

***Interactive comment on “Investigating the quality of modeled aerosol profiles based on combined lidar and sunphotometer data” by Nikolaos Siomos et al.***

**Anonymous Referee #1**

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The paper of Siomos et al. presents an interesting example of aerosol model evaluation based on remote sensing observations. The manuscript highlights the potential and pitfalls for such a comparison, therefore it could be of interest for the wider atmospheric community. The manuscript is worth publishing after addressing several comments listed below.

**General comments**

1) A main issue with the presented analysis is that the authors compare fine and coarse particles defined in two fundamentally different ways. According to the text, the model's fine mode is defined as particles with aerodynamic diameter less than 2.5  $\mu\text{m}$ , while LIRIC's fine mode is defined as particles with (optical) diameter less than  $\sim 0.4$

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– 1.2  $\mu\text{m}$ . Before this study is published, the authors should thoroughly discuss this issue and justify why their comparison gives any meaningful results.

2) Desert dust is included in the model only as a boundary condition and this explains, according to the authors, the poor performance of the model in forecasting coarse aerosol concentration. However most desert dust is produced outside the model's domain. Given appropriate boundary conditions, CAMx should transport the dust in its domain and produce good prediction of dust concentration. Do the authors imply that the MACC models provide bad boundary conditions or does CAMx do a poor job transporting the dust within its domain?

3) Section 2.5 should define the uncertainties of the LIRIC algorithm. Several references to evaluation studies are given in the last paragraph, but the authors should briefly present the outcome of these studies, at least to the extent that are relevant for the discussion of their results.

4) The author's definition of PBL is not consistent with the description of the LIRIC algorithm. The authors claim that they search for PBL's top height between “400m and 2.5km”. However, LIRIC's lower boundary is set to 600m. In addition LIRIC is “demanding a certain degree of vertical smoothness in the final product”, possibly masking the true PBL top. The authors should address these discrepancies and provide estimated of the resulting uncertainties. They should also compare the PBL values derived from LIRIC with the PBL values assumed in the corresponding model profiles.

**Technical corrections**

Page 1

1: missing parenthesis “with extensions (CAMx).” This applies also to page 2, line 3.

2: “updated version of the former”. This is awkward wording.

Page 2

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13: “For example Mona et al. (2014) compare [...] the dust extinction”. Delete “between”.

31: “(ENVIRON, 2010)”

Page 3:

27: “Schneider et al. (2000)”. The citation seems misplaced and poorly formatted.

Page 7:

20: “In the current dataset the full overlap height was calculated at 900m. The lower boundary is set to 600m where the overlap function is still above 90%.”. Provide more information about these calculations.

Page 10:

3: How are Q factors calculated?

Many citations are badly formatted and need to be corrected.

Table 2, caption: “The a and c symbols”. “a” should be “z”.

Fig. 2: What is the meaning of black dots in the HYSPLIT plots?

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