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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #1

Received and published: 17 July 2018

First, I apologize for the delay of my review.

The paper provides measurements of the aerosol phase function from a custom made polar nephelometer for atmospheric aerosols observed at a high altitude site in Spain. The measurement period covers the month of June 2006 during which different cases of aerosols transport from the Atlantic Ocean, the Mediterranean, and the Sahara desert were measured. Dust and non-dust aerosol cases were distinguished based on the Scattering Angstrom Exponent and backtrajectory analysis. Results confirm previous observations that dust aerosols have larger forward and side scattering and less backscattering compared to non-dust cases. The asymmetry factor and its relation to the backscatter fraction is also investigated for the different aerosol observations. The paper provides valuable measurements of the phase function of aerosols of different origins and types, which is of interest for remote sensing and climate applications. Nonetheless, the paper has several weaknesses, both in terms of the presentation

form and discussion of the obtained results. Detailed comments are provided in the following. My recommendation is major revisions.

General comments

Introduction: The introductory part is quite poor and references are in part outdated. For example, numbers provided in the first three lines of the introduction are from a paper published 30 years ago. I suggest to revise the numbers on aerosol emission based on more recent literature. Also, more in general, I would suggest to better place your work in the literature context. In particular: I suggest to discuss briefly the state of the art and uncertainties on the phase function estimates for dust particles, difficulties related to its modelling and measurements, and the implications related to the improvement of its estimate.

Air-mass classification: I have a concern about the representativeness of the data for dust cases. Measurements are done on atmospheric aerosols classified as Saharan or non-Saharan based on the Angstrom exponent and trajectories. However, the possible mixing of dust with other aerosol types cannot be excluded in principle. This should be quantified or at least discussed. Also, what about the local aerosol contribution? I would suggest to compare the phase function obtained for dust aerosols in this paper with the one estimated by previous studies, possibly on pure dust, in order to assess possible differences and similarities and link them to atmospheric conditions.

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?

Specific comments

Page 1, line 29: please check the extra comma in the text

Page 2, line 4: add references after “larger particles”

Page 2, line 12: E should be replaced by S, I guess

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

Page 3, line 5: I do not like the expression “usual aerosol”, please be more specific (pollution aerosols, fine aerosols?)

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

Page 3, line 25: how the extrapolation is done?

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?

Page 4, line 12: again there is the expression “usual aerosol” to modify

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. Moreover, what about the integrating nephelometer (model, data treatment, uncertainties)? The data shown in Figure 5 for example are corrected for truncation, and if yes, how? And what about the uncertainty?

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.

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