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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Angular Scattering of the Sahara Dust Aerosol" *by* Helmuth Horvath et al.

Helmuth Horvath et al.

helmuth.horvath@univie.ac.at

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Q:In general, the paper misses from a formal uncertainty analysis of measured and derived parameters. Also, uncertainties are missing in all plots. Please correct this and add more formal error discussion. For example, in Figure 7 of the paper we can see differences between the dust and non-dust cases, but what is the real difference within uncertainties? A:In figure 7 the standard deviation of the average of the Sahara and Non_Sahara data has been added. It is obvious that a significant difference between the two datasets exists. Doing this I realized that I plotted the wrong average for the Sahara aerosol. Instead of copying the average I copied the line above, which was the last measurement of the Sahara aerosol

Q:Specific comments Page 1, line 29: please check the extra comma in the text: A: has been corrected

Q: Page 2, line 4: add references after "larger particles" A: I have added a short discussion of the average residence time of the particles, including a reference

Q: Page 2, line 12: E should be replaced by S, I guess A: This was a mistake, thank you for pointing it out.

Q: Page 2, line 30: please check the formula since I think you missed a minus sign before the angstrom exponent; if I am right, then check the following discussion. A: There are two ways to use the Angström formula: $\sigma(\lambda) = \sigma(\lambda 0)$Âů$(\lambda/\lambda 0)\alpha$ or $\sigma(\lambda) = \sigma(\lambda 0)$Âů$(\lambda/\lambda 0)$-$\alpha$ I have used the first possibility, which historically was used earlier. It is used consistently in the paper.

Q: Page 3, line 5: I do not like the expression "usual aerosol", please be more specific (pollution aerosols, fine aerosols?). A: I have replaced "usual aerosol" by "non-Sahara aerosol"

Q: Page 3 line 5; I would replace with "is a sign for desert aerosol particles" with "it is a sign for large aerosols, as desert dust" or similar A: I have changed it to "an aerosol containing larger particles, in this study mainly desert particles"

Q: Page 3, line 25: how the extrapolation is done? A: The method is described in detail in the reference (Horvath, 2015) given in the paper under discussion. Since this reference is a 10 page paper I can only give a short description: Analyzing a large set of scattering functions of both spherical and non-spherical particles it was found, that it is possible to predict the shape of the scattering function for a few degrees ahead if the shape of the curve is known up to the point, where the extrapolation starts. Since only 5 degrees are missing this can be done quite accurately.

Q: Page 4, line 5: you refer to "all the instruments", which instruments? Please describe clearly the instruments used. I am also a bit confused by the fluxes. A flux of aspiration for the custom made nephelometer is specified in the previous page, while here there is reference to a different flow rate. What is this for? Q: The SLOPE study mainly

was intended to determine the vertical structure of the aerosol by remote sensing instruments. So the main instruments were sun and sky photometers and an airplane. Obviously ground based instruments were also used. At the Albergue Universitaria, several instruments were operated. It is a standard practice to connect these instruments to a central sampling port. This is a vertical tube extending above the roof, through which air is sucked into the laboratory by a blower. The flow rate is chosen such that as little as possible disturbances of the aerosol take place, thus it can be assumed that the instruments sample undisturbed outside air. I have listed the other instruments, although they are irrelevant for this study.

Q: Page 4, line 12: again there is the expression “usual aerosol” to modify A: Has been replaced by non-Sahara aerosol

Q: Page 4, line 19-22: the integrated nephelometer mentioned in this paragraph was not introduced before. Please, again, clearly indicate the used instruments and their configuration. A: I have listed the other instruments although they are irrelevant for this study.

Q: Moreover, what about the integrating nephelometer (model, data treatment, uncertainties)? A: I have added three lines on the Integrating Nephelometer and a reference to the NOAA site. (Since NOAA uses this instrument since more than 20 years at their baseline station, the instrument is thoroughly tested and competent instructions on calibration and evaluation can be found on the site)

Q: The data shown in Figure 5 for example are corrected for truncation, and if yes, how? A: In figure 5 no truncation procedure is needed to apply. The calibration of the Integrating Nephelometer is done according to the NOAA instructions and compared to the integrated volume scattering function of the polar nephelometer, which should be identical.

The effect of truncation is shown in Figure 9 and I have added an explanation how the signals BsbG and BsG are obtained, when using the measured volume scattering

function.

Q: And what about the uncertainty? A: This question is difficult to answer. Under laboratory conditions i.e. when a constant aerosol is produced e.g. by a constant output atomizer, the Integrating Nephelometer measures a signal which is constant as long as the atomizer is in operation. Similarily the polar nephelometer measures identical volume scattering functions, which, when plotted on top of each other are one line. So the uncertainty of both instruments is 2% or even better. BUT the atmosphere is not laboratory with a constant aerosol, especially at the site in the Sierra Nevada with a layered aerosol. This can best be seen in Figure 5. The continuous line is the scattering coefficient of the aerosol (if the aerosol were constant the instrument would produce a horizontal line). So the aerosol is variable and the instruments measure this variable aerosol with very little uncertainty. The variability of the aerosol can best be seen in figure 7 and Table 2. For the aerosols classified as Sahara, the phase function at 90° e.g. is 0.35 sr-1 with a standard deviation of 0.04sr-1 or 11%. But this variability is not caused by an imprecise instrument, but by an aerosol which just is not constant.

Q: Section 5: together with the asymmetry factor is also possible to retrieve the lidar ratio at the used wavelength of 532 nm? If yes, I would suggest to do it. The lidar ratio is a useful parameter to provide as output. A: The lidar ratio is defined as the extinction coefficient divided by volume scattering coefficient at 180°, or 4π /([P(180°) .ω], with ω the single scattering albedo. I have used an average value for ω and the value for the lidar ratio is listed in table 2. I have appended teh revised version of the paper

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-464/acp-2018-464-AC2-supplement.pdf

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