

Refinement and Maintenance of the MODIS Chlorophyll Algorithm: Ensuring Continuity of a Long-term Satellite Data Record of Chlorophyll

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Goal: *To ensure continuity of the global ocean chlorophyll time series that began with the SeaWiFS data record in 1997 by maintaining and refining the chlorophyll algorithm applied to MODIS data.*

- (1) characterizing uncertainty in the MODIS and SeaWiFS algorithms, and recommending refinements to both algorithms to reduce the uncertainty;
- (2) evaluating candidate analytical algorithms proposed by Ocean Color Science Team members, and recommending selection of new algorithms based on community consensus;
- (3) investigating the improvement achieved with a better characterization of oceanic provinces, and developing a strategy for implementing a global province-based approach.

Cross Validation of MODIS aerosol properties over the northeastern US coast using AERONET

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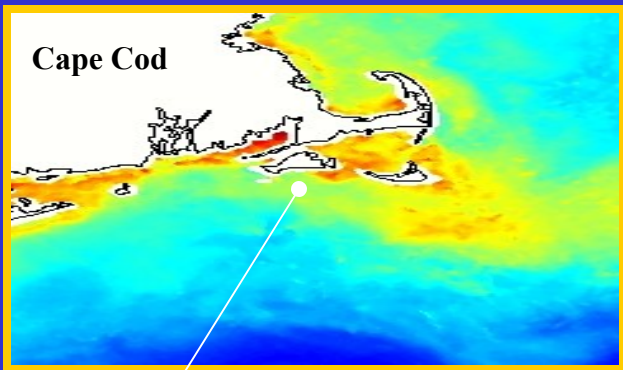
In collaboration with

H. Sosik (WHOI) and R. Arnone (NRL)

Outline

- MVCO Validation (MODIS-OC)
- Motivation/Objectives
- Cross validation approach
- Results and summary

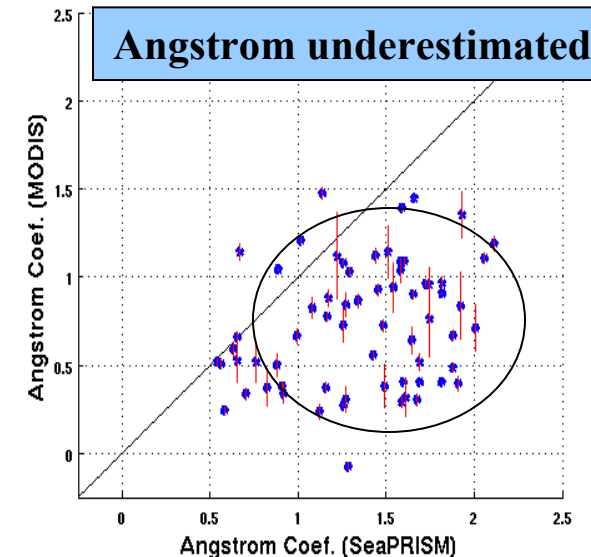
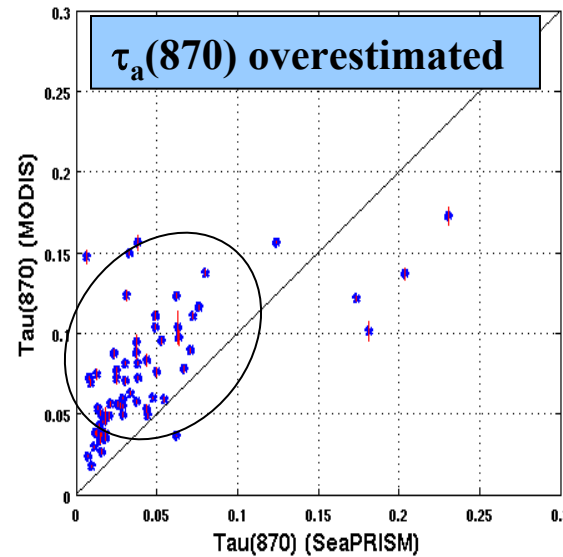
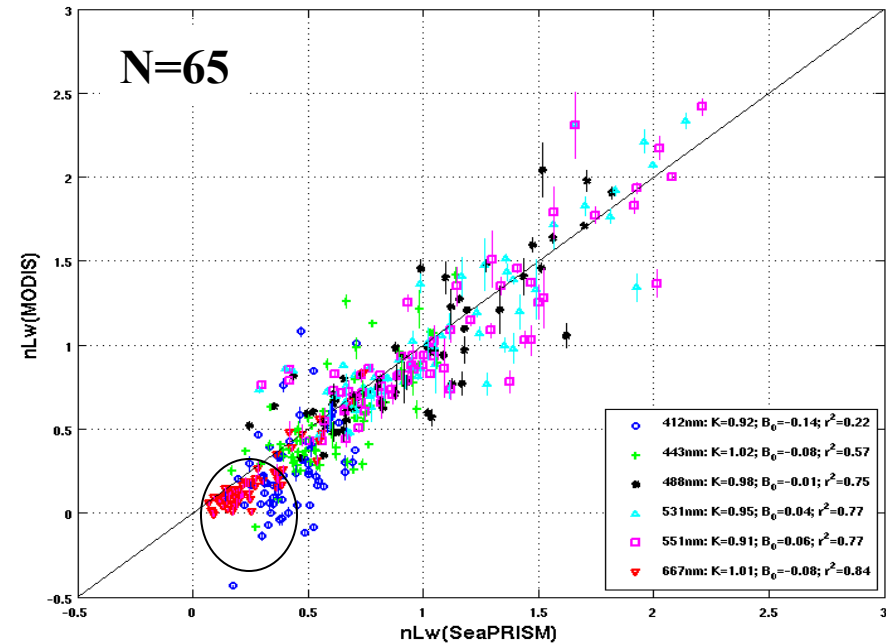
MVCO Matchup Validation: MODIS-ocean color vs. SeaPRISM (2004-2005)



AERONET/SeaPRISM

(Feng et al., 2008, in press)

$nL_w(412)$ underestimated



MVCO MODIS-ocean color validation summary



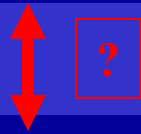
#1: MODIS- nL_w @488, 531, and 551nm performs well.



#2: MODIS- $\tau_a(870)$ is overestimated
MODIS- $\alpha(531)$ is underestimated significantly

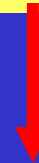


#3: MODIS nL_w(412) is underestimated significantly with ~15% negative values



Motivation/ Objectives

A) Is #2 always true along the US eastern coastal regions ?



B) Is there a linkage between #2 and #3 ?.

C) Is there any way to improve #3 ?

MODIS aerosol products over ocean (Level -2); 2004-2005

	MODIS Ocean Color team (MODIS-OC)	MODIS Atmosphere team (MODIS-ATM)	AERONET
Measurement	1km x 1km	250mx250m 500m x 500m	Ground-Point
Retrieval	1km x 1km	10km x10km	
Different aerosol inversion schemes			
Spectral bands for $\tau_a(\lambda)$	412, 443, 488, 531 551, 667, 748, 869nm	470, 550, 660,870 , 1243,1610 2130nm	340, 380, 440,500, 555,670 , 870, 1020,1650nm
Microphysical retrievals	N/A	Yes	Yes
	SeaDAS 5.0.x	Collection 004	Version 1
Aerosol models for LUT computation	12 candidate models (3 key models vary with RH) (Gordon and Wang, 1994)	9 candidate models (4 fine and 5 coarse modes) Remer et al, 2005	
RT code	Gordon and Wang, 1994	Ahmad and Fraser, 1981	

Cross-validation approach:

MODIS-ATM
10km-by-10km



MODIS-OC:
1km-by-1km

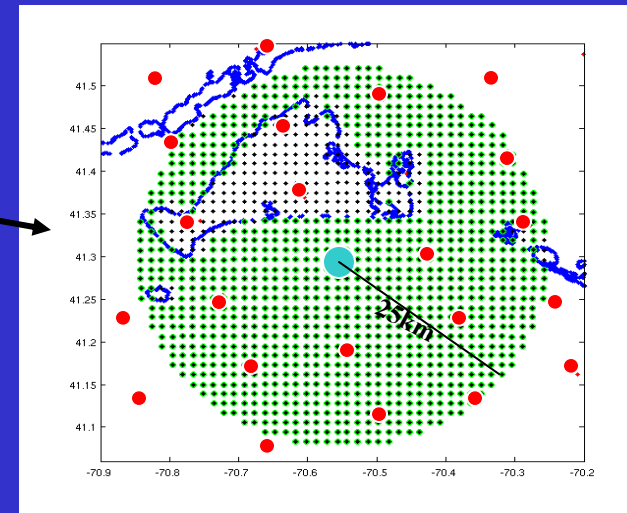
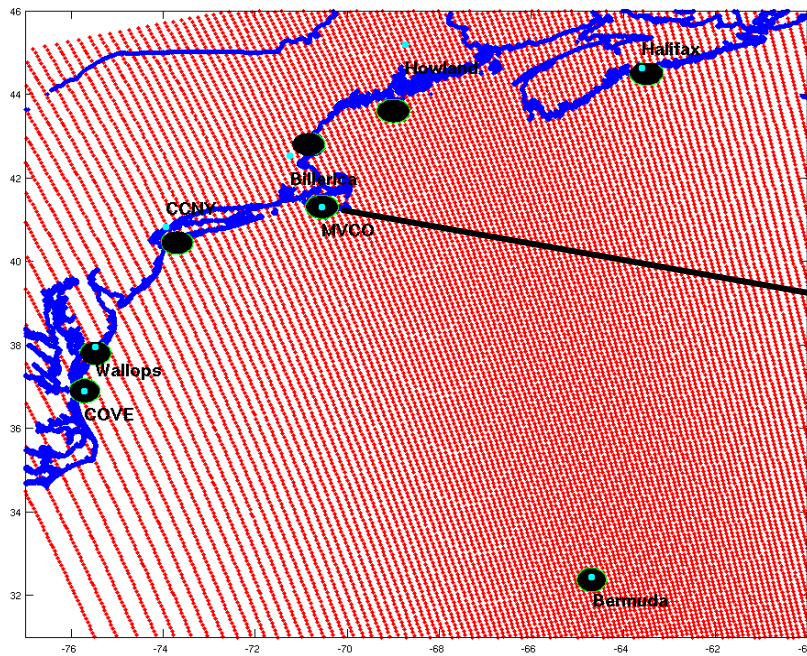


AERONET

Match-up details

- A circle area with a 25km radius
 - centered on 3 AERONET oceanic sites
 - ocean locations closest to 5 AERONET land sites
- Only ocean pixels are considered for MODIS-ATM
- ± 30 min time window between AERONET and MODIS pass time

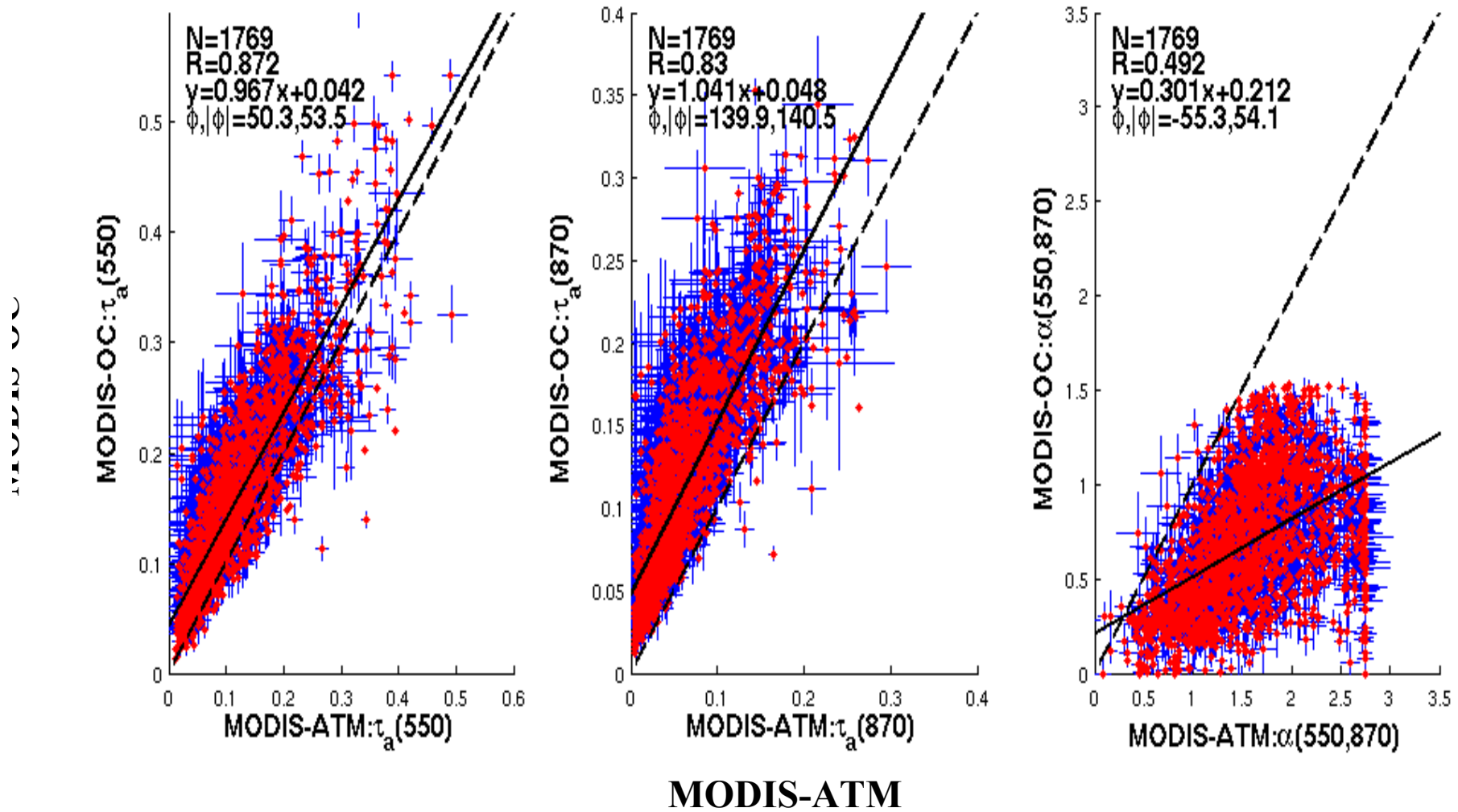
Spatial match-up explanation



MICO

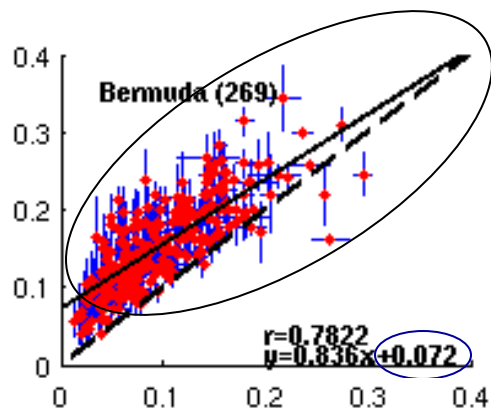
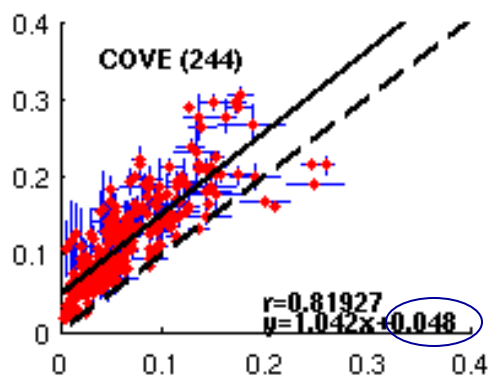
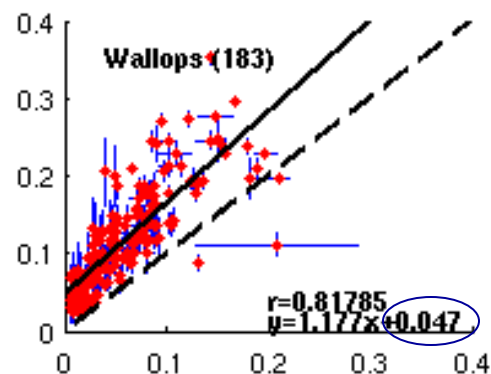
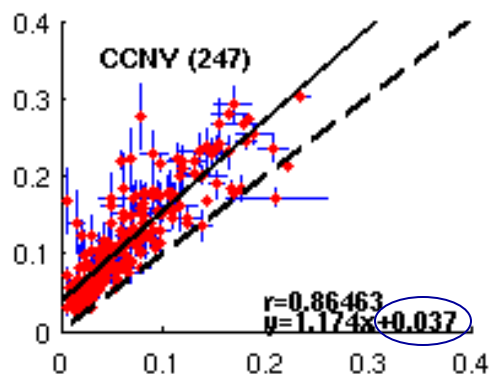
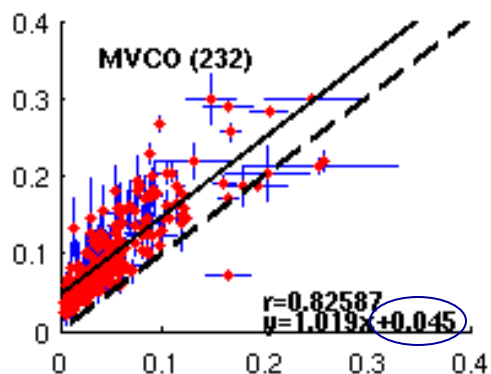
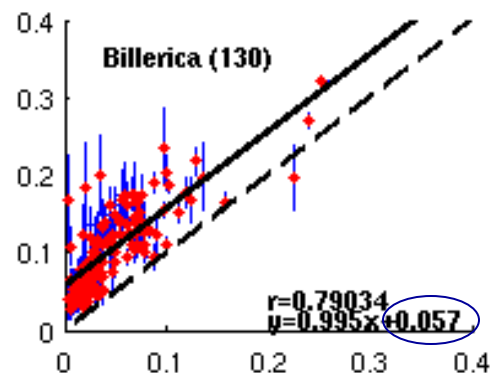
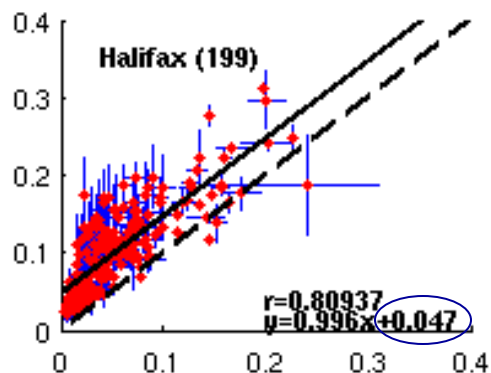
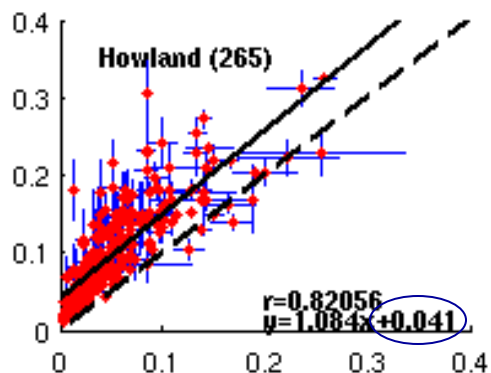
AERONET: 8 coastal sites: 3 sites over ocean

MODIS-OC Vs. MODIS-ATM for all sites



MODIS-OC vs. MODIS-ATM for individual sites

Y axis : MODIS-OC $\tau_a(870)$

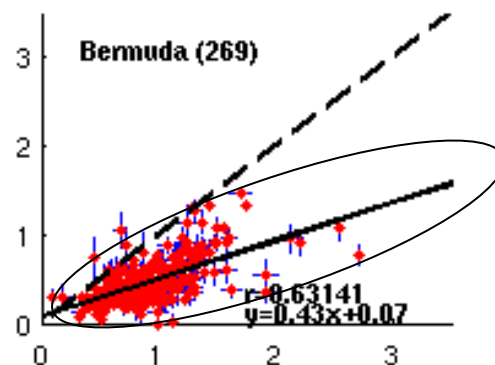
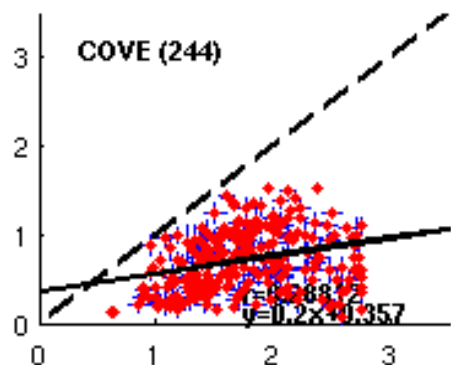
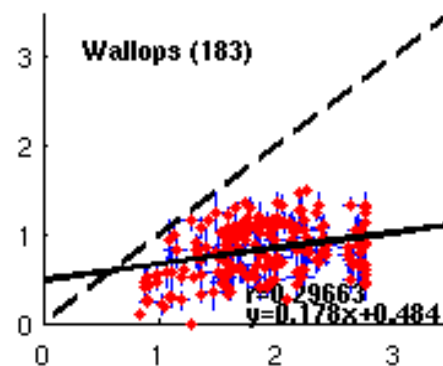
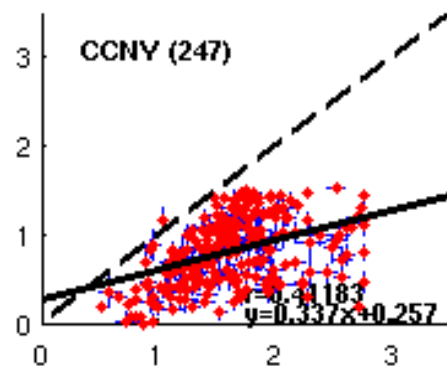
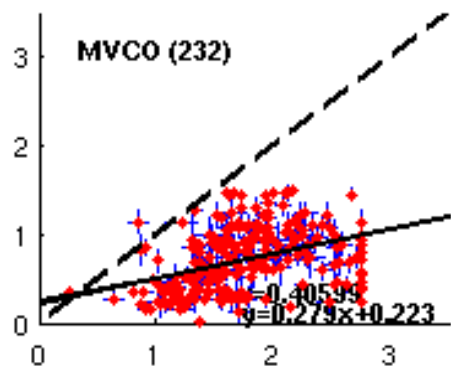
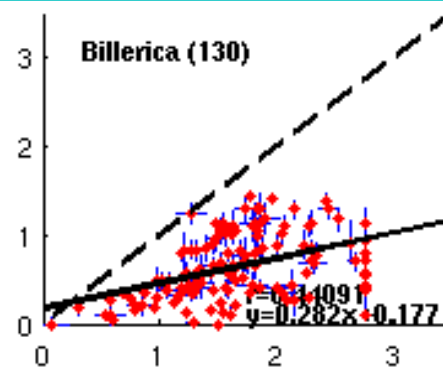
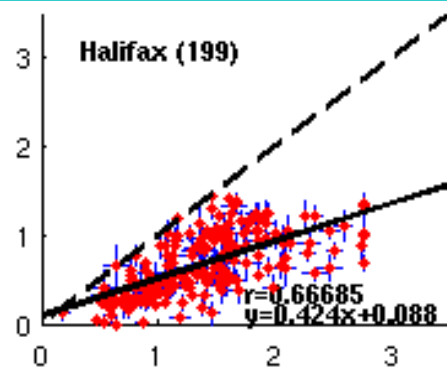
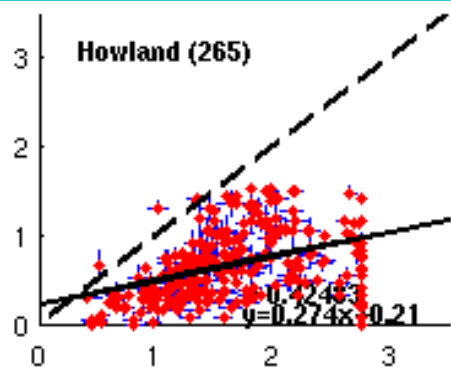


Error bars: ± 1 standard deviation of MODIS pixels

X axis : MODIS-ATM $\tau_a(870)$

MODIS-OC Vs. MODIS-ATM for individual sites

Y axis : MODIS-OC Angstrom $\alpha(550,870)$

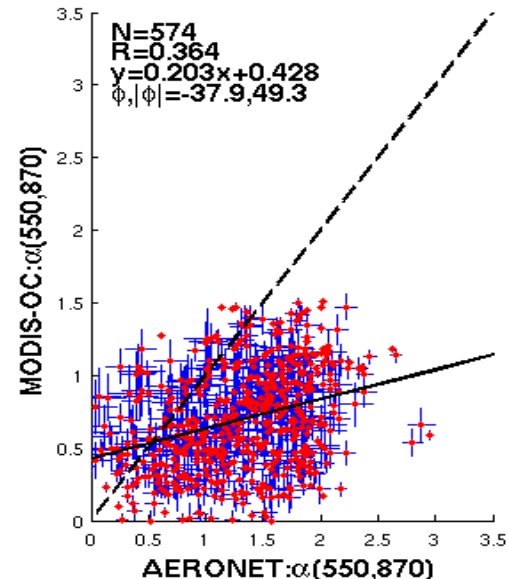
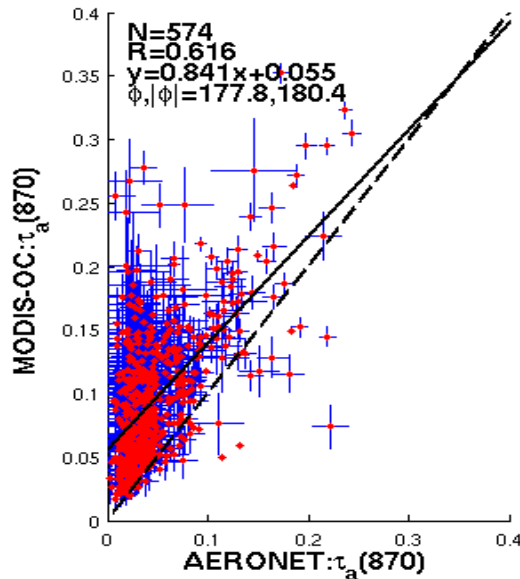
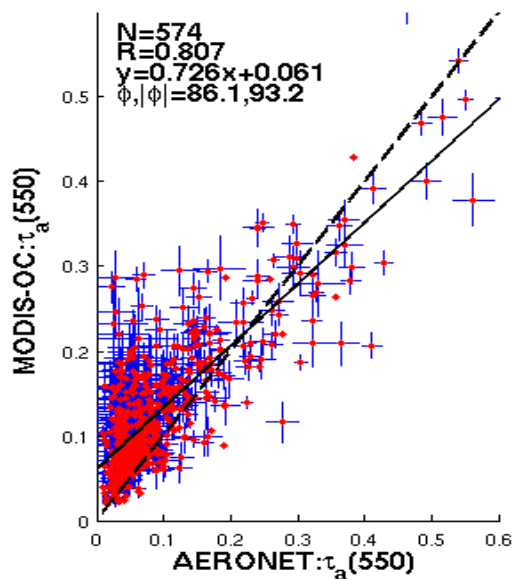


Error bars: ± 1 standard deviation of MODIS pixels

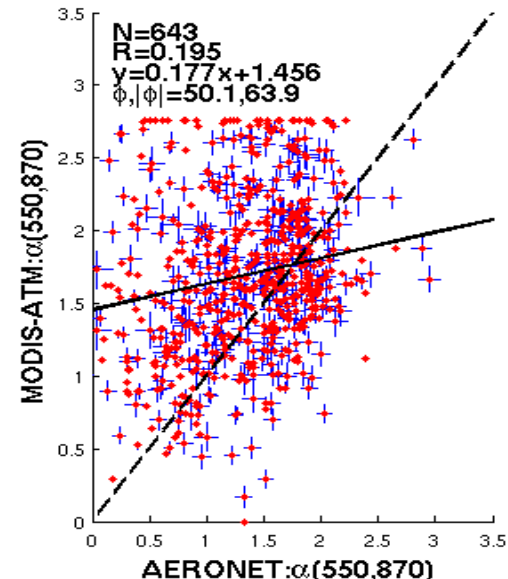
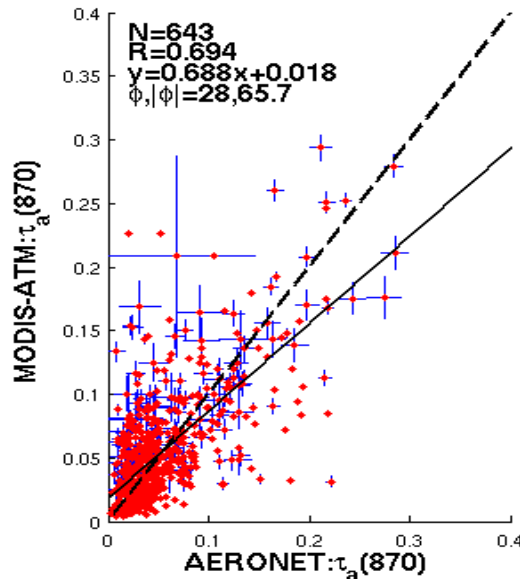
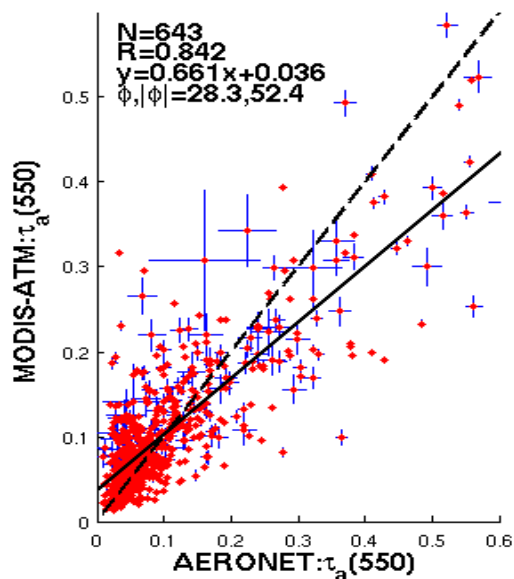
X axis : MODIS-ATM Angstrom $\alpha(550,870)$

Summary 1: MODIS-OC vs. MODIS-ATM

- MODIS-OC and -ATM $\tau_a(870)$ are highly correlated ($r > 0.8$)
- MODIS-OC $\tau_a(870)$ is systematically overestimated (+0.05)
- MODIS-OC $\alpha(550, 870)$ is systematically underestimated



Scatter plots of MODIS-OC vs. AERONET



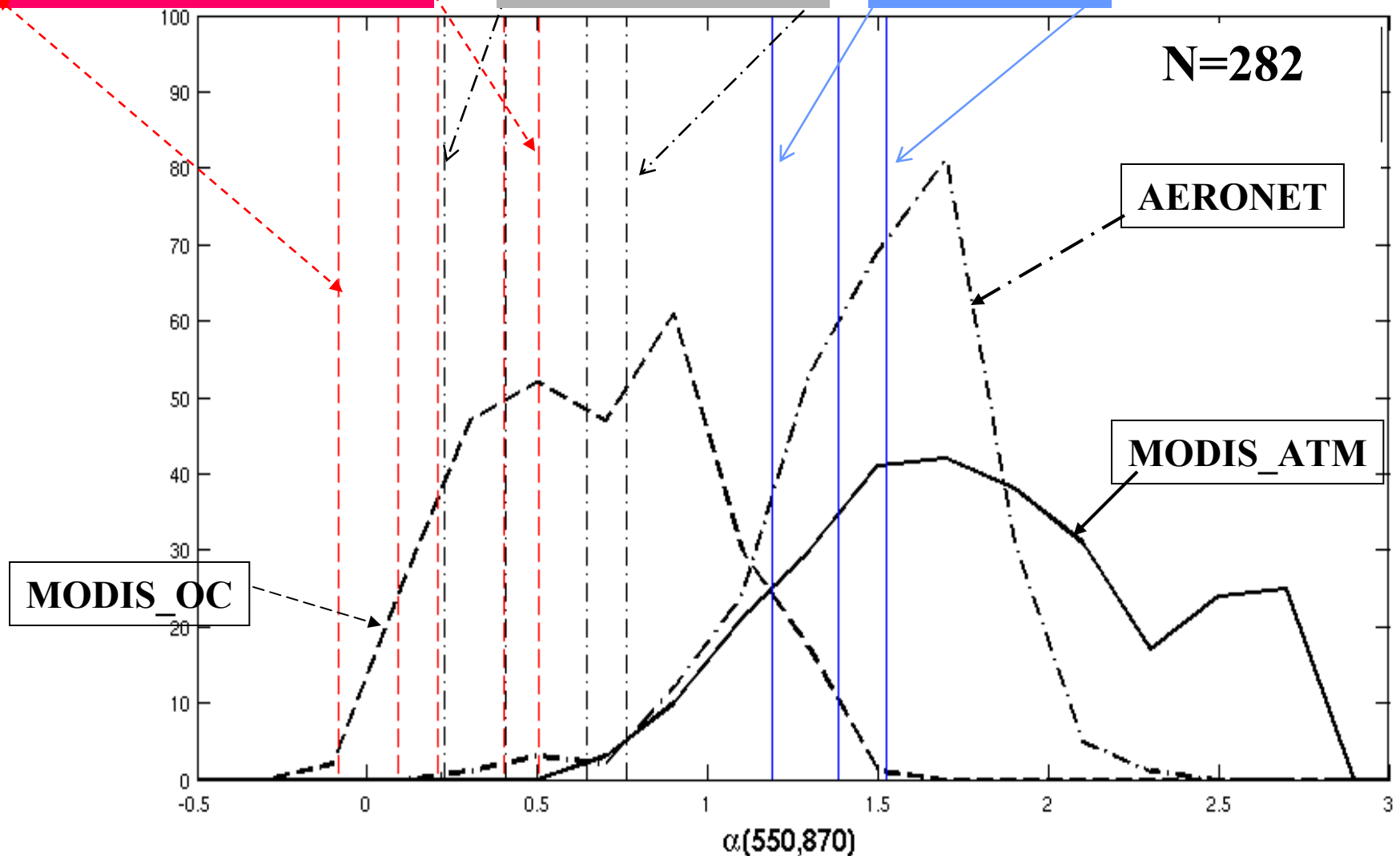
Scatter plots of MODIS-ATM vs. AERONET

Comparison of angstrom $\alpha(550,870)$ (MVCO, Wallops, COVE): An implication of MODIS/AERONET aerosol models

O99,M99,M90,M70,M50

C99,C90,C70,C50

T99,T90,T50



Summary 2

- **MODIS-ATM vs. AERONET:**
 - For MODIS-ATM $\tau_a(870)$, there is no significant bias with moderate correlation
 - For MODIS-ATM $\alpha(550, 870)$, there is low bias with low correlation
- **MODIS-OC vs. AERONET:**
 - MODIS-OC $\tau_a(870)$ is systematically overestimated with moderate correlation
 - MODIS-OC $\alpha(550, 870)$ is systematically underestimated with low correlation
- **MODIS-OC candidate aerosol models mismatch AERONET and MODIS-ATM ones in the US northeast coastal region**

Acknowledgements

Funds:

- NASA MODIS Instrument contract (NNG04HZ37C, J.W. Campbell, P.I.)
- NASA OBB (NNX07AB20G, J. Morrison, P.I.).

Others:

- AERONET PIs for data
- NASA DAAC for MODIS-OC and MODIS-ATM data

Extra supporting slides

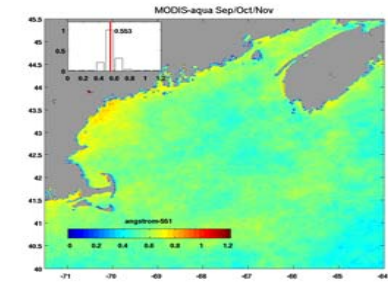
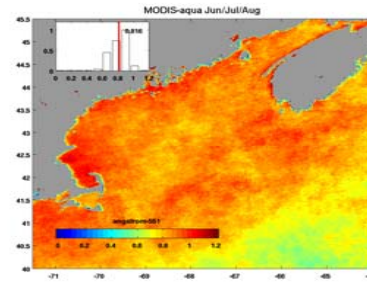
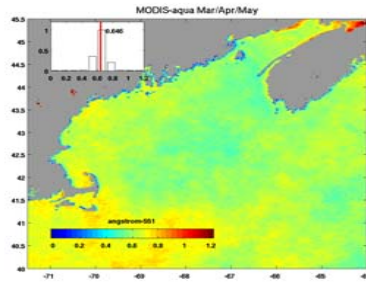
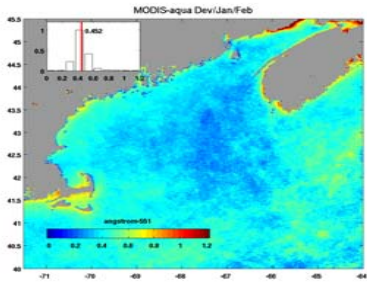
Seasonality of MODIS-OC Angstrom $\alpha(550,870)$ statistics: aerosol models

Winter (DJF)

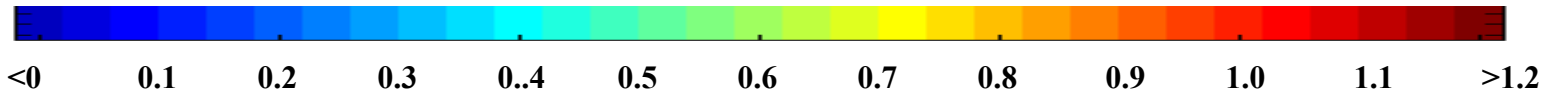
SPRING (MAM)

SUMMER (JJA)

FALL (SON)



MODIS-OC Angstrom $\alpha(550,870)$

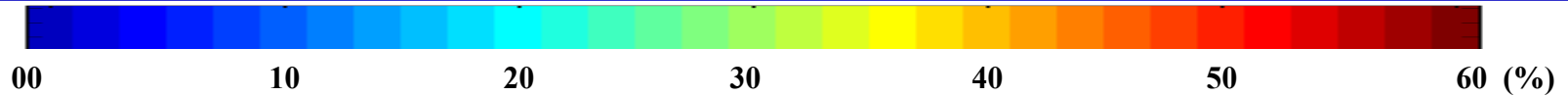
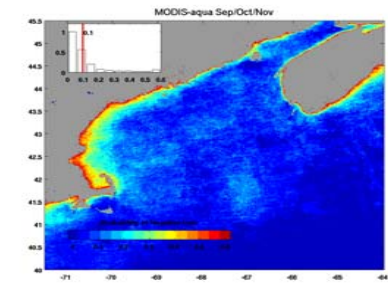
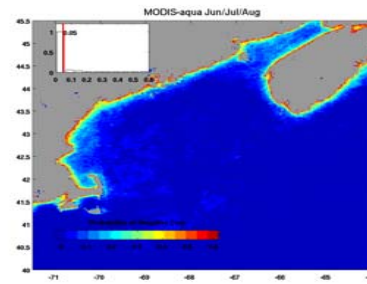
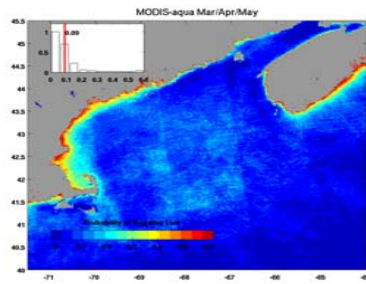
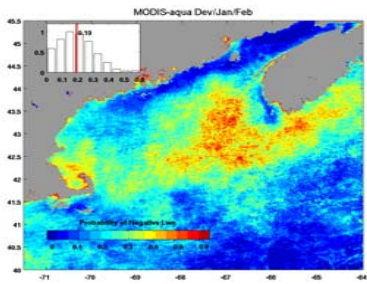


O99,M99,M90,M70,M50

C99,C90,C70,C50

T99,T90,T50

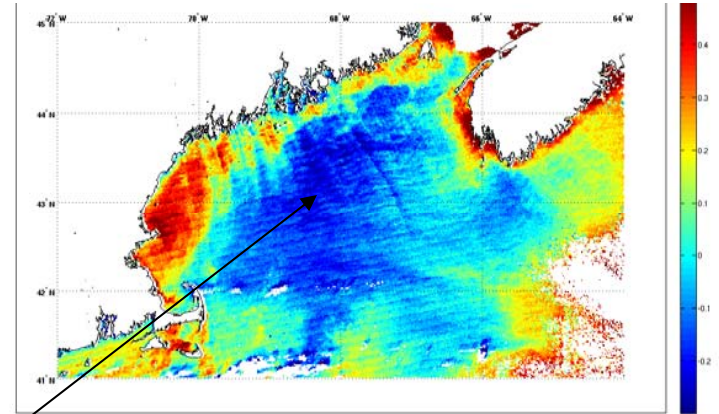
Seasonality of MODIS-OC negative nLw(412) statistics



An example : A MODIS cross-algorithm comparison in the Gulf of Maine region

MODIS-ATM $\tau_a(869)$ (Left)
vs.
MODIS-OC $\tau_a(870)$ and $nL_w(412)$
(Right)

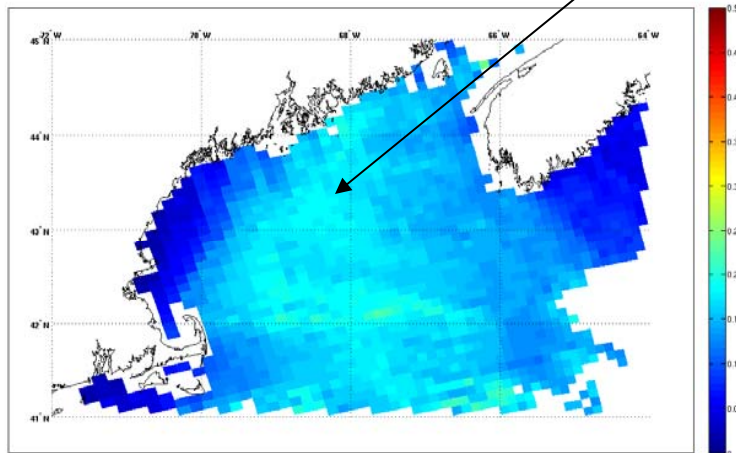
MODIS-Ocean color $nL_w(412)$: 1km²



Feb 27, 2004 (A2004058.1715.004)

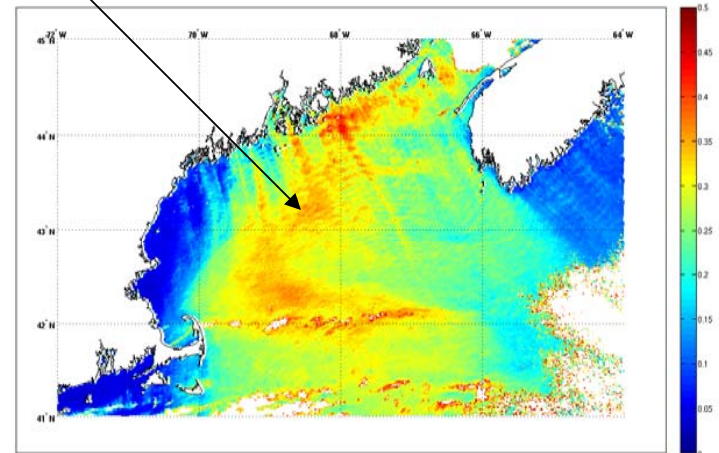
$nL_w(412) < 0$

MODIS-Atmosphere $\tau_a(869)$:10km²



Feb 27, 2004 (MYD04_L2.A2004058.1720.004)

MODIS-Ocean color $\tau_a(870)$: 1km²



Feb 27, 2004 (A2004058.1715.004)