Dark Target aerosol retrievals from MODIS: What have we learned in 10 years?

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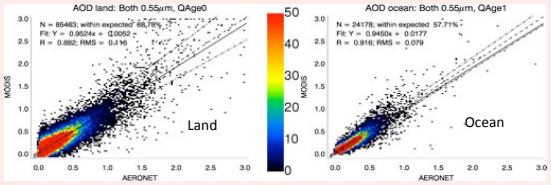
Overall Performance and Data Quality

Global Scatterplots Define Global Expected Uncertainty



Compared to collocated AERONET observations on a **global** basis, we demonstrate global expected uncertainty of the Collect 5 Dark target AOD:

Land: 1 σ (66%) of retrievals fall within **±(0.05+0.15τ)**

Ocean: 1 σ (66%) of retrievals fall within **±(0.04+±0.05τ)**

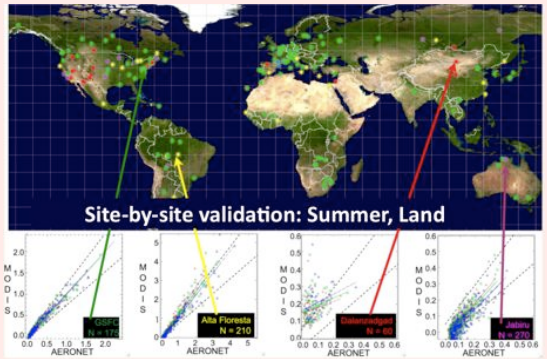
Quality Confidence flags must be accounted for to achieve accuracy

Land and Ocean: QAC > 0 for minimum acceptable statistics

Land: QAC=3 for best agreement with AERONET

Ocean: QAC≥1 for best agreement with AERONET

Regional Scatterplots Identify Systemic Regional Biases…



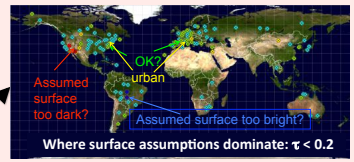
…and help to separate surface and model issues

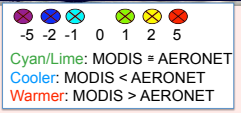
Some regions are characterized by surface reflectance different than assumed by global algorithm, resulting in systematic AOD biases:

- The North American intermountain region is systematically 0.10 too high
- Urban centers such as New York City are also systematically too high
- South American Cerrado region is too low in the non-biomass burning season

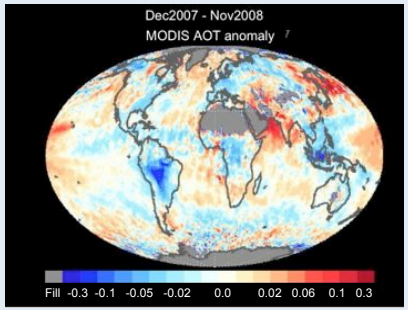
Some regions are characterized by aerosol single scattering albedo or other properties that are different than assumed by the global algorithm, resulting in AOD biases:

- South American Cerrado region is too high in the biomass burning season
- West African smoke/dust mixing region is too low.





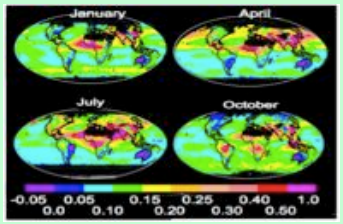
Global AOD and Variability



General Conclusions

1. **We have learned a great deal about the product – the details of its strengths and limitations. We have defined global expected uncertainty and identified where and why we have systematic biases.**
2. **We have learned how sampling affects aggregation to temporal and spatial means.**
3. **We can use MODIS aerosol products to view the global aerosol system as a whole. For example we can identify interannual variability of the global and regional aerosol system.**

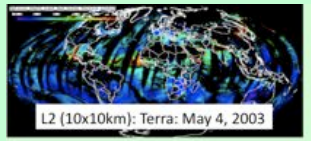
Sampling, Aggregation and Global Mean AOD



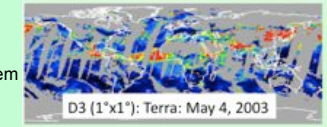
Long term seasonal "mean" AOD
Computed from Level 3.

What does this really mean?

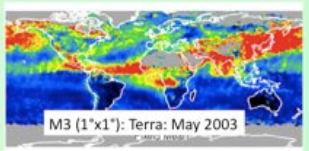
Level 2 (L2) = basic 10 km retrieval
L2 covers < 10% of the globe on any day
-clouds, deserts, snow, glint
-orbital gaps

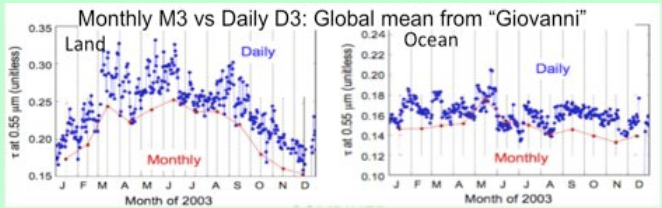


Level 3 daily (D3) is *spatial* aggregate of L2
We have made *decisions* as to which L2 retrievals to include and how to weight them
D3 covers ~ 30% of the globe



Level 3 monthly (M3) is temporal aggregate of D3
We have made decisions as to which D3 grid squares to include and how to weight them
M3 covers ~ 70% of the globe





L2 mean ≠ D3 mean ≠ M3 mean!!

- It all depends on how you average the data
- Daily Level 3 is "confidence weighted" by QA flags
- Monthly Level 3 is "pixel weighted" by the number of L2 retrievals
- Different methods accentuate different aspects of sampling
- **Global means can vary by as much as 40%,** all using 'reasonable' methods of averaging.

Levy, R. C., L. A. Remer, R. G. Kleidman, S. Mattoo, C. Ichoku, and T. F. Eck, 2009: Atmos. Chem. Phys. Disc. In preparation

Levy, R., G. Leptoukh, R. Kahn, V. Zubko, A. Gopalan, and L. Remer, 2009: *IEEE Trans. Geosci. Remote Sens.*, ***47, No. 9, 2942-2956.***,