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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol optical and microphysical retrievals from a hybrid multiwavelength lidar dataset – DISCOVER-AQ 2011" *by* P. Sawamura et al.

Anonymous Referee #1

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GENERAL COMMENTS

The authors present a comprehensive study on optical and microphysical aerosol properties during the DISCOVER-AQ 2011 campaign. They use combined optical data from airborne high-spectral-resolution lidar, ground-based elastic-backscatter lidar and sun photometer and apply a microphysical retrieval scheme to this hybrid dataset. The data are carefully evaluated. Assets and drawbacks of the approach are discussed, and comparisons with in-situ observations are provided and scrutinized. There are only minor corrections necessary before the paper can be published. However, next to the corrections, the authors should also work on the conciseness of the text. The paper

obviously results from a PhD dissertation and suffers from the somewhat lengthy and repetitive descriptions which might be due to copying parts of the text directly from the thesis.

SPECIFIC COMMENTS

Page 3115, line 24: “Many ground-based lidar networks. . .” should be replaced by “Several ground-based lidar networks. . .” There are not so many.

Page 3115, line 29: “angstrom coefficient” should be replaced by “Ångström exponent”. Note, (extinction, backscatter, scattering) coefficients are extensive properties, whereas the Ångström exponent is an intensive parameter. There should be a clear distinction in the wording.

Page 3117, lines 13-22: This paragraph does not fully describe the idea of the hybrid data set, since it doesn’t mention the sun photometer. Without the AOD constraint, it is not possible to get the extinction coefficient at 355 nm with sufficient accuracy. The experienced reader gets confused here, because the extinction information at 355 nm is obviously missing in the described setup. It becomes only implicitly clear later on that this information is “created” by a constraint retrieval making use of the AOT from the sun photometer. The authors should be more precise here and they should also discuss the related shortcomings/errors compared to a direct measure of the extinction coefficient.

Page 3119, lines 7-19: This paragraph is misleading. It is not correct that the method described by Wagner et al. (2013) uses backscatter and extinction coefficients obtained with Raman lidar. Instead, this algorithm uses elastic backscatter lidar signals at three wavelengths as input. Therefore, it is not true that there is no temporal collocation with the sun photometer data. For completeness of the discussion, the authors should also refer to Lopatin et al. (2013) who also developed a combined lidar and sun photometer retrieval that does not need Raman lidar observations either.

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Page 3120, lines 11-14: Both HSRL and Raman lidar deliver independent information on extinction and backscatter. While this fact is described here for the HSRL, it has not been explicitly mentioned before when the Raman lidar approach to obtain 3+2 data was discussed. The independent information is the major prerequisite for microphysical retrievals. This fact should be better emphasized and also discussed in the context of the missing fully independent extinction measurement at 355 nm.

Page 3124, lines 13/14: What do the three numbers with the colon in between mean?

Page 3124, lines 20/21: How are the errors created and distributed to the input data?

Page 3125 ff., Chapter 4: The order of discussion of the results is a bit confusing. First an overview of AOD for the measurement days is presented, but it is up to the reader to relate Fig. 5 to the cases discussed before and listed in Tab. 1 and Fig. 3 and 4. Then, Fig. 6 shows a particular lidar measurement for one day without further discussion. The results for this day are presented in more detail only 9 pages later. Next, the authors discuss findings from another paper of Veselovskii et al. (2012c) which do not help the reader at all in understanding anything, since no results of their own study have been shown yet. Thus, there is nothing to compare or relate at this point. Afterwards, Fig. 7 is mentioned but not discussed, and general results (mean values for the entire campaign, Table 2) are presented. Probably, the idea of this order of presentation would become clearer when Chapter 4 was started with Section 4.1 "Overview of measurement results", with some more general explanation and interpretation, before going into more details in the following sections. I also had a problem with the comparison of averaged data, before knowing more about the details of the individual cases.

Page 3126, line 18: "subset 1 contains subset 2" is unclear. I guess you mean the cases are contained. However, Level 1.5 and Level 2.0 might be different in terms of the values. Please clarify.

Page 3128, line 11: Why is the ALH not determined separately for each measurement

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case?

Page 3129, line 3, lidar retrievals at 532 nm: The lidar retrievals assume a wavelength-independent value for refractive index and single-scattering albedo. Why should they hold exactly for 532 nm?

Page 3137, line 20, "The work presented in this dissertation. . .": Seems to be copy and paste. The paper, and in particular the conclusion, suffers from the somewhat lengthy and tedious explanatory style of a dissertation. It would be worthwhile to condense and focus the discussion in order to make the paper better readable.

TECHNICAL CORRECTIONS

Page 3117, lines 28: Washingtion -> Washington

Page 3119, lines 4-5: European Aerosol Lidar Research Network - > European Aerosol Research Lidar Network

Page 3119, lines 25 and 26: add nm after the numbers 532 and 1064

Page 3123, line 1: distributions -> distribution

Page 3123, line 13/14: spherical aerosols -> spherical aerosol particles

Page 3124, line 4/5: Weitkamp, 2005 – do not cite the editor, better cite the specific chapter and its authors.

Page 3128, line 20: contains -> contain

REFERENCES

A. Lopatin, O. Dubovik, A. Chaikovsky, P. Goloub, T. Lapyonok, D. Tanré, and P. Litvinov: Enhancement of aerosol characterization using synergy of lidar and sun-photometer coincident observations: the GARRLiC algorithm, Atmos. Meas. Tech., 6, 2065-2088, 2013

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