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Atmospheric Measurement Techniques Discussions

Interactive comment on "Synergy between CALIOP and MODIS instruments for aerosol monitoring: application to the Po Valley" *by* P. Royer et al.

Anonymous Referee #4

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In this paper the authors combine observations from CALIOP and MODIS to study aerosols in the Po Valley. MODIS column AOD is used to constrain CALIOP aerosol retrievals, yielding aerosol extinction profiles and column-average lidar ratio (or BER). This is an interesting study showing the synergy between these two instruments and shows various intercomparisons which provide insight into data quality.

First, I agree with the other reviewers – use lidar ratio instead of BER. The vast majority of lidar literature expresses the lidar ratio as S (or Sa), the inverse of BER.

1) I see two areas where greater care is required:

a) Results of an error analysis are shown in Figure 5 but the results shown are not di-

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rectly applicable to the BER retrievals shown later. The analysis is applied to the mean AOD, with a mean error of 17%, whereas some of the AODs are much smaller and have errors of 100% or more (figures 3 and 4) which must lead to very significant BER errors. Indeed, some of the lidar ratios (BER values) are much larger (smaller) than seems reasonable based on modeling and other measurements. This error analysis should be extended and used to add error bars to the values shown in Figure 8.

b) Uncertainties introduced by using MODIS-Terra AOD and applying daytime MODIS AOD to nighttime CALIOP profiles should be addressed in more detail. The lowest values of BER are due to applying MODIS AOD to nighttime CALIOP data, implying the MODIS AODs may not be representative of nighttime conditions. Given the significant AOD differences between MODIS-Terra and MODIS-Aqua shown in Figure 4, there seems little justification for applying daytime AODs to nighttime profiles.

Specific comments:

2) The uncertainties stated in the last sentence of the second paragraph of Section 2.1 are unsupported and should be deleted.

3) The retrieval algorithm should be discussed in more detail. The Klett algorithm which is referenced is a single component retrieval and not appropriate for the cases of interest here. In particular, what are the conditions for convergence and what causes the algorithm to diverge? How does error in MODIS AOD propagate to the retrieved BER?

4) The description of the CALIOP retrieval algorithm in Section 4.2 is not entirely correct, perhaps because the references cited are either incomplete or outdated. The CALIOP aerosol typing algorithm is best described in (Winker, et al. 2009) and (Omar, et al. 2009).

5) Section 2.2 – Terra is not in the A-train

6) Section 4.2 – The purpose of the long discussion of other BER values in the literature

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is not clear. BER values derived here should be explicitly discussed relative to other values in the literature.

7) Table 1 only considers local sources. What about long range transport of smoke or dust?

8) Figure 7 – It is hard to determine the bin boundaries – please re-plot to make clearer.

9) Fig 9 – Are these profiles averaged over 40 km? Explain these profiles in more detail. Give AOD and lidar ratios for each of the four profiles.

Omar, A., D. Winker, C. Kittaka, M. Vaughan, Z. Liu, Y. Hu, C. Trepte, R. Rogers, R. Ferrare, R. Kuehn, C. Hostetler, 2009: "The CALIPSO Automated Aerosol Classification and Lidar Ratio Selection Algorithm", J. Atmos. Oceanic Technol., 26, 1994–2014, doi:10.1175/2009Â■JTECHA1231.1.

Winker, D. M., M. A. Vaughan, A. H. Omar, Y. Hu, K. A. Powell, Z. Liu, W. H. Hunt, and S. A. Young, 2009: "Overview of the CALIPSO Mission and CALIOP Data Processing Algorithms", J. Atmos. Oceanic Technol., 26, 2310–2323, doi:10.1175/2009JTECHA1281.1.

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