MAIAC Status

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MODIS STM

Silver Spring, June 8, 2016

MAIAC: General Information

Status:

- *MAIAC is at MODAPS for C6+ re-processing of MODIS (MCD19)*

Products (gridded):

- ***Atmosphere****: WV, CM, AOT, SSA, aerosol type (background/smoke/dust), FMF (over water) @1km resolution;*
- ***Land Surface****: spectral BRDF (RTLS model, naturally gap-filled), BRF (surface reflectance) @1km and 500m, albedo;*
- ***Detected Snow****: snow grain size, and sub-pixel snow fraction (1km);*

Last-minute changes to algorithm while it is under testing in MODAPS. ATBD in preparation.

As MODIS algorithm is fixed, VIIRS code will be delivered in 2-3 weeks.

Multi-Angle Implementation of Atmospheric Correction (MAIAC)

Features

1. *Grid TOA L1B data to 1km fixed grid – work with polar-orbit data as "geostationary-like";*
2. *Sliding window algorithm – store 4-16 last days of measurements in memory;*
3. *RT with fully coupled BRDF model;*
4. *Accumulate surface-related information for each grid cell (spectral BRDF, BT-contrasts etc.)*

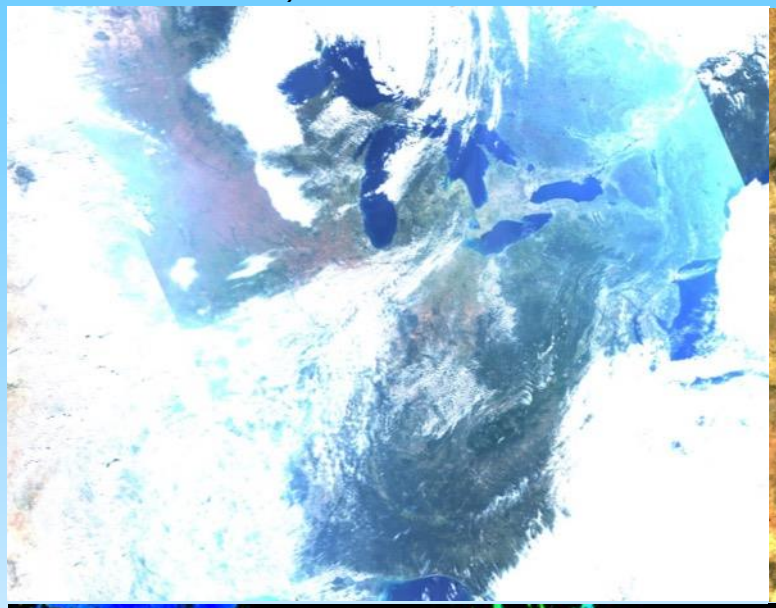
Main Results

1. *Advanced cloud (snow) detection – particular improvements over tropics and at northern lat. (vegetation analysis);*
2. *AOD data globally over dark and bright land surface;*
3. *Aerosol at 1km resolution & low urban bias – strong interest from AQ community;*
4. *AC at $AOT_{0.47}$<1.5, RTLS retrievals at $AOT_{0.47}$<0.6*

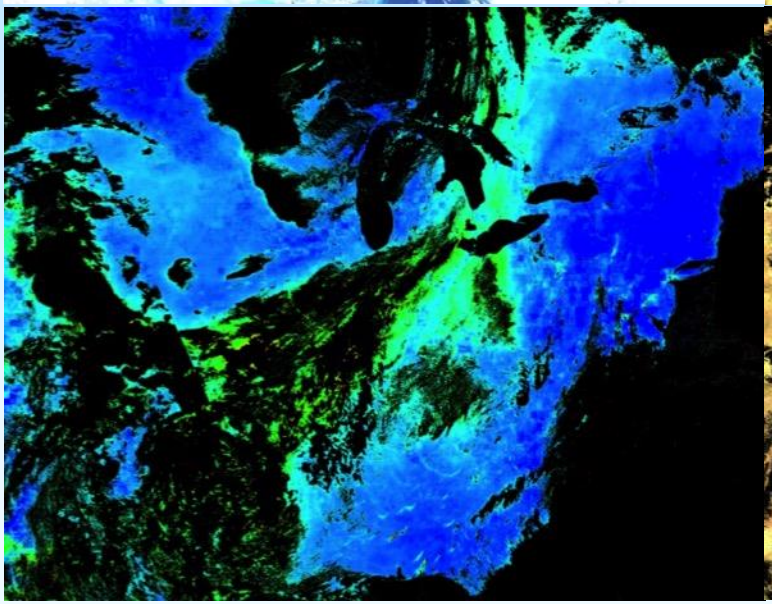
MAIAC = *Time Series + Spatial Analysis*

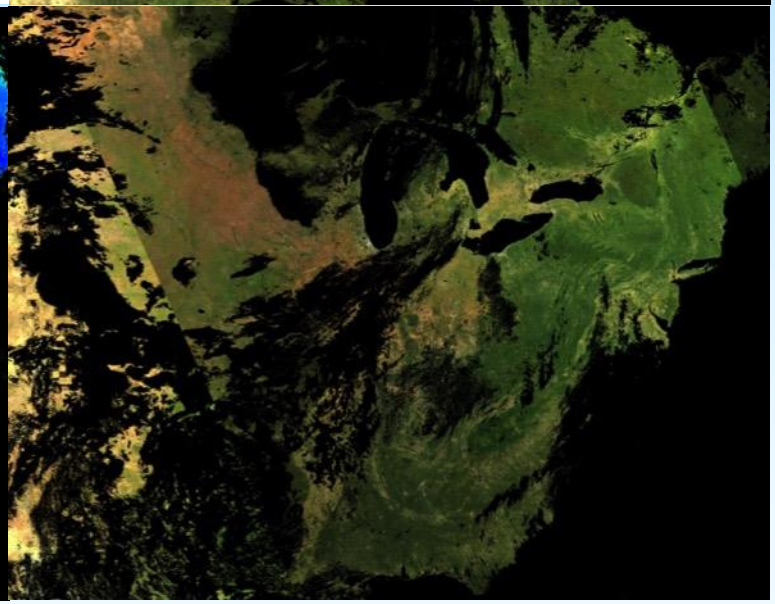
MODIS, TOA RGB

NBRF



AOT





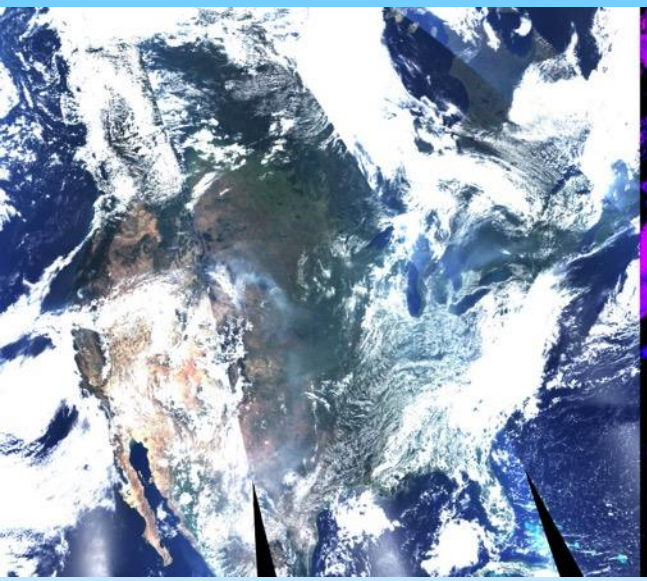
BRF

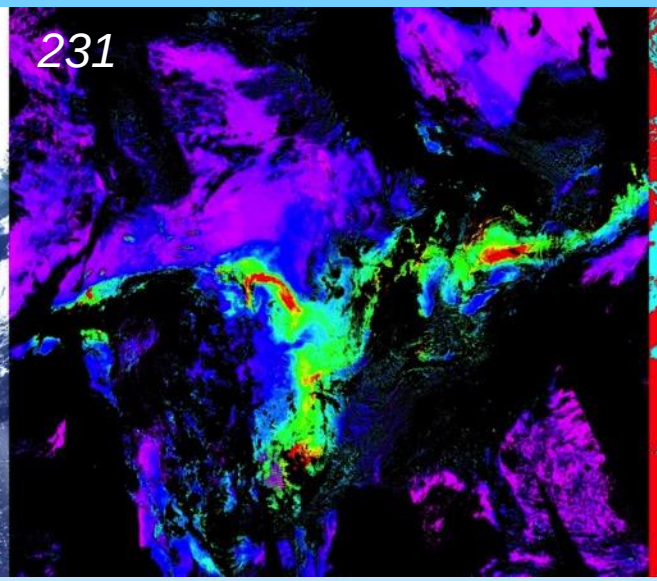
Idaho/Wyoming – Yosemite Fires (08-2013)

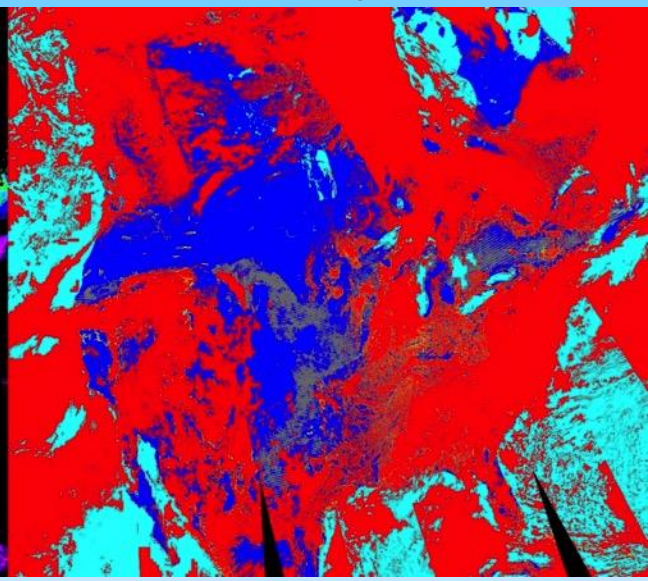
TOA RGB

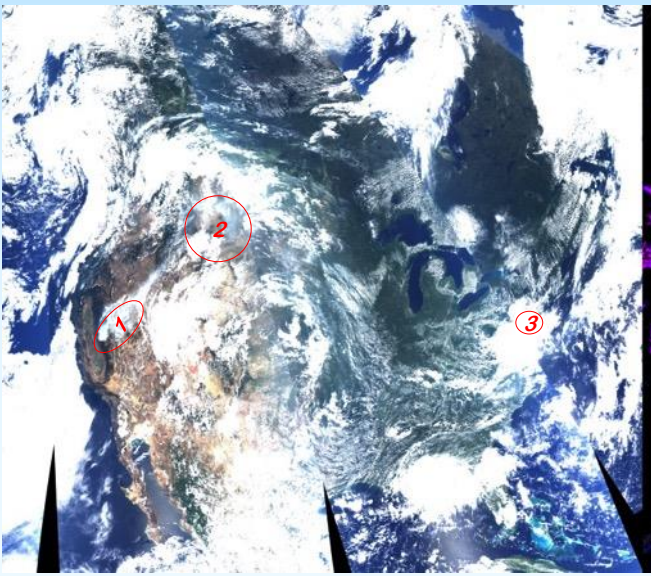
MAIAC AOT(0.47)

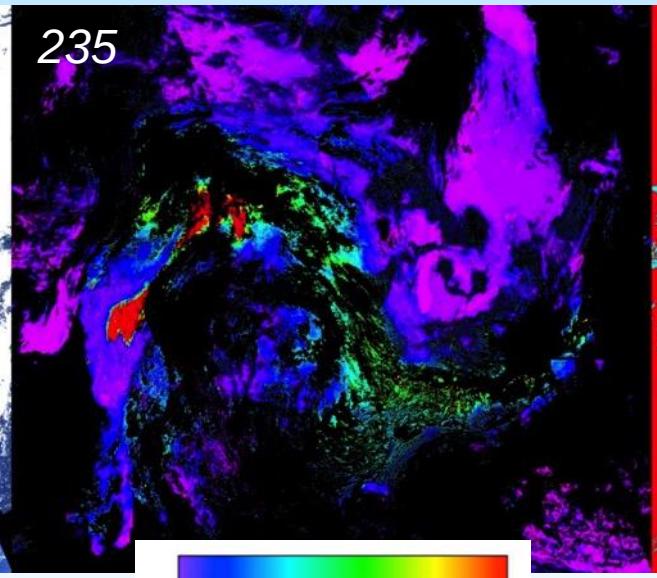
MAIAC CM: Red – Clouds; Grey – Smoke;

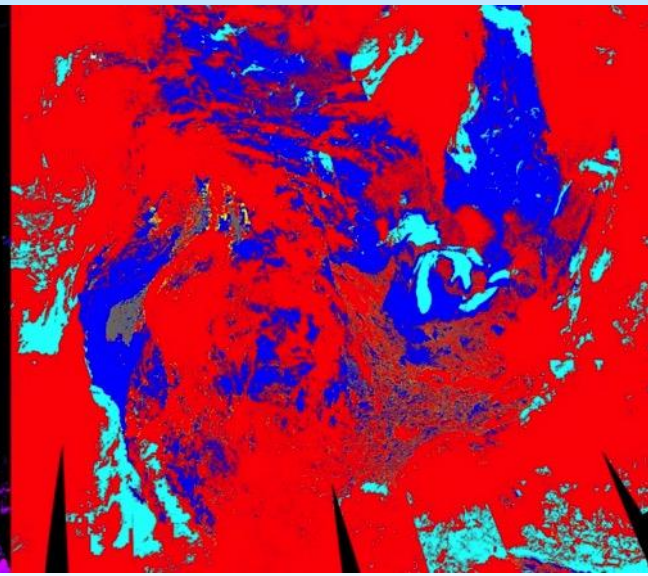


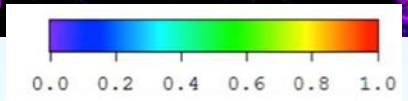




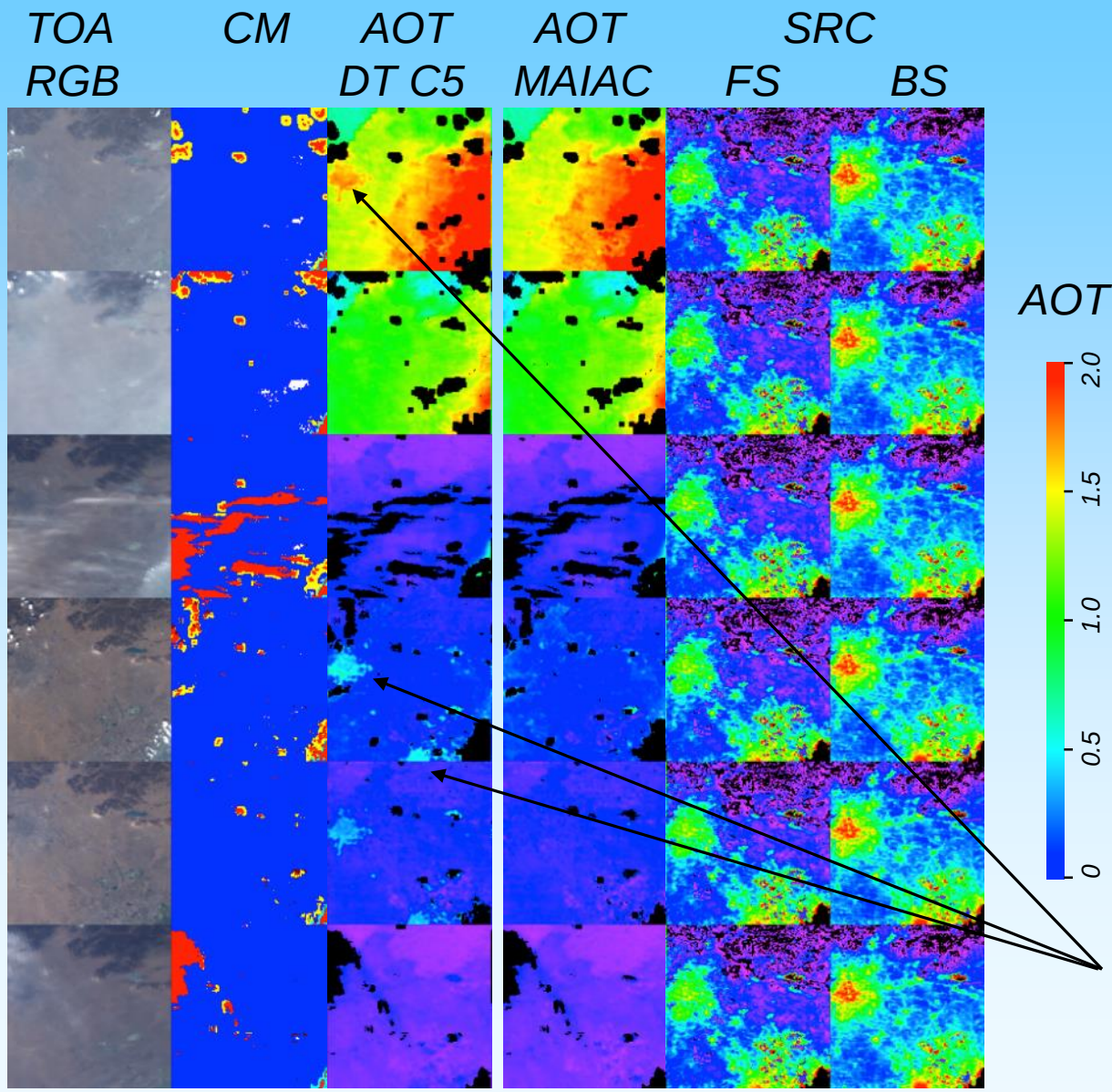








Urban Bias: Xianghe



$\rho_{0.47} = SRC \times \rho_{2.1}$

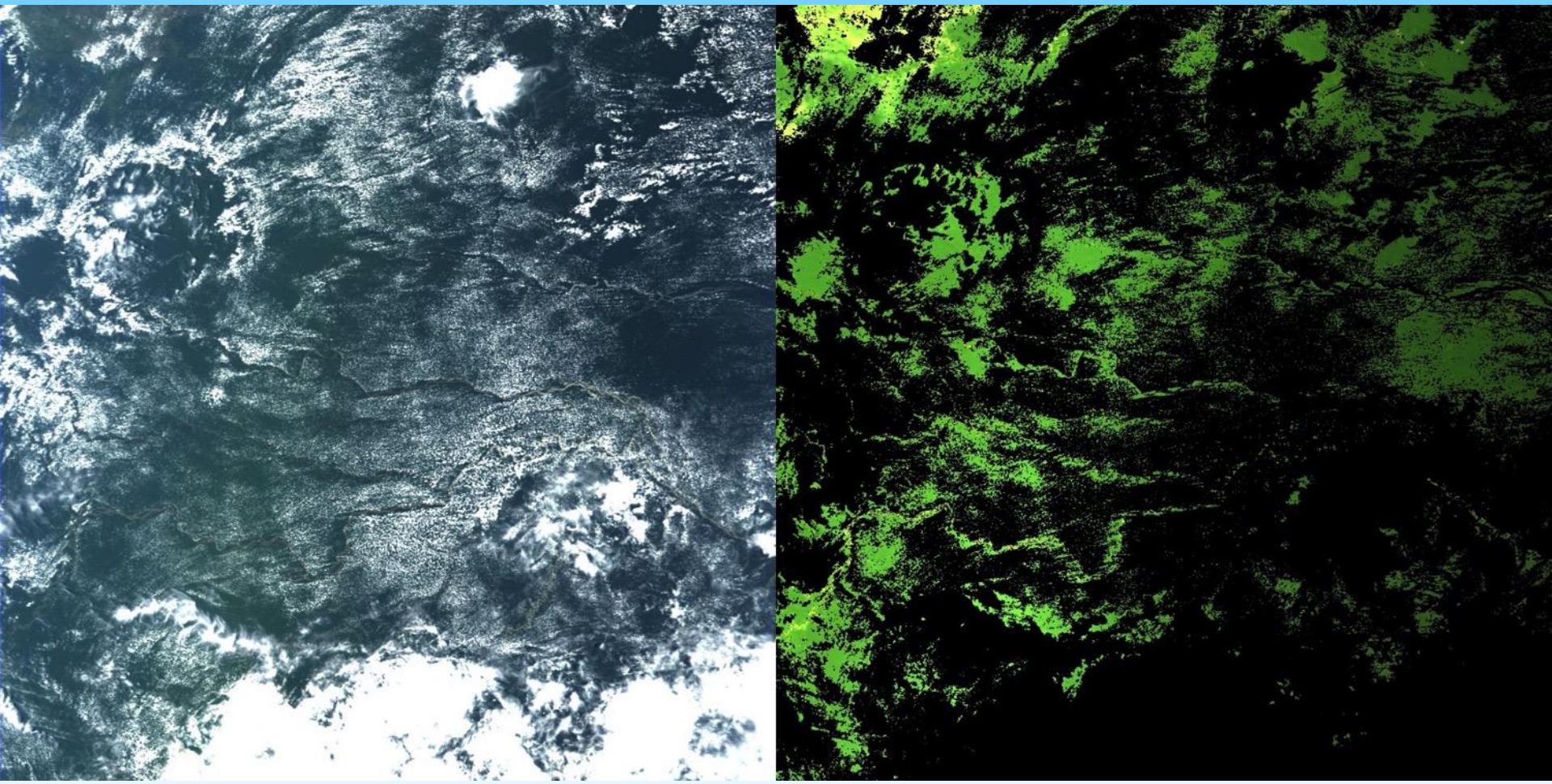
BRDF shape is not spectrally-invariant

DT bias over urban areas where C5 parameterization does not work

Quality of Atmospheric Correction …

TOA RGB

BRF RGB

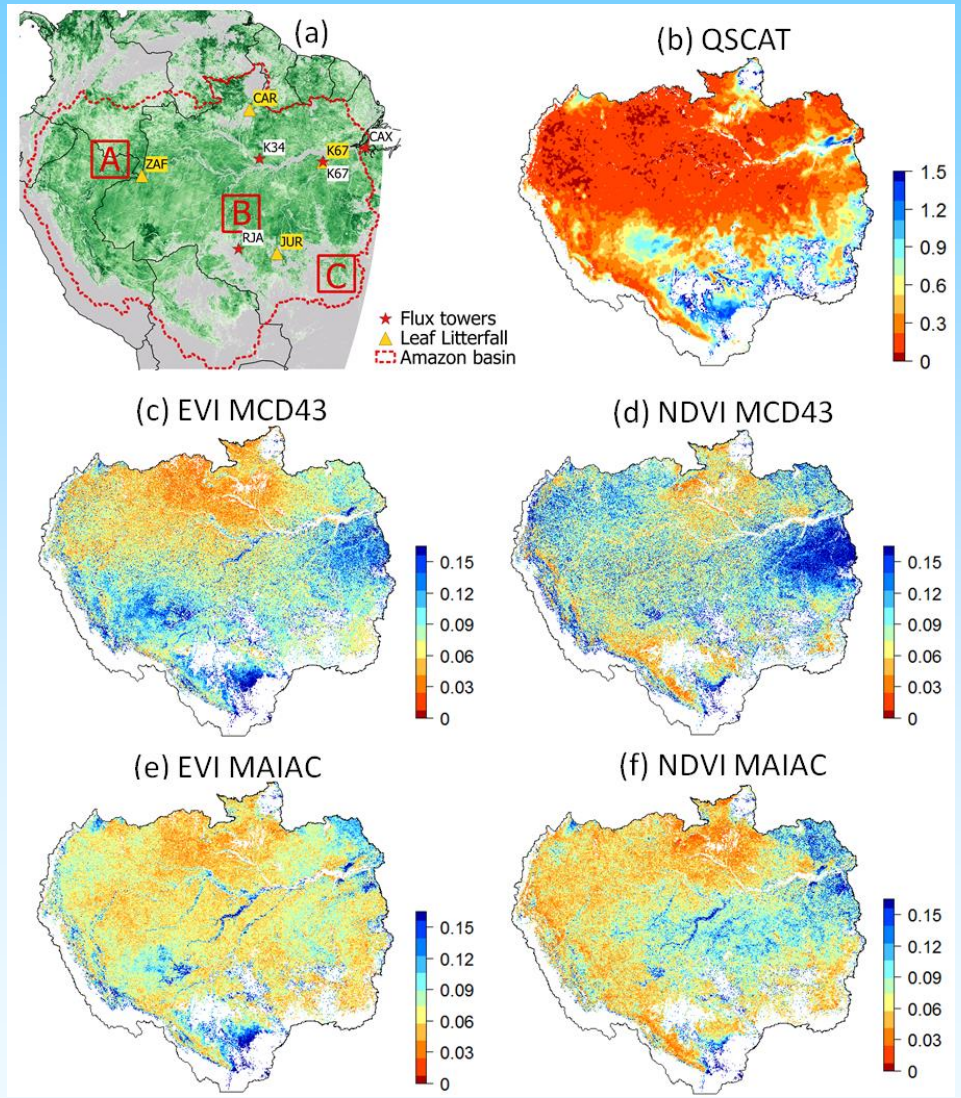


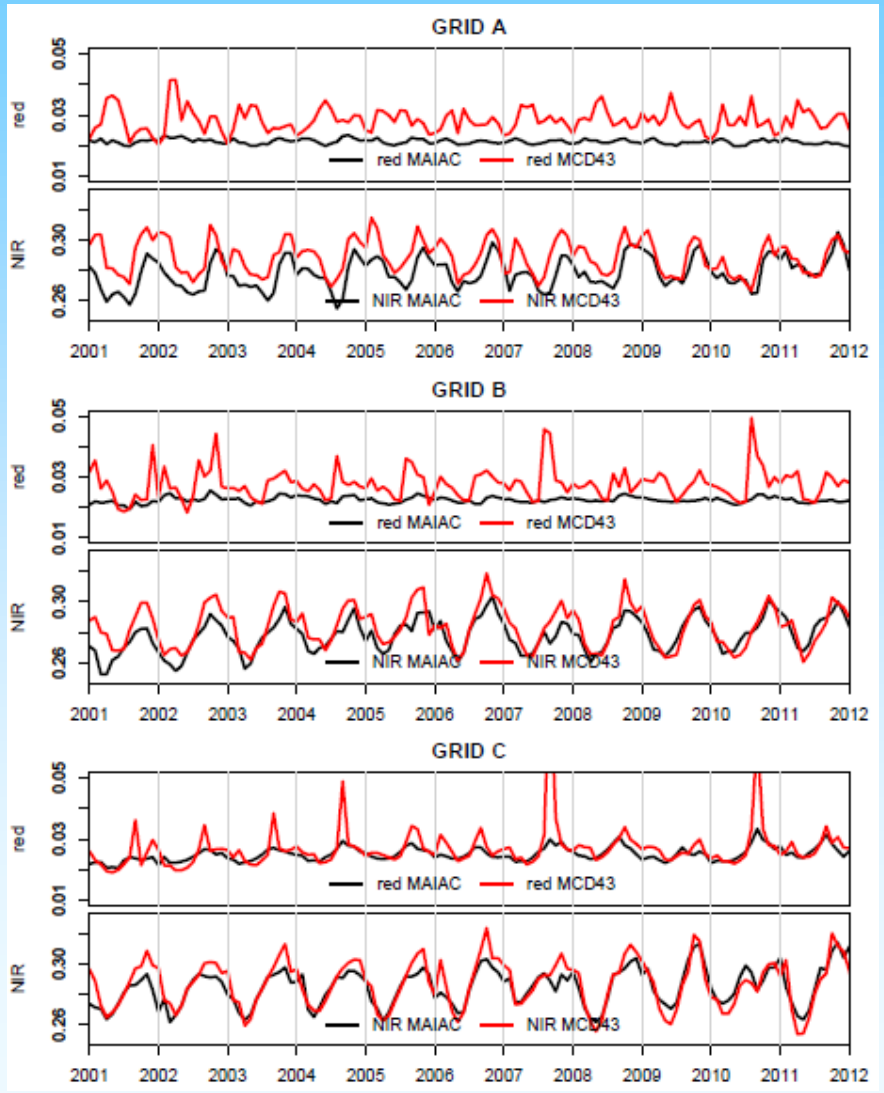
1200 km

Decreasing brightness – moving from backscattering towards forward scattering

Quality of Atmospheric Correction

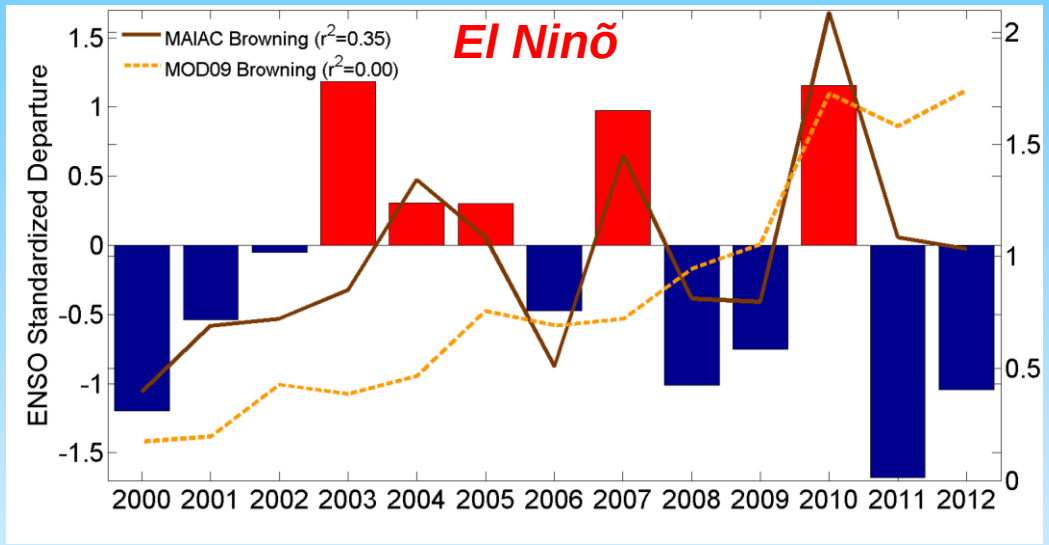
Maeda, E., Mendes Moura, Y., Wagner, F., Hilker, T., Lyapustin, A.I., Wang, Y., Mõttus,M., Aragão, L., Shimabukuro Y. Consistency of vegetation index seasonality across the Amazon rainforest (in press).

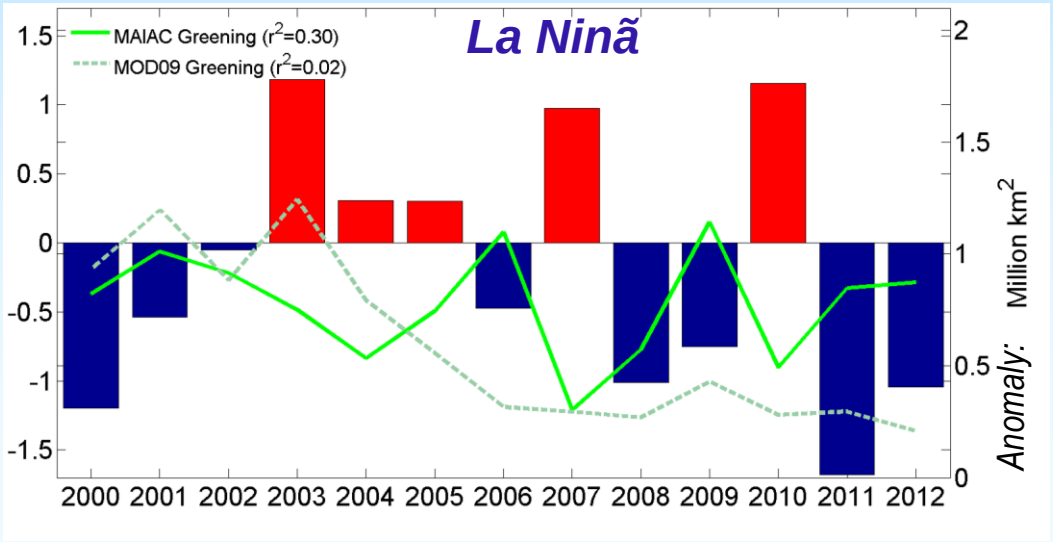




Interannual Variability

Hilker, T., A. I. Lyapustin, C. J. Tucker, F. G. Hall, R. B. Myneni, Y. Wang, J. Bi, Y. M. de Moura, P. J. Sellers (2014), Vegetation dynamics and rainfall sensitivity of the Amazon, PNAS, 111 (45), 16041-16046.





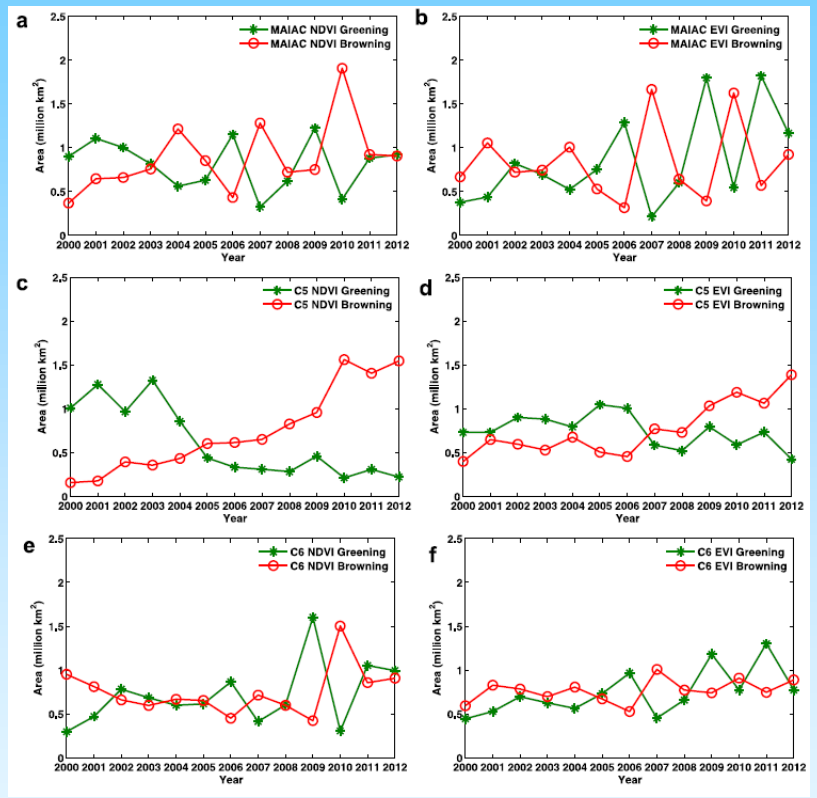
***Amazon** Browning and Greening Anomalies from MOD09 C5 (dashed) and MAIAC C6 L1B data (solid).*

Anomaly Analysis – Myneni & Jian (BU)
Correlation with MEI – Hilker & Lyapustin

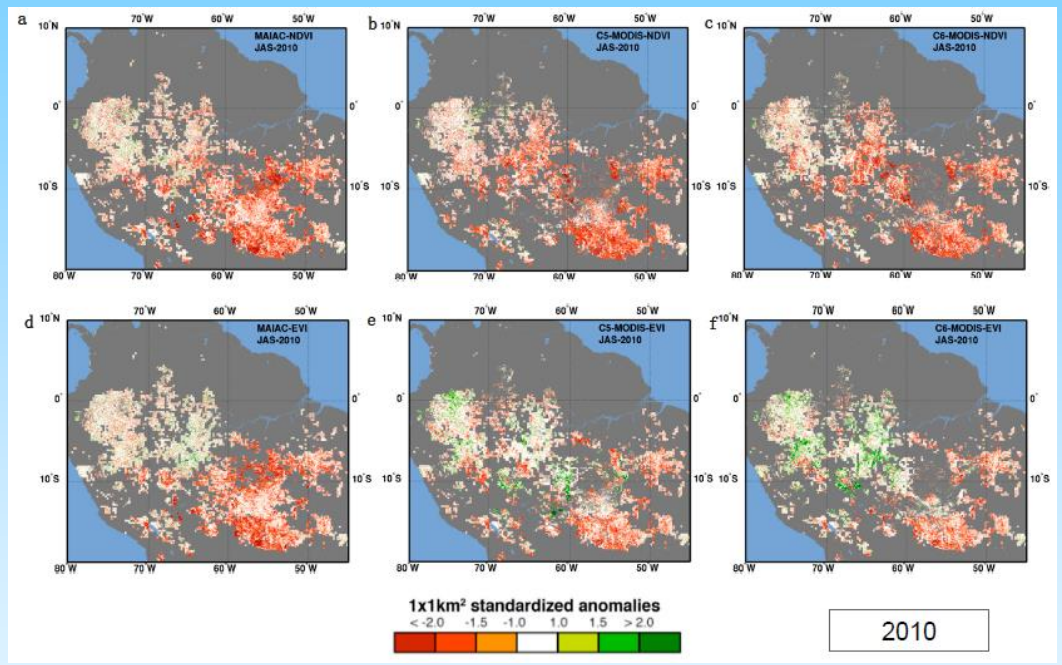
Significant interannual variability in MAIAC B/G anomalies and expected physical correlation with the short-term climate variations.

Interannual Variability

Bi, J., R. Myneni, A. Lyapustin, Y. Wang, T. Park, C. Chen, K. Yan, Y. Knyazikhin, Amazon forests' response to droughts: a perspective from the MAIAC product, Remote Sens., 2016.



Amazon basin Greening and Browning area from MAIAC and MOD09 C5 and C6

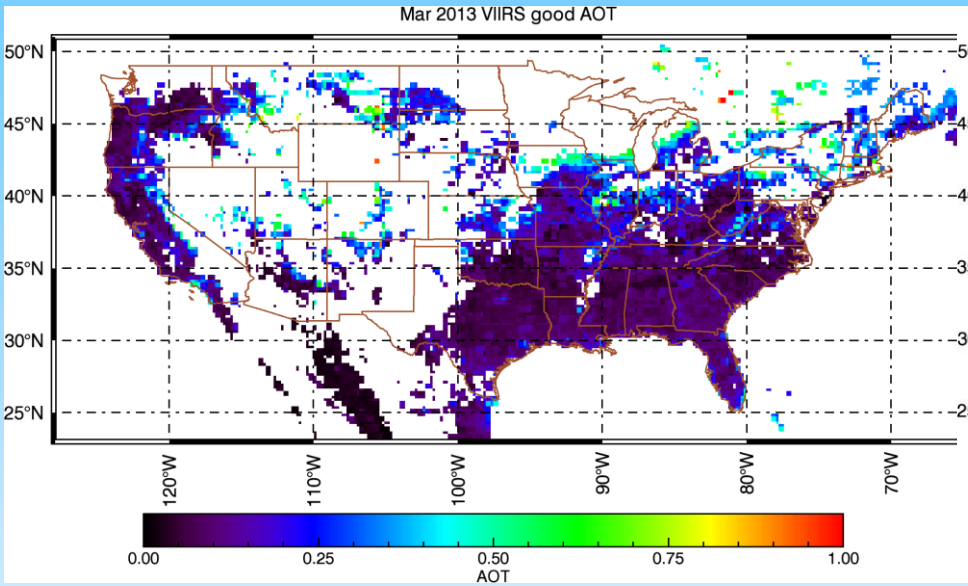


Standardized anomalies for 2010 drought for MAIAC and MOD09 C5 and C6 NDVI, EVI

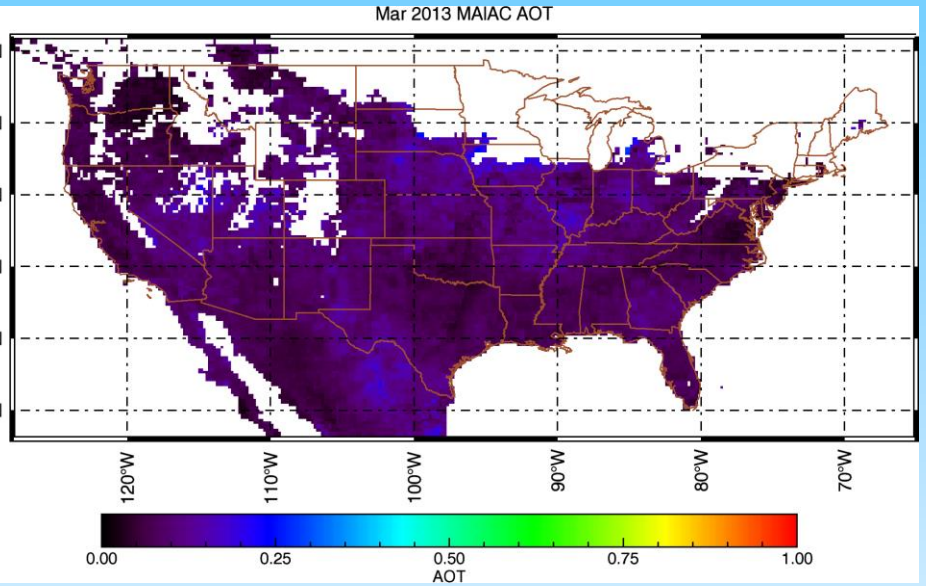
VIIRS AOT IP vs MODIS MAIAC (25km)

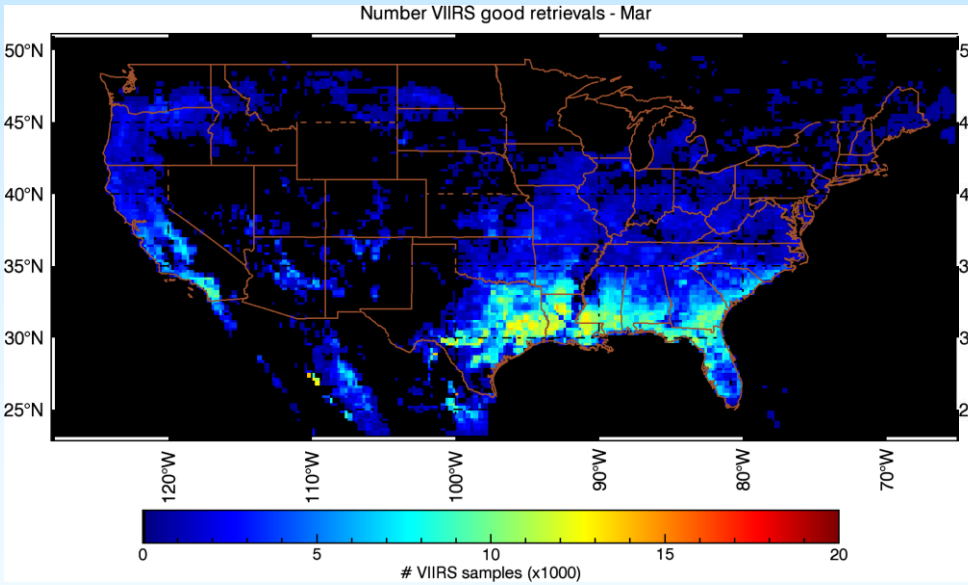
Superczynski, Kondragunta et al., to be subm., 2016)

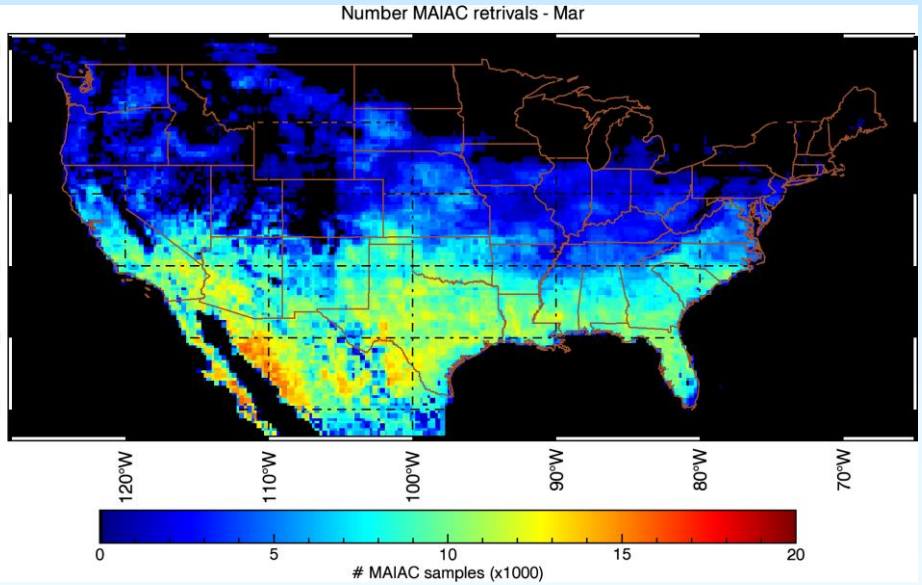
NOAA VIIRS



MAIAC MODIS

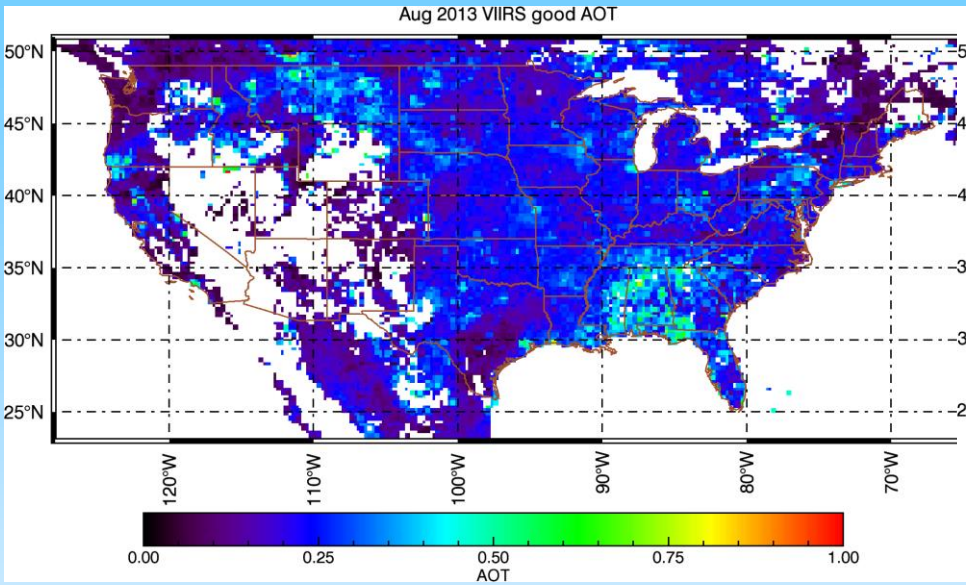


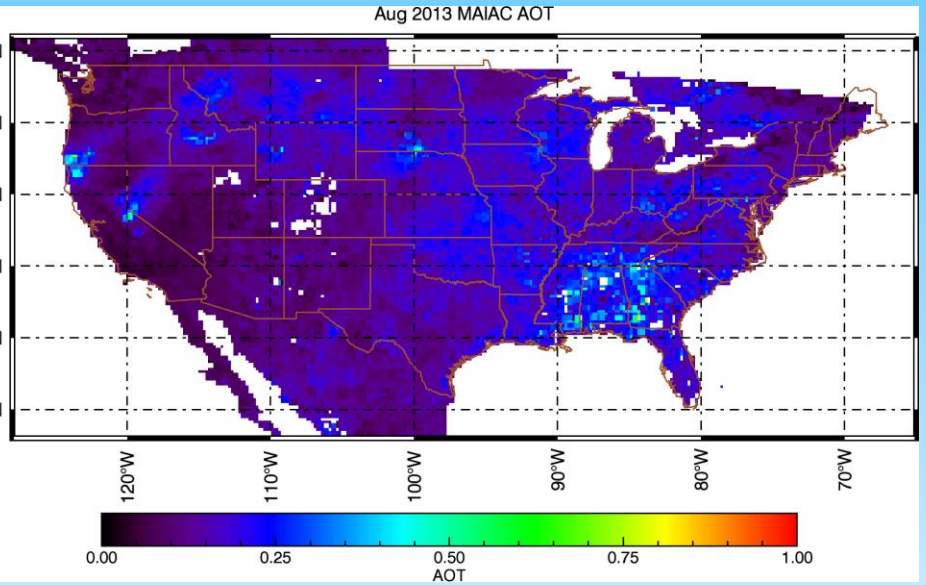


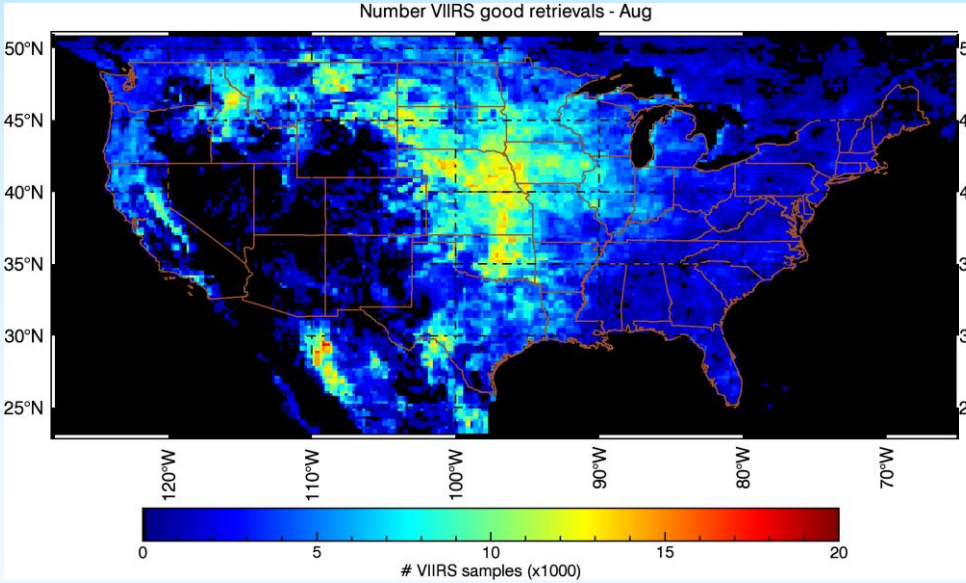


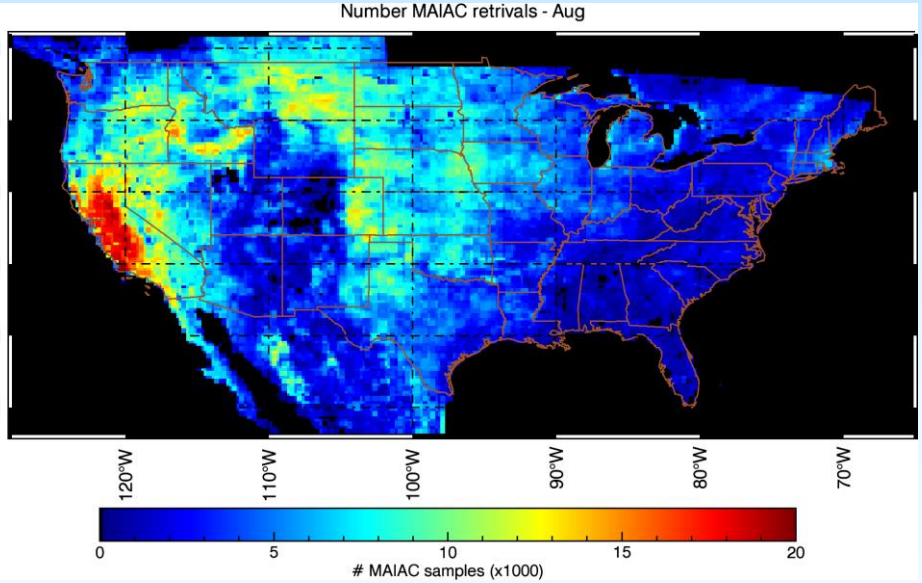
VIIRS AOT IP vs MODIS MAIAC (25km)

(S. Kondragunta, S. Superczynski (NOAA), study for NASA GeoCAPE project)









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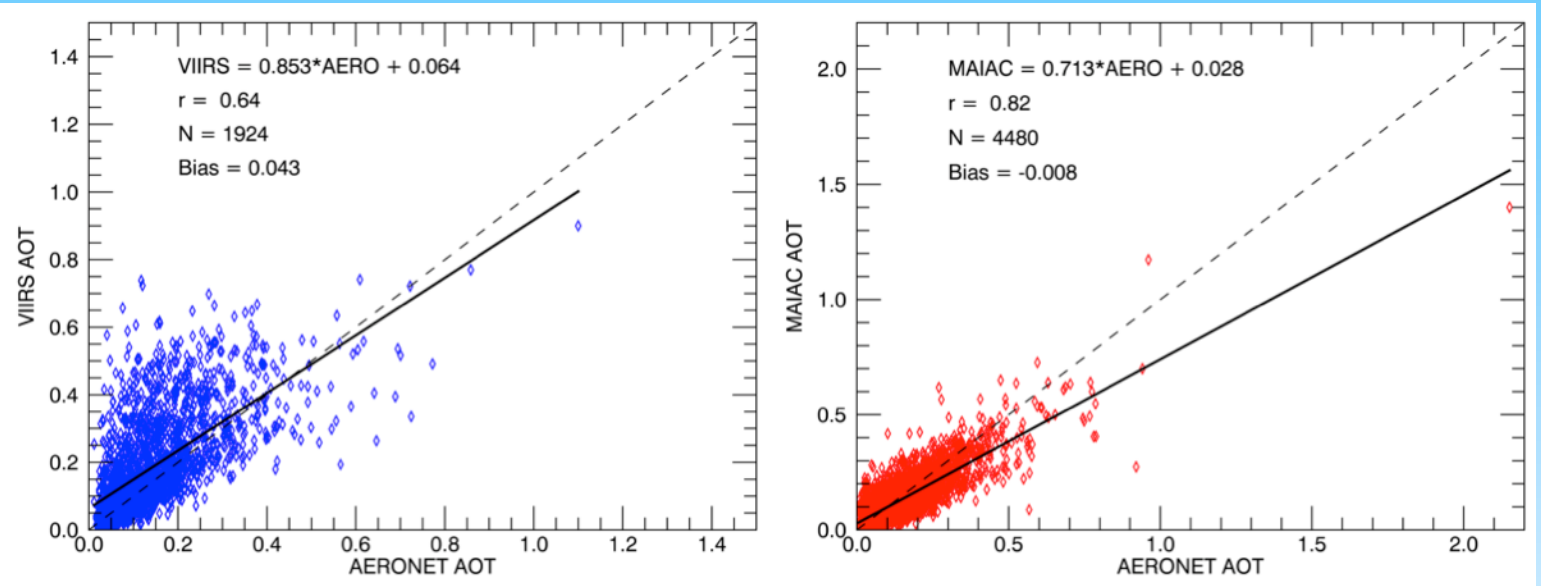
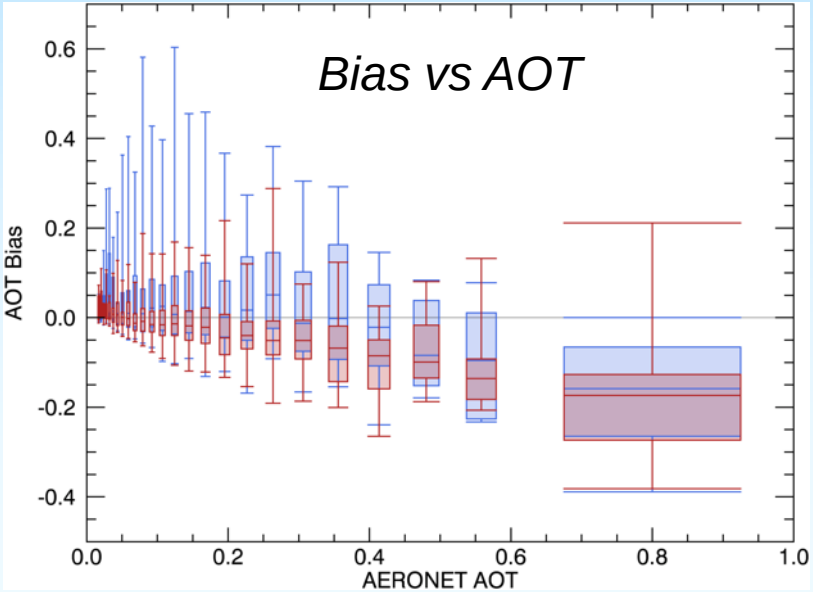
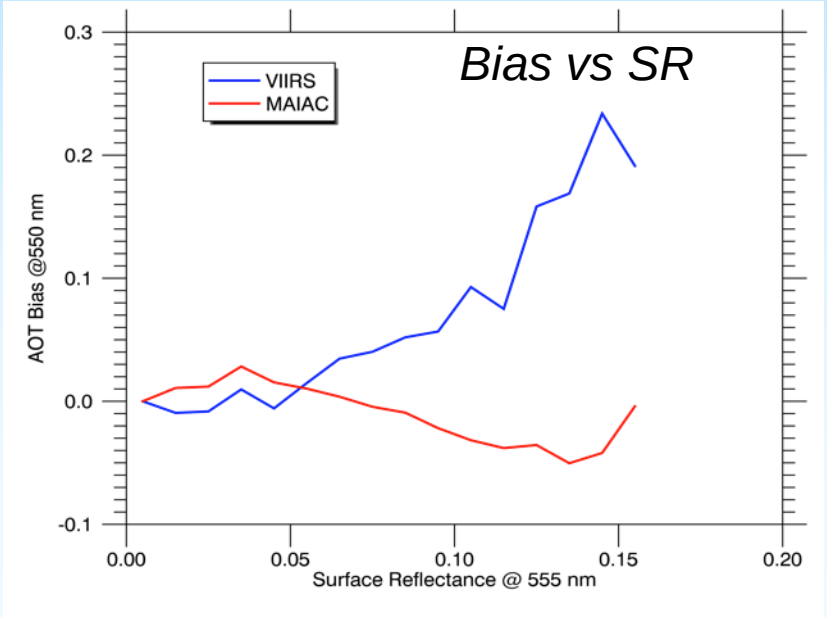
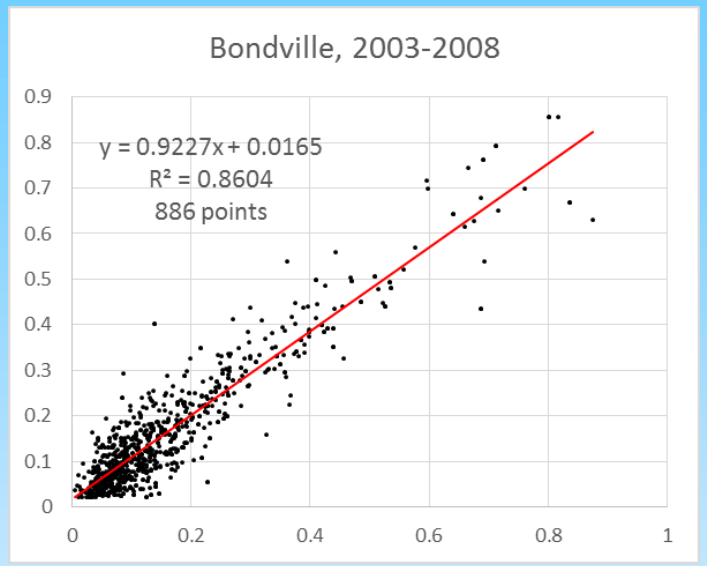




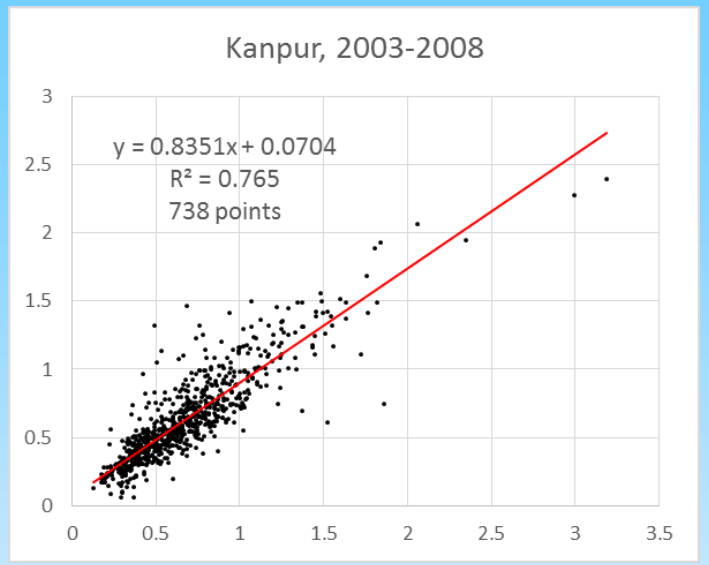


AERONET Validation

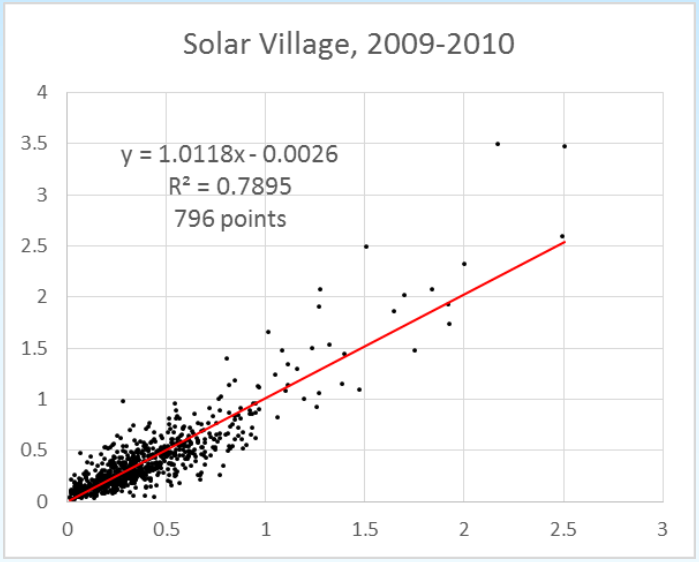
Strong seasonal surface dynamics

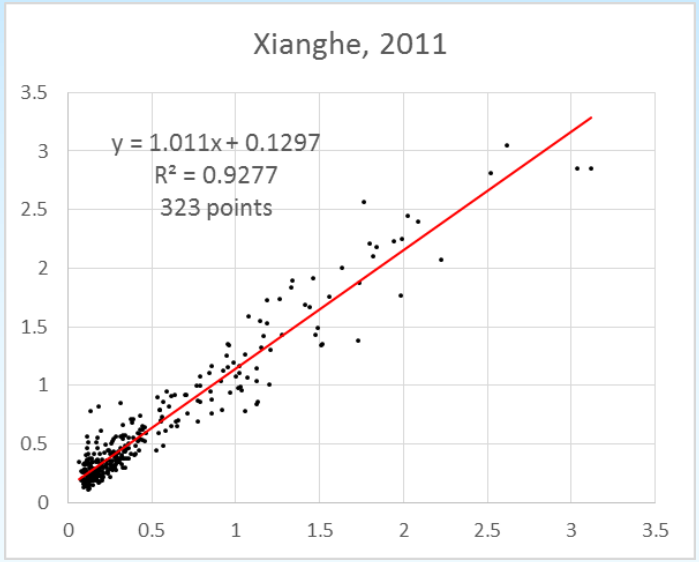


Surface dynamics, variable aerosol type



Bright surface

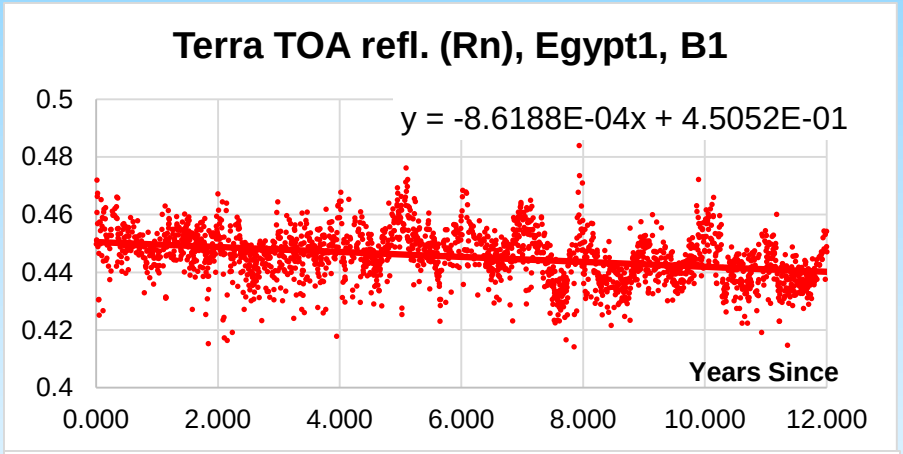


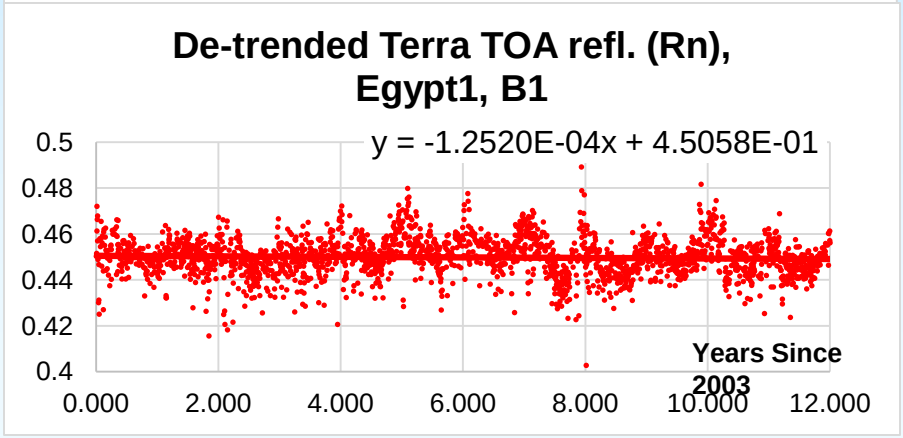


MODIS De-Trending and X-Cal

- New MCST RVS characterization for Aqua → new OBPG Terra Polarization Correction (PC) coefficients → MODAPS generated 50km L1B subsets for CEOS desert cal. sites;
- Method: a) run MAIAC retrievals (AOT, BRDF etc.); 2) compute TOA reflectance (R_n) for fixed geometry (VZA=0°, SZA=45°) and evaluate trends in both Terra and Aqua; 3) Apply de-trending and compute T-A X-calibration factor (gain correction for T)

Lyapustin, A., Y. Wang, X. Xiong, G. Meister, S. Platnick, R. Levy et al, **Science Impact of MODIS C5 Calibration Degradation and C6+ Improvements**, *AMT*, 7, 7281-7319, 2014.



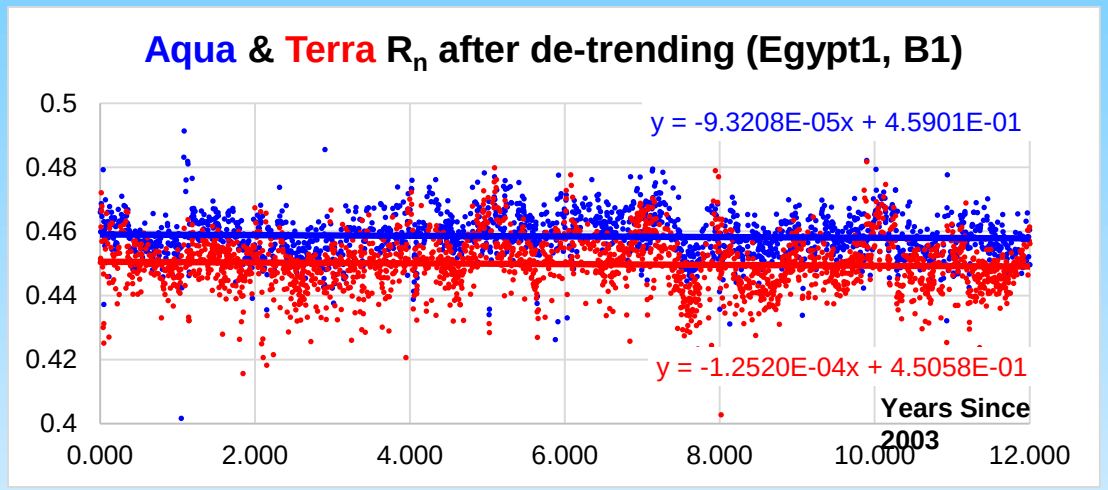


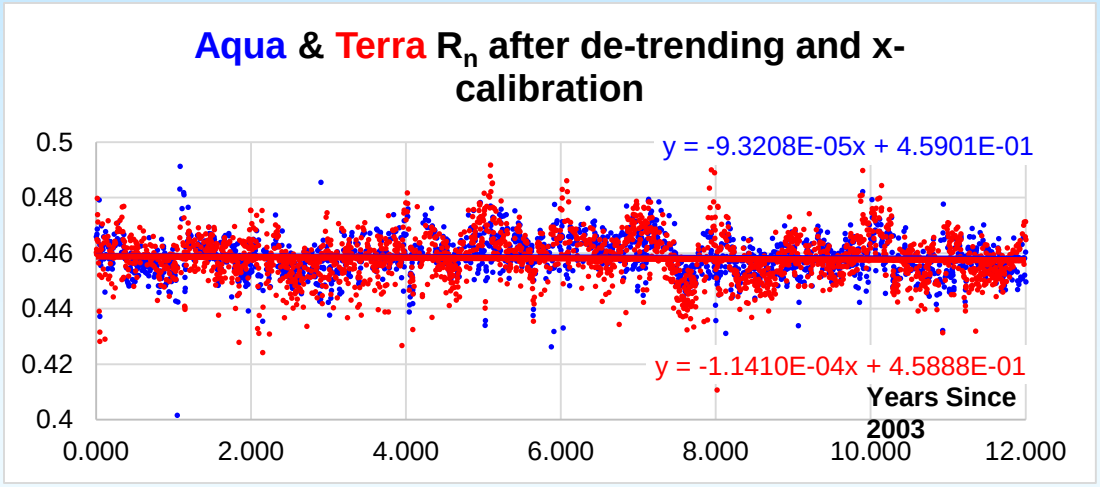
Average trend/year/unit_refl.

	Δ_{Terra}	σ_{Terra}	Δ_{Aqua}	σ_{Aqua}
TOA_B01	-1.6884E-03	2.6114E-04	1.5848E-06	3.9377E-04
TOA_B02	7.7780E-04	2.4303E-04	-6.5120E-05	3.5583E-04
TOA_B03	-8.8922E-04	4.5314E-04	-3.1763E-04	2.8486E-04
TOA_B04	-5.6629E-04	3.2829E-04	-3.9831E-05	5.0202E-04
TOA_B05	1.9477E-04	3.3019E-04	4.5784E-06	3.3528E-04
TOA_B06	-3.9516E-04	3.0211E-04	-3.1194E-04	2.8191E-04
TOA_B07	2.0259E-04	2.4491E-04	-5.8419E-04	3.2705E-04
TOA_B08	-1.2627E-03	1.0018E-03	-5.5178E-04	1.0915E-04
TOA_B09	-3.9874E-04	5.2176E-04	1.3724E-04	2.1120E-04
TOA_B10	-7.2800E-04	8.2601E-04	-3.0632E-04	7.1498E-04

Terra-Aqua X-Calibration

After MCST RVS de-trending for Aqua, we see trend reduction (a factor of 12 in B1 and a factor of 2 in B3) compared to our previous analysis.





Average X-gain for Terra

	Average	Stdev
TOA_B01	1.018776	0.000949
TOA_B02	1.000523	0.001054
TOA_B03	0.989436	0.001268
TOA_B04	1.00109	0.001448
TOA_B05	0.98862	0.001855
TOA_B06	0.997128	0.000898
TOA_B07	0.999368	0.000373
TOA_B08	1.003774	0.000948
TOA_B09	1.0014	0.001488
TOA_B10	1.014141	0.002077