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Atmospheric Measurement Techniques Discussions

Interactive comment on "Synergy processing of diverse ground-based remote sensing and in situ data using GRASP algorithm: applications to radiometer, lidar and radiosonde observations" *by* Anton Lopatin et al.

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The paper by Lopatin et al. employed the GRASP algorithm to investigate the benefits of combining multiple ground-based observations (namely sun-photometric, lidar and radiosonde observations) to constrain aerosol retrievals in terms of their vertical concentration distribution, refractive index, size distribution and spherical particle fraction. With the assumption of temporal continuity of aerosol properties, the synergetic retrieval mitigates the insufficient information content in lidar only night-time retrieval and brings up the retrieval accuracy. The full-length paper covers a large amount of

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valuable work on algorithm development, test and validation. My comments below are mainly to suggest clarifications on some implementation details:

1. Section 3.1.1 discusses the multi-temporal retrieval of combined COBALD, AERONET and MPL observations. Regarding the balloon-borne COBALD data, does the retrieval underlying Figs.1-3 use a series of COBALD temporal measurement during the night of Aug 05, 2015 ? If multiple COBALD measurements are inverted, then it will be helpful to add a time series plot showing the temporal evolution of certain retrieval aerosol quantity (e.g. fine aerosol concentration or other properties). Following the use of multiple COBALD measurement (if this is true), does the “Fine night” and “Coarse night" in Figs. 1-3 averages the retrievals of night measurements from 13:21UTC to 05:16UTC of next day ?

2. In some figures (e.g. Figs. 25-31), I saw terms “multi-pixel” in legend, but "multi-temporal” in figure caption. To clarify, did the balloon-borne COBALD measurement resolve both multiple pixel and multiple-temporal measurements so that smoothness constraints were imposed in both dimensions ?

3. Table 2: it might be helpful to add another column providing the measurement uncertainties for MPL, COBALD and sun-photometer which are used in retrieval.

4. In Section 3.1.1, demonstration of retrieval results were provided for refractive index, size distribution and vertical profiles of aerosol concentration. How about the spherical aerosol fraction ? Is it also retrieved retrieved and worthwhile to demonstrate ?

5. Section 3.2.1 and Section 3.2.2, do the stand-alone COBALD and LILAS retrieval involve the use of any multi-temporal/mullti-pixel constraints ? Please clarify.

6. Figs. 25, 26, 27, 29, 30 and 31, it took me a while to confirm the meaning of “components” in the figure legends. For clarify, authors might mention it again in Fig. 25 caption that “components retrieval” here mean “stand-alone COBALD” (or “stand-alone COBALD” retrieval) with a) turning off temporal constraint and b) using pre-determined

size distribution for all aerosol types (Table 5), while “multi-pixel retrieval” means a) using all types of instrumental data and b) imposing temporal constraint in retrieval.

7. As the authors pointed out, Fig. 29 indicates “some significant differences ... in the lower part of the extinction profiles at 455 nm below 500 m.” Could this be due to the impact of measurement uncertainties, or neglecting the multiple scattering in the model, or others ? Is there any constraints imposed on the vertical variations of aerosol concentration or properties ? If so, maybe it’s worthwhile to try relaxing the constraint and see if one can observe more consistency in the two types of retrievals.

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