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Atmospheric Measurement Techniques Discussions

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4, C2328–C2333, 2011

Interactive Comment

Interactive comment on "Trend analysis of the Aerosol Optical Thickness and Ångström Exponent derived from the global AERONET spectral observations" *by* J. Yoon et al.

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Dear anonymous referee,

Thanks for your suggestions and comments to improve this discussion paper.

Major Comments

C1. The use of the Gobbi et al. (2007) classification methodology to determine fine/coarse breakdown is problematic since it relies on 2 channel computations of AE that are subject to large errors from the uncertainty in AOD of ~0.01. This is especially

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true of the 675-870 nm wavelength range AE since the AOD values of these 2 wavelengths are quite close in magnitude therefore the AOD errors of 0.01 can result in very large errors in AE (675-875), especially for lower AOD values.

A: Apparently, the Gobbi et al. (2007) classification methodology generates large errors if the AOT is less than 0.15. Therefore, in order to avoid these errors, we take into account only AOTs (440 nm) larger than 0.15.

C2. Another issue is the use of the Dubovik et al. (2002, not 2001 as in your paper; D02) table statistics in your analysis, since spherical particle shape was assumed for all aerosols (including dust) and quality control was poor at that time in AERONET (even Version 1 quality checks had not yet been established and now the current Version 2 quality checks are even more rigorous). For example the desert dust sites of Bahrain, Solar Village and Cape Verde all include seasons with significant fine mode aerosol from industrial sources (oil industry in the Mid East; biomass burning in the Sahel) and therefore the 'dust' statistics in D02 are more representative of mixtures of dust and fine mode combustion aerosols. Examples of miss-characterization of fine/coarse mode AOD from Figure 5 include AE of Oceanic aerosol of $\sim$1.2, when Smirnov et al. (2002) has shown that AE for marine aerosol is typically $\sim$0.3-0.7; another is AE of 1.4 in the upper part of Fig 5 as the dividing line between 50% fine/coarse modes when Eck at al. (2010) has shown that the 50% fine-coarse mode point for mid visible wavelength occurs at $\sim$0.75 AE (440-870 nm), based on the latest Dubovik retrievals.

A:

1. There might be weaknesses in terms of accuracy of the typical aerosol optical properties in Dubovik et al. (2002) because the climatology in the paper (Dubovik et al., 2002) was based on the earlier version of the retrievals.To the best of our knowledge, there is no other newer published climatology of AERONET retrievals. This climatology is utilized in numerous applications and, at present, no significant problems were identified in this climatology. This can be explained by the fact described in Dubovik

et al. (2002) that the authors applied very rigorous filtering of the retrievals that entered the climatology. Later those criteria were used for defining Level 2 retrieval result in AERONET V2 version. This probably can explain the fact that this climatology is consistent with present V2 retrievals.

2. Results in Dubovik et al. (2002) were solely based on the retrievals using a spherical model. However, the authors in the paper used a much more elaborated procedure to eliminate possible effects related with unaccounted effect of aerosol particle non-sphericity. Actually, those developments were used later to properly introduce the accounting for non-sphericity of particles in latest AERONET retrievals.

3. The reviewer's statement for the desert dust sites of Bahrain, Solar Village and Cape Verde could be incorrect. Only the data at Bahrain site show mixed aerosols (Dubovik et al. (2002)). The data for Solar Village and Cape Verde seem to be dominated by desert dust. Apparently, some maritime aerosol could be present over Cape Verde, but it generally has very low loading and could hardly affect the total column aerosol properties especially during desert dust outbreaks (these events drive the dust climatology).

4. For the model of oceanic aerosol, we agree with the reviewers, that the Dubovik (2002) model probably corresponds to a mixture of maritime aerosol and pollution. The climatology by Smirnov et al. (2002) seems to be more appropriate. We note here, that the reviewer does not hesitate to recommend this paper, even it is based on older version of AERONET retrieval similarly to Dubovik et al. (2002).

5. The reviewer recommends to use ∼0.75 ÅE as the dividing line between 50% fine/coarse modes. However,∼0.75 ÅE seems to bias the analysis toward coarse dominated aerosol (it would practically include maritime aerosol). Therefore, we would like to modify the classification line in Fig. 5 using 50% of fine volume fraction shown in S-Figures 1 and 2 (supplement).

6. As the typical aerosol optical properties in Dubovik et al. (2002) are not enough to

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be representative for all real aerosols, we have simulated the ÅE and ÅED using Mie theory with all combinations (about 25000 cases) of aerosol median radius, variance, refractive indices, and fine volume fraction shown in Tab. 2. Based on this simulation, we set up the new classification line in in S-Figures 1 and 2 (supplement).

C3. I strongly suggest replacing the current fine/coarse mode designation with the fine/coarse mode AOD values determined by the Spectral Deconvolution Algorithm (SDA) of O'Neill et al. (2003). These values of fine/coarse AOD are much more robust (based on quadratic fit of the AOD spectra in 5 channels from 380 to 870 nm, minimizing AOD errors), and also agree well with the Version 2 Dubovik retrievals of fine/coarse mode AOD (see Eck et al., 2010 Figure 3 b and d). The SDA values of fine/coarse mode AOD are computed and available from the AERONET website (use the Level 2 data if you do follow this suggestion).

A: Basically, the authors agree with reviewer's comments. However, there are some reasons why we cannot replace the current fine/coarse mode designation with level 2.0 SDA data.

1. The level 2.0 SDA data released in April 2010 are not available for all stations defined in our paper (Tab. 1). As shown in S-Figure 3 (supplement), the SDA data at the stations (a) Avignon, (b) Banizoumbou, (c) Beijing, and (j) Ouagadougou are not provided by AERONET. Furthermore, the stations (d) Dakar and (g) Mauna_Loa are not suitable for the trend analysis because they do not satisfy the selection criteria necessary (and defined in our paper).

2. For level 2.0 SDA retrievals, there are additional criteria which must be met [http://aeronet.gsfc.nasa.gov/new_web/data_description_AOD_V2.html]. It means that the level 2.0 observation number is not only depending on only cloud disturbance, which leads in turn to the problem, that the weighting method cannot be applied as it is.

3. Level 2.0 SDA data cover the fine/coarse mode AOTs only at 500 nm while the

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present paper provides the fine/coarse-mode dominant AOTs at four wavelengths, 440, 675, 870, and 1020 nm.

Therefore, we would like to keep the original analysis using the new classification shown in S-Figures 1 and 2 (supplement). By applying a new red classification line, it is possible to analyze the trends of fine-mode dominant AOTs at Solar_Village as referee pointed out (S-Figures 4 and 5 (supplement)).

Specific Comments

As for all your specific comments, we will try to improve and modify the paper accordingly.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 5325, 2011.

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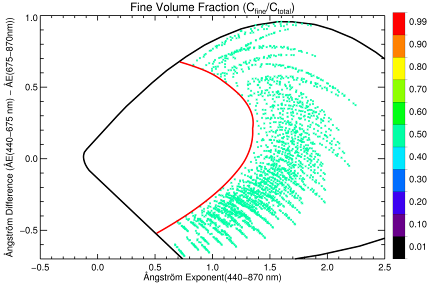
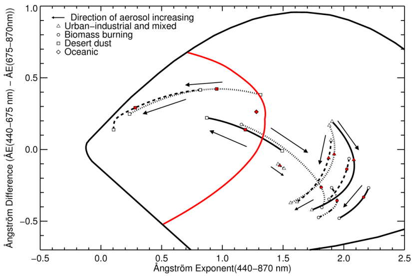


S-Figure 1. New classification line (red) for fine- and coarse-mode dominant aerosol.



S-Figure 2. Mie simulations for the typical aerosols and new classification line (red).

Fig. 1.