Atmos. Chem. Phys. Discuss., 5, S3536–S3539, 2005
www.atmos-chem-phys.org/acpd/5/S3536/
European Geosciences Union


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "A review of measurement-based assessment of aerosol direct radiative effect and forcing" *by* H. Yu et al.

**H. Yu et al.**

Received and published: 31 October 2005

We appreciate Dr. Jens Redemann's insightful comments on the work. We have been trying to review the issue comprehensively, resulting in this long paper. To help readers digest easily, we will incorporate his excellent suggestion of adding a table of contents and some sub-sections in the revision. We are also following the other reviewer's suggestion by simplifying the description of non-AERONET ground-based measurements. These revisions should significantly improve readability of the paper.

Response to the specific comments is followed.

1) We agree that the reported standard error does not generally denote a true experimental uncertainty, but instead the spread of results from different methods. On the

other hand, because we are using independent approaches with independent sources of errors - models and measurements, the difference examined is thus indicative of the uncertainty. We will clarify these points in the revision.

2) We will make rigorous definitions for aerosol radiative effect and forcing and clarify the exact spectral range for which results are reported in text and captions of tables and figures. The forcing efficiency results in Tables 14-17 are the direct solar radiative effect normalized by AOD at 550 nm. We have converted “published Et values with respect to the AOT at wavelengths other than 550 nm to that with respect to AOT at 550 nm by using aerosol Angstrom exponents either from available observations or from the MODIS retrievals” (section 3.3.3, p.7690).

3) We will check the use and omission of articles. Thanks.

4) The US Climate Change Science Program (CCSP) was established by the president in 2002 to coordinate and integrate scientific research on global change and climate change sponsored by 13 federal agencies. (http://www.climatescience.gov/Library/stratplan2003/final/ccspstratplan2003-all.pdf). - added.

5) Yes, we now add this statement.

6) We now rephrase the sentence as “Ĕ..over both ocean and land surfaces, including sunglint regions and bright desert aerosol source regions”.

7) We have rephrased this sub-section and will also remake Figure 2.

8) We now clarify in both text and figure caption that AOD is at 550 nm and the DRE results are diurnally averages of solar radiation perturbations by aerosols under cloud free conditions.

9) We add some details as described in Kaufman et al. (2005): By examining the relationship between AOT and the cirrus reflection at 1.38 um in 13 zones over ocean (as defined in Figure 5), it is estimated that, on average, residual cirrus causes 0.015



**ACPD**

5, S3536–S3539, 2005

$\pm$ 0.003 high bias in the MODIS AOT at 550 nm over the oceans. Correlation of the difference between the simultaneously measured MODIS and AERONET AOT with cloud fraction measured from MODIS shows that for average cloud conditions the total cloud contamination (including cirrus) of the AOT is about 0.02 $\pm$ 0.005.

10) You are right that some effects (e.g., new particle formation in the vicinity of clouds) can not be considered in such large-scale models. We will clarify in the revision.

11) On global average, the DRE shows small interannual variations (e.g., Remer and Kaufman, 2005; Loeb and Manalo-Smith, 2005). However, interannual variations could be significant on a regional basis, such as in the northern Pacific Ocean during the spring (Loeb and Manalo-Smith, 2005). On the other hand, as we discussed in section 3.3, differences among various approaches are generally much larger than the detected seasonal variations. We don't expect that different data years would significantly affect the intercomparison.

12) For MODIS over-ocean AOD, values in Table 4 are weighted with the number of aerosol retrieval that roughly corresponds to the clear-sky fraction (Remer and Kaufman, 2005). Because aerosol optical depth generally increases with cloud fraction (Kaufman et al., 2005), these weighted values are smaller than un-weighted AOT values in Table 6c. A small AOD difference for MO_MI_GO over land may come from with/without area weighting when deriving global averages. We will find it out and correct in the revision.

13) We now discuss uncertainties and biases associated with individual methods more quantitatively and in more detail when introducing the methods in section 3.1.

14) We are not certain what cause this regional difference opposite to global average. Your suggestion may be a plausible explanation, a spherical assumption in the MODIS retrieval algorithm may have resulted in a bias of AOT with the prevalence of dust.

15) We now clarify that MODIS, CERES_A, CERES_B, and CERES_C don't estimate



**ACPD**

5, S3536–S3539, 2005

the aerosol direct effect at the surface.

16) We agree and has clarified the definition of radiative efficiency in captions by re-wording like “Summary of the clear-sky radiative efficiency E$\tau$, defined as the aerosol radiative effect (Wm-2) per unit aerosol optical depth ($\tau$ at 550 nm), in xxx region.”

17) We agree that such a simplified equation will result in uncertainties in any situation where aerosols and clouds co-exist, especially where absorbing aerosols reside above clouds and aerosols are below thin clouds. For example, aerosols under cloud with reflectance of 0.2 (corresponding to optical depth of 2) will have 75% of the effect as aerosol in cloud free area. Given complexity of the issue, we have decided to limit our analysis to clear-sky only and the referred statement will be deleted.

18) We now clarify in text and footnote of the table.

19) It is an excellent suggestion and we will create some short bullets.

References:

Kaufman, Y. J., Remer, L. A., Tanre, D., Li, R.-R., Kleidman, R., Mattoo, S., Levy, R., Eck, T., Holben, B. N., Ichoku, C., Martins, J., and Koren, I.: A critical examination of the residual cloud contamination and diurnal sampling effects on MODIS estimates of aerosol over ocean, submitted to IEEE Trans. on Geoscience Remote Sensing, 2005.

Loeb, N.G., and Manalo-Smith, N.: Top-of-Atmosphere direct radiative effect of aerosols over global oceans from merged CERES and MODIS observations, J. Clim., 18, 3506-3526, 2005.

Remer, L. A., and Kaufman, Y. J.: Aerosol effect on the distribution of solar radiation over the global oceans derived from five years of MODIS retrievals, Atmos. Chem. Phys. Discuss., 5, 5007-5038, 2005. SRef-ID: 1680-7375/acpd/2005-5-5007.

---

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 7647, 2005.