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Atmospheric Measurement Techniques Discussions

Interactive comment on "Validation of CALIPSO space-borne-derived aerosol vertical structures using a ground-based lidar in Athens, Greece" *by* R. E. Mamouri et al.

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We would like to thank the anonymous referee for his constructive and helpful comments/suggestions on our paper. Referee comments (italics) and authors' replies are presented below.

Abstract: - Mention in the abstract which CALIPSO product is under study. – Mention in the abstract what the space-time constraints for the collocation are.

The CALIPSO product under study (Level 1 attenuated backscatter coefficient profiles) and additionally the space-time collocation constraints (maximum distance of 100 km and duration of 2 hours centered at CALIPSO overpass time) were mentioned in Ab-

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stract.

- page 564 line 8: Calipso was launced in April, but started measurements in June

This is true and has been corrected in the final manuscript.

- page 564 line 26: remove “the” in “In the Sect. 2”

Corrected in the final version of the manuscript

- page 565 line 10: what is the bandwidth of the detection of the Athens lidar? Indicate here what the limitations are for daytime/nighttime observations.

All the specific information is mentioned in section 2.1 at the new version of the paper.

- Page 565 line 21: Whiteman

Corrected in the final version of the manuscript

- Page 567 line 23: The authors argue why they chose to validate the L1v201 data product, rather than the L2 data, which are still unvalidated. While a validation of the L2 data cannot be done properly whithout first validating the L1, I am tempted to think that the authours are actually in a position to make an attempt to validate L2 data (eventually starting from a subset of best cases that come out of this study). My impression is that this study (of L2 data) is actually under way, but outside the scope of this paper. Perhaps the authors could reflect in this.

Reviewer’s impression is correct, since the authors are additionally working on L2 data validation. The authors chose to first present their validation on the L1 CALIPSO products and the conclusions of this work refer to CALIPSO capabilities to record an acceptable attenuated coefficient profile. In general, discrepancies between ground-based and space-borne profiles in L2 profiles could be additionally attributed to a number of CALIPSO’s algorithm assumptions (e.g. the lidar ratio assumption). Authors believe that this is a future work that needs much more effort and additional discussion on aerosol type presented over Athens (which drives the lidar ratio assumption).

AMTD

2, C234–C238, 2009

- Page 569 line 14: Since the Raman channels are not (fully?) operational during daytime, the nighttime derived lidar ratio is extrapolated for use during daytime. While this may be permitted for some cases, such as the case used as an example, I doubt whether this can be done during cases of higher atmospheric variability. Perhaps the authors could reflect in this.

This is true, since the lidar ratio can vary during the two CALIPSO overpasses (daytime and nighttime). However, the selected dataset of 40 coincident ground-based measurements was carefully selected, excluding days with high atmospheric variability and strong aerosol layering changes during the day. From the 72 total coincident measurements, only 40 were finally analyzed and presented due to these constraints (and additionally due to the presence of lower clouds). In our final dataset of 40 cases, only 12 cases are referring to daytime measurements. The authors could exclude these cases to avoid the lidar ratio assumption, but they considered the importance of demonstrating the increased signal noise of CALIPSO daytime measurements (comparing with nighttime). Then, it is possible to present the improvement on the averaged profiles when averaging for 20 km horizontal distance instead of 5 km (appropriate for nighttime measurements).

- Page 570 line 7: “both the daytime and nighttime”

Corrected in the final version of the manuscript

- Page 570 line 20: “: : : dust outbreak occurred : : :”

Corrected in the final version of the manuscript

- Page 571 line 3: The sentence “so the profiles would be correlative” is a bit unclear. I assume it is meant to say that the height binning is done to make the profiles from both instruments comparable to each other.

Corrected in the final version of the manuscript

- Page 571 line 20: “the two systems”. I think it is actually meant to say here that the

AMTD
2, C234–C238, 2009

aerosol profile observed by both instruments etc.

Corrected in the final version of the manuscript

- Page 571 line 7-8: Temporal and spatial averaging of the CALIOP data is extended from 5 to 20km to reduce noise in the first place. Apparently, the authors chose not to reduce the vertical resolution. Why not? By decreasing the along track resolution to 20km also raises the point of representativity (also addressed in Fig. 8). Perhaps the authors could reflect on where the limits are: i.e. what (might) happen when the averaging is further increased and would there be a distance beyond which the correlation clearly decrases?

The vertical resolution for both the ground-based and spaceborne instruments is already reduced so the profiles would be comparable to each other. Further vertical averaging from the one reported in our paper (250 m) increases the validation differences, since the profiles are not further representative of the true aerosol layering. Authors strongly believe that the main reason for the deviations between the profiles is the horizontal distance between the instruments and the aerosol horizontal inhomogeneity within. The 20km horizontal spatial averaging was enough to reduce the signal noise of CALIPSO daytime profiles. Increasing this horizontal averaging distance was considered unnecessary for further signal noise removal.

- Page 574 line 8: ": : : distributions are in most cases inhomogeneous".

Corrected in the final version of the manuscript

- Page 575 line 7: Mentioning the subject of overlap height at this point in the manuscript is too late. This should be done in Sec 2.1, with the description of the ground based lidar. Also, for non-lidar people, some explanation about the consequences on incomplete overlap might be helpful. Clearly this is a systematic effect that would result in a bias. What is the direction/sign of the bias expected. Is this consistent with the results and what are the implications for your conclusions? If the implications

AMTD

2, C234–C238, 2009

of the instrumental effects of the ground based lidar are large in the region of incomplete overlap, it might be better to restrict the graps and conclusions based on them to distances beyond the full overlap.

Overlap information for the ground-based lidar was added in Sec. 2.1. A reference on overlap issues was added. For NTUA lidar, overlap corrections are applied and only altitudes with overlap factor greater than 0.5 are used for the analysis. For these altitudes the overlap correction is considered safe. These corrections were tested for our lidar during lidar hardware intercomparisons taken place within EARLINET (Matthias et al., 2004). However, to remove overlap uncertainties from our validation in this paper, all heights bellow 1000 m were excluded from our figures, results and conclusions.

- Page 581 Fig 2-3.: What is the color scale? Are they comparable?

The color scale for ground-based measurements (Fig. 2) represents the range-corrected signal in Arbitrary Units. Figs 2 and 3 are not comparable. We are showing Fig. 2 just to demonstrate the stability of the atmospheric vertical structure during a case study. The comparison between Figs 2 and 3 would be in any case impossible due to spatiotemporal restrictions.

- Page 583 Fig 3: replace “up” and “down” by “top” and “bottom” respectively, also in the main text.

Corrected in the final version of the manuscript

- Page 584-585 Fig 5-6: I have the impression that the plots are interchanged. The description above the graphs do not match the figure captions.

The referee was right. The descriptions of Figs 5-6 were corrected.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 561, 2009.