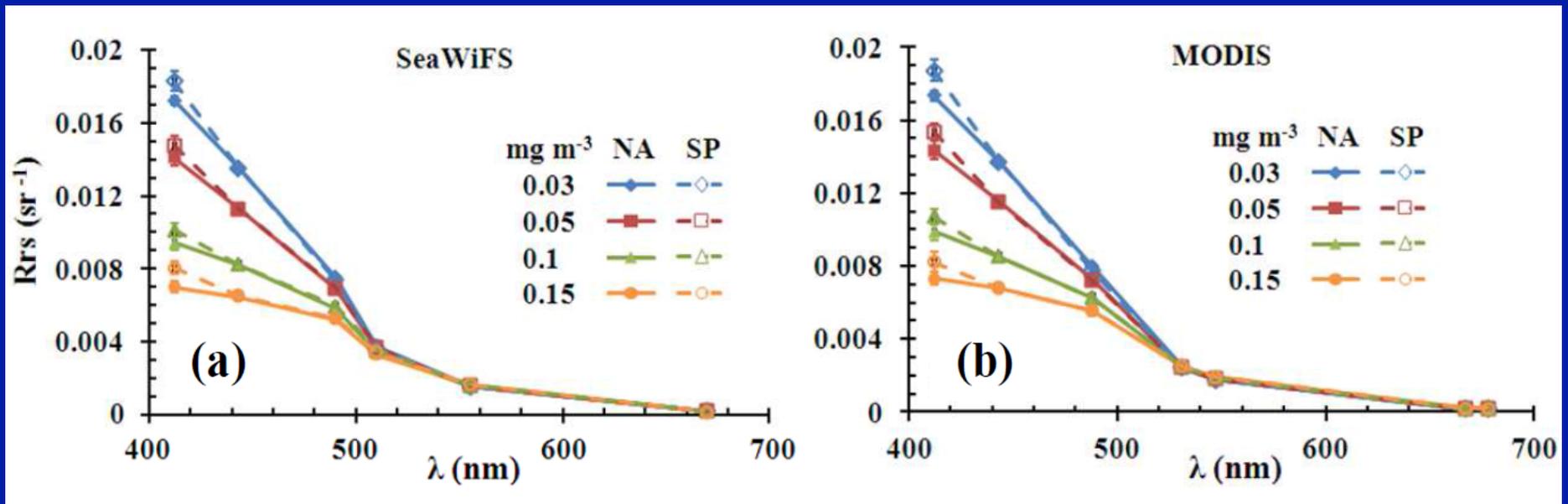
2010305

Conclusion

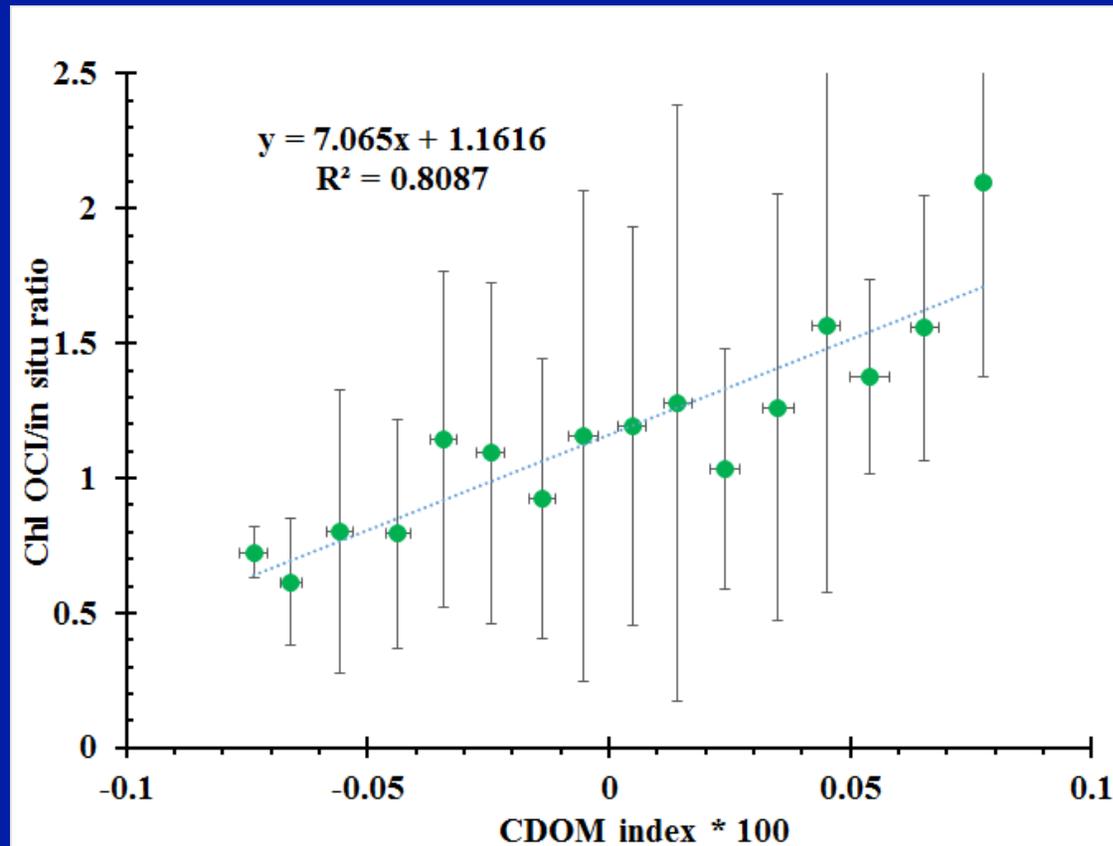
- OCI2 nearly as good as OCI
- Transition zone from 0.175 – 0.25 to 0.25 – 0.4
- OCI2 almost 0.01 lower than OCI in ocean gyres
 - which is right?
- Need high-quality data for Chl < 0.05, especially between 0.01 – 0.03

Motivations

3. OCI does not differentiate the various in-water constituents, then how to reduce such CDOM impacts on OCI retrievals?



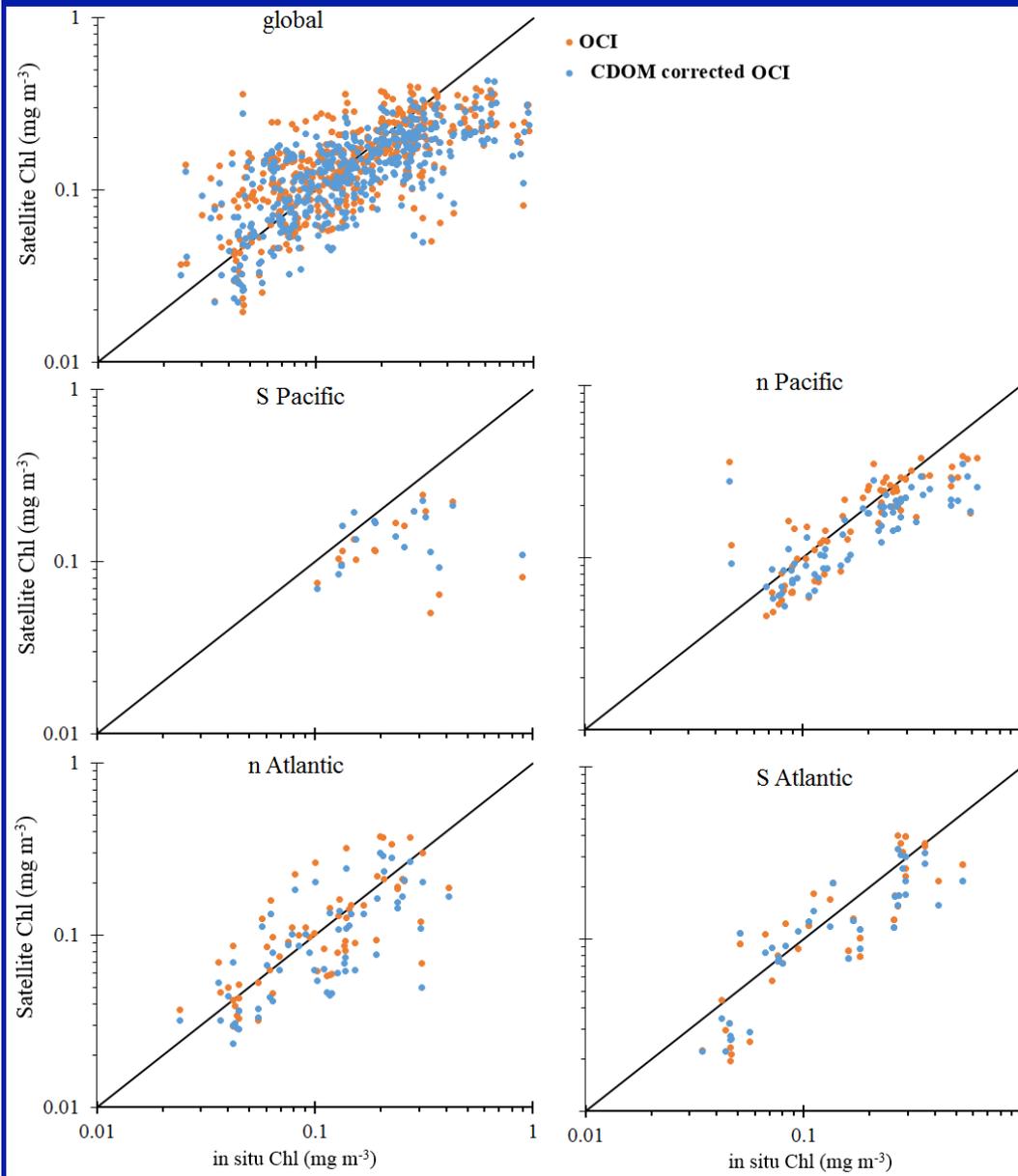
CDI index proposed to reduce CDOM impacts



$$CDI = R_{rs,443} - R'_{rs,443}$$

$$R'_{rc,443} = R_{rc,412} + (R_{rc,490} - R_{rc,412}) \times (443 - 412) / (490 - 412)$$

Results Performances of CDI

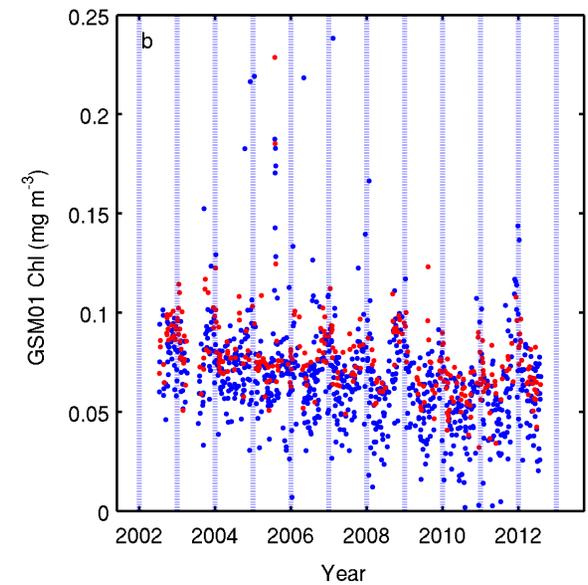
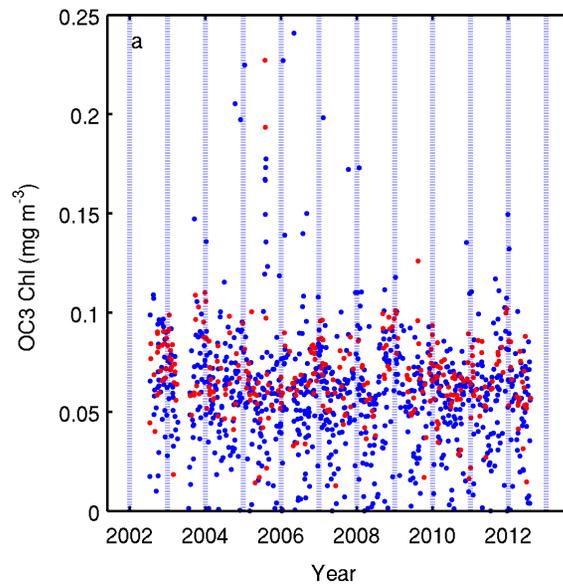
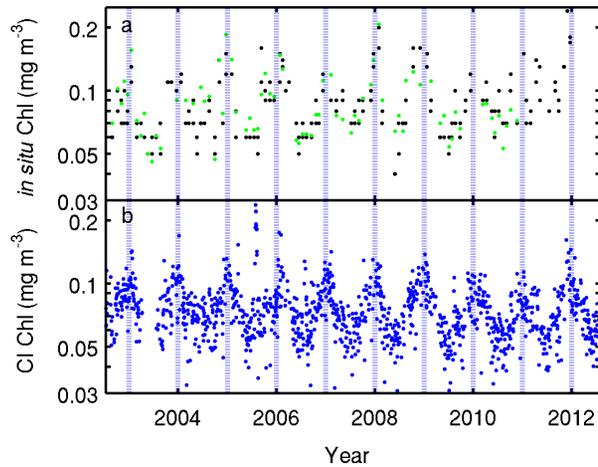


| Area | N_Points | Chl satellite/in situ | |
|------------|----------|-----------------------|-----------------|
| | | OCI | CDOM corrected |
| global | 450 | 1.13 ± 0.76 | 0.99 ± 0.64 |
| s_pacific | 21 | 0.63 ± 0.22 | 0.68 ± 0.28 |
| n_pacific | 70 | 1.02 ± 0.9 | 0.85 ± 0.68 |
| n_atlantic | 63 | 1.15 ± 0.65 | 0.94 ± 0.54 |
| s_atlantic | 48 | 0.92 ± 0.42 | 0.86 ± 0.41 |
| Others | 248 | 1.09 ± 0.68 | 1.25 ± 0.79 |

CDI is not satisfactory way to reduce CDOM effects on Chl OCI

Time Series

with and without standard flag



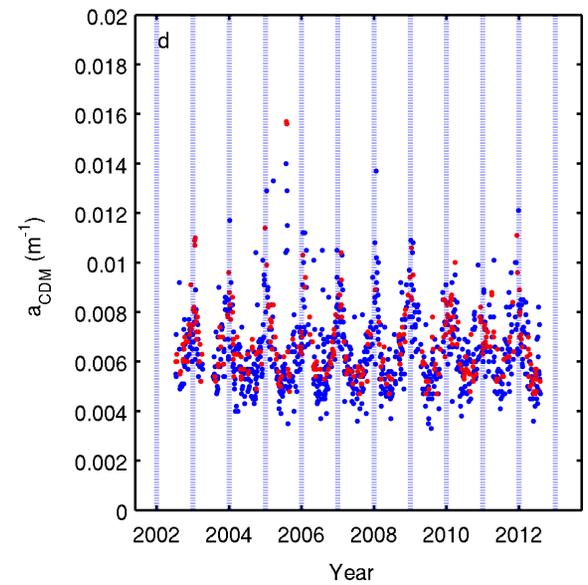
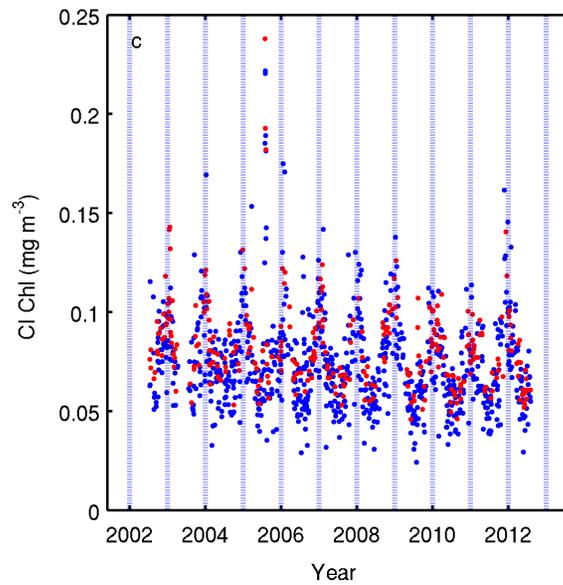
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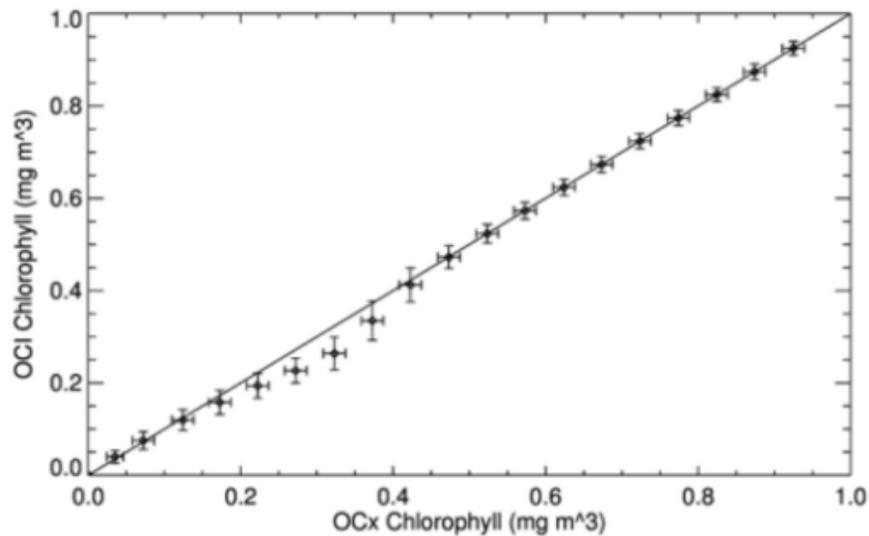
$n_{\text{total}}=3133$



Motivations

2. Discontinuity in histogram (transition 0.25-0.3)

OCI Corrected (transition 0.25 - 0.3)



OCI Revised (transition 0.15 - 0.2)

