Inter-comparison and Validation of the Two Aerosol Products in the Terra CERES/SSF-MODIS ED1A Data

X.-P. Tom Zhao and I. Laszlo

NOAA/NESDIS/ORA

28th CERES STM
(Norfolk, VA)

May 6-8, 2003

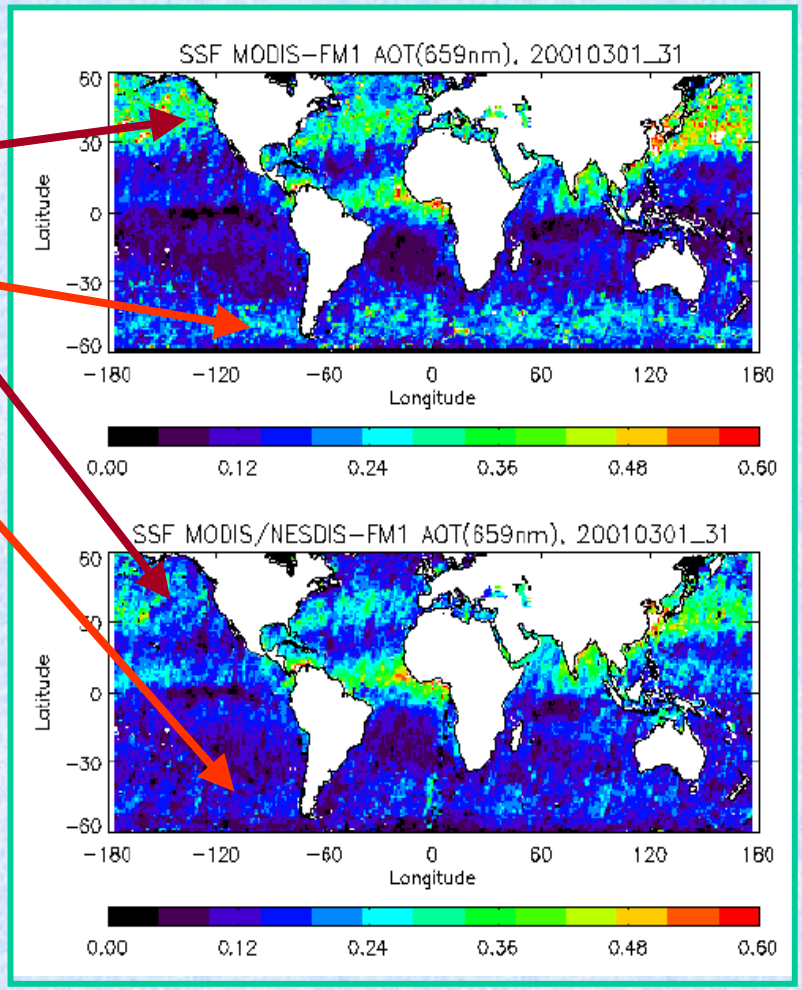
Motivation

Two aerosol products are available in the Terra CERES/SSF Data

There are some obvious differences in the two SSF aerosol products.

The causes of the differences need to be identified before the data can be reliably used in applications.

Example
(global map of two SSF AOTs at 0.66μm)



- **Objective**
  - Find the causes for the differences of the two aerosol products in the CERES/SSF-MODIS data set.

- **Approach**
  - Inter-comparison of the two products.
  - Validation against the surface AERONET observation.

Data Set

SSF-MODIS (Terra) Ed1A (FM1, FM2) Data — March 2001

Retrieval Algorithms

NESDIS (Stowe et al.)

- **Input Radiance:**
  - MODIS (0.66, 1.64μm)
- **Cloud Screening:** Minnis et al.
- **Surface Reflection:**
  - Fresnel (v=1m/s) + Small Diff. Ref.
- **Aerosol Model:** (size dis. & ref. index)
  - Globally fixed one model
  - Mono-Lognormal
- **Sampling:**

  $\gamma > 40^o$ + anti-solar side of orbit

MODIS (Tanré et al.)

- **Input Radiance:**
  - MODIS (0.55, 0.66, 0.87, 1.24, 1.64, 2.13μm)
- **Cloud Screening:** Ackerman et al.
- **Surface Reflection:**
  - Fresnel (v=7m/s) + Black
- **Aerosol Model:** (size dis. & ref. index)
  - Variable models
  - Bi-Lognormal (4 small/5 large)
- **Sampling:**

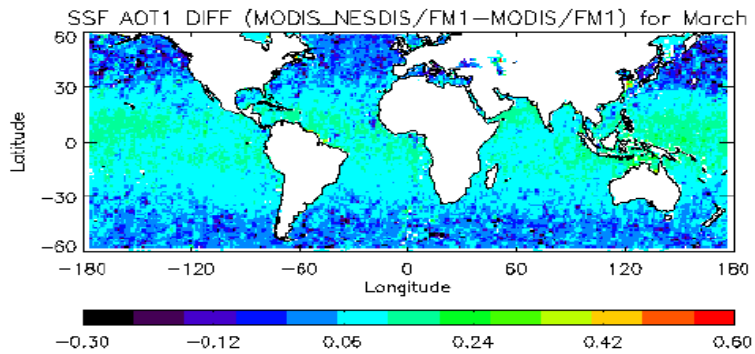
  $\gamma > 40^o$

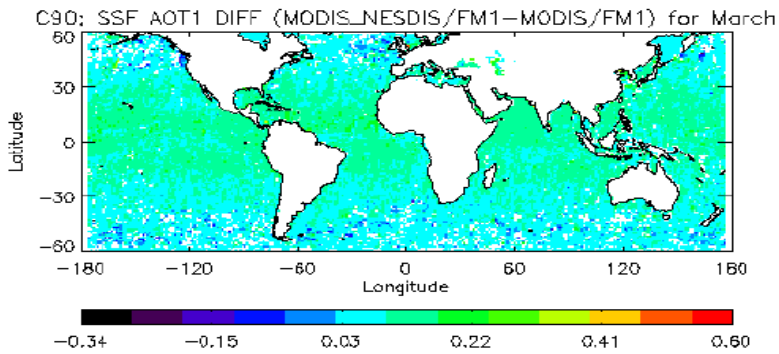
Global Map of $\Delta\tau$ — (MODIS/NESDIS - MODIS)

FM1- March 2001

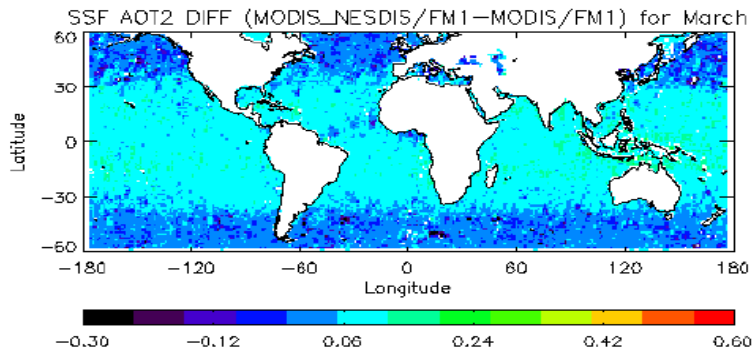
Original Data | **Very Clear Condition (CSI > 90%)**

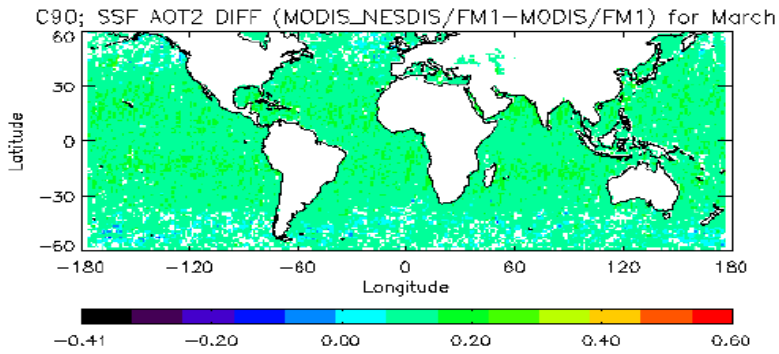
$\Delta\tau_1$





$\Delta\tau_2$



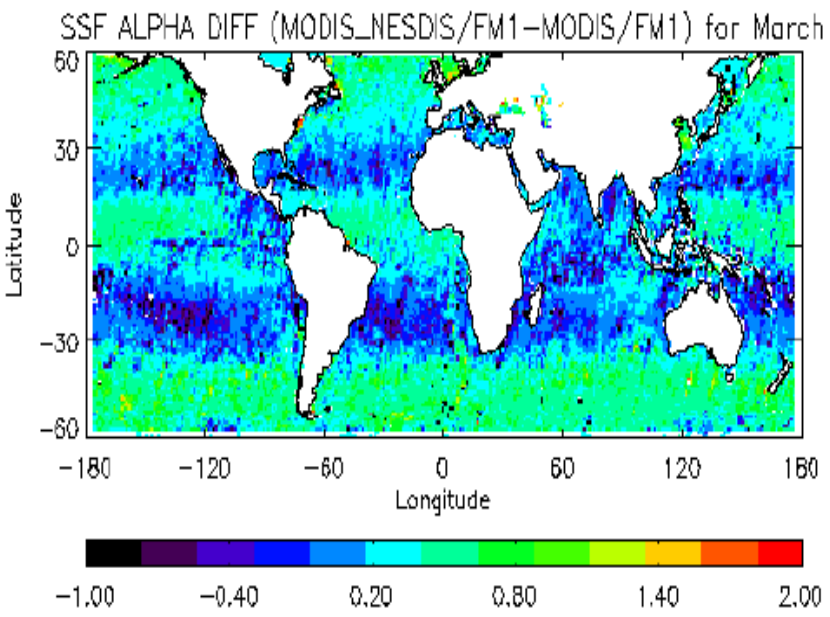


"Cloud Contamination" Explains the Major Differences of the Two SSF AOT Products at High Latitudes of SH and NH.

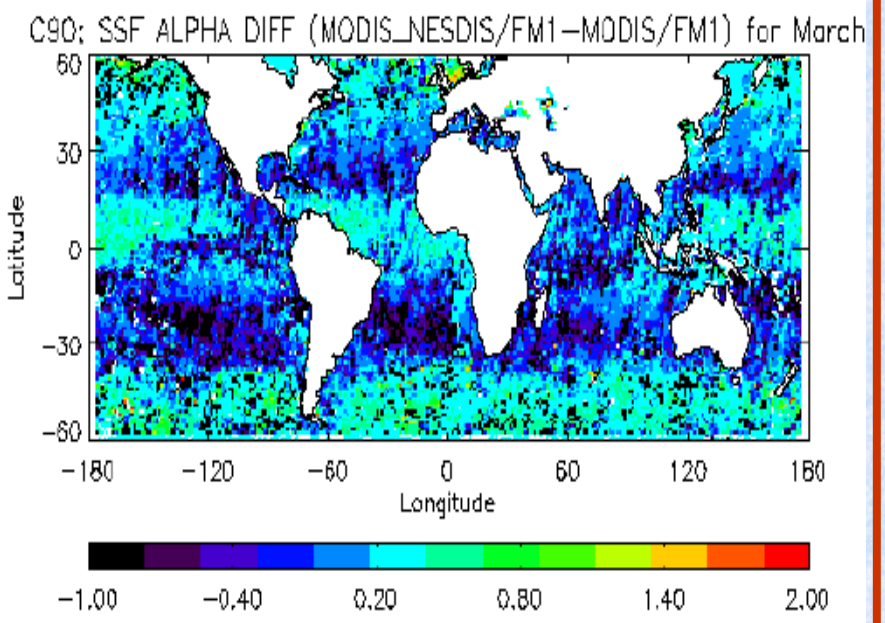
Global Map of the Δα — (MODIS/NESDIS - MODIS)

FM1- March 2001

Original Data

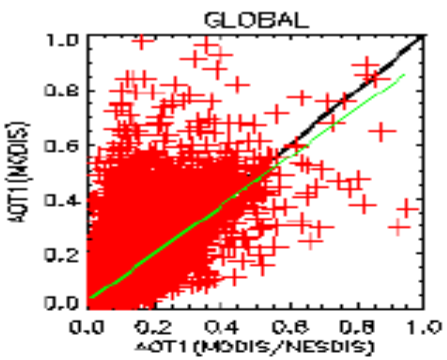
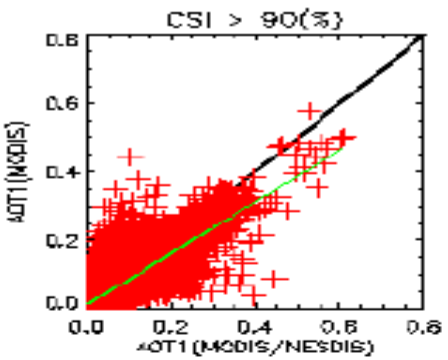
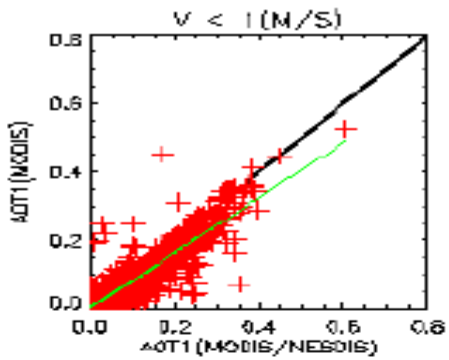
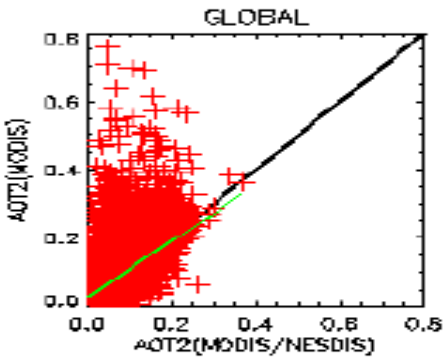
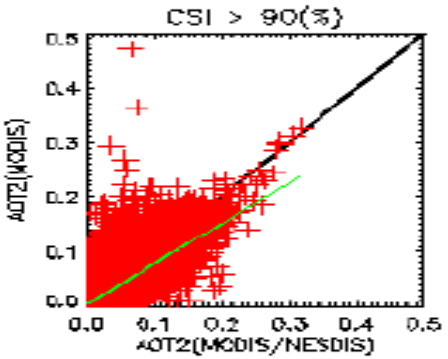
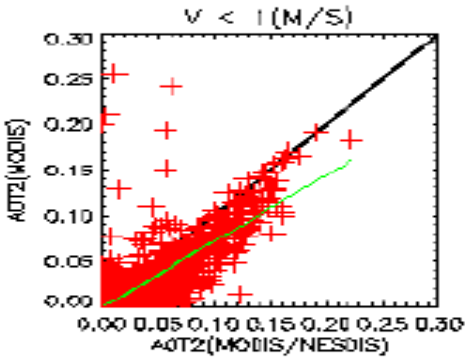
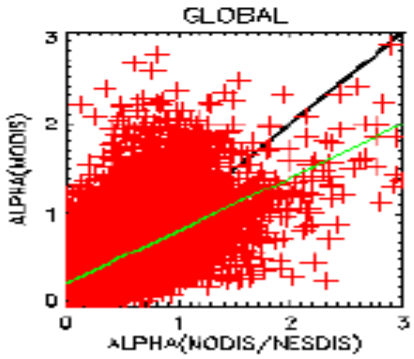
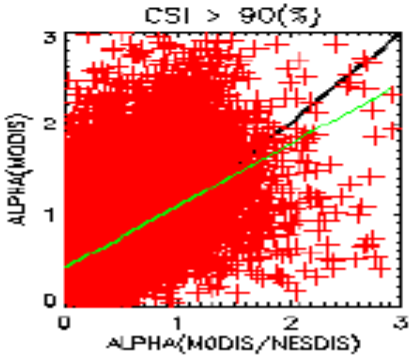
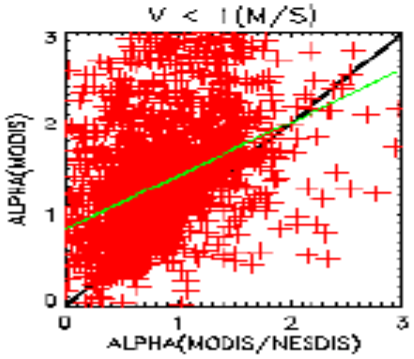


Very Clear Condition (CSI > 90%)



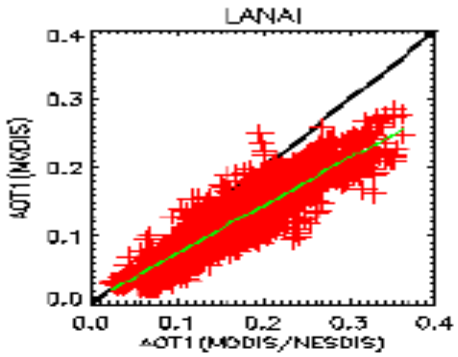
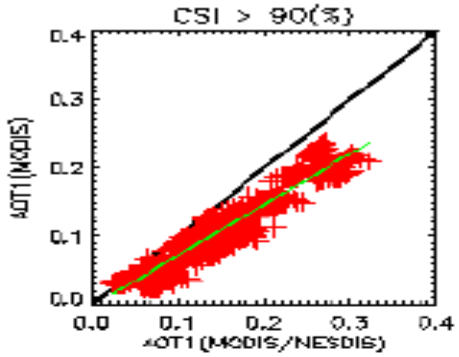
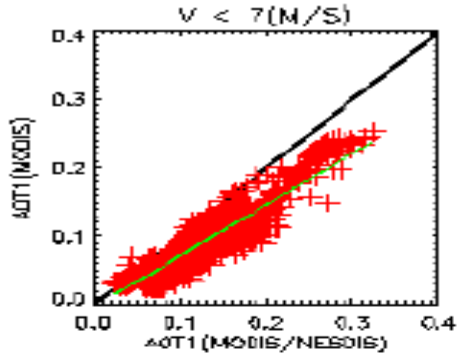
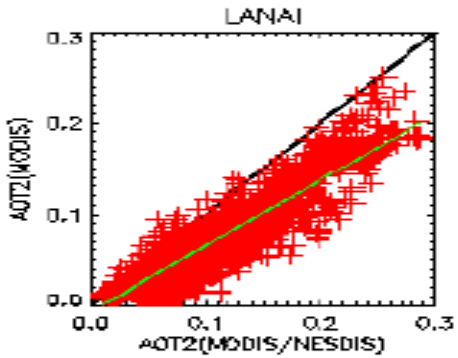
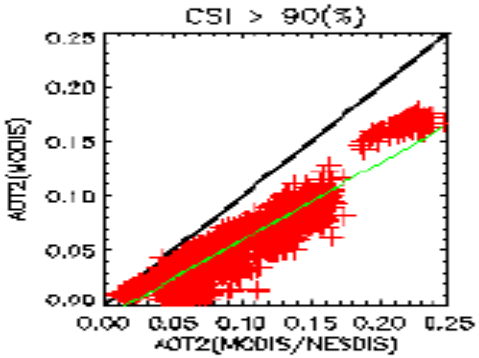
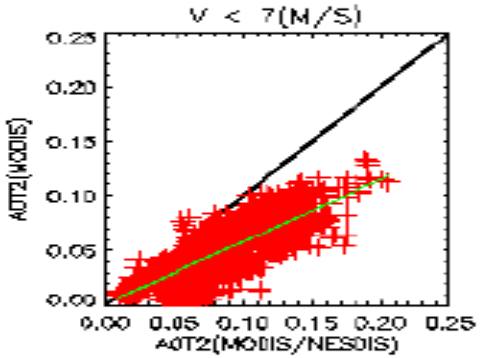
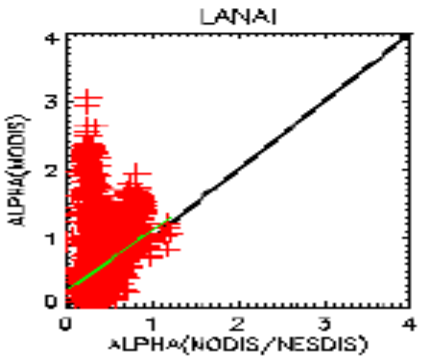
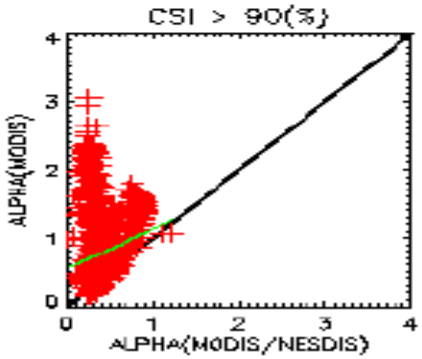
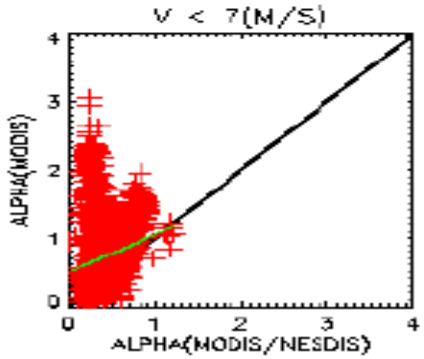
"Cloud Contamination" also Masks the Differences in the two Angstrôm Exponents α that are Associated with the Differences in the Aerosol Model Assumptions of the two Retrieval Algorithms

Global Inter-Comparison
(FM1- March 2001)

	Original Data	Very Clear	Calm Surface + VC
τ_1 (0.66μm)			
τ_2 (1.64μm)			
α			

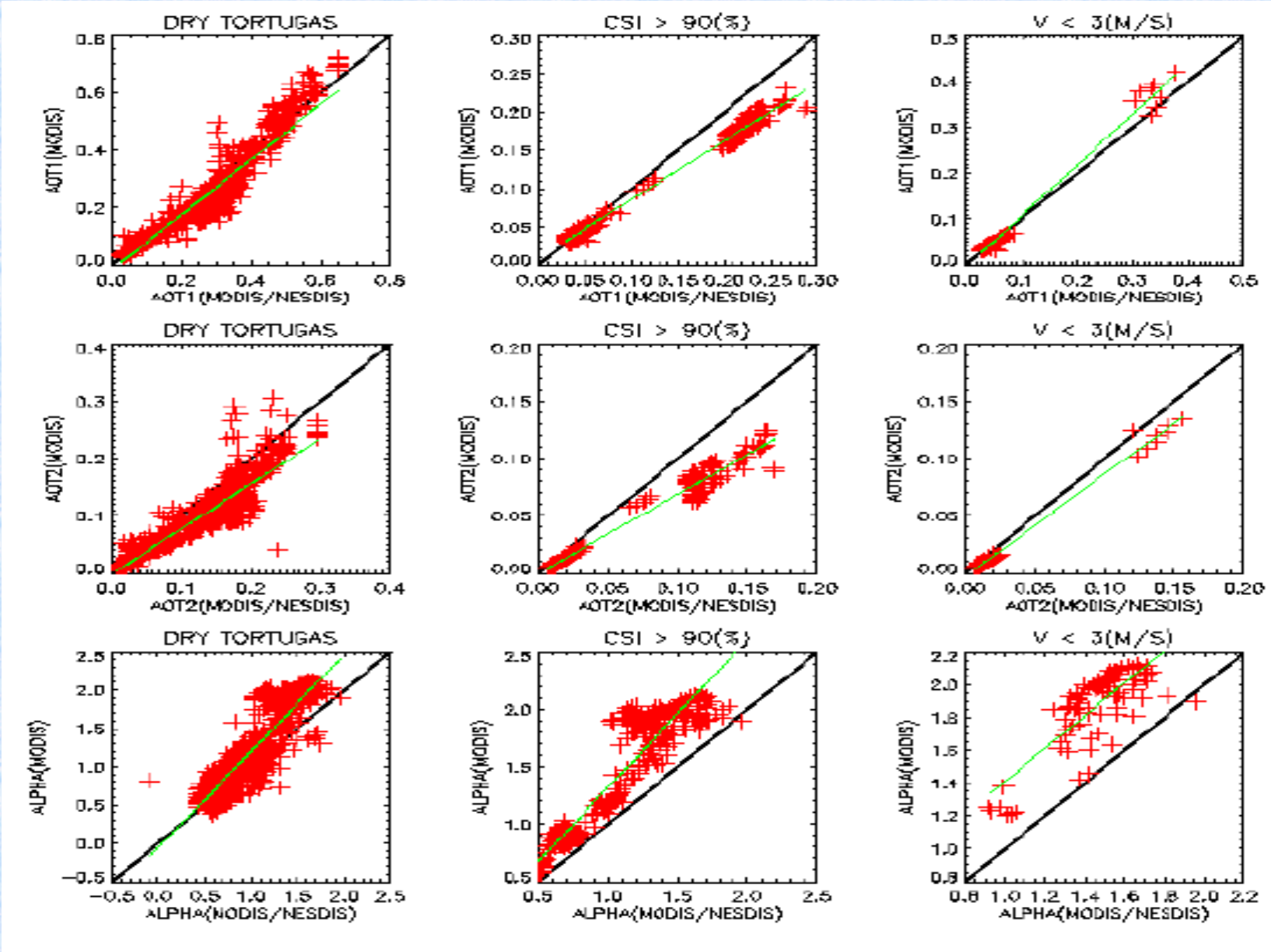
Regional Inter-Comparison

(Lanai — 20.8N, 157E; FM1 - March 2001)

	Original Data	Very Clear	Calm Surface
τ_1 (0.66μm)			
τ_2 (1.64μm)			
α			

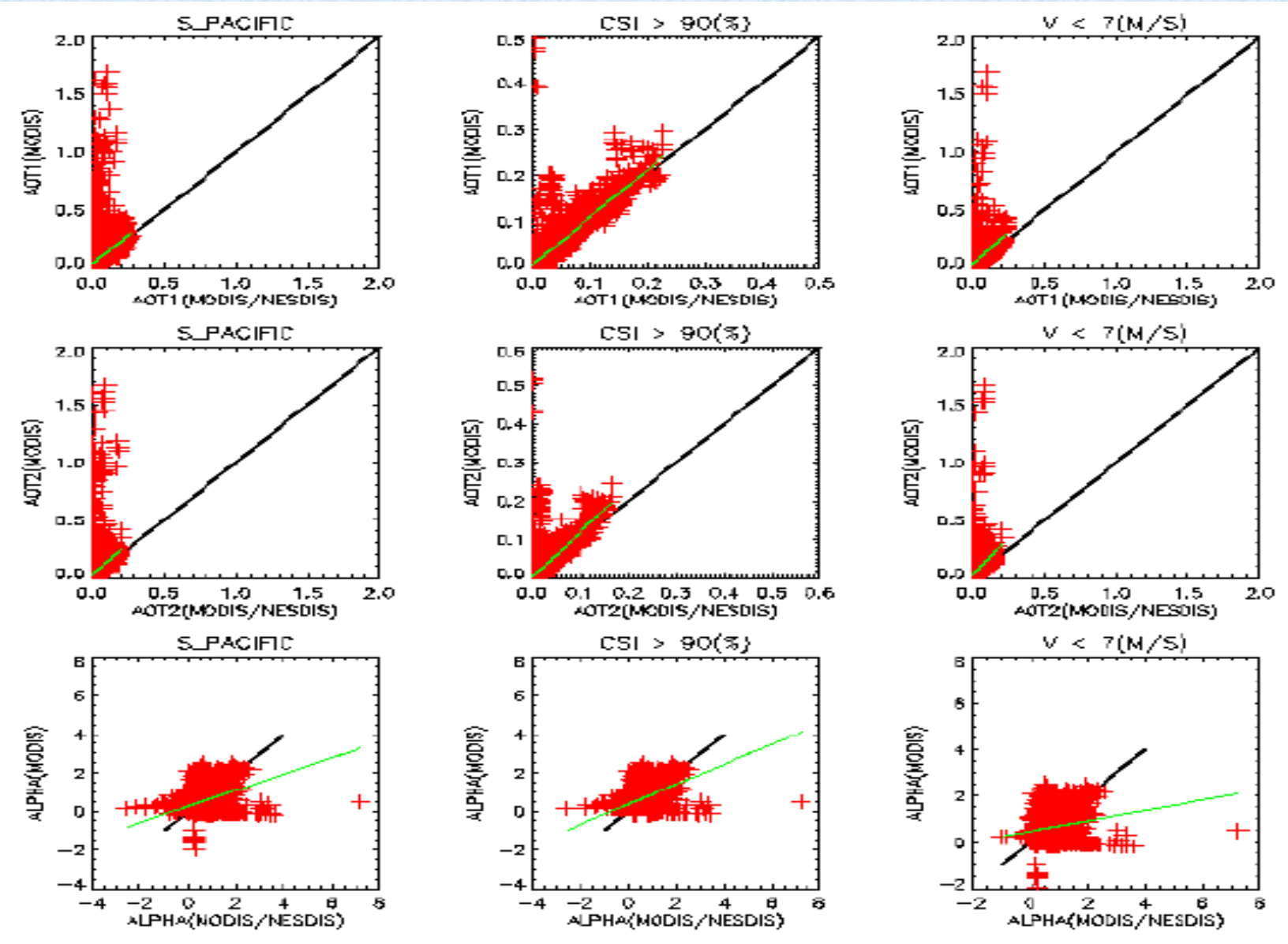
Regional Inter-Comparison

(Dry Tortugas — 24.6N, 82.8W; FM1- March 2001)



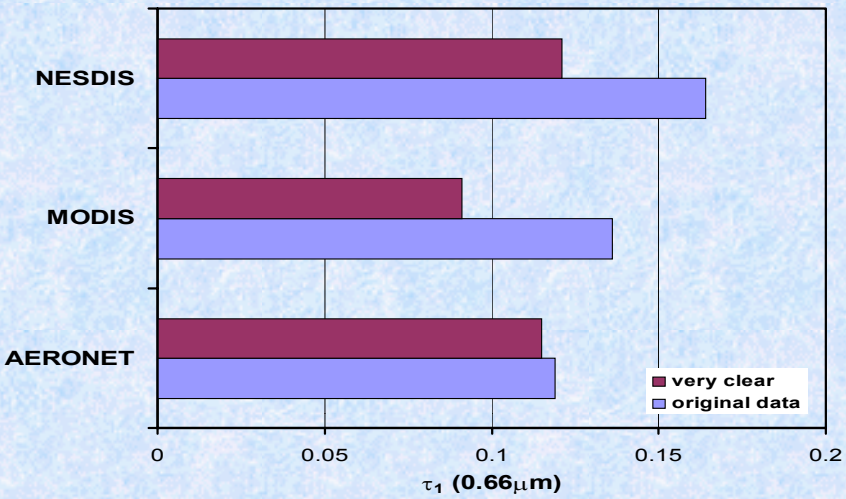
Regional Inter-Comparison

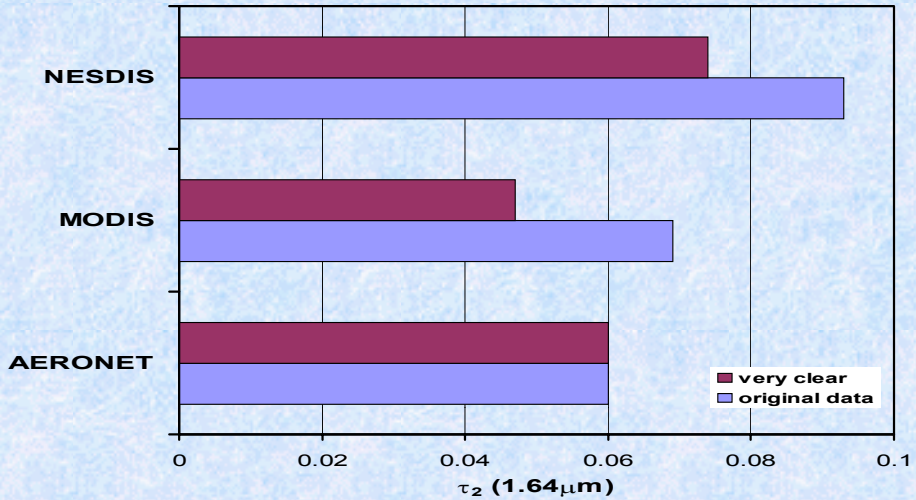
(S. Pacific Ocean — 45S, 120W; FM1-March 2001)

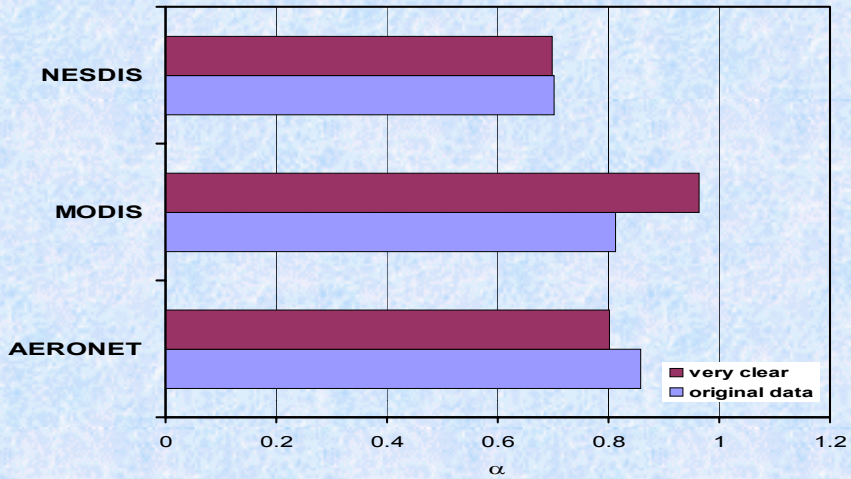


Comparison of Monthly Mean τ_1, τ_2, and α for the Match-ups of Two SSF Aerosol Products and AERONET Observations

(global ensemble - FM1 + FM2, March 2001)

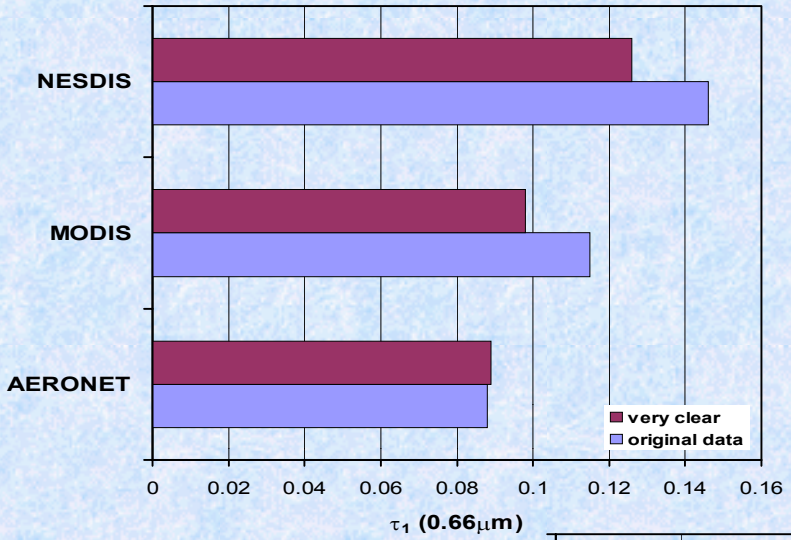


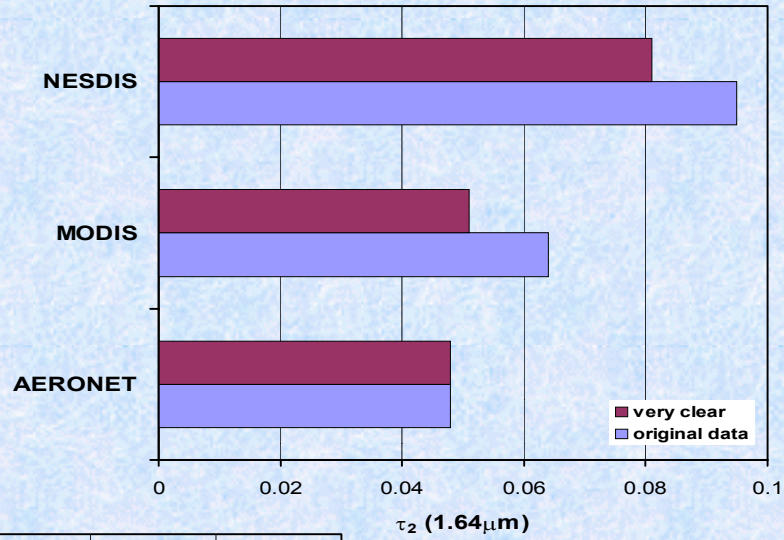


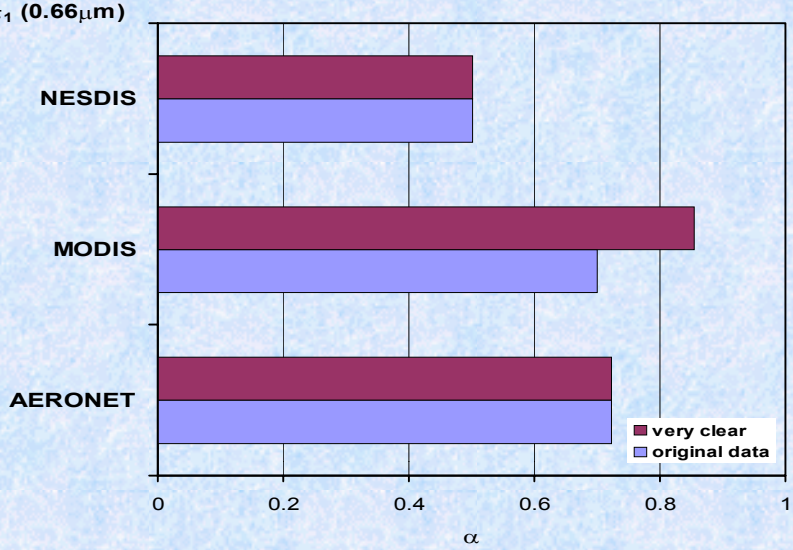


Comparison of Monthly Mean τ_1, τ_2, and α for the Match-ups of Two SSF Aerosol Products and AERONET Observations

(Lanai - FM1 + FM2, March 2001)

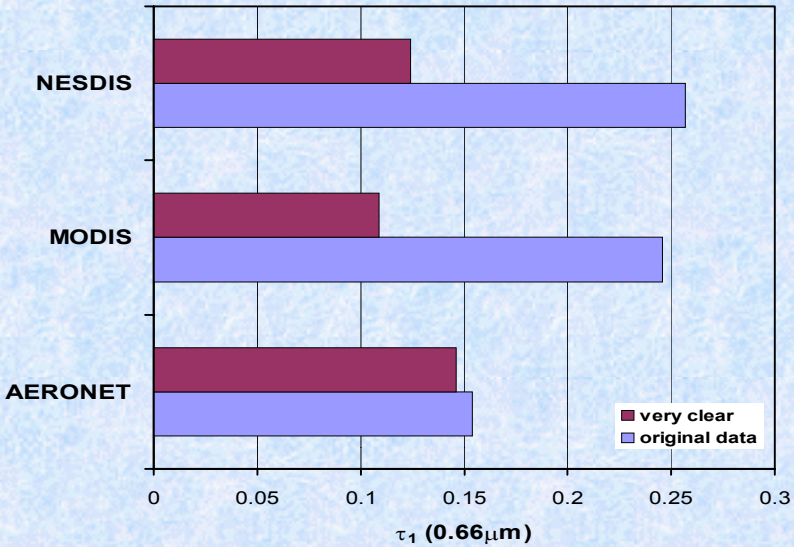


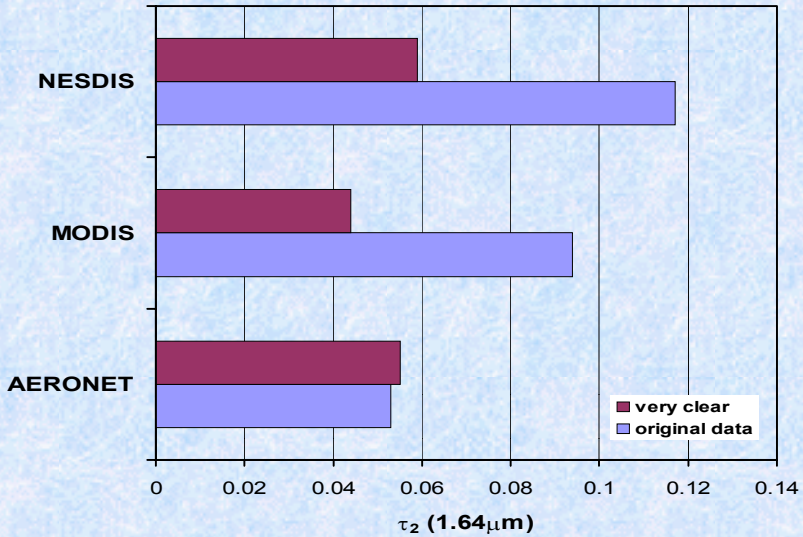


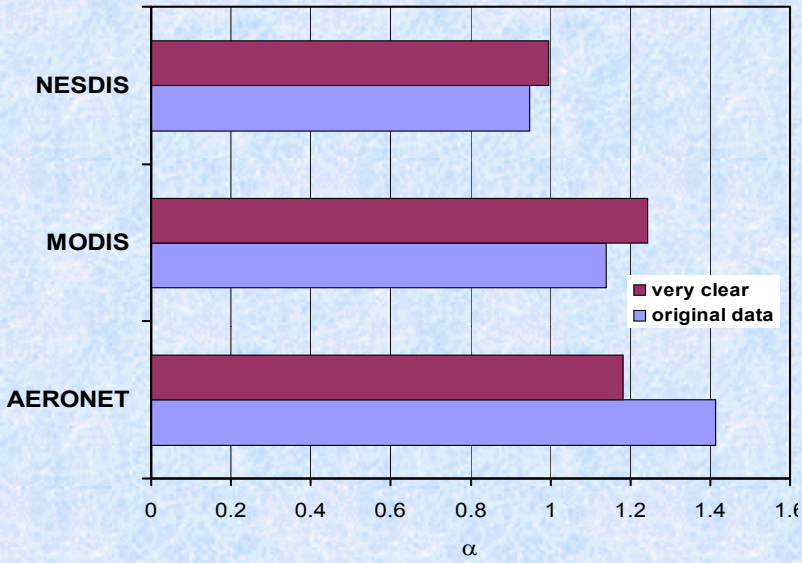


Comparison of Monthly Mean τ_1, τ_2, and α for the Match-ups of Two SSF Aerosol Products and AERONET Observations

(Dry Tortugas- FM1 + FM2, March 2001)







Summary

- "Cloud contamination" may explain the major differences in the AOTs of the two SSF/MODIS aerosol products at high latitudes. The surface disturbance is only important in limited regions.
- "Cloud contamination" and surface errors mask the difference in the two Angstrôm exponent α that are associated with the different aerosol model assumptions in the two SSF aerosol retrievals.
- The two SSF AOTs agree reasonably well in their global mean, the NESDIS retrieval being slightly larger. The two SSF α comparison in the global mean are not as good as that of AOT, the MODIS values being slightly larger.
- Limited validation using AERONET observations also suggests possible "cloud contamination" in the two SSF aerosol products. After reducing the potential "cloud contamination", AERONET AOT and α values fall between the values of the two SSF aerosol products in the global mean sense, with MODIS τ < NESDIS τ and MODIS α > NESDIS α.

Future Works

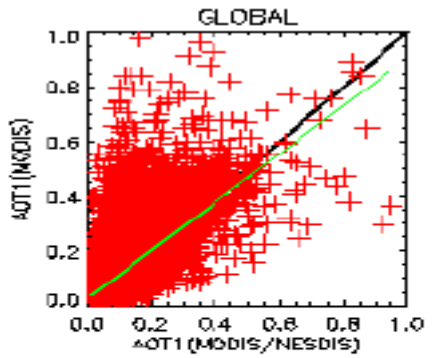
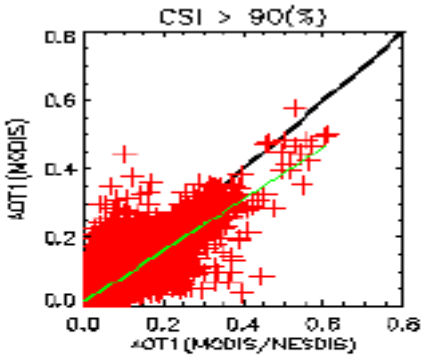
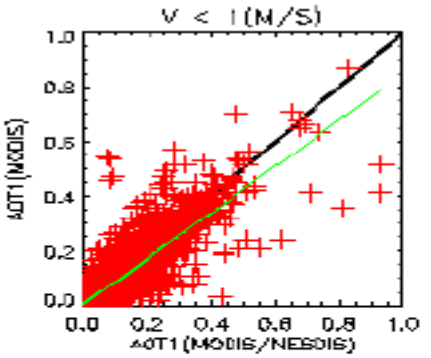
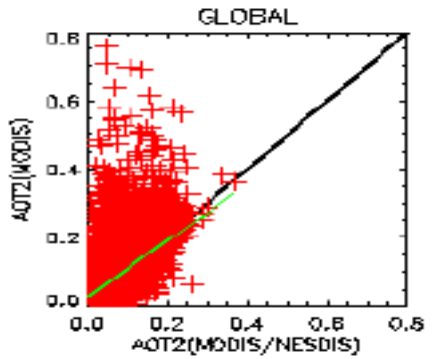
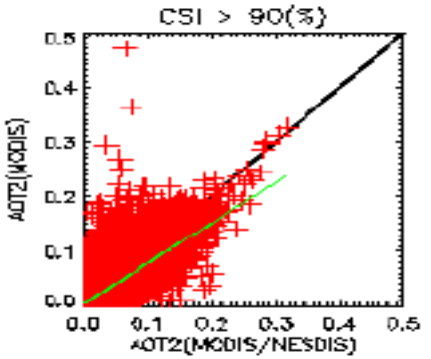
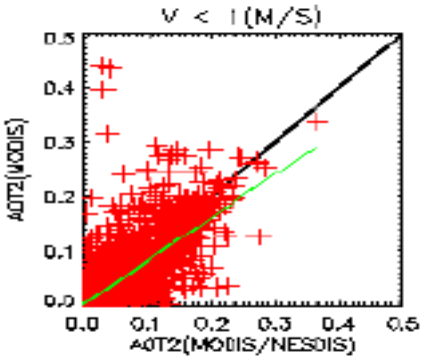
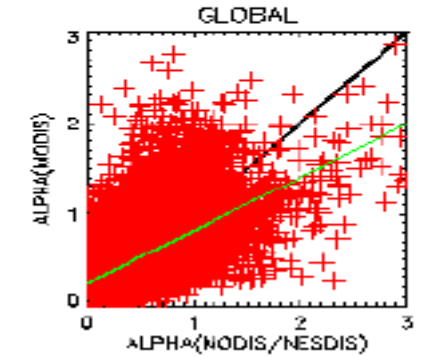
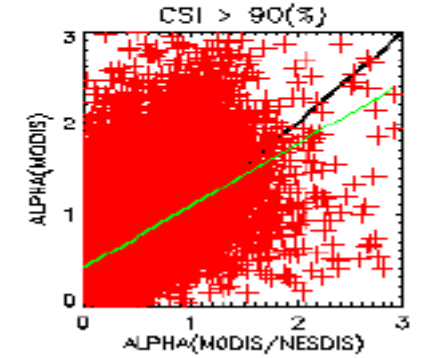
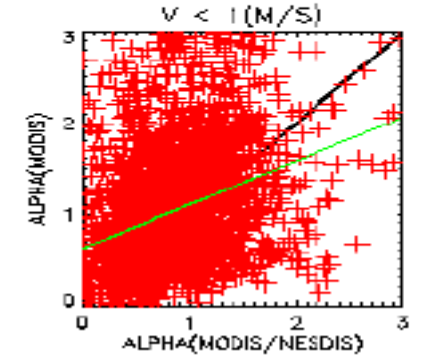
- Make more conclusive and quantitative analysis by including more data (such as a full year of 2001).
- Apply the quality assured aerosol data and the error estimations in aerosol radiative forcing studies.

Acknowledgements

- E. Geier, L. Hunt, K. Morris et al., & Langley DAAC
- B. Wielicki and CERES Program
- P. Minnis and Cloud Group
- L. Stowe and A. Ignatov
- CERES Science Team Members

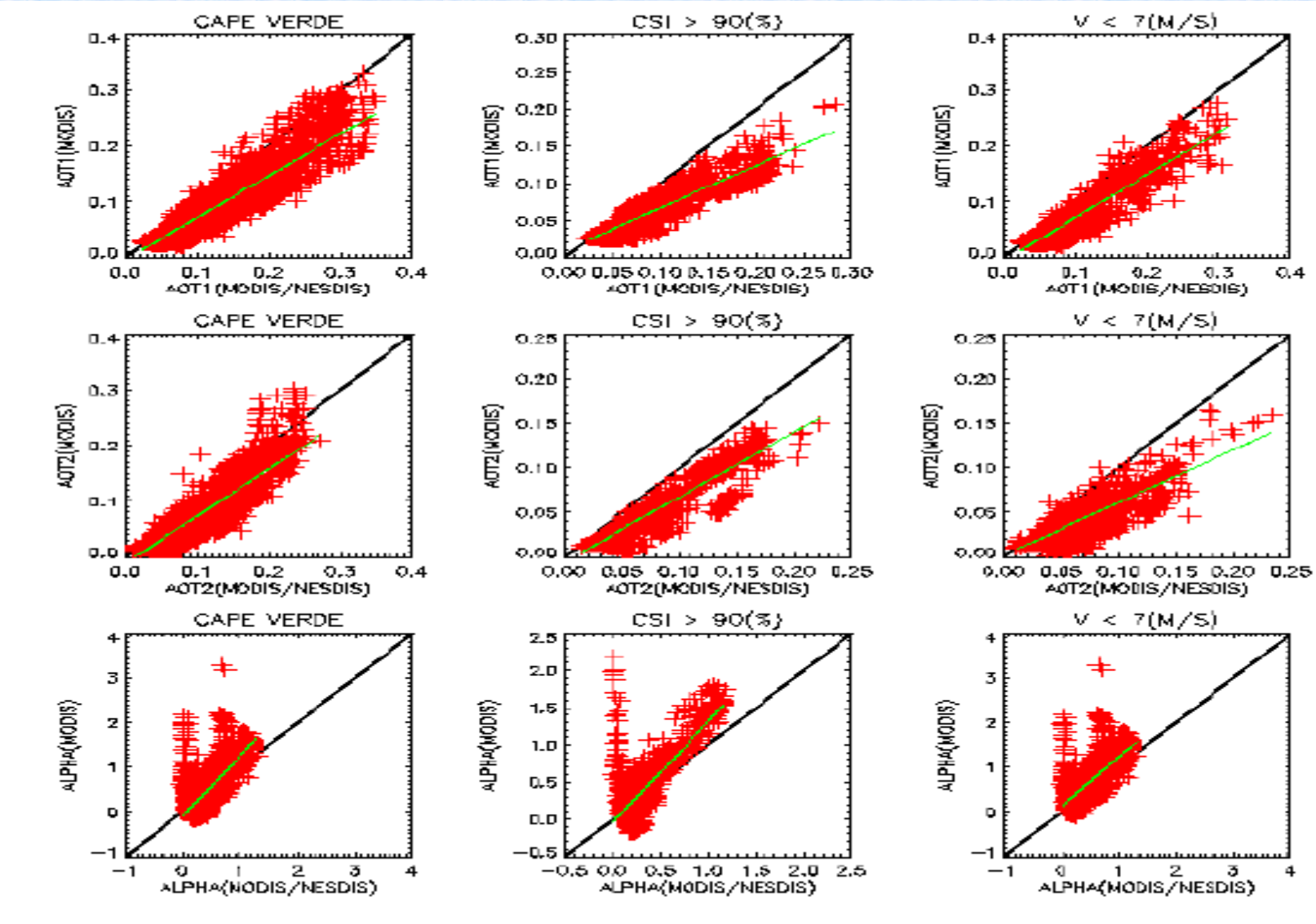
Backup Slides

Global Inter-Comparison
(FM1-March 2001)

	Original Data	Very Clear	Calm Surface
τ_1 (0.66μm)			
τ_2 (1.64μm)			
α			

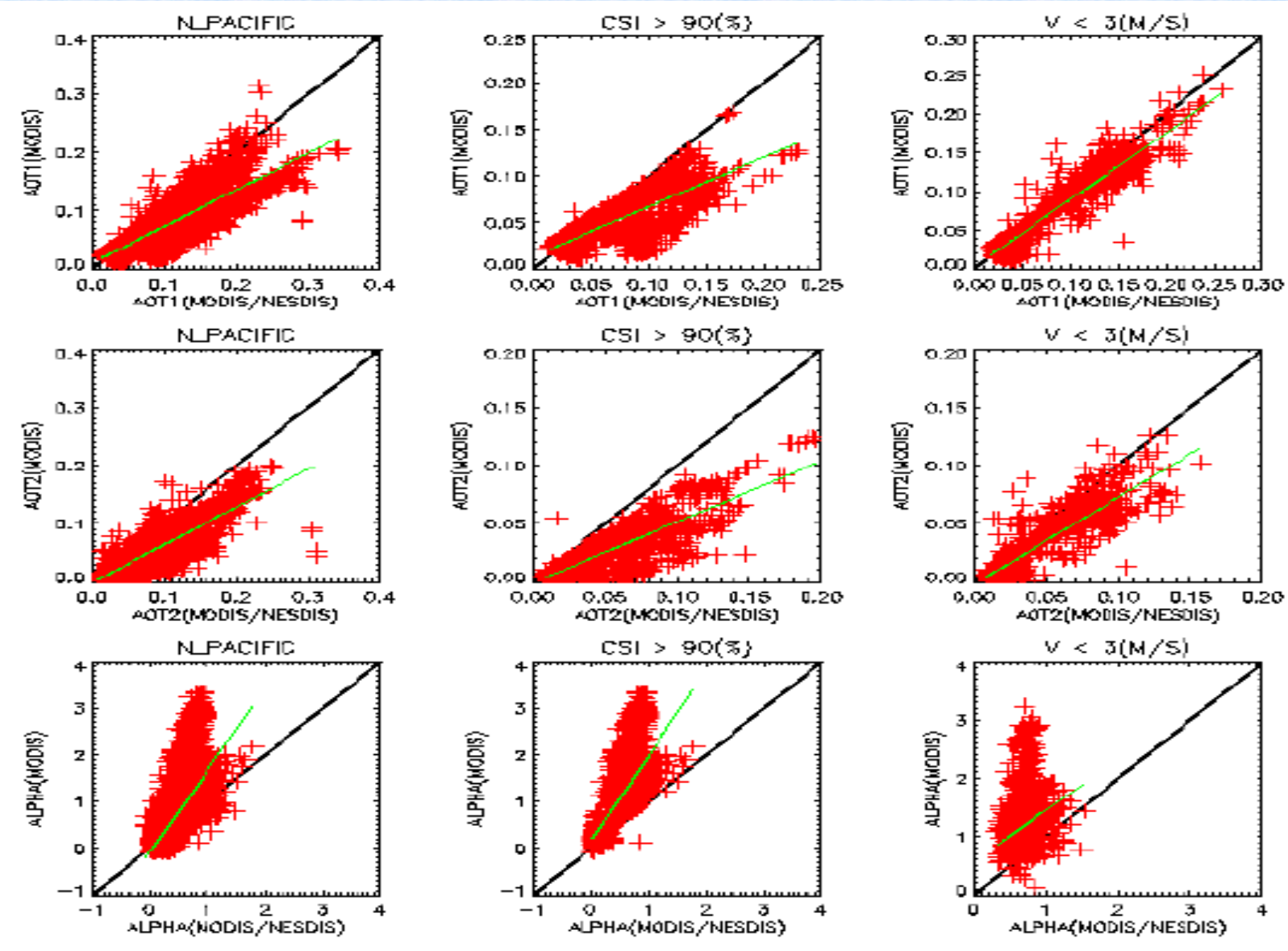
Regional Inter-Comparison

(Cape Verde — 16.7N, 22.9W; FM1 - March 2001)



Regional Inter-Comparison

(N. Pacific Ocean — 20N, 130W; FM1-March 2001)



Comparison of Monthly Mean τ_1, τ_2, and α for the Match-ups of Two SSF Aerosol Products and AERONET Observations

(Cape Verde - FM1 + FM2, March 2001)