Quality Assuring Satellite Remote Sensing Reflectance Spectra and Its Impact on Long-term Observations

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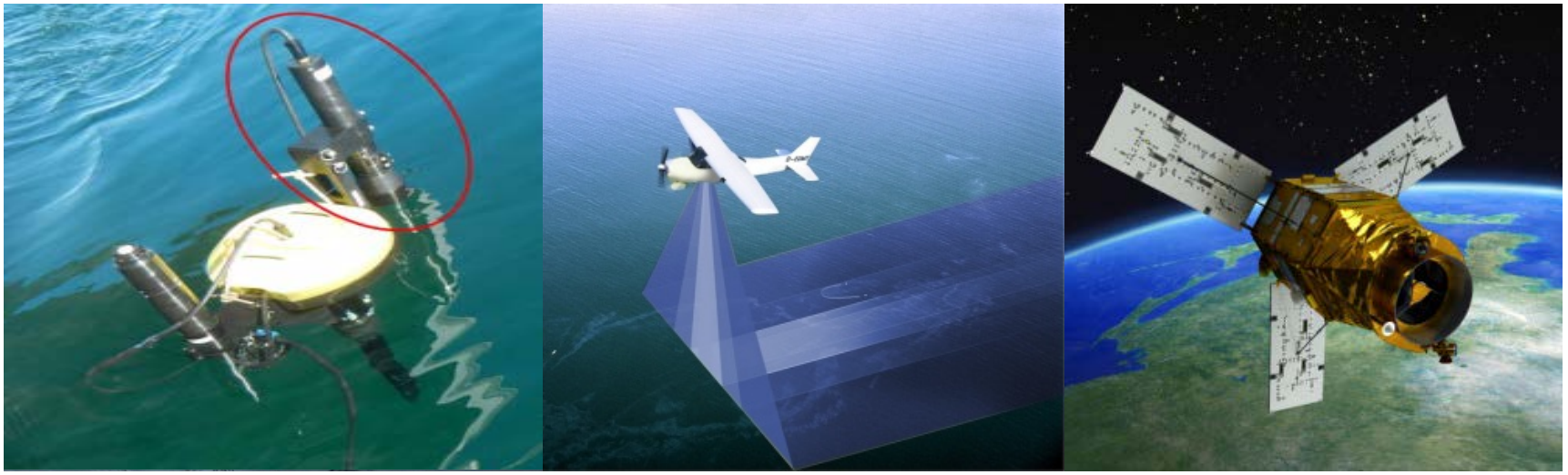
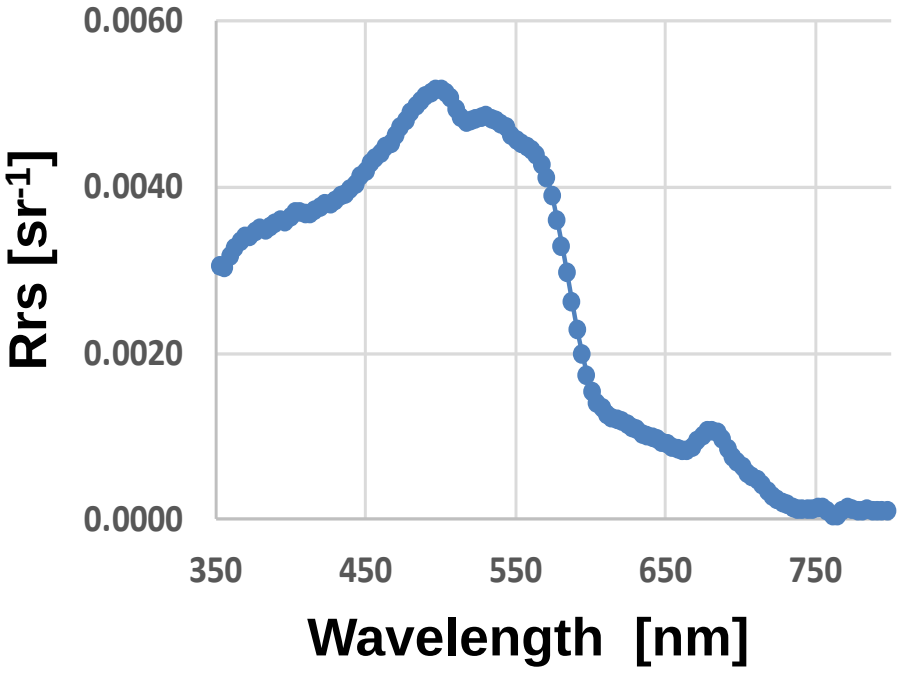
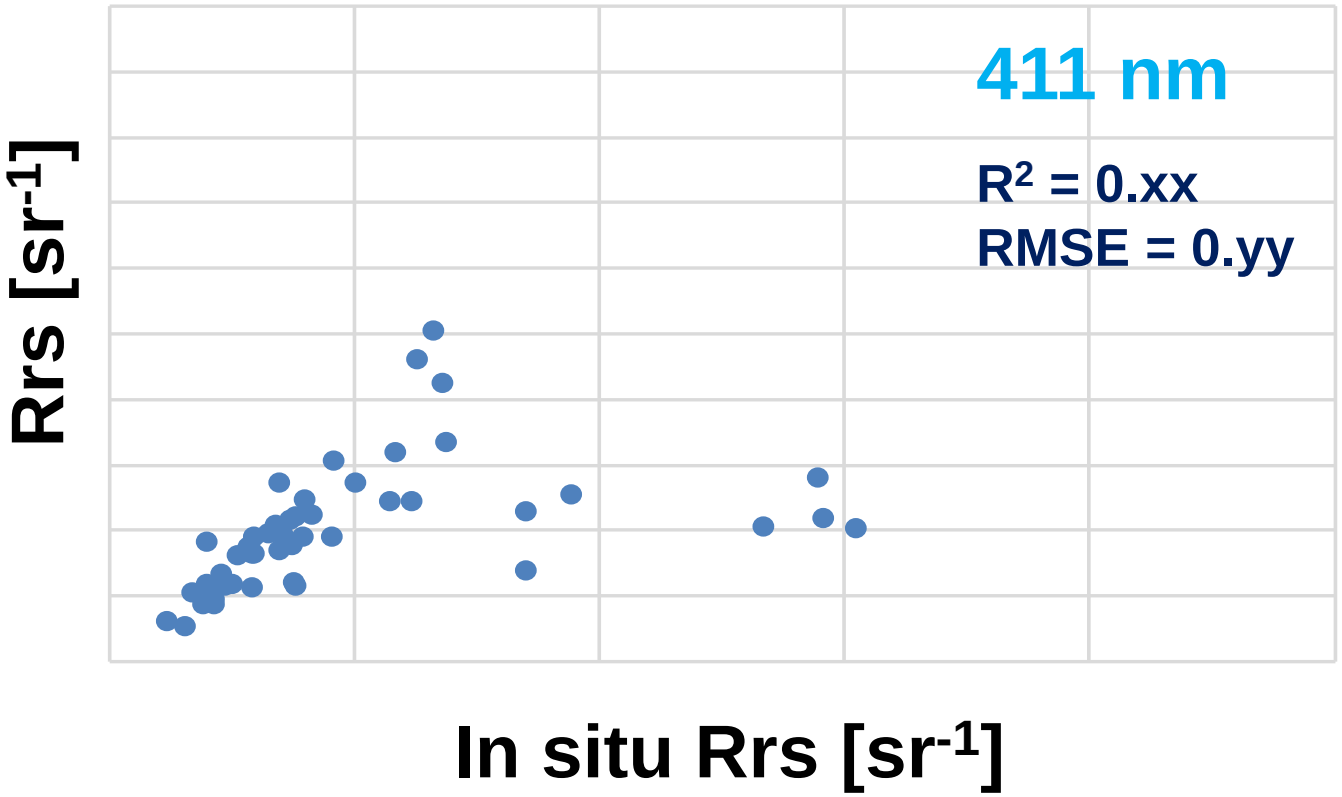




[CHL]
IOPs
POC
PIC
PFT
.
.
.

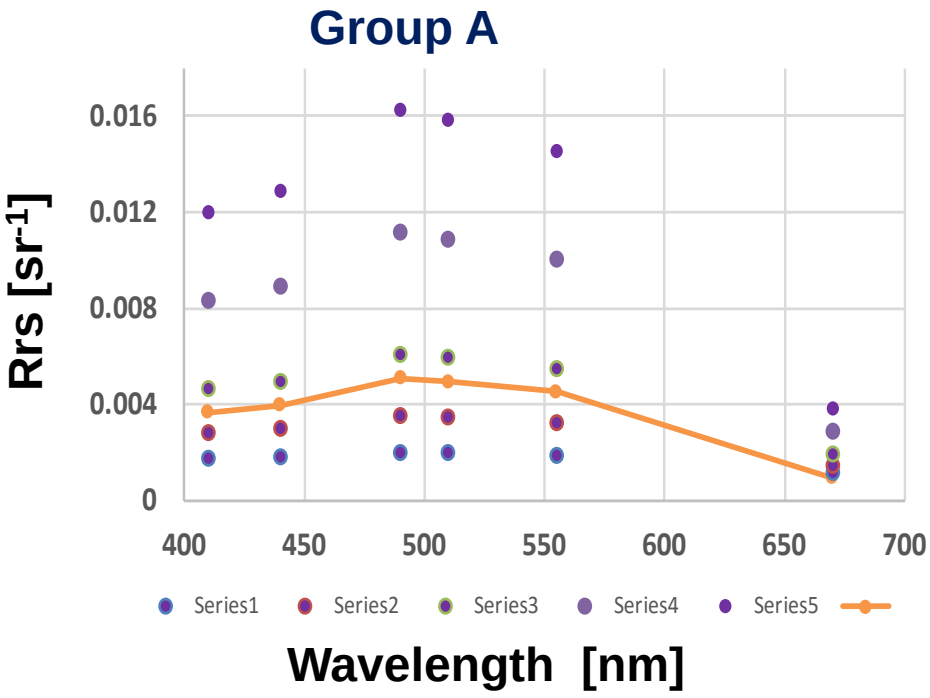
Quality of Rrs is extremely important!

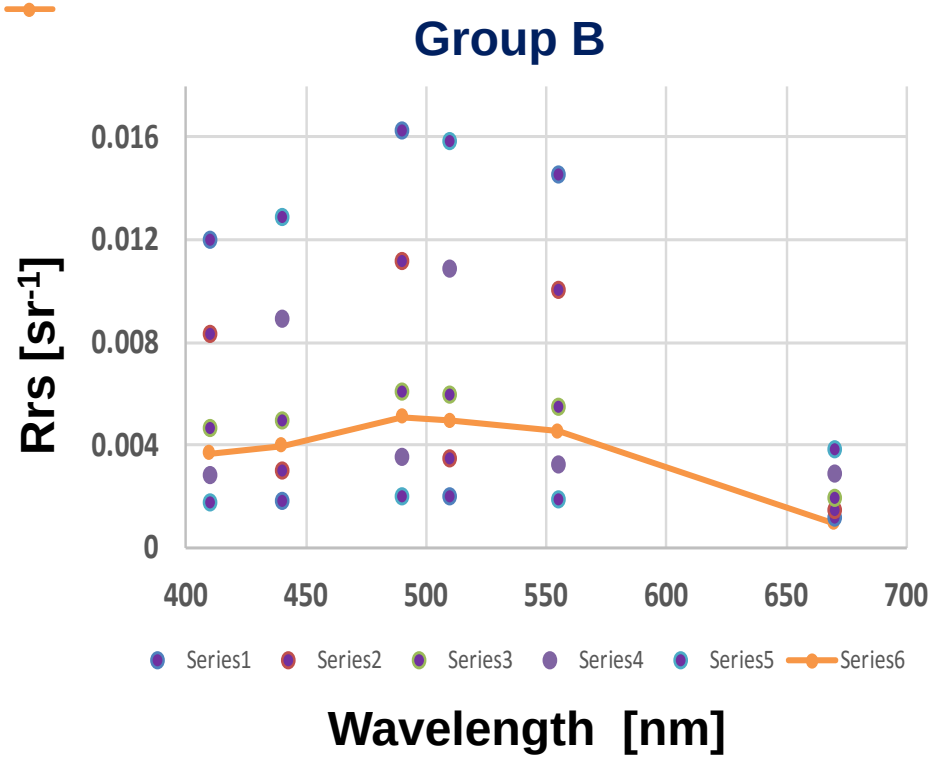
Common practice to evaluate Rrs

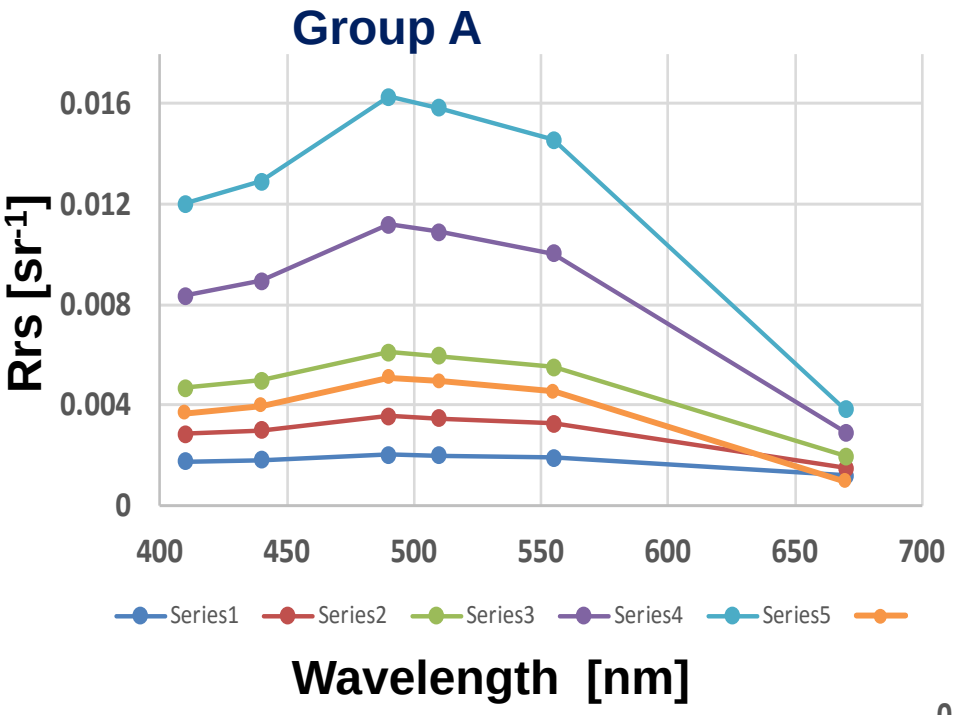


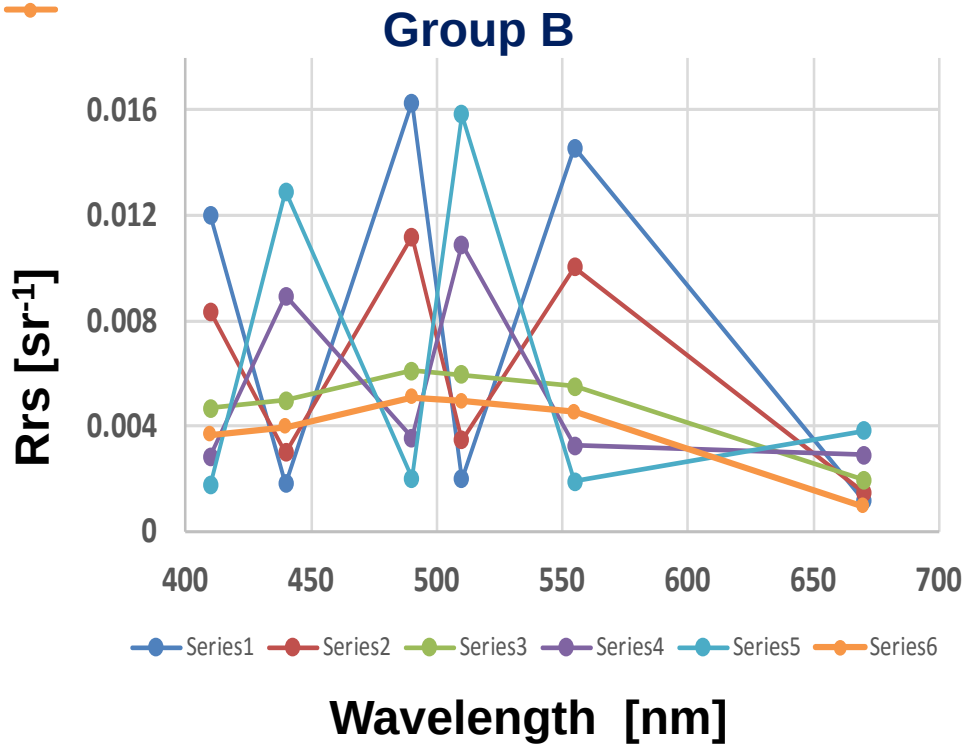
[CHL], IOPs, PFTs, … are not derived from Rrs at 1 band, rather from an Rrs spectrum

Such regression analysis cannot measure the quality of an Rrs spectrum!


Group A
Rrs [sr-1]
0.016
0.012
0.008
0.004
0
400
450
500
550
600
650
700
Series1
Series2
Series3
Series4
Series5
Wavelength [nm]

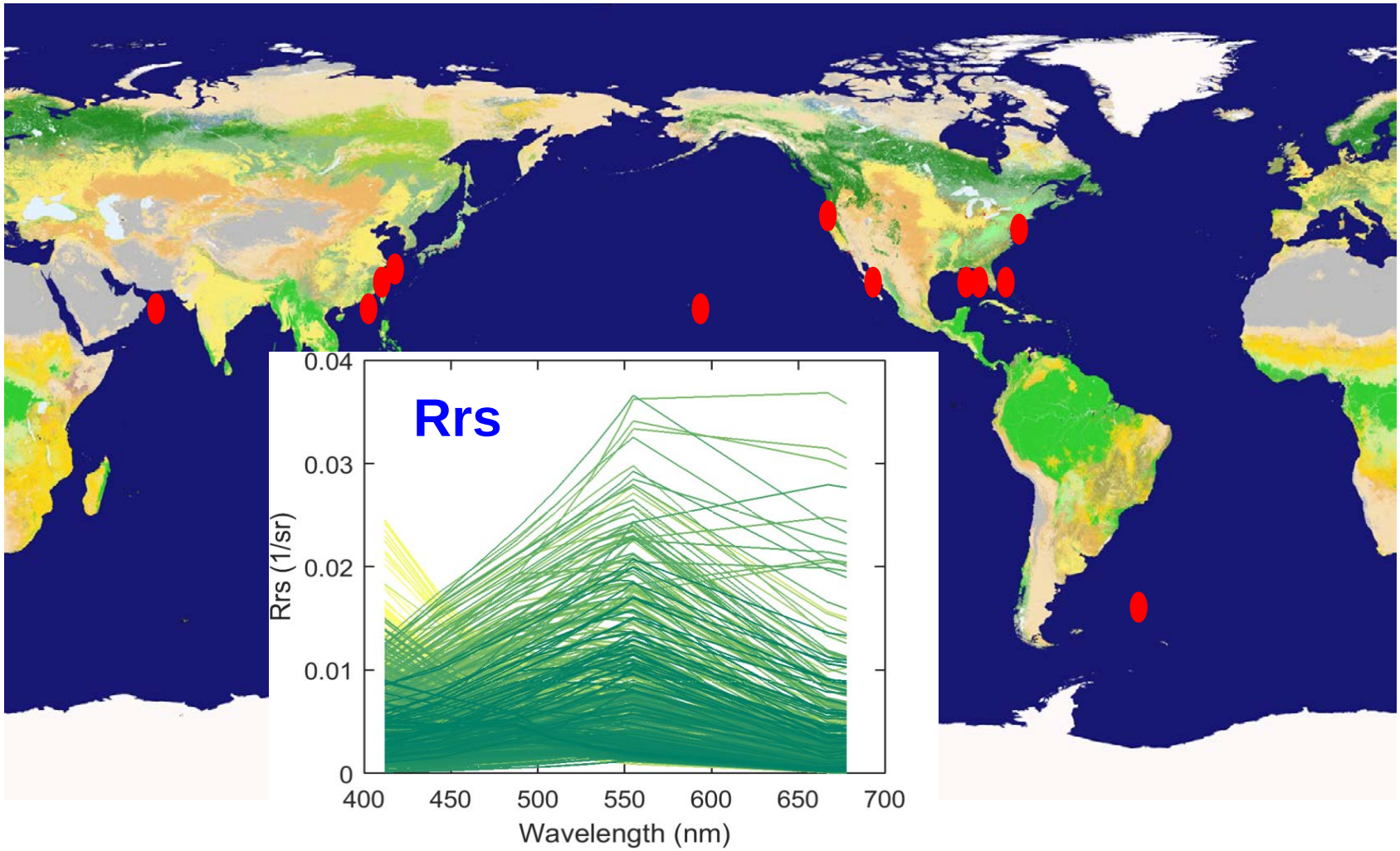

Group B
Rrs [sr-1]
0.016
0.012
0.008
0.004
0
400
450
500
550
600
650
700
Series1
Series2
Series3
Series4
Series5
Series6
Wavelength [nm]





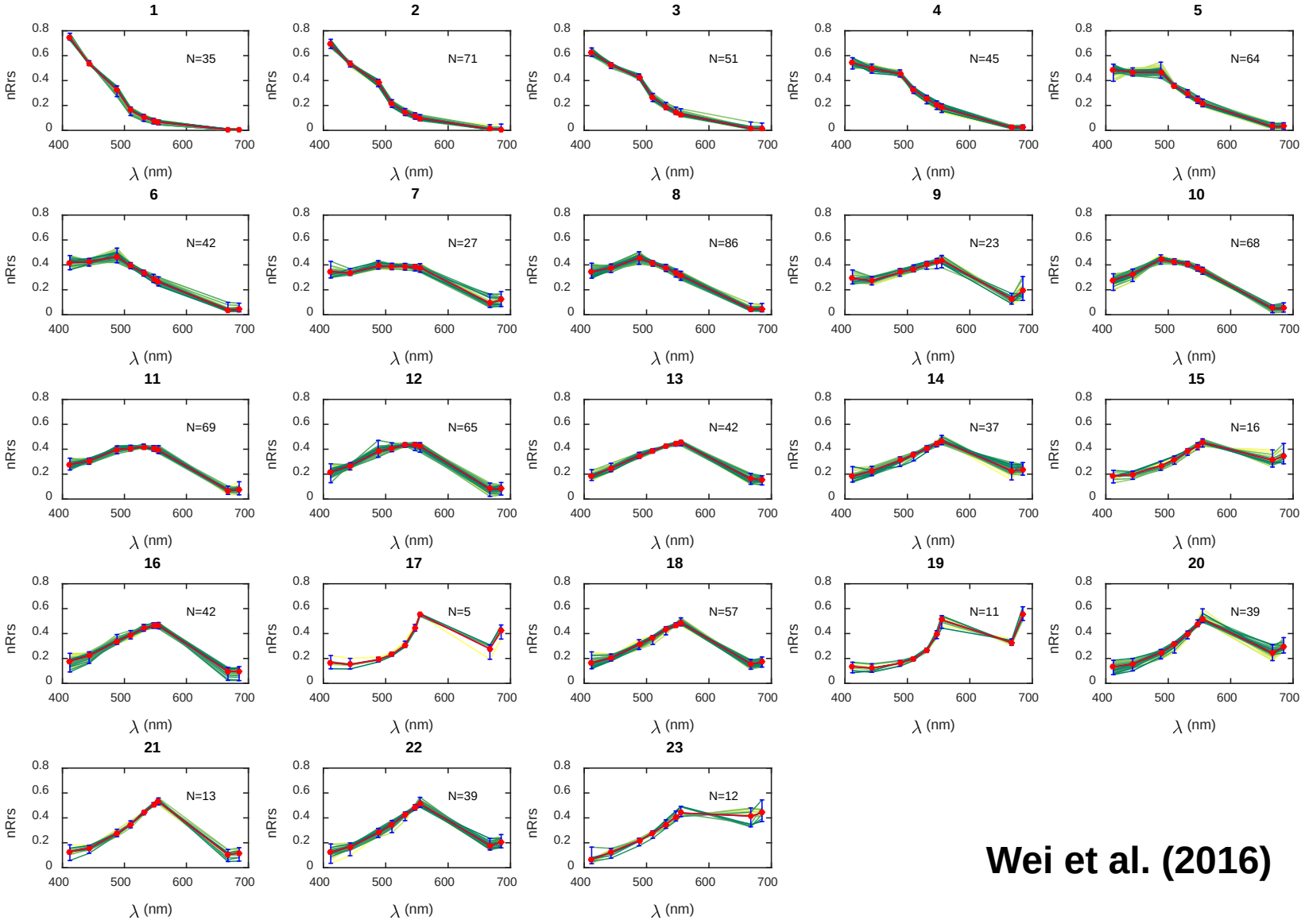
Need to measure the quality of an entire Rrs spectrum!

> 900 hyperspectrsl Rrs



Quality Assurance System to measure Rrs spectrum quality

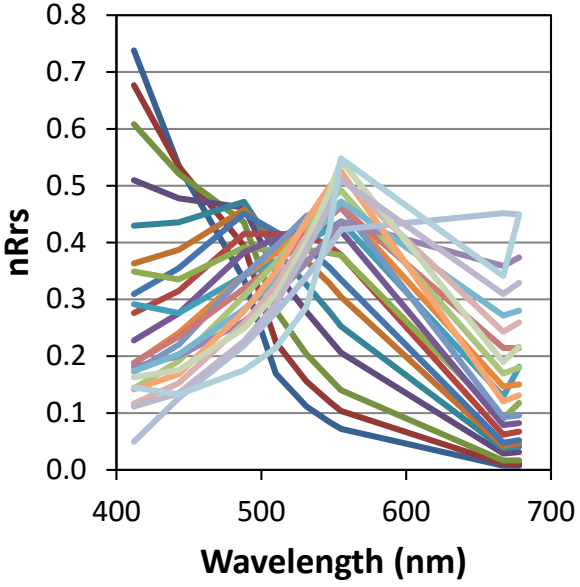
23 water types



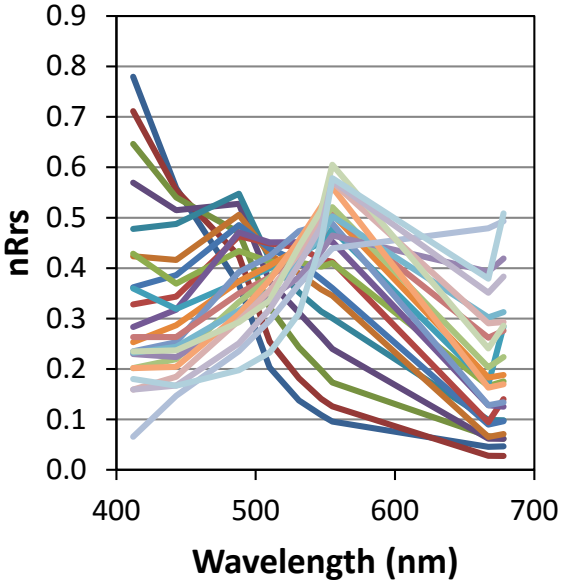
Wei et al. (2016)

Three spectral Rrs matrices

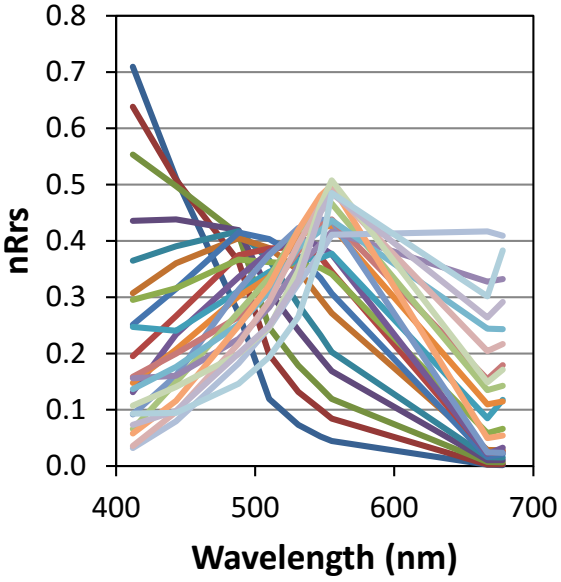
Centroids



Upper bounds

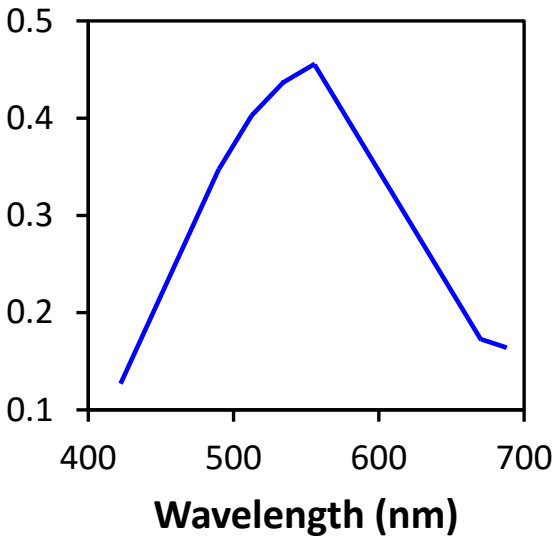


Lower bounds

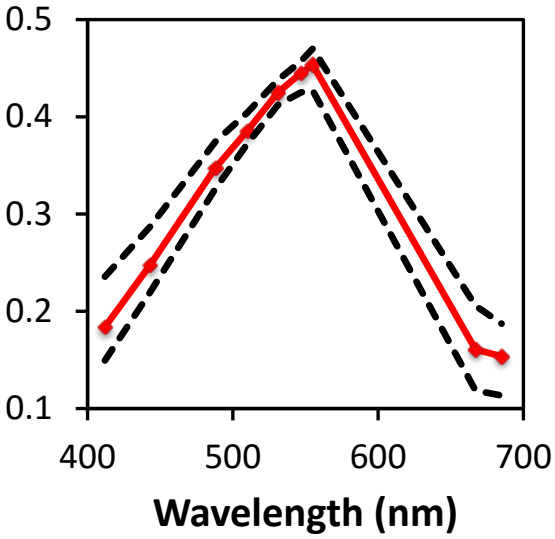


Wei et al. (2016)

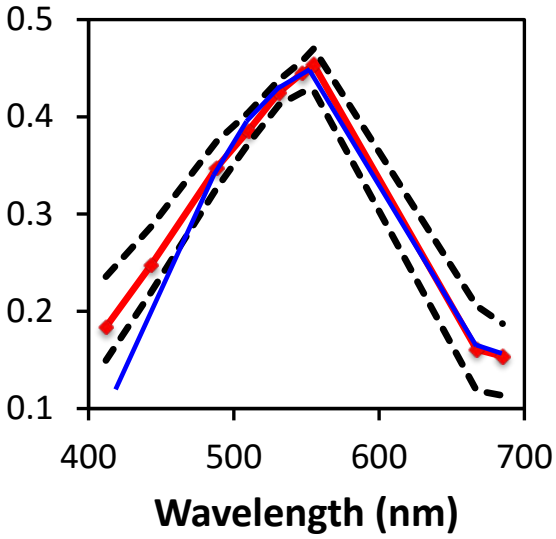
an Rrs spectrum



Find reference Rrs



Compare and score

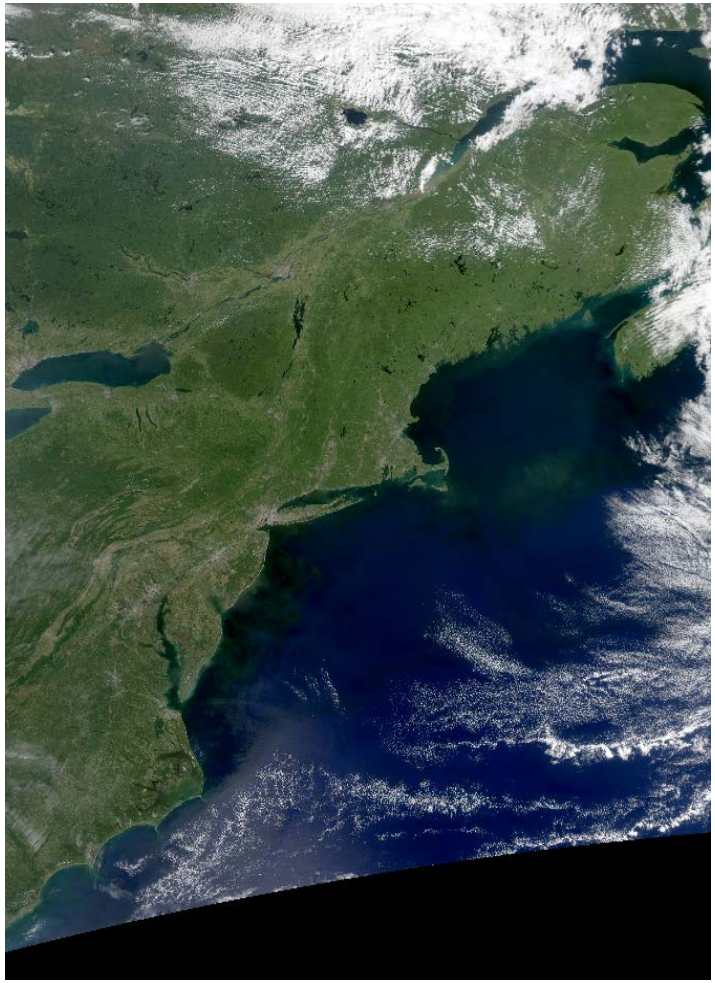


Quality Score:

$$C_{tot} = \frac{0+0+1+\ldots+1}{9} = 0.78$$

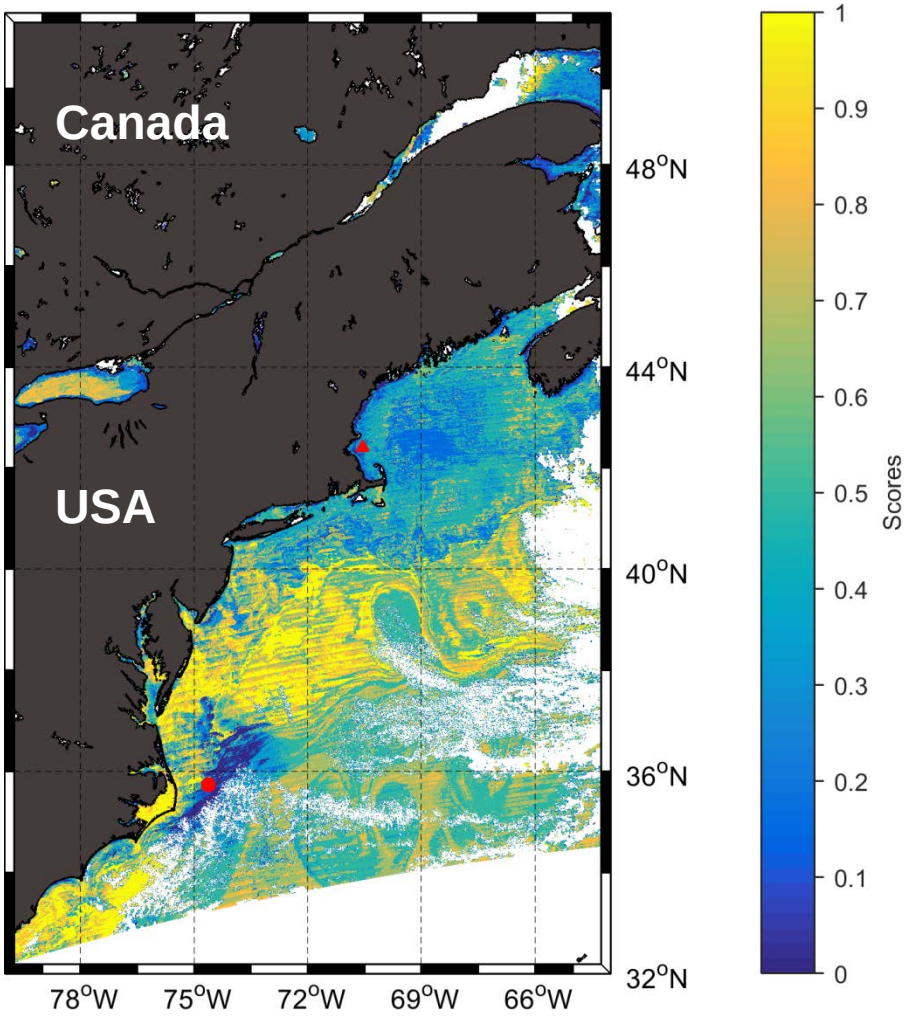
Wei et al. (2016)

Truecolor image



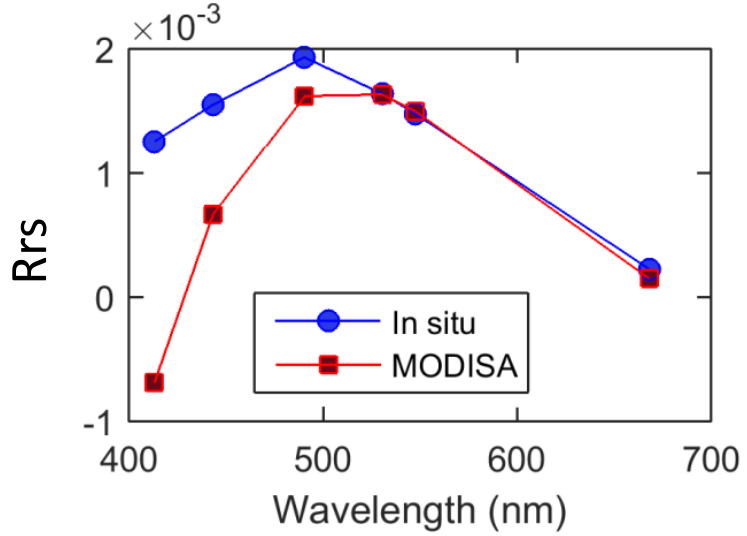
A2015258180000.L2_LAC

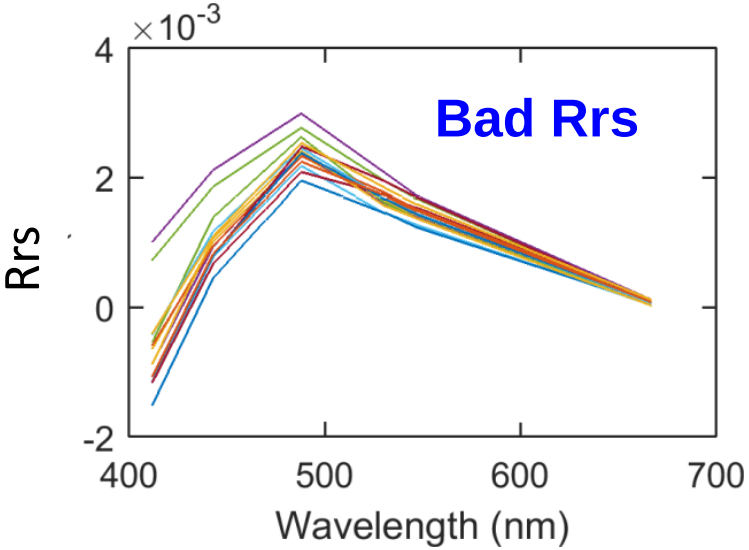
Per-pixel scores



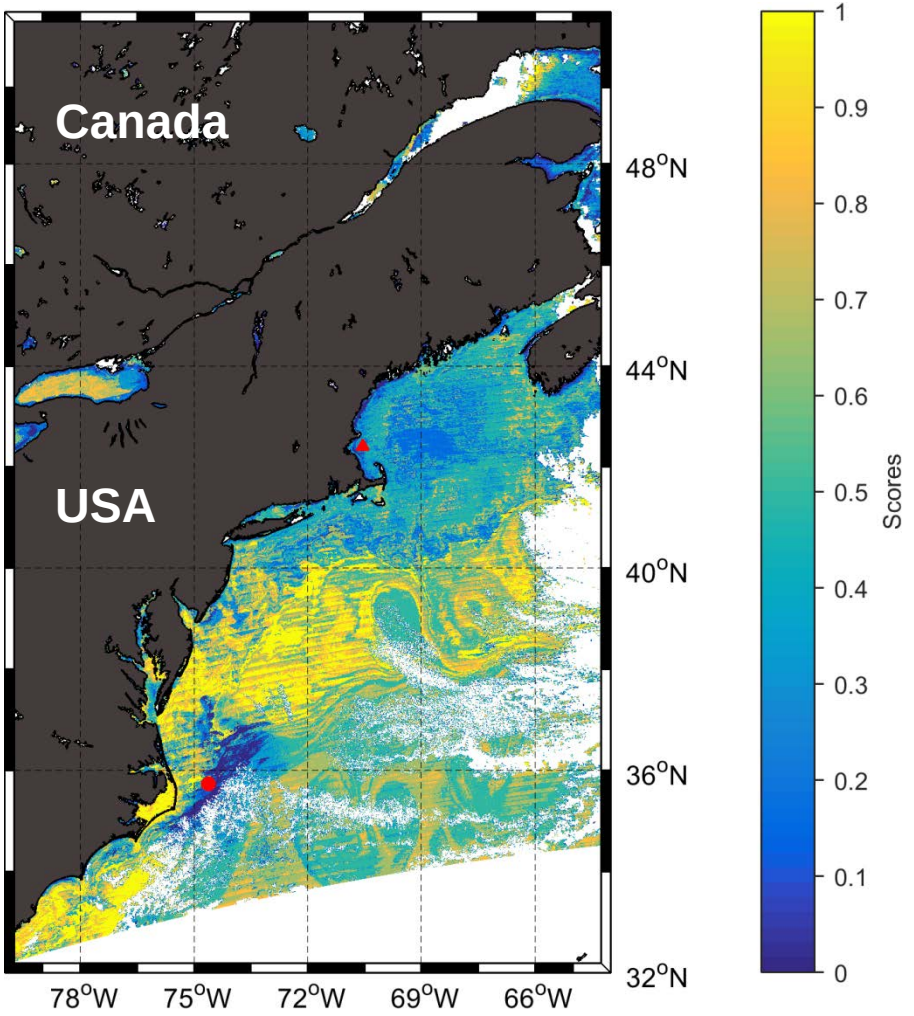
Low scores in blue,
high scores in yellow

Rrs matchups



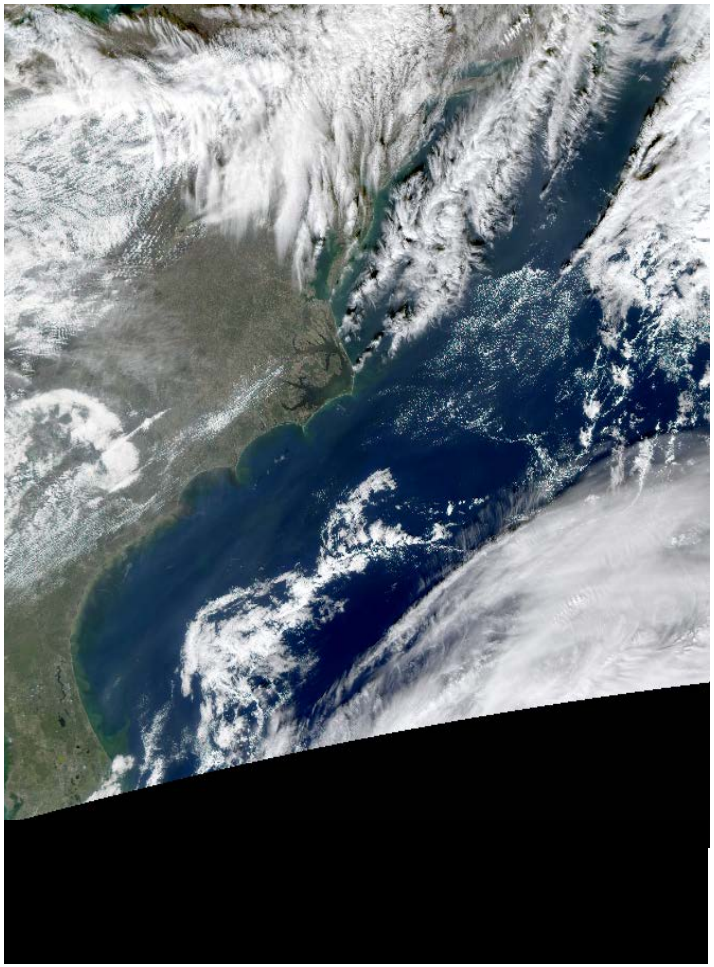


Per-pixel scores



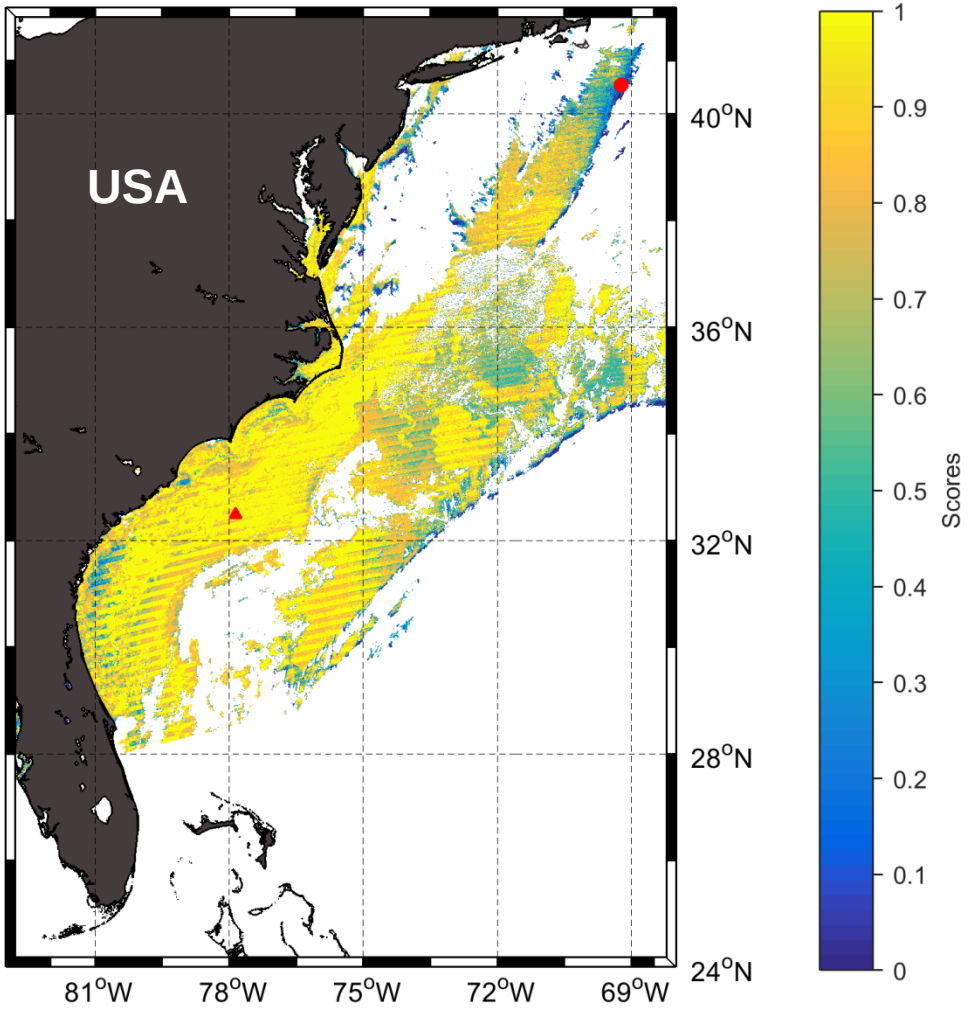
Low scores in blue, high scores in yellow

Truecolor image



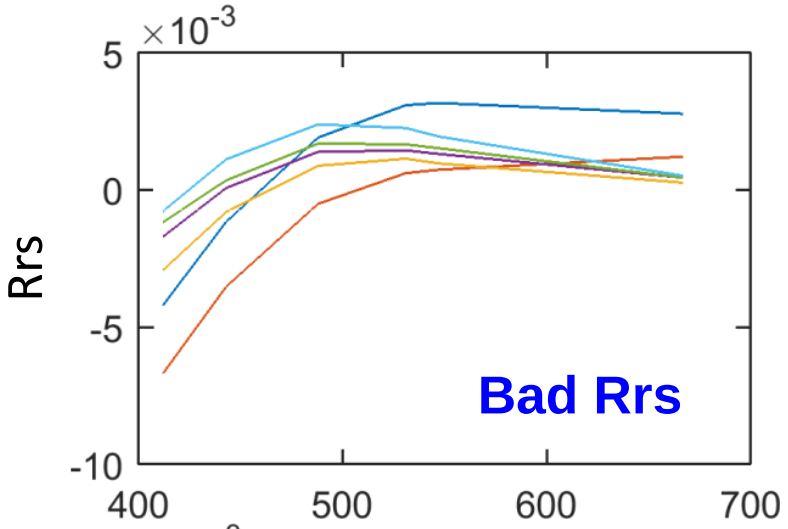
A2015345180500.L2_LAC

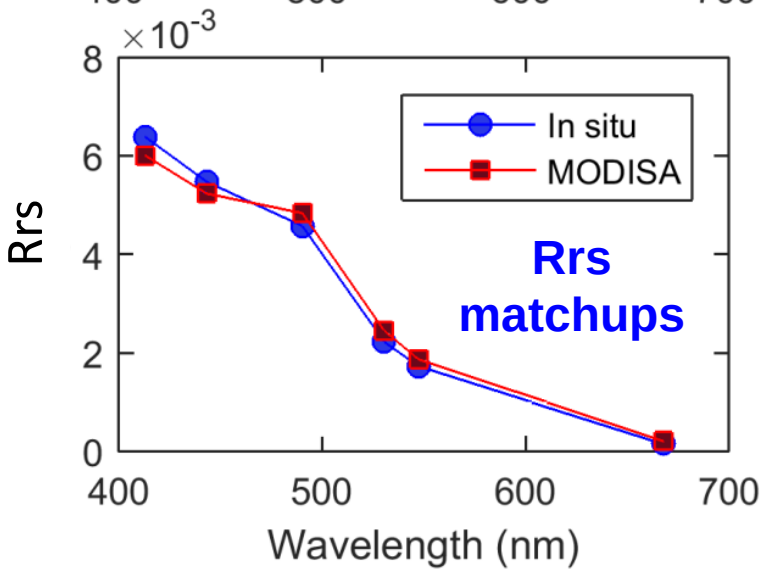
Per-pixel scores

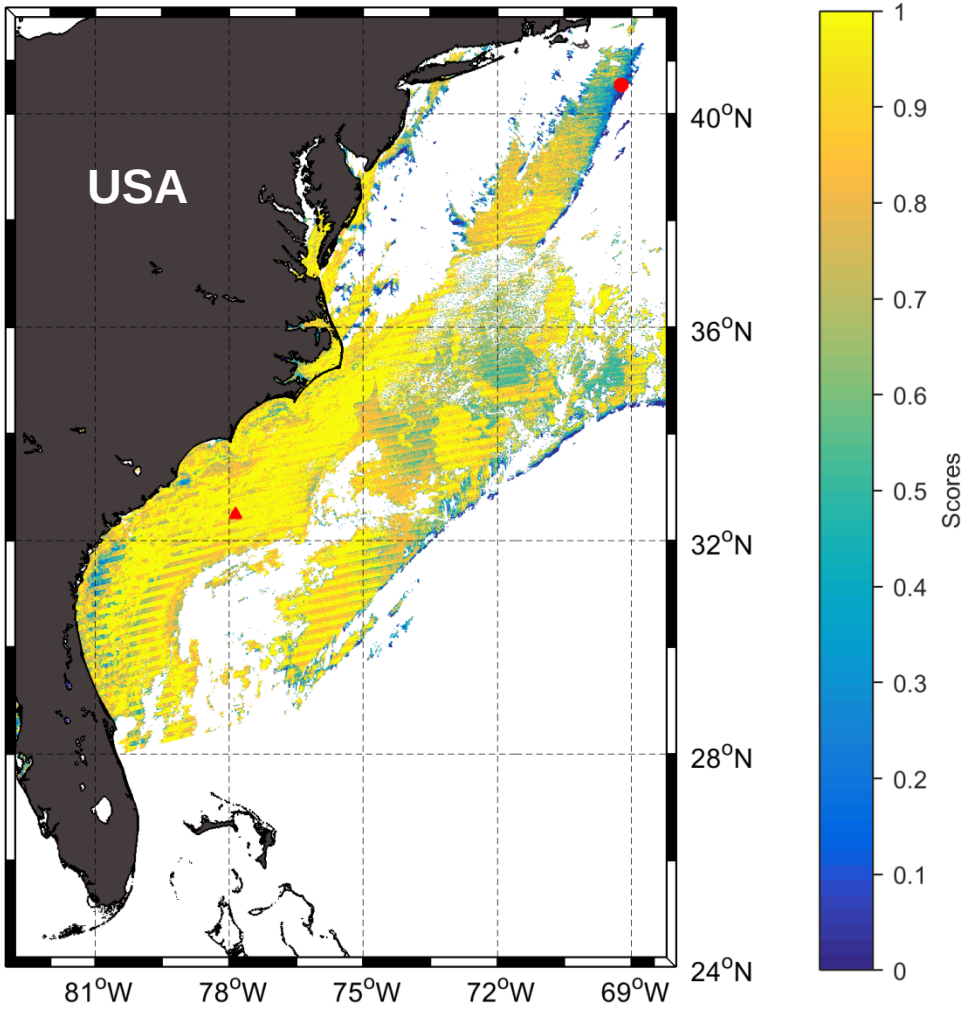


Low scores in blue,
high scores in yellow

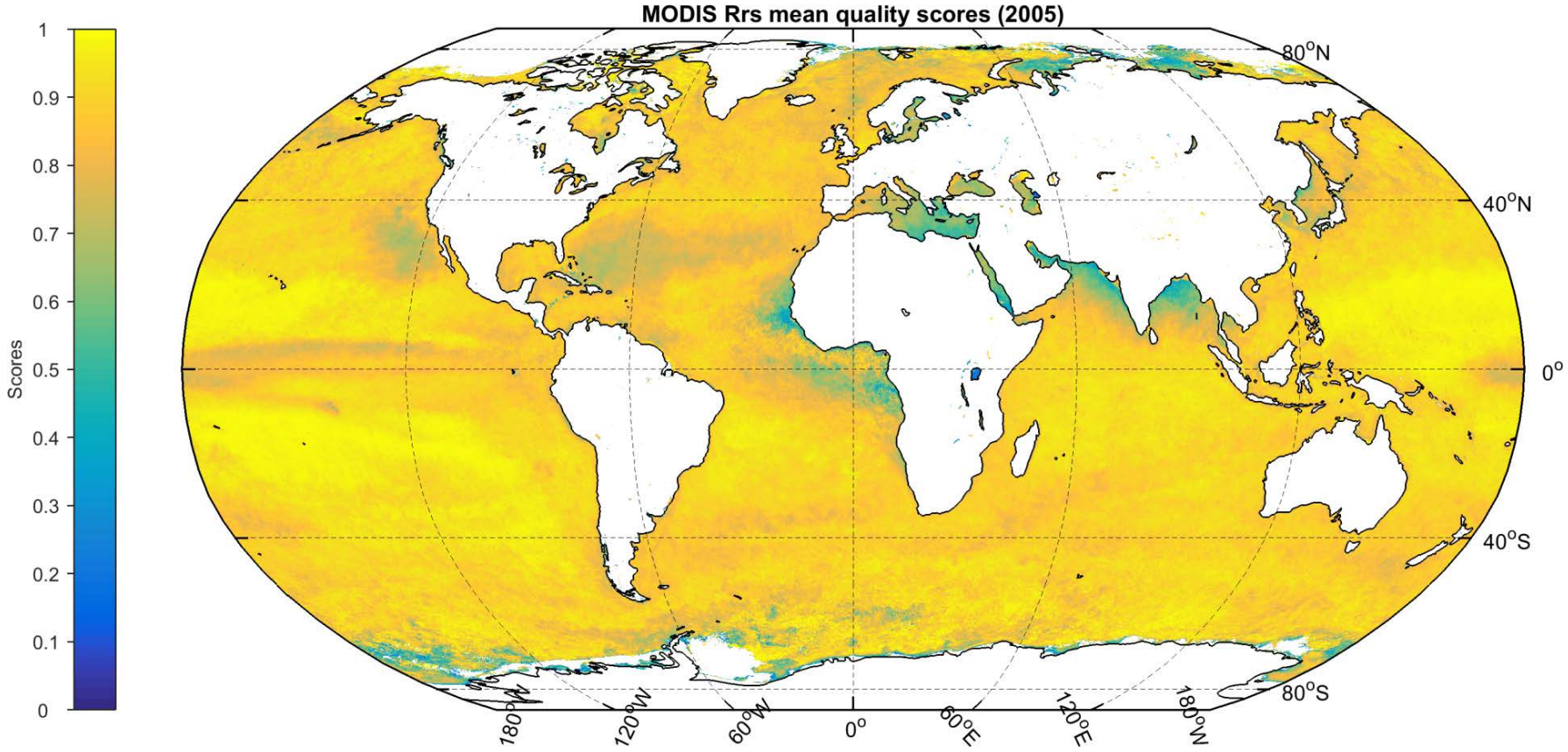
Per-pixel scores





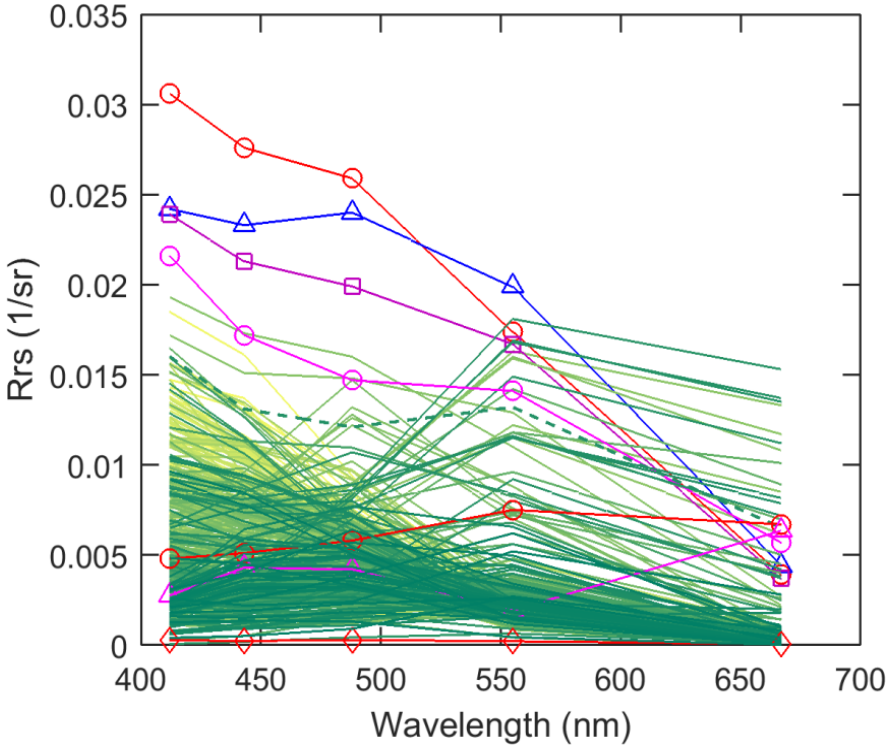


Low scores in blue, high scores in yellow

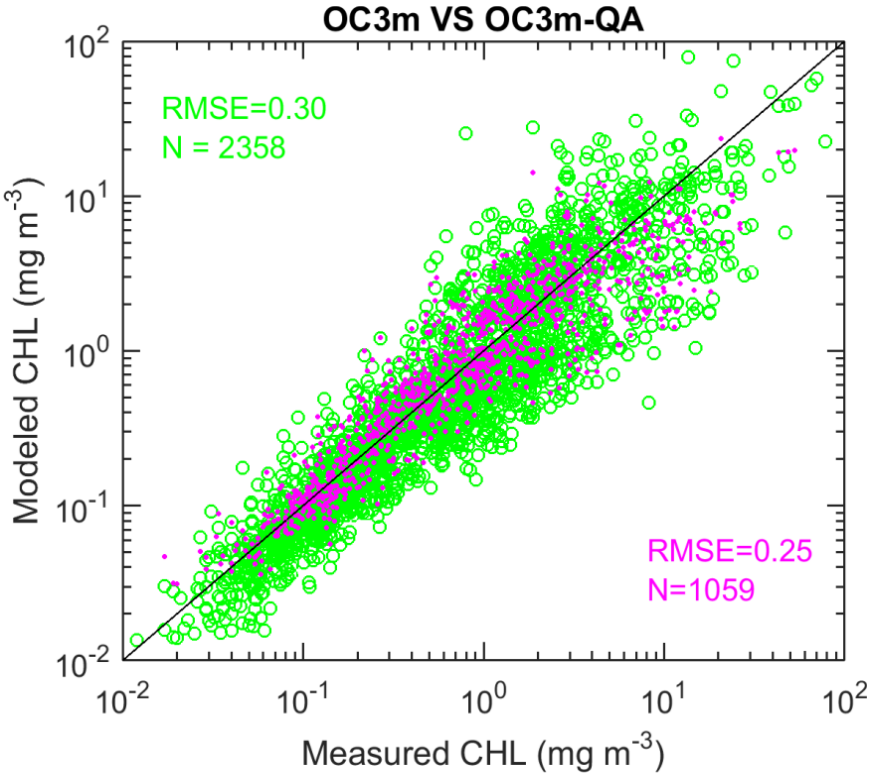

MODIS Rrs mean quality scores (2005)
Scores
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
80°N
40°N
0°
40°S
80°S
180°W
120°W
60°W
0°
60°E
120°E
180°W

What is the impact of questionable Rrs spectra?

SeaBASS

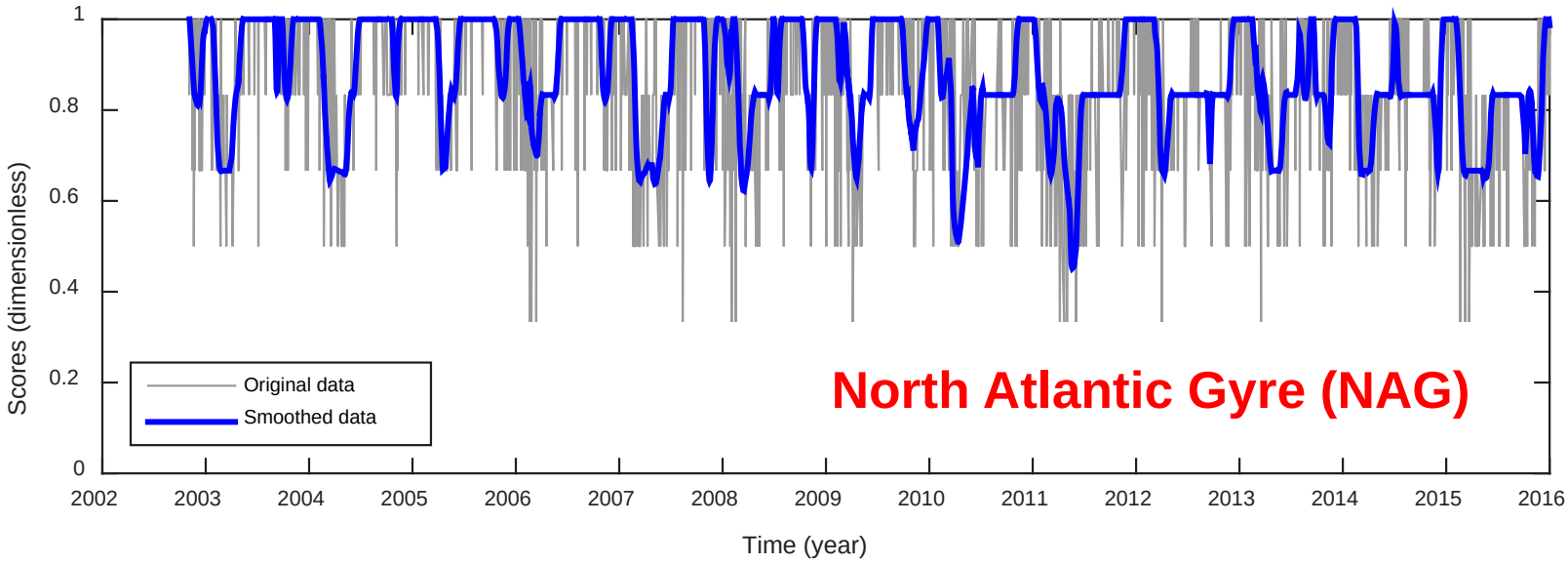


[CHL] algorithm

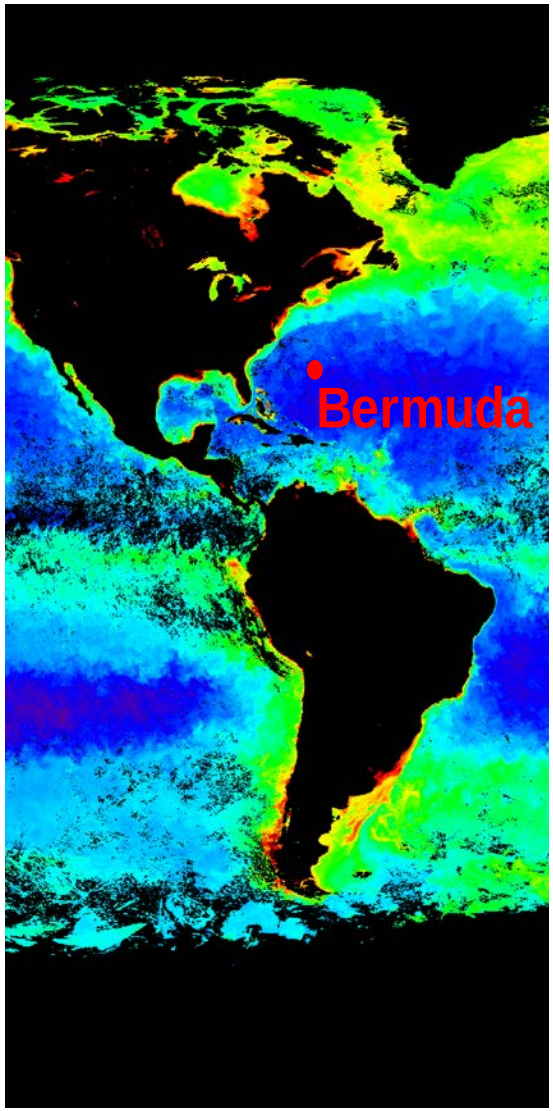


Wei et al. (2016)

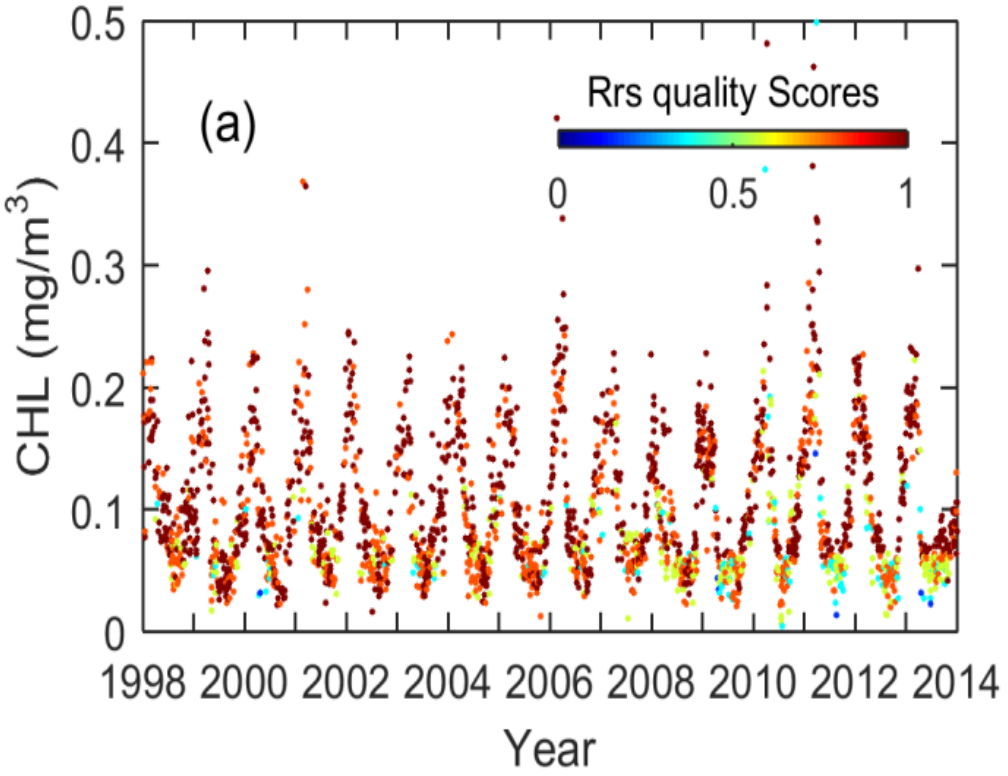
MODIS Rrs


Scores (dimensionless)
1
0.8
0.6
0.4
0.2
0
Original data
Smoothed data
North Atlantic Gyre (NAG)
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Time (year)

Impact on long-term “trends”

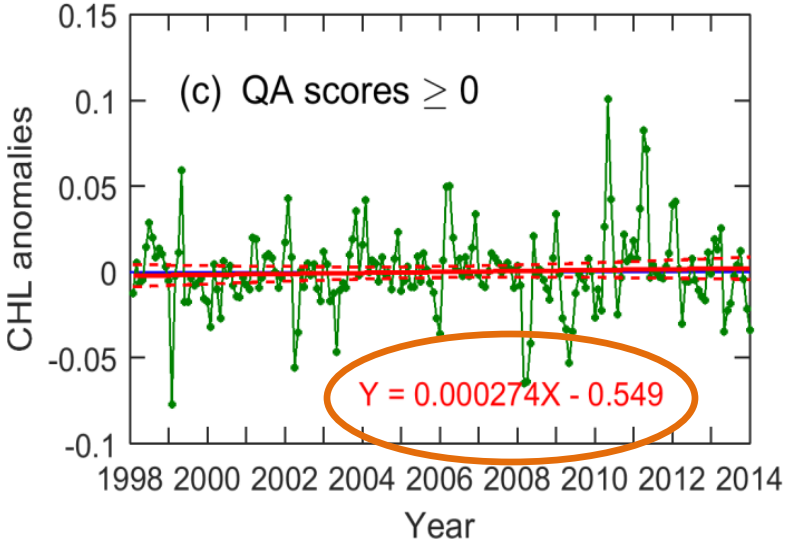


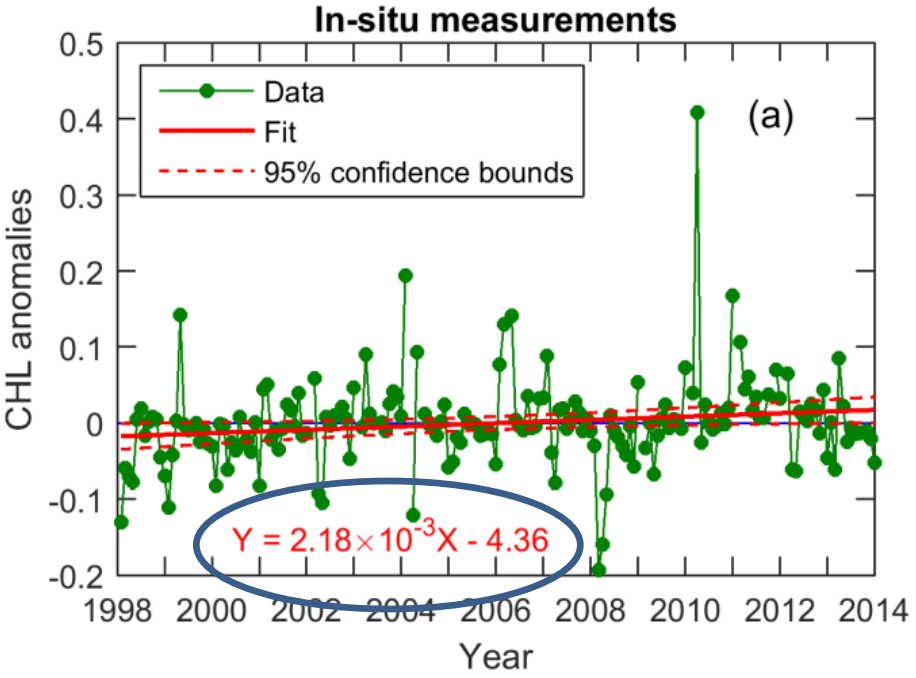
Monthly Chl with OCx algorithm

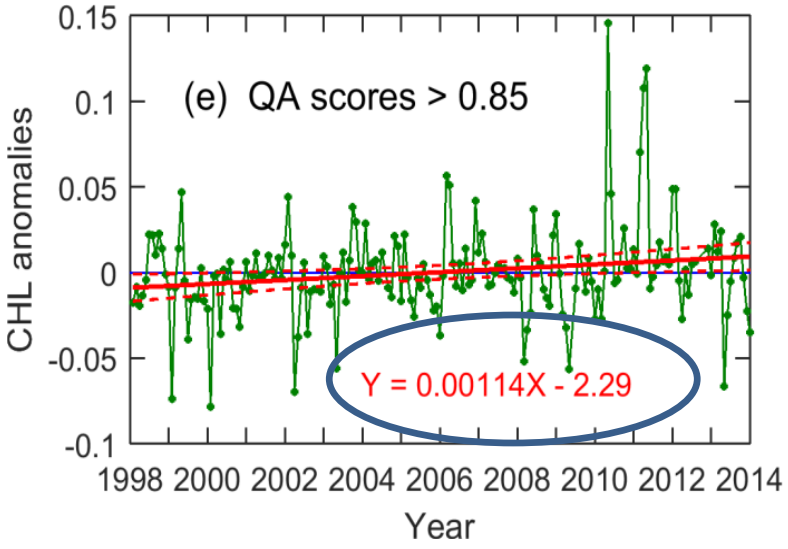


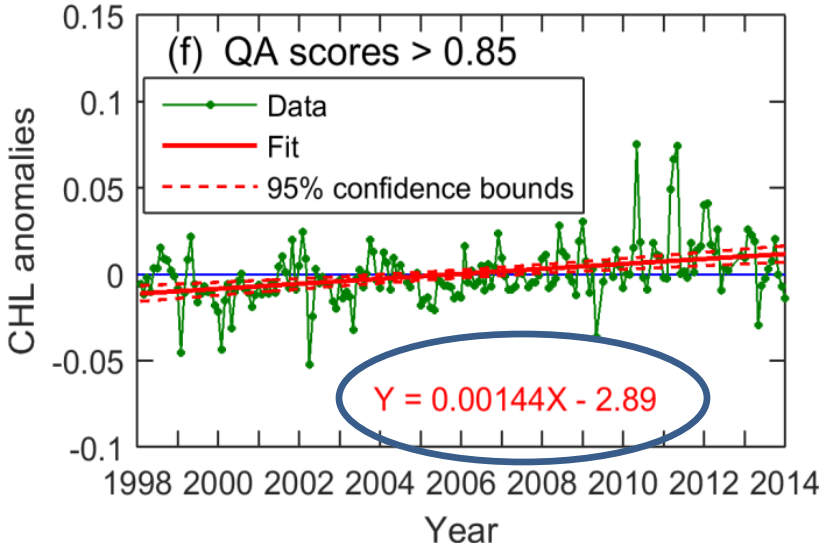
Wei et al. (2017)

Anomaly of Chl by OCx









Wei et al. (2017)

Summary:

- Evaluations of Rrs at discrete bands provide a partial answer of the quality of Rrs spectrum
- It is required to measure the quality of an Rrs spectrum, ie treat the entire Rrs spectrum as an entity
- A QA system is now developed to meet this requirement, which can be refined with the availability of more high-quality Rrs data
- Applications of the QA system obtained QA scores consistent with our understanding of good and bad Rrs spectra
- Implication of the QA system to ocean color satellite Rrs can filter out questionable Rrs spectra and obtain more consistent results on long-term variations of ocean BGC properties
- It is recommended to implement such a QA system to obtain improved longer-time (eg 8-day, monthly, etc.) data products

Thank you!