Consistency of spectral Aerosol Optical Depth from *Terra/Aqua* MODIS over ocean

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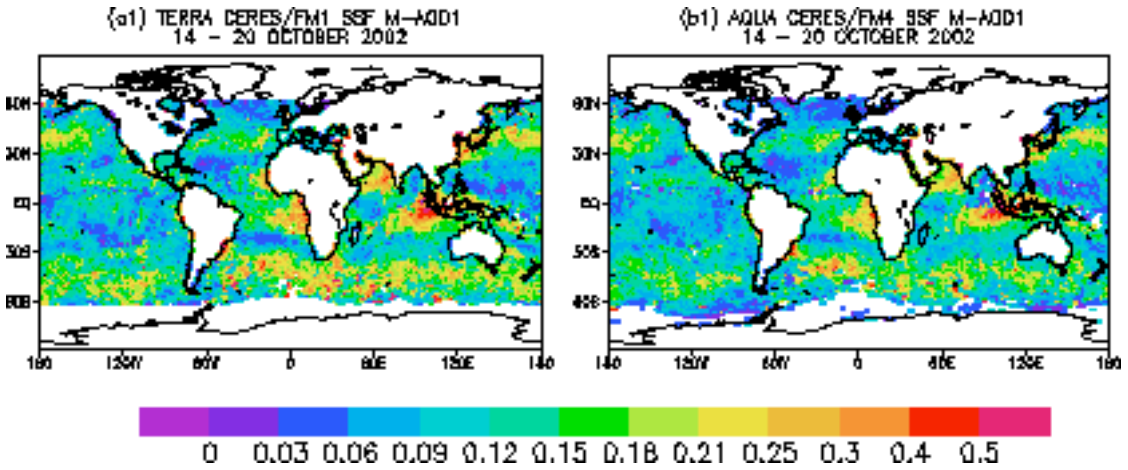
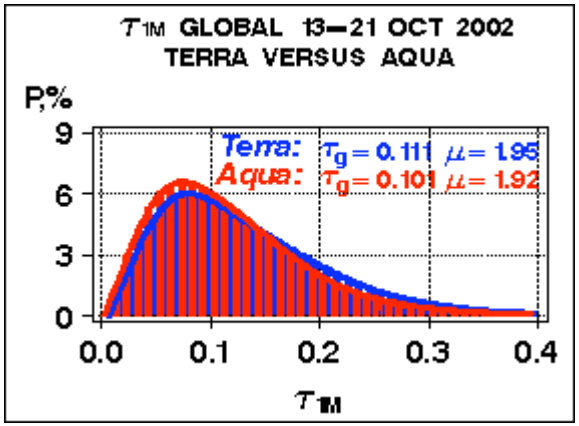
CERES SSF data obtained from ASDC and CERES Science Team

Consistency of *Terra*/Aqua _@0.66 _m on M*D04 collection 4 (Oct 2002)

Terra *Aqua*





Particles dry out in the afternoon?

or

Terra "under-screened"?

or

Aqua "over-screened?"

(Consistency of global MODIS AODs over ocean on Terra and Aqua CERES SSF. JGR 2006, in press.)

Terra/Aqua _(_) spectral consistency over ocean

Objective

- Check *Terra*/*Aqua* spectral AODs over ocean for consistency
- Spectral AOD _(_): 7-dimensional vector (7_ from 0.47-2.13 _m)

Method

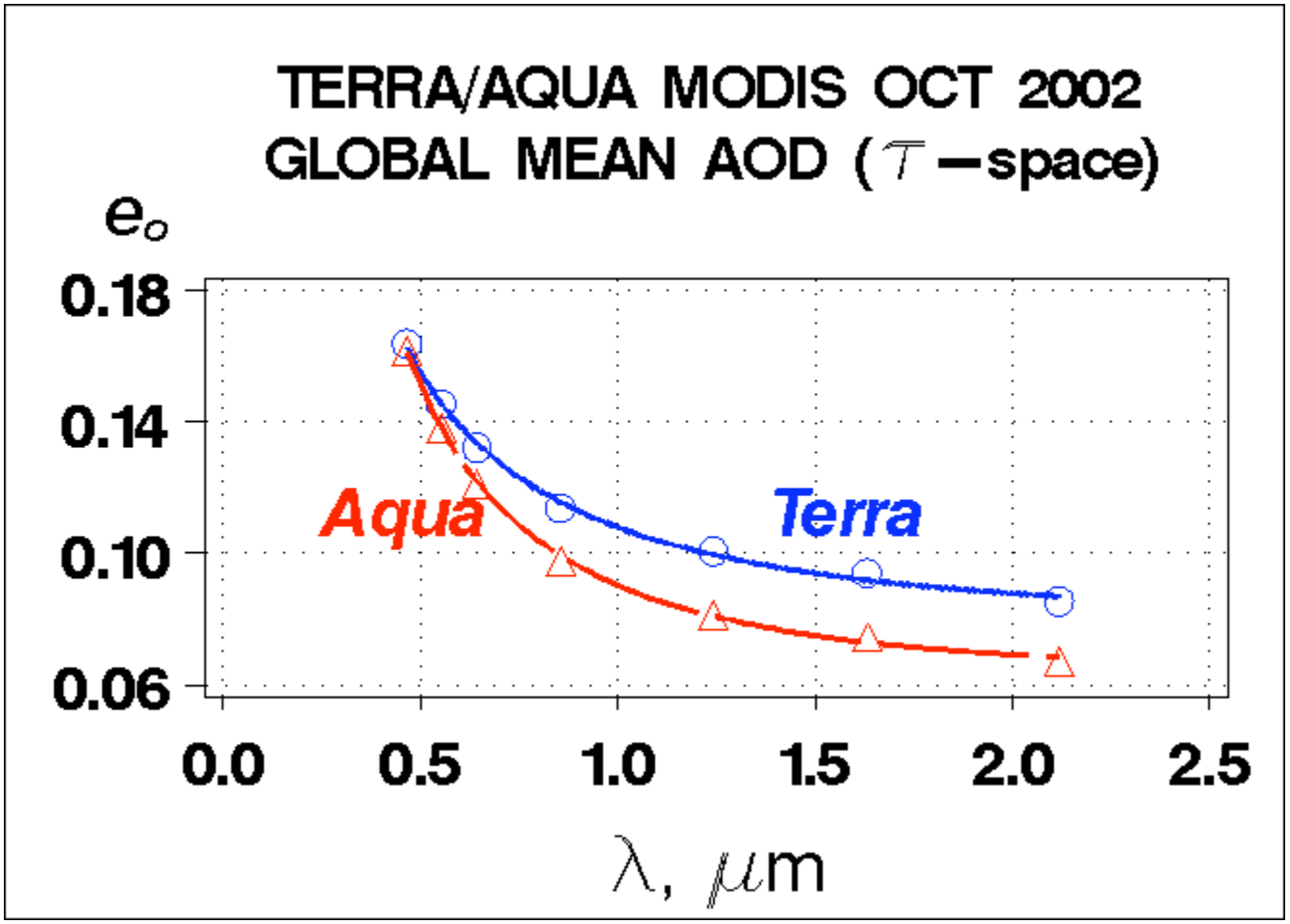
- Compressed representation of _(_) using PCA/EOF

$$?(?) \approx e_o(?) + ?_1 e_1(?) + ?_2 e_2(?) + ?_3 e_3(?)$$

Data

- M-product on CERES SSF (M*D04 collection 4)
- *Terra*/FM1 Ed2A and *Aqua*/FM4 Ed1B
- Domain: Global, 13-21 October 2002
- CERES FOV data aggregated to $(1°)^2$
- *Terra*/*Aqua* merged by Lat/Lon/Day: 96,229 pairs of _(_)

Terra/Aqua global mean _(_) differ



Particles dryer in the afternoon?

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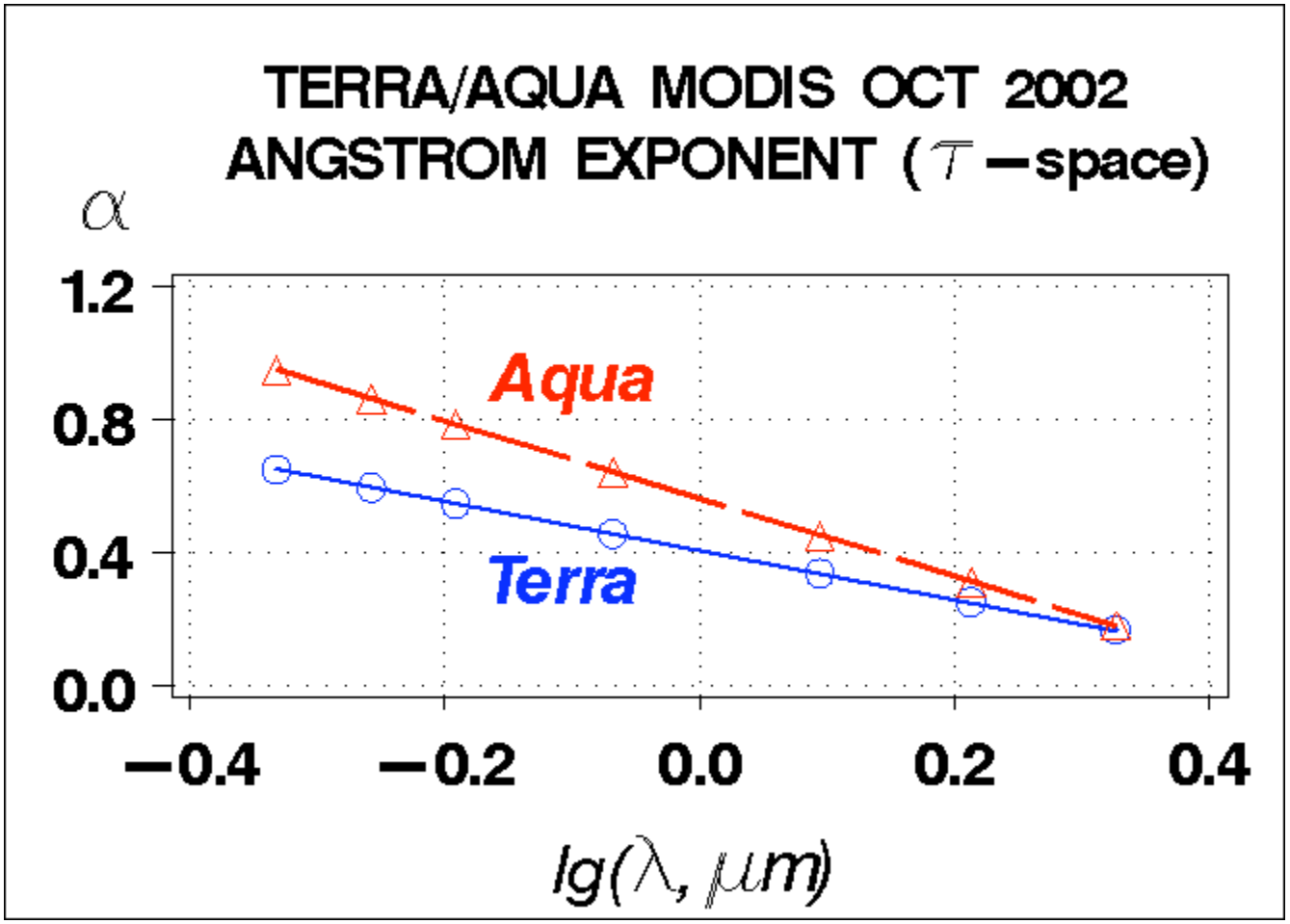
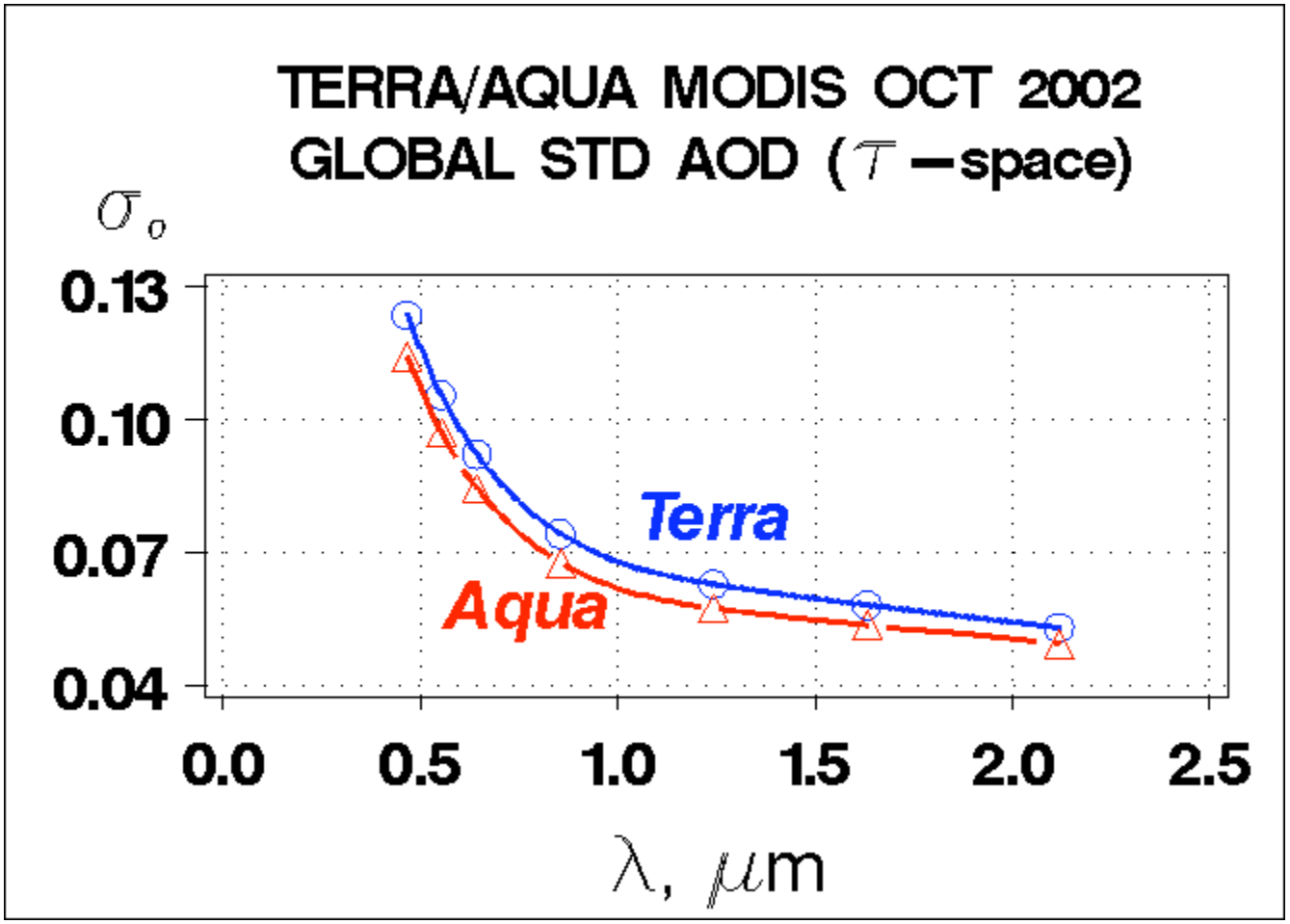
Particles from *Terra* are larger than from *Aqua*

Terra/Aqua spectral Ångström Exponent



STD of Terra/Aqua spectral AOD



Particles dryer in the afternoon?

or

Terra "under-screened"?

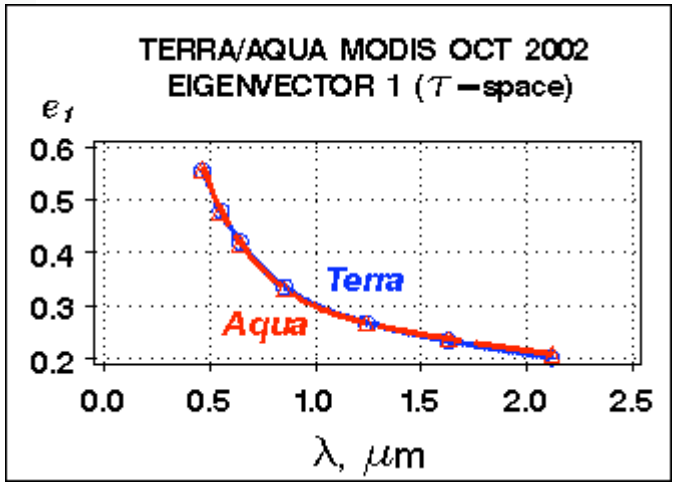
or

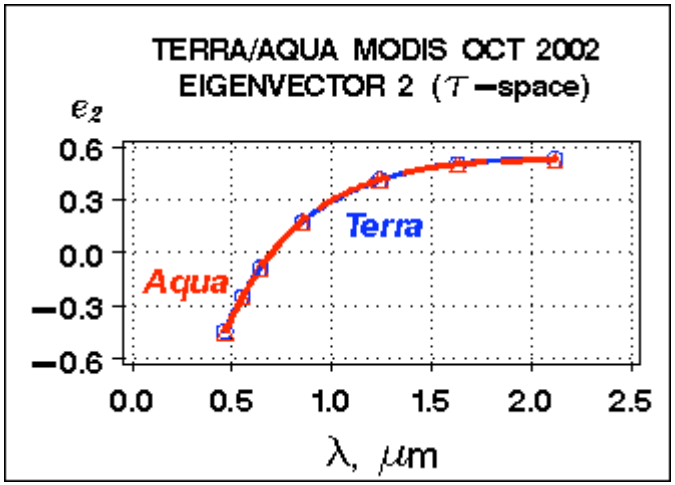
Aqua "over-screened?"

$$?(?) ? e_o(?) ? ?_1 e_1(?) ? ?_2 e_2(?) ? ?_3 e_3(?)$$

Empirical Orthogonal Functions (EOF)

EOF1: ~94.0-94.5%

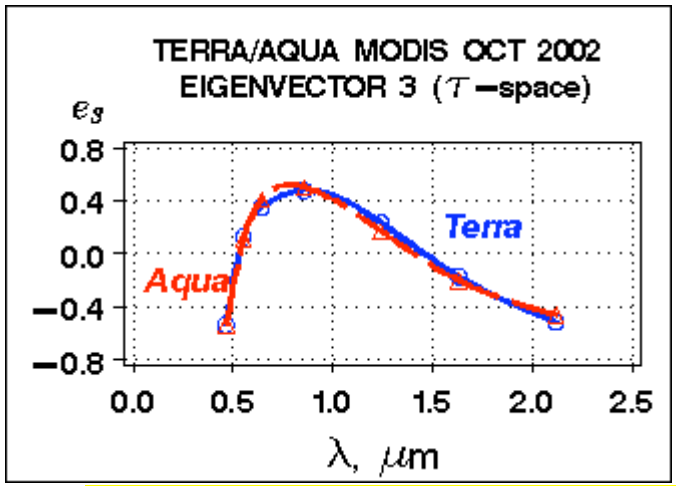


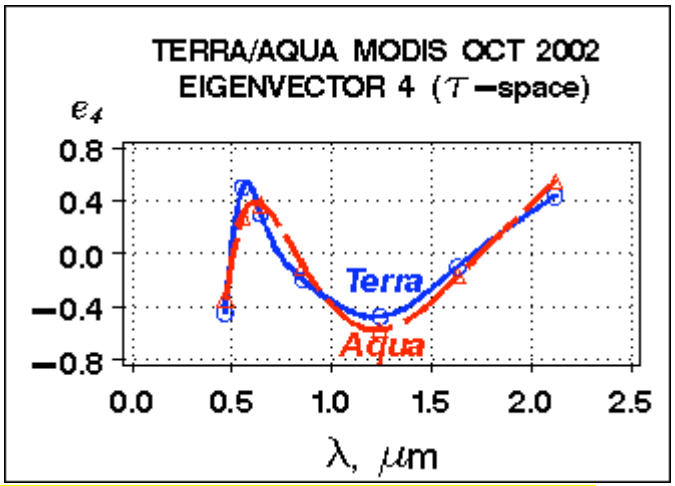


EOF2: ~5.3-5.8%

2EOFs: 99.76-99.80%

EOF3: ~0.17-0.23%





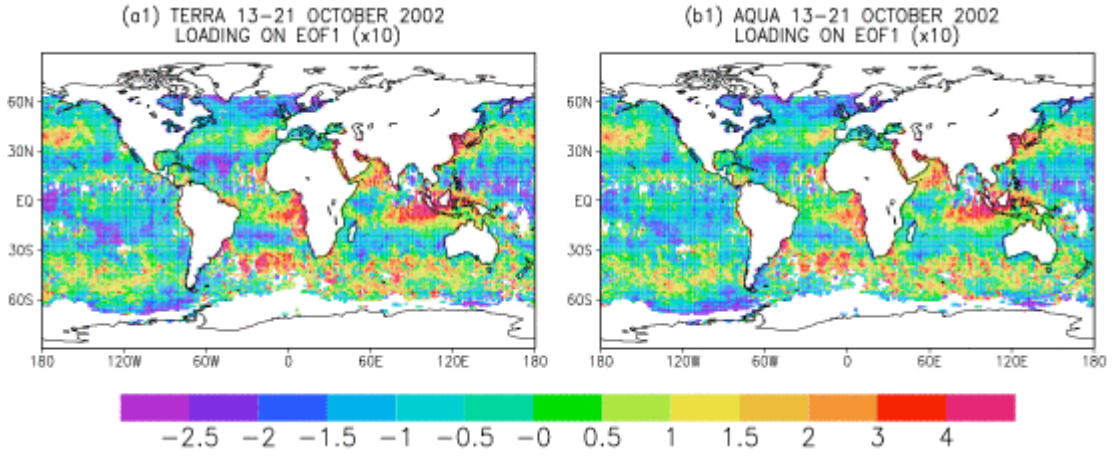
EOF4: ~0.02-0.03%

4EOFs: 99.9972-99.9997%

Is this real EOF structure of _(_) or artifact of MODIS inversion?
(Can check with AERONET)

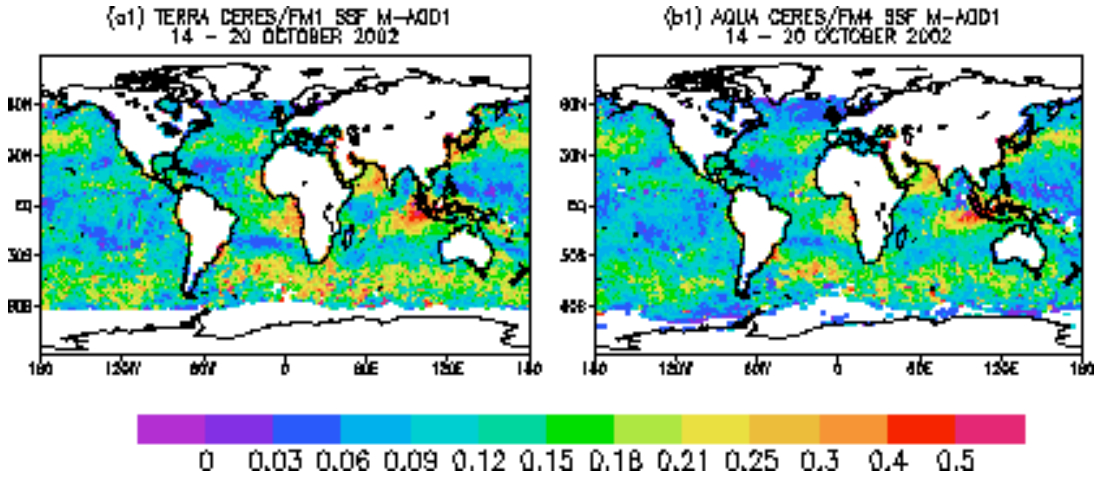
PC1 vs. AOD@0.66 _m

PC1



Terra *Aqua*

AOD1



~94.0-94.5%

Single-channel retrievals: relatively accurate

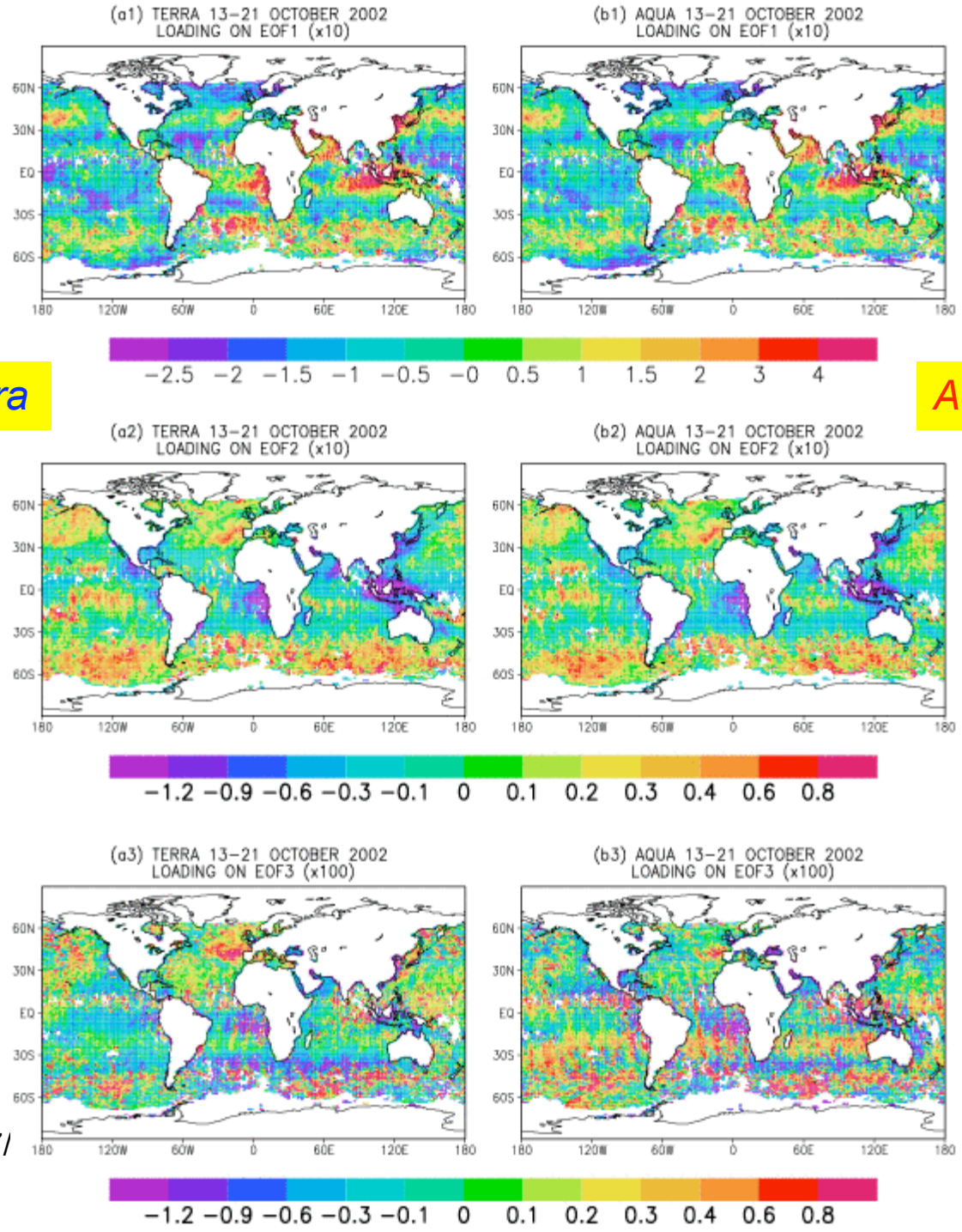
PC1

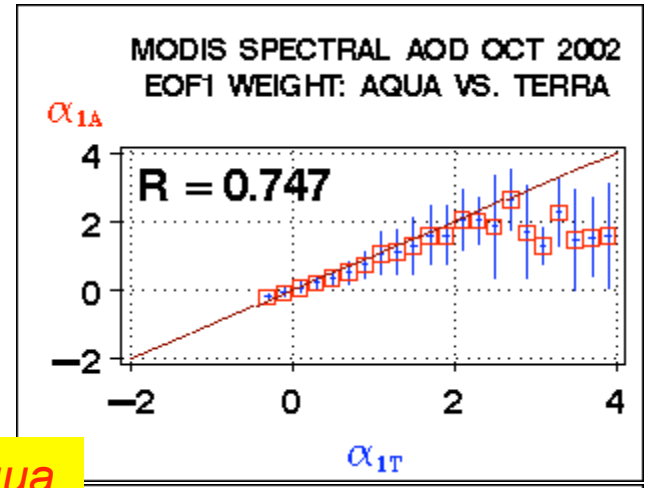
PC2

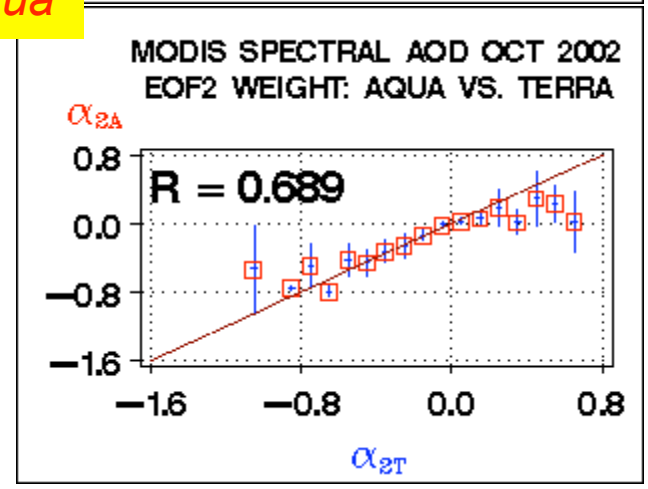
PC3

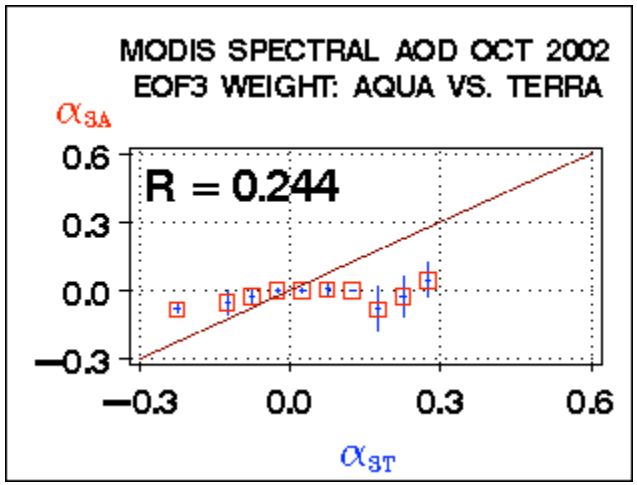
Terra

Aqua

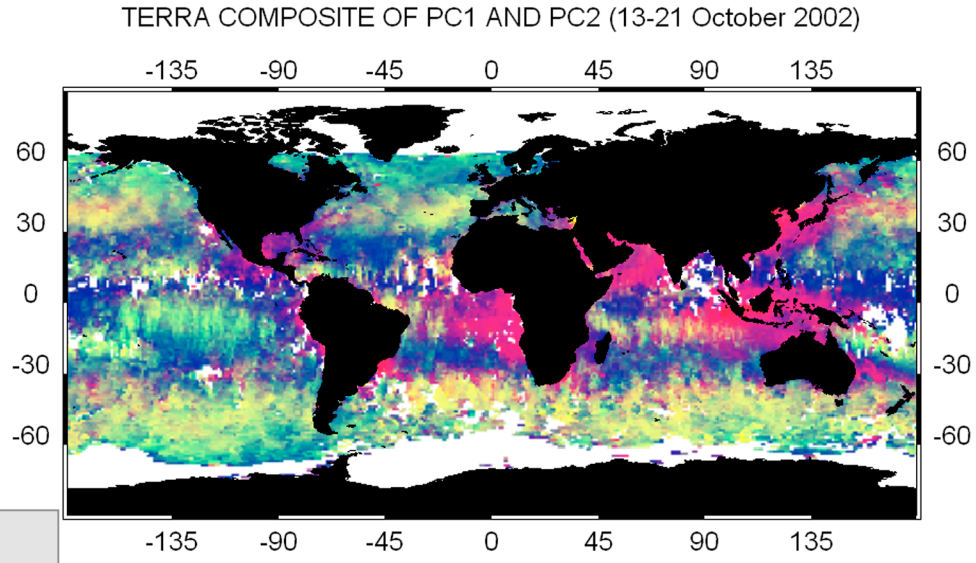








Terra

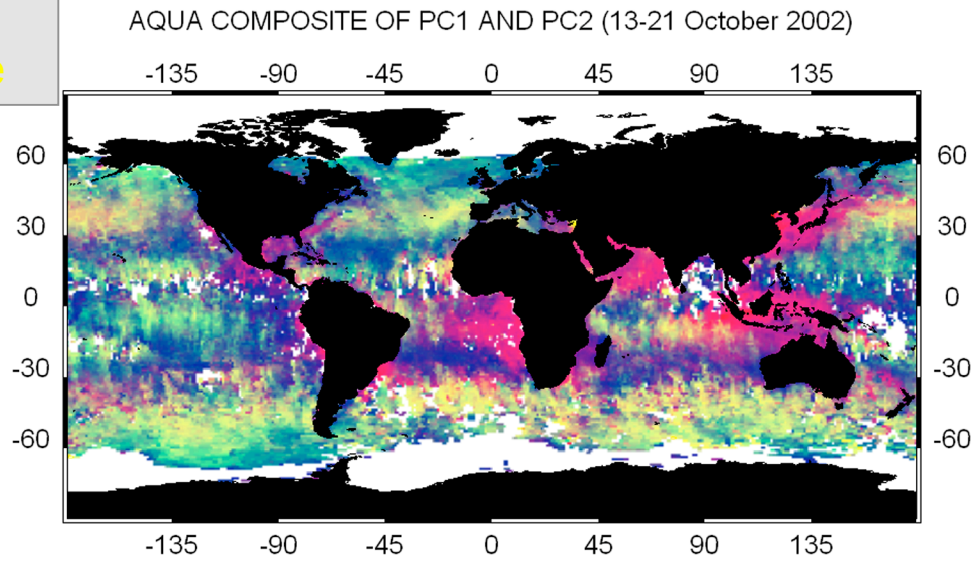


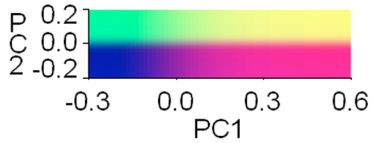
AOD=small/AOD=small

AOD=Large/Size=Small

AOD=Large/Size=Large

Aqua





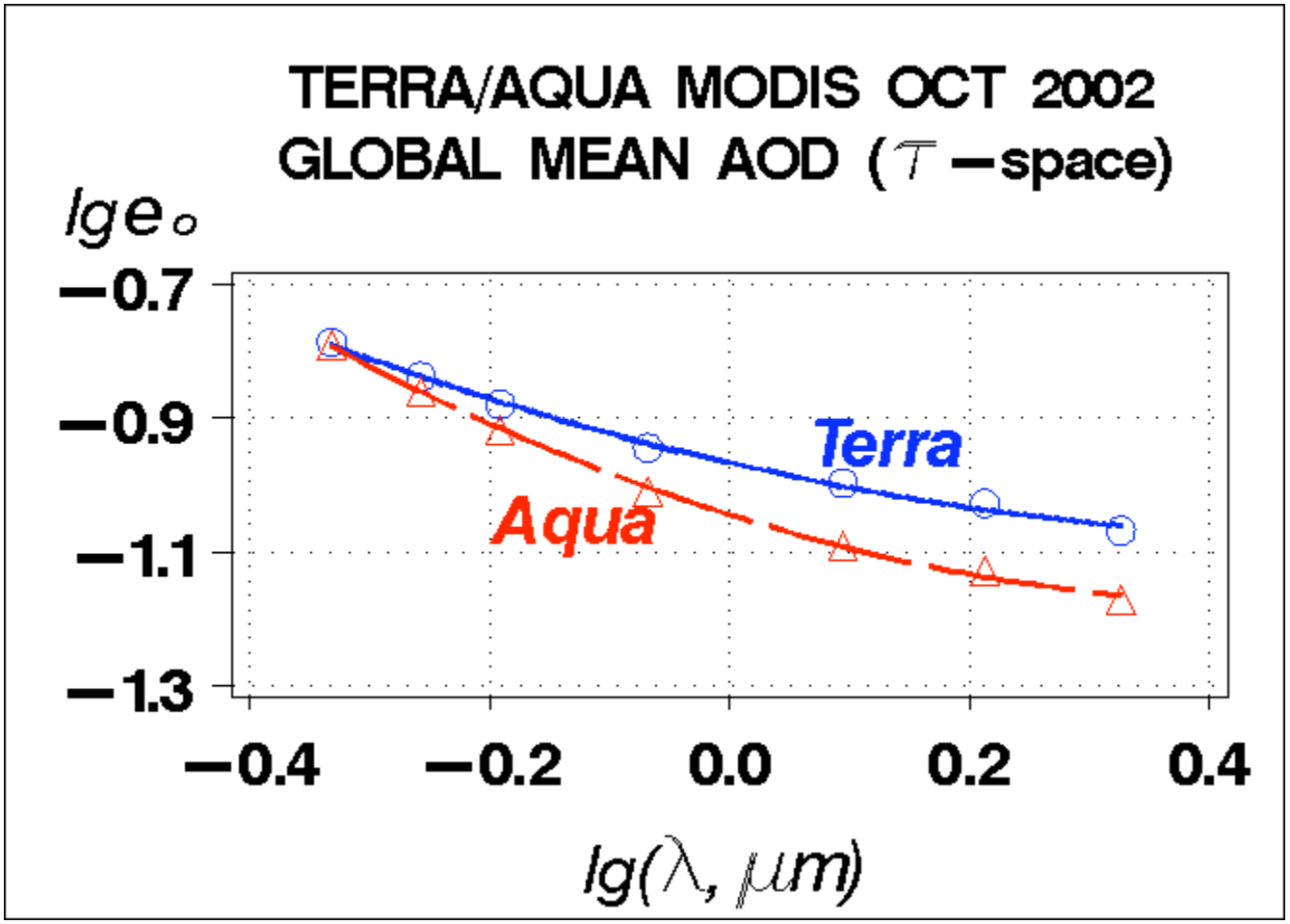
Conclusion
[to collection 4; data from 13-22 Oct 2002]

- Spectral AODs *Terra/Aqua* differ (AE@0.66_m: *Terra~0.55*; *Aqua~0.80*)
- Stat structure of _(_)-variability (EOFs): Well reproducible between *Terra/Aqua*
  - 1st PC explains 94.0-94.5%. Correlates between *Terra/Aqua* & with AOD
  - 2nd PC explains 5.3-5.8%. Correlates between *Terra*/*Aqua*
  - 3rd PC explains 0.17-0.22%. (Currently, it's noise)
- EOFs of _(_): Real or artifact of MODIS inversions? (Check with AERONET)
- Single-channel retrievals: Picks 94-94.5% of aerosol signal!
- QC/Signal-from-noise: PCs stripy/noisy. M*D04 needs improvement
- Use EOFs to compress _(_): Constrain the inversion? Facilitate assimilation?

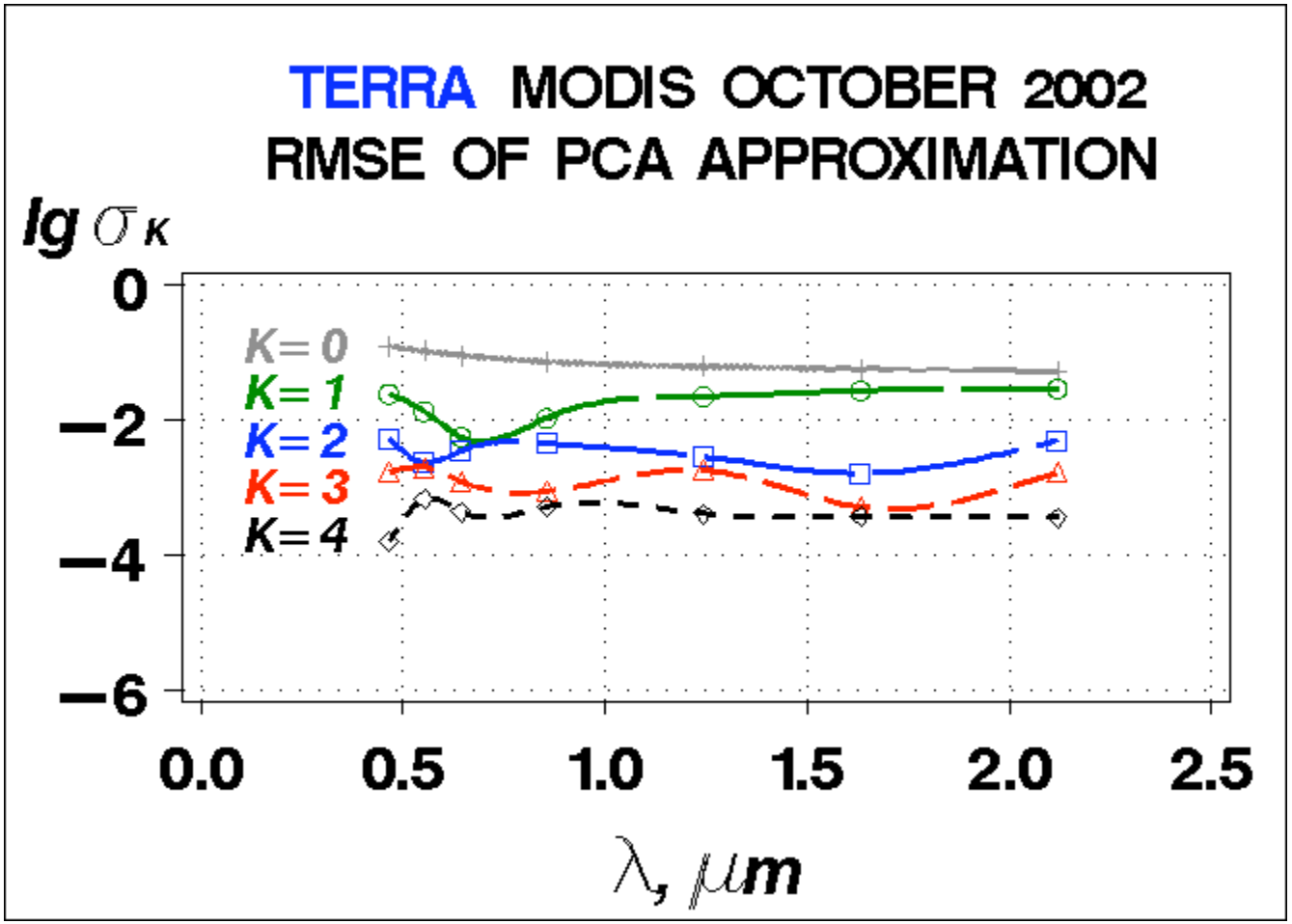
Future work

- Document Terra/Aqua spectral consistency analyses
- Work with RMIB/EUMETSAT on MSG/SEVIRI aerosol retrievals/analyses
- Document VIRS aerosol product on TRMM CERES SSF
- Explore long-term Terra/Aqua aerosol consistency

Terra/Aqua log_-log_: Non-Ångström

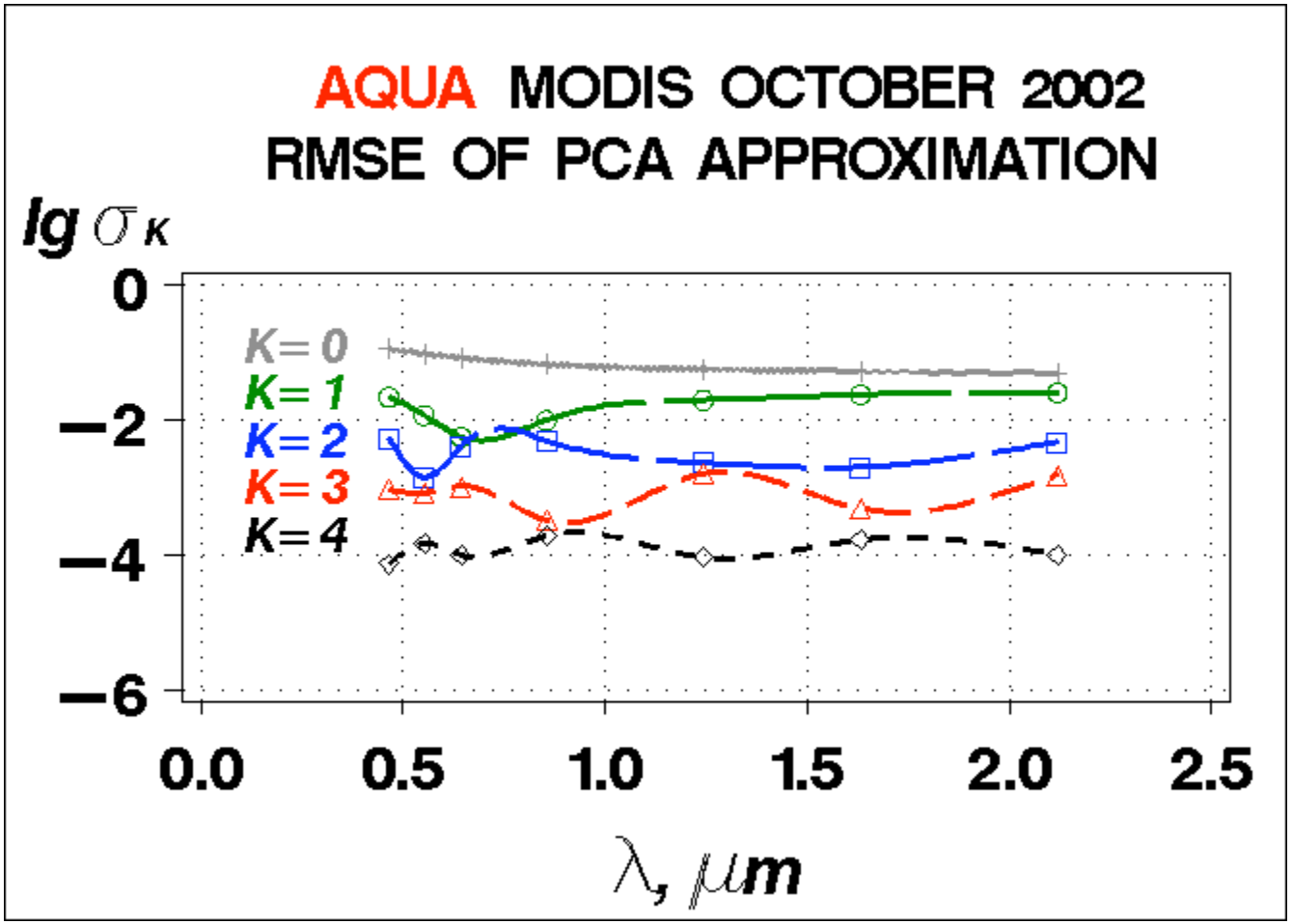


*RMSE of PCA approximation: **Terra***



$$?(?) ? e_o(?) ? ?_1 e_1(?) ? ?_2 e_2(?) ? ?_3 e_3(?)$$

RMSE of PCA approximation: ***Aqua***



$$?(?) ? e_o(?) ? ?_1 e_1(?) ? ?_2 e_2(?) ? ?_3 e_3(?)$$