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Atmospheric Measurement Techniques Discussions

Interactive comment on "Development of a new data-processing method for SKYNET sky radiometer observations" *by* M. Hashimoto et al.

Anonymous Referee #1

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Review for Atmospheric Measurement Techniques

Title: Development of a new data-processing method for SKYNET sky radiometer observations

Authors: M. Hashimoto, T. Nakajima, O. Dubovik, M. Campanelli, H. Che, P. Khatri, T. Takamura, and G. Pandithurai

General Comments:

This is a very useful paper, as the topic of data quality screening is very important yet not often given sufficient attention in the scientific literature. The authors have shown how more rigorous screening based on basic principles has helped to improve the statistics of single scattering albedo (SSA) retrievals from SKYNET (yielding better agreement with AERONET values). This is a significant development and worthy of publication. However, I found some other aspects of the paper to be much less developed and even somewhat misleading. In particular the authors suggest the need for extending the size distribution limits for dust from 15 microns to 30 microns radius in order to account for certain cases. However, their main evidence for this size extension in radius is SKYNET retrievals of dust cases, which does not in any way prove that the true dust size distributions include significant volume of particles in these size ranges. In fact, several papers that have analyzed in situ measurements of dust size distributions did not find any evidence for extending the size distribution beyond 15 microns radius. For instance Reid et al. 2003 (African dust), Reid et al. 2008 (Middle East dust) and Johnson and Osborne 2011 (African dust) all showed that the current upper radius limit of 15 microns (as used in AERONET retrievals) was sufficient to account for the dust size ranges as measured by in situ instruments. Additionally, one aspect of this paper that needs more development is the issue of the impact of assumed earth surface reflectance on the retrievals of SSA and size distribution. Papers by Siniuk et al 2007 and Eck et al. 2008 both showed the importance of using accurate earth surface reflectance as a boundary input to the AERONET sun-sky radiometer retrievals. However in the present paper the authors compute the error incurred from inaccurate surface albedo values, yet do not adequately describe how the current or future SKYNET retrievals will be improved with respect to this important input parameter.

I recommend that this revised paper be published after significant revisions and suggest that it could make an important contribution to the literature.

Specific Comments:

p. 4363: "…those from AERONET, which is regarded to be the most accurate due to its rigorous calibration routines." Should be "…those from AERONET, which is regarded to be the most accurate due to its rigorous calibration routines and data quality and cloud screening algorithms."

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Interactive Comment

p. 4363: "Therefore, we developed a new data quality control method that eliminates these error sources..." This is overstated. You do not eliminate these sources of error or even adequately address the surface albedo issue.

p. 4365: It is highly unusual to place a figure (Fig 1) in the Introduction section. However my main objection to Fig 1 is the comparison of SKYNET and AERONET values at two different wavelengths. There is no point in including this figure unless the data are interpolated to a common wavelength, since quantitative comparison is pointless unless the parameters are given for a common wavelength. For AOD a 2nd order polynomial fit in logarithmic space with wavelength allows for accurate interpolation to 0.5 microns (Eck et al. 1999; who also note that the AERONET measured AOT are accurate to $\sim$0.01). Linear interpolation in wavelength for SSA is probably sufficient.

p. 4365: "For the cloud screening, AERONET and SKYNET adopt Smirnov et al. (2000)..." should be "For the cloud screening of AOT, AERONET and SKYNET adopt Smirnov et al. (2000)..."

p. 4365: "Each AERONET instrument is checked by means of intercalibration with reference instrument every 6 months..." should be "Each AERONET instrument is checked by means of intercalibration with reference instrument every 12 months..."

p. 4366: "The AERONET reference instruments are calibrated at Mauna Loa site in Hawaii, by using the normal Langley plot method and the lamp method for the determination of the calibration constants and solid view angles, respectively." Should be "The AERONET reference instruments are calibrated at Mauna Loa site in Hawaii for direct sun Vo's , by using the normal Langley plot method, and the lamp method for the determination of the calibration constants for sky radiance measurement."

p. 4371, last sentence: Please explain here that the error in SVA results in a sky radiance calibration error, and that this is the reason for the error of 0.03 in SSA.

p. 4377: "As discussed later, an enhanced coarse mode SDF is possibly required

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for several dust storm cases." You need to provide references in order to support this statement."

p. 4378: Discussion of the Cirrus case in Figure 9: In reality cirrus ice crystals typically have radius > 30 microns, therefore there is an underestimation of the Optical Depth of the cirrus by as much as a factor of 2 due to forward scattering effects into the field of view (see Kinne et al., 1997). Did you account for this in your simulations? You should also mention that cirrus is typically not spatially homogeneous and that the AERONET symmetry check (Holben et al., 2006) of the two sides of the almucanatar scan typically eliminates these cases. However the SKYNET scan only has 1 side of the almucanatar and thus cannot use that particular data symmetry quality check.

p. 4379: "In the period of cirrus contamination, AERONET consistently rejected data through their cloud screening (Smirnov et al., 2000)." This is NOT true for Oct 23, 2008 at Pune, since the AOT did pass the Smirnov cloud screening (only applied to AOT data), but the retrievals did not reach level 2 due to large error between the measured and computed sky radiances and the almucantar asymmetry check (see Holben et al., 2006).

p. 4379: In reference to the Beijing case of April 14, 2004 (Fig 12& 13): The Angstrom exponent of 0.49 indicates a fine/coarse mode mixture (see Eck et al., 2010), NOT necessarily very large coarse mode particles. In situ data are needed to support your case for the presence of very large coarse mode dust as suggested by the SKYNET retrieval. You also need to mention if the surface reflectance inputs to both the SKYNET and AERONET retrievals were the same for this comparison, since in practice they typically are not the same and that difference alone can account for some difference in retrieved SSA and size distribution.

p. 4380: Note that Yoram Kaufman stated that the cloud screening of Kaufman et al, 2006 does not work for cases where coarse mode dust dominates the size distribution.

p. 4382: You should note here in the text that determining the empirical values of the

Cv threshold requires a large database, and that this complicates it's implementation.

p. 4383: "The differences in the spring SSA at Pune in May and Beijing in April were 0.073 and 0.008, respectively, and the differences in the autumn SSA at Pune in October and Beijing in September were 0.017 and 0.043, respectively." Please state in the text whether the AERONET data were for fully cloud-screened data and whether these were Level 2 AERONET retrievals.

p. 4385: "For such dust cases, the SSA can be underestimated by AERONET because of their constraint on the presence of very large particles in the SDF, which do not have a large volume for radius values greater than 10 μm." This is NOT proven in this paper and therefore should not be included in the Conclusions section. Just because SKYNET retrieves larger coarse mode particles and higher SSA does not mean that the AERONET retrieval of SSA is an underestimate. Other recent studies have shown good agreement between AERONET retrievals and in situ measurements for both SSA and PSD (see Toledano et al. 2011, and Johnson and Osborne, 2011).

p. 4385: "There are past reports (e.g. Mikami et al., 2006; Formenti et al., 2011) that show measured SDFs of soil particles with an extended tail for sizes larger than 10 μm." However other papers suggest that the SDF's of airborne dust does not have a tail beyond 10 micron radius (see Reid et al. 2003 (African dust), Reid et al. 2008 (Middle East dust) and Johnson and Osborne 2011 (African dust)). Therefore it seems that you are overstating your case here for the presence of these large dust particles, which will tend to be removed quickly from the atmosphere by gravitational settling.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 4361, 2012.