MODIS Atmosphere Solar Reflectance Issues

1. **Aqua VNIR focal plane empirical re-registration status**

Ralf Bennartz, Bob Holz, Steve Platnick[2]

[1] U. Wisconsin, Madison, [2] NASA GSFC

2. Terra trend anomalies in cloud and aerosol data records

Steve Platnick[1], Rob Levy[2]

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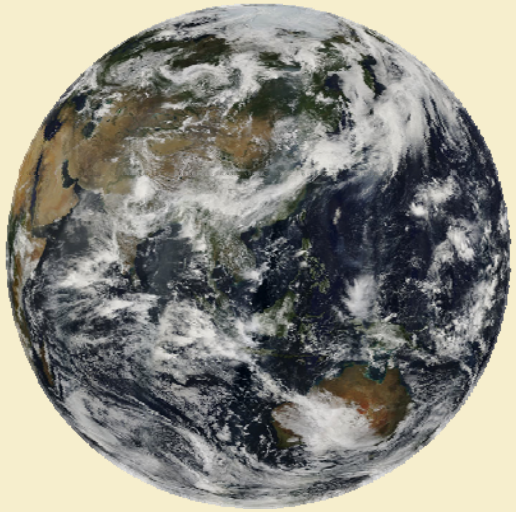

MODIS Cal-Val Mtg., 17 May 2011

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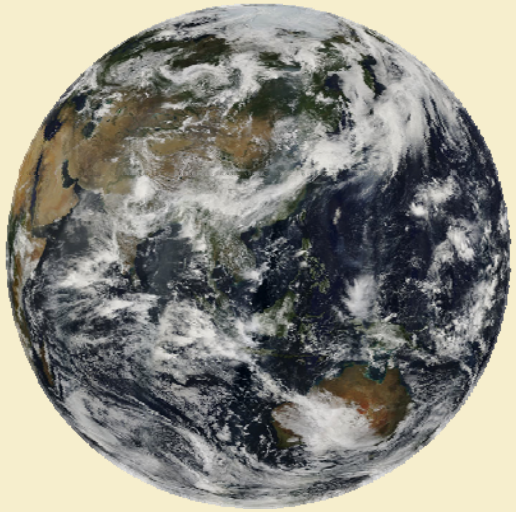

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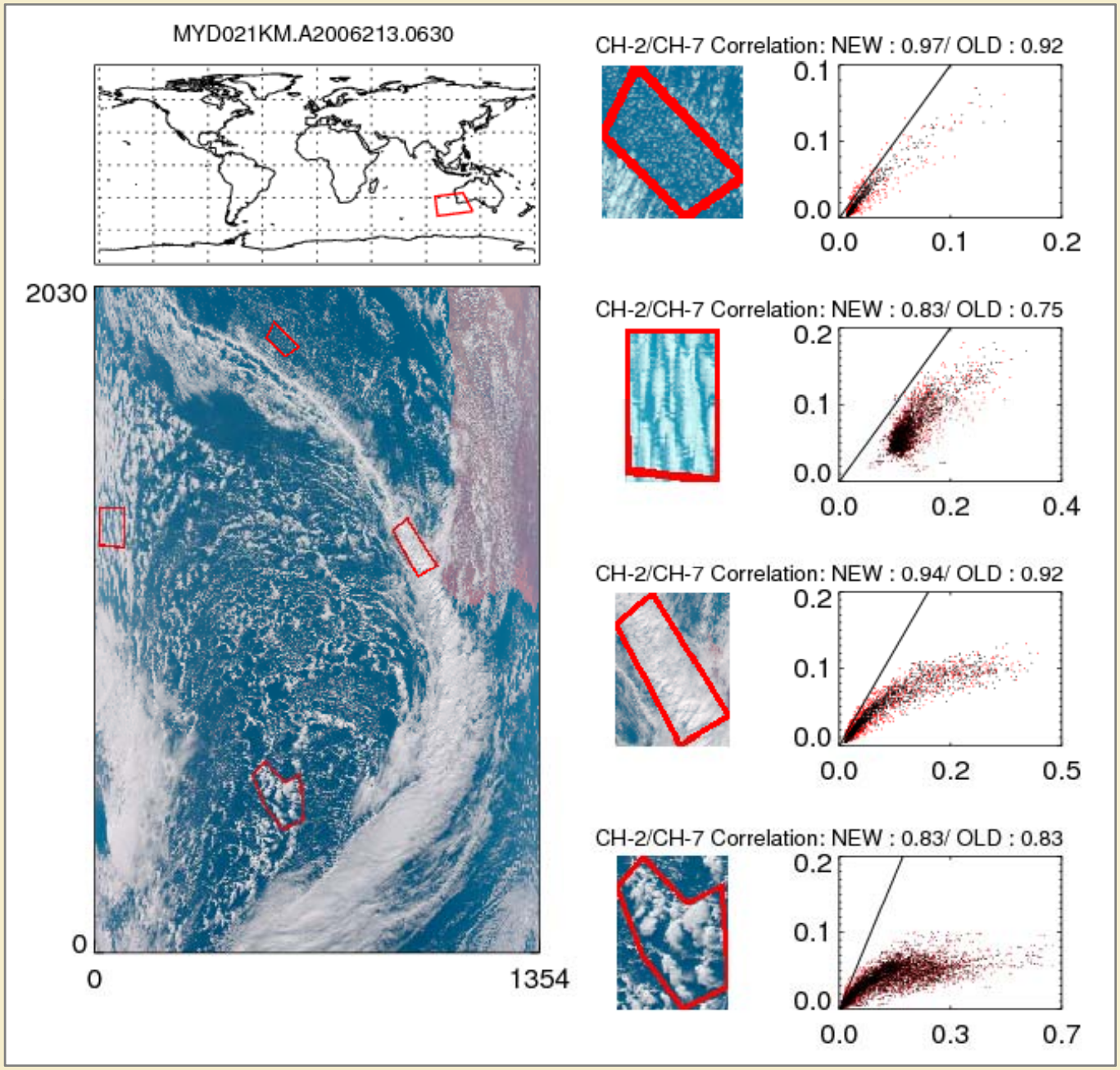
Overview

- AQUA MODIS VNIR focal plane arrays are misregistered by about 200m (cross-track) to 500m (along-track) relative to the SWIR/MWIR/TIR focal plane arrays.
- Misregistration expected to be important for algorithms that use both VNIR and other bands *and* observe strong spatially inhomogeneous scenes (e.g., cloud properties for trade Cu clouds).
- A revised VNIR 250 m → 1 km empirical aggregation approached had already been developed to minimize the misregistration.
    - Empirically-derived weights minimize focal plane mismatch from 250m resolution channels by minimizing the cross-correlation between aggregated VNIR vs. SWIR bands for selected scenes (Levenberg-Marquardt minimization).
    - Empirical weights used to aggregate 250m data to a 1 km file.
- New method has been tested in the UW-Madison Atmosphere PEATE for two months of Aqua MODIS data.
- Results for Level-1 results are reported here.
- Study on impact of new/old aggregation on Level-2 cloud products is ongoing.

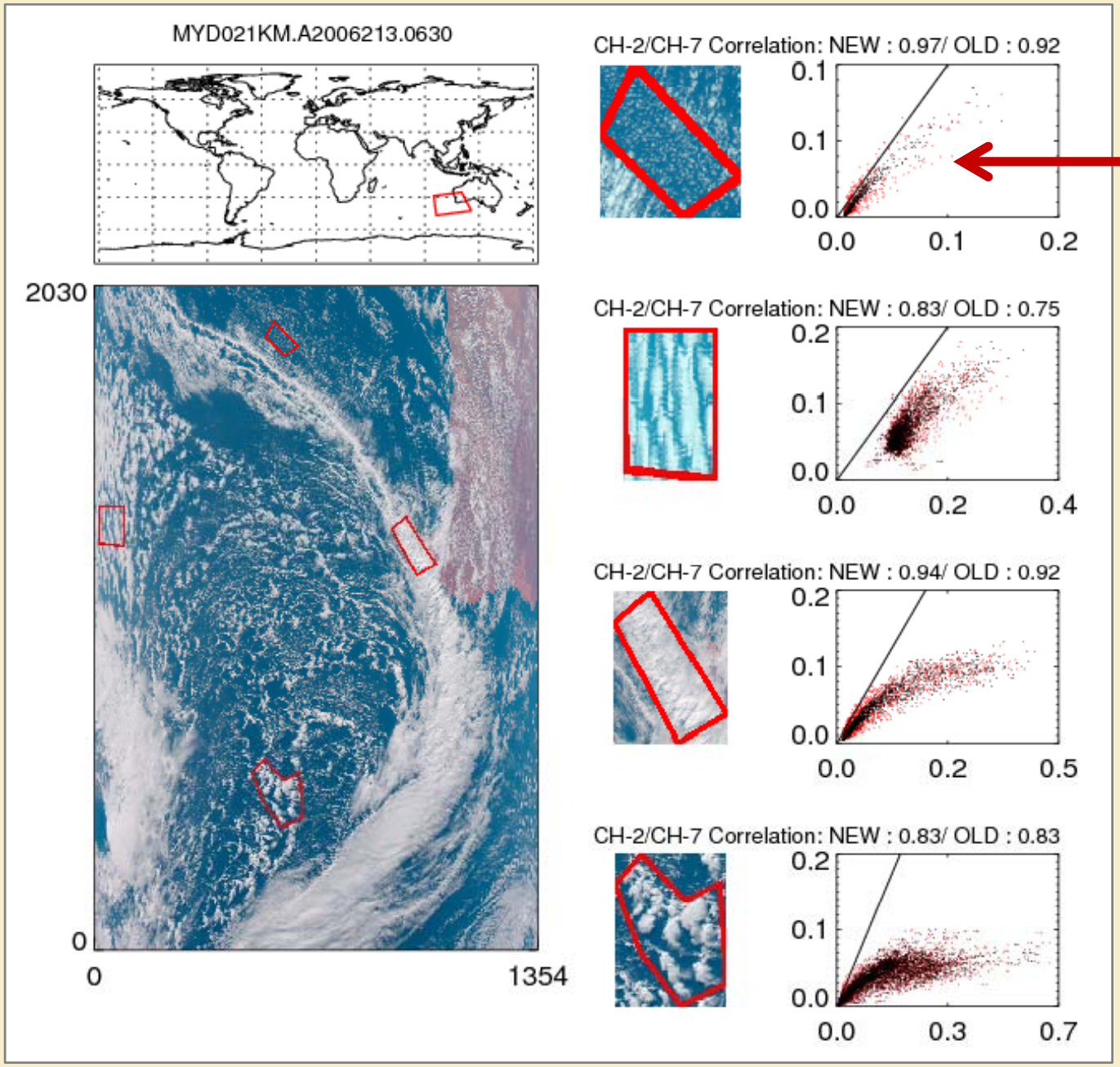
Results for new Level-1 1km aggregation

- New aggregation method provides significantly better co-registration results VNIR with SWIR/MWIR bands than standard method. Results with new method are similar to Terra-MODIS (Terra-MODIS does not suffer from this issue and can be used as a reference).
- As expected, inhomogeneous cloud scenes are significantly affected. In those scenes the correlation between VNIR and SWIR/SMIR channels is significantly improved (see example).
- For homogeneous scenes the new method does not affect results.
    - About 10 % of the MODIS aggregated VNIR pixels show a difference larger than 0.01 in reflectances between the new and old aggregation scheme. About 1% of the pixels show a difference larger than 0.05 in reflectance.
- Initial results for Level-2 cloud products show small but potentially systematic differences in cloud mask and optical properties retrievals in certain cloud regions. Testing impact on C6 cloud product test code is ongoing.

Example: L1b correlation between b2 and b7

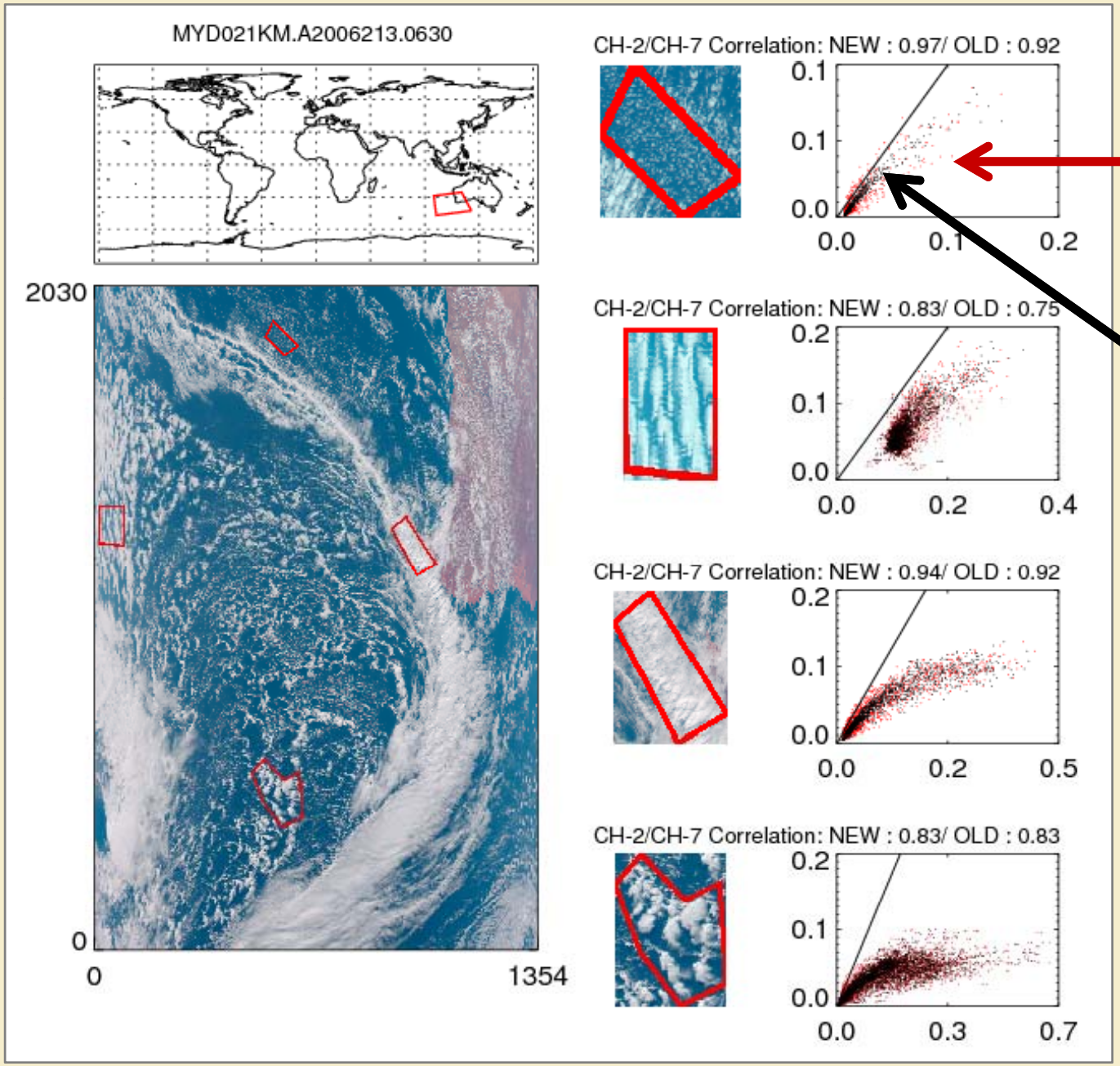


Example: L1b correlation between b2 and b7



Red dots: MODIS operational aggregation

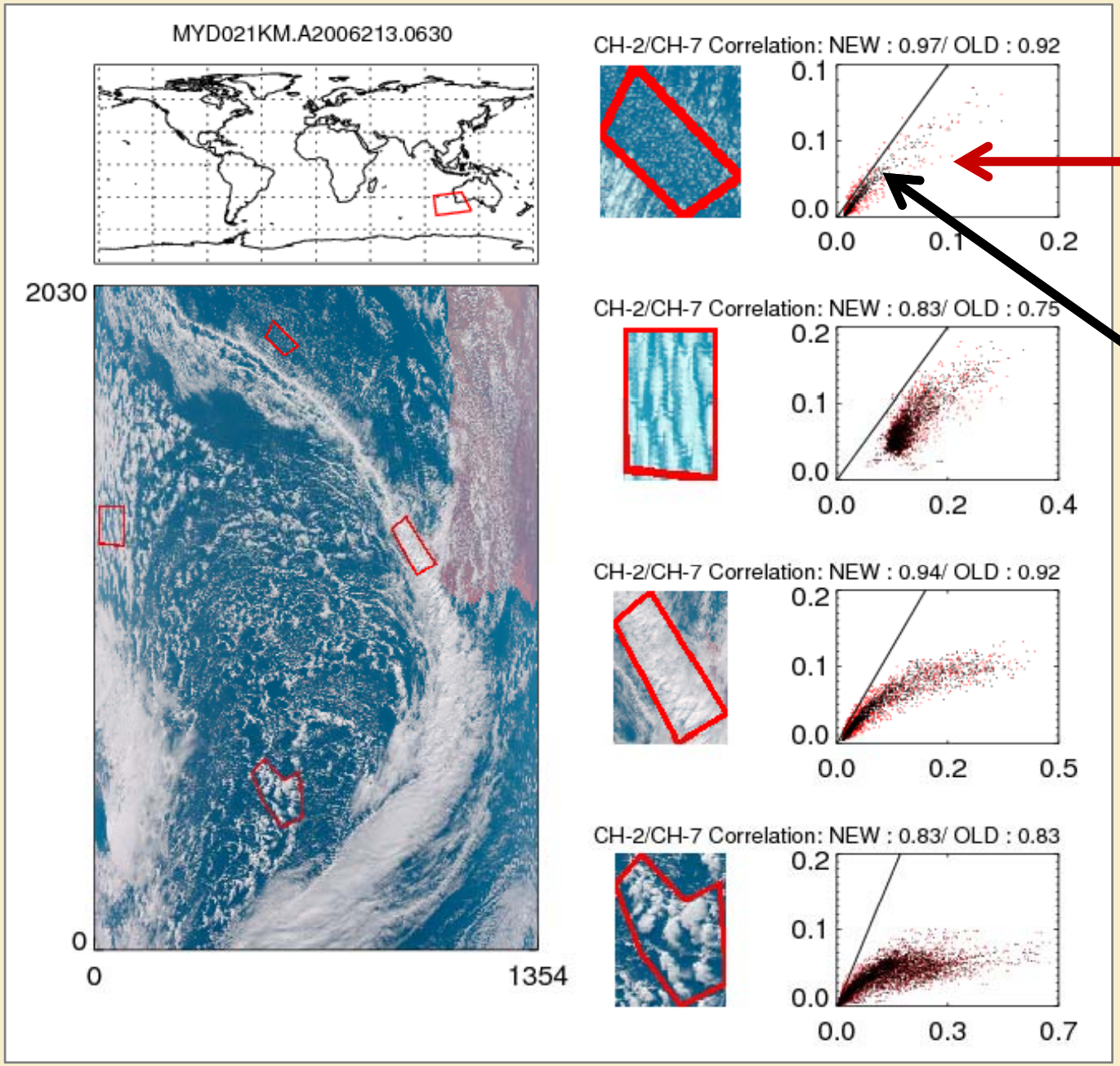
Example: L1b correlation between b2 and b7



Red dots: MODIS operational aggregation

Black dots: MODIS new empirical aggregation

Example: L1b correlation between b2 and b7

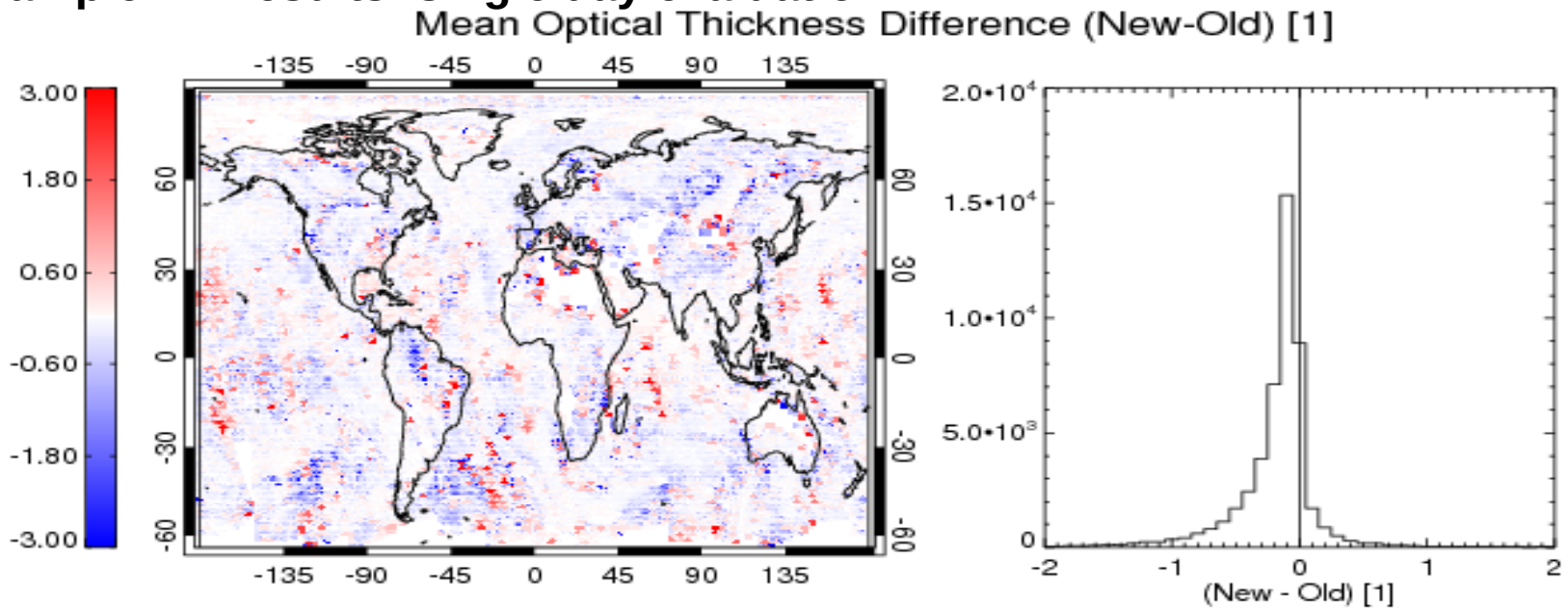


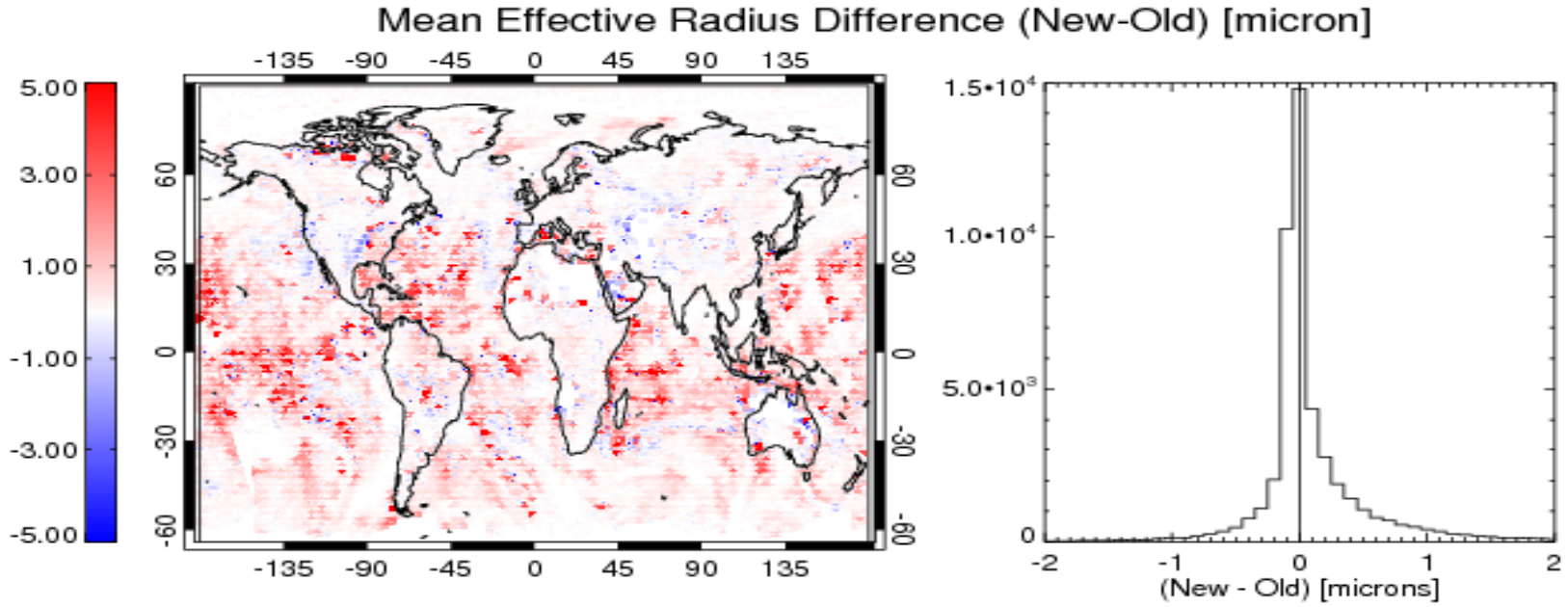
Red dots: MODIS operational aggregation

Black dots: MODIS new empirical aggregation

Significantly improved b2 vs. b7 correlation w/new aggregation in broken cloud regimes.

Example L2 Results- single day evaluation





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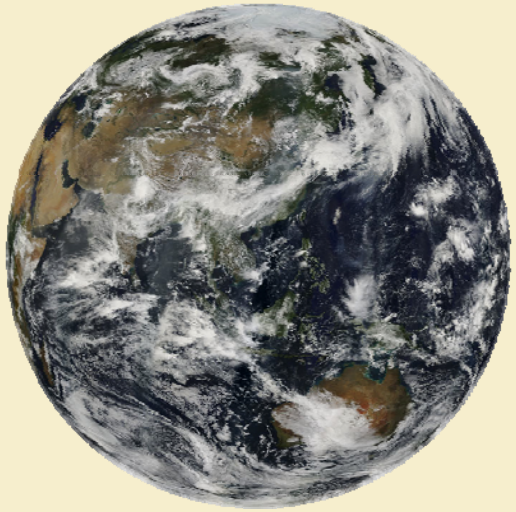

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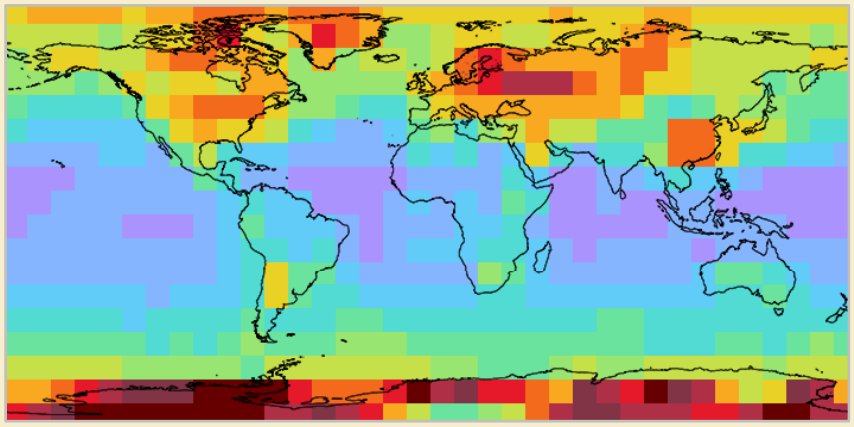
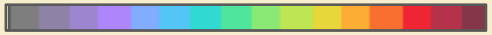
Annual Mean (July 2000 – June 2001)

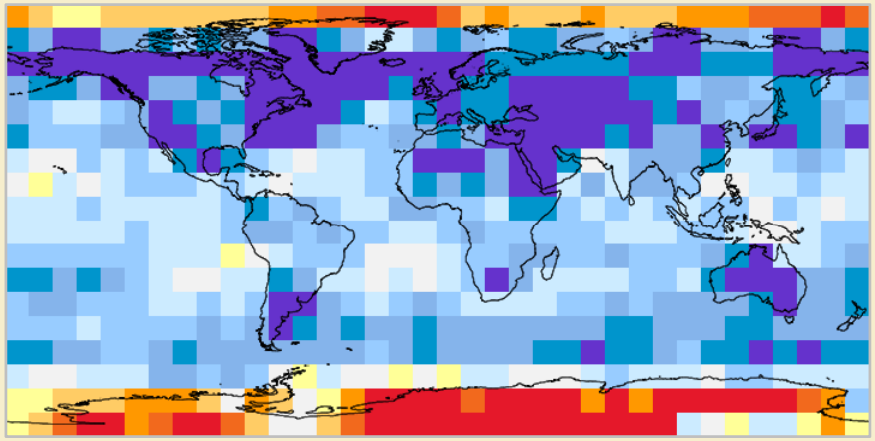




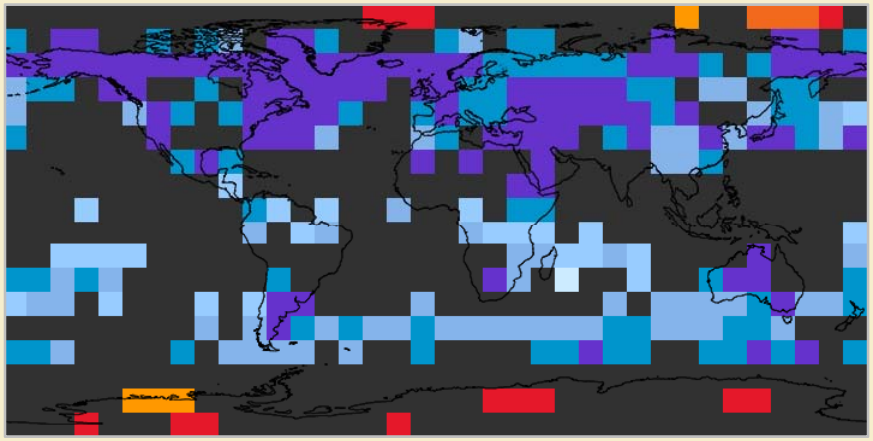
0 15 30

Cloud Optical Thickness, water clouds, Terra (10° binning, daytime observations only)

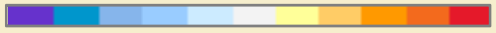
Optical Thickness Trends
(July 2000 – June 2010)



Trends Masked by Significance Level <0.05



%/decade



≤20 0 ≥20

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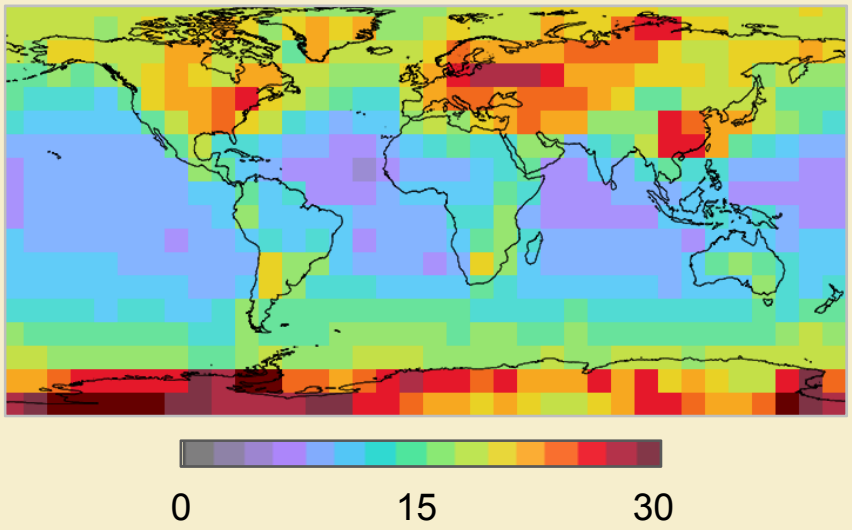
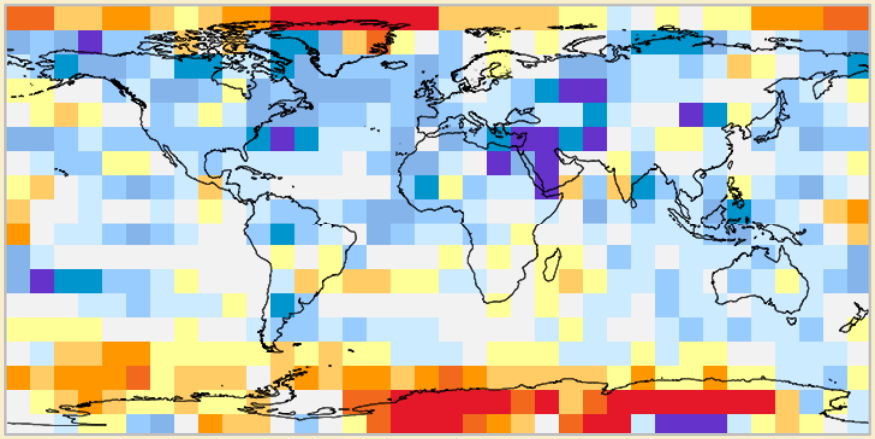
Annual Mean (July 2002 – June 2001)

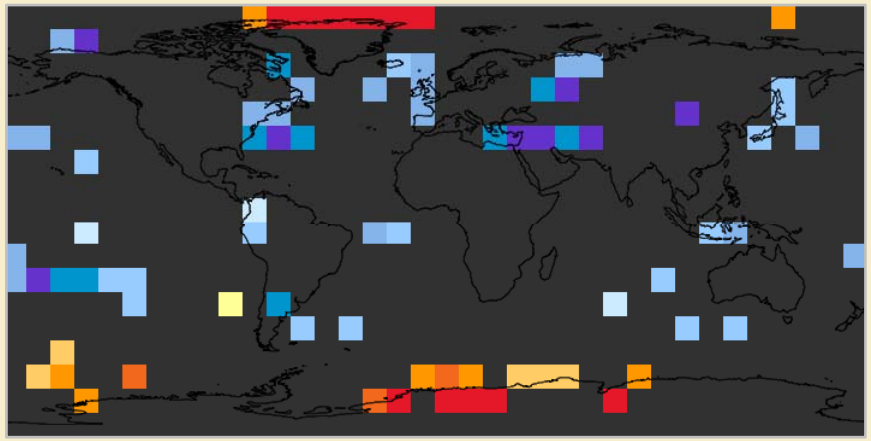


Cloud Optical Thickness, water clouds, Aqua (10° binning, daytime observations only)

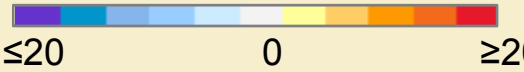
Optical Thickness Trends
(July 2002 – June 2010)



Trends Masked by Significance Level <0.05



%/decade



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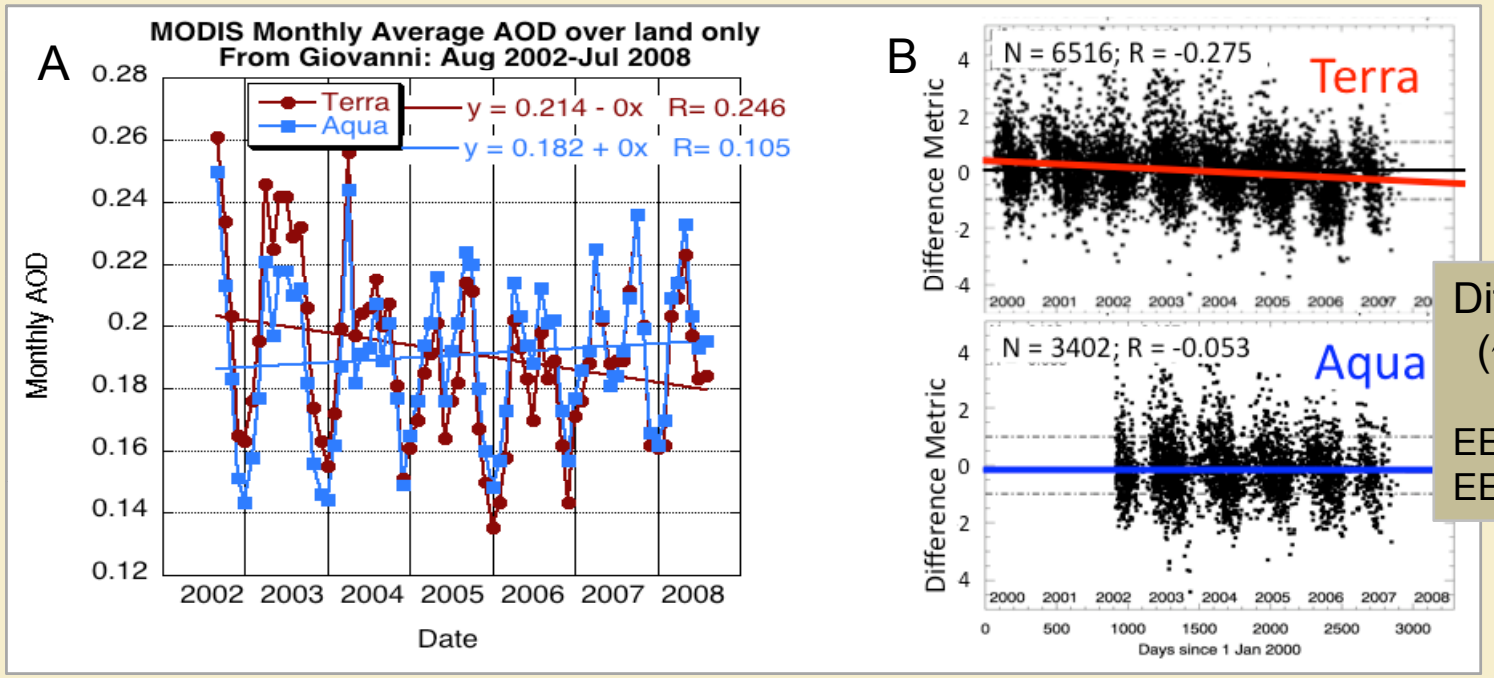
Trends in C5 Terra AOD over land: Artificial?

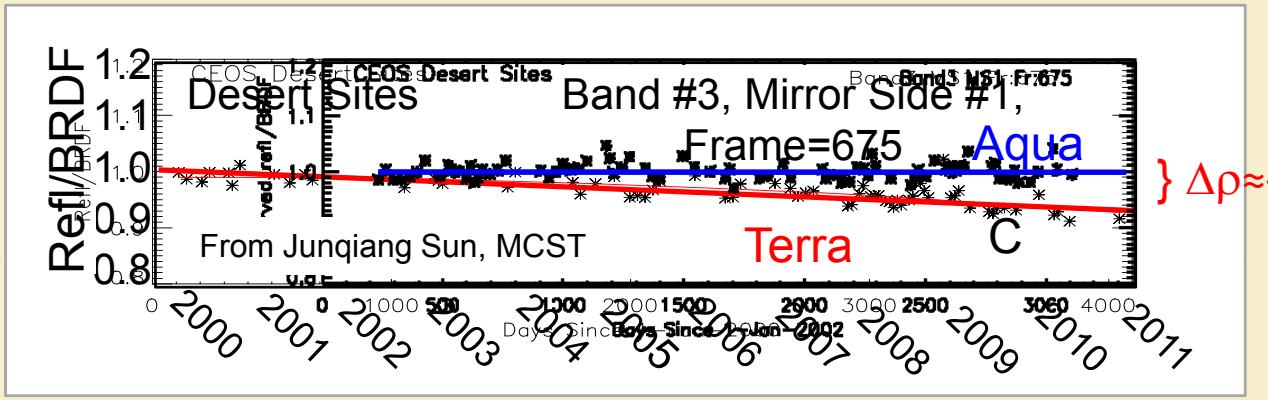


} $\Delta\tau \approx -0.03$

Difference metric = $(\tau_{MODIS}-\tau_{AERO}) / EE$

EE = "Expected Error"
$EE = 0.05 + 0.15\tau_{AERO}$

A) Terra and Aqua show different AOD trends over land (Terra's is statistically "significant")
B) Difference with AERONET shows trend for Terra but not Aqua
C) Consistent with trend in "Earth View" calibration of Band #3 (0.47μm) used for AOD retrieval



} $\Delta\rho \approx -0.0040$

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Instrument Artifacts?

Trends (%/decade), ±60° latitude, areal averaging

Cloud Optical Thickness, Land (~ band 1)

	Aqua (8 yrs)	Terra (8 yrs)	Terra (10 yrs)
τ_{liquid}	-3.44	-15.62	-14.56
τ_{ice}	-0.98	-11.20	-10.71

Cloud Optical Thickness, Ocean (~ band 2)

	Aqua (8 yrs)	Terra (8 yrs)	Terra (10 yrs)
τ_{liquid}	-2.6	-12.6	-10.0
τ_{ice}	-1.4	-13.1	-10.5

Aerosol AOD, Land (~ band 3)

	Aqua (8 yrs)	Terra (8 yrs)	Terra (10 yrs)
τ_a (pixel-weighing of grids)	-1.0	-24.0	-12.4
τ_a (no weighting)	-0.9	-25.9	-15.3

Instrument Artifacts? C5 Aqua & Terra Band 2 Trends vs. AOI (frame #)

MCST evaluation via desert ground targets (from S. Junqiang)