Atmos. Chem. Phys. Discuss., 15, C314–C319, 2015
www.atmos-chem-phys-discuss.net/15/C314/2015/

Atmospheric Chemistry and Physics Discussions
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Interactive comment on "LIVAS: a 3-D multi-wavelength aerosol/cloud climatology based on CALIPSO and EARLINET" *by* V. Amiridis et al.

Anonymous Referee #2

Received and published: 19 February 2015

General comments:

This paper presents a 3D multi-wavelength global aerosol and cloud optical climatology, LIVAS, based on multiple approaches. Such a database is useful and needed for the simulation, performance evaluation, and testing algorithm of future space lidar measurements. I suggest the paper is published after revisions are made.

In this study, the derivation of the factors that convert the CALIPSO backscatter and extinction measurements at 532 nm to other wavelengths is a key, where more discussion and work can be done. The LIVAS aerosol models are compared with the CALIPSO aerosol models. Comparisons are presented in Figures 2 and 7 and the authors conclude on page 2267 that "Overall, we found that the LIVAS and CALIPSO

aerosol models agree only for the polluted continental aerosols, whereas for the rest of the aerosol types the LIVAS model to be closer to the ESA-CALIPSO measured value than the CALIPSO model." This conclusion does not seem to be fully supported by Figures 2 and 7. For the modeled lidar ratios at 532 nm for the four aerosol types (polluted continental, smoke, dust, and polluted dust) where the ESA-CALIPSO measurements are available (lower left panel in Figure 7), CALIPSO produces closer model values than LIVAS, except for 'polluted continental' where the CALIPSO modeled value is larger than the ESA-CALIPSO measured value only by 10

Although the ESA-CALIPSO measurements are not available at 1570 nm and 2050 nm that the authors can make comparison to, there seem to be other references that the authors can reference to. The two references given in below model the backscatter at 2.1 um for the space or air borne lidar application and the authors can make comparison with these studies.

1. Srivastava V, et al., Wavelength dependence of backscatter by use of aerosol microphysicsandlidardatasets:applicationto2.1-mm wavelength for space-based and airborne lidars. Appl. Opt. 2001; 40(27): 4759–69.

2. Wu D, et al, Simulation of coherent Doppler wind lidar measurement from space based on CALIPSO lidar global aerosol observations, Journal of Quantitative Spectroscopy and Radiative Transfer 122, 79-86.

My minor comments are given in below

1. Page 2253, line 1: "The horizontal resolution of CALIPSO is. . .", the vertical resolution at 532 nm is 30 meters from the surface to 8.2 km.

2. Page 2253, line 11: "according to layer type and sub-type" can be deleted.

3. Page 2253, line 13: ". . .using an assumed lidar ratio (LR) for each detected aerosol layer" is not really true. When clear air is available both above and below a layer, the transmittance constrained retrieval is applied in the CALIPSO standard data processing

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(see Young and Vaughan, 2009).

4. Page 2254, line 1: “and two nighttime measurements per week with low background light in order to perform Raman extinction measurements”, does this mean that the retrieval of extinction is not available for the daytime measurement? It would be useful to provide a list of primary parameters that EARLINET can measure during day and night.

5. Page 2256, line 25: “The definition of representative size distributions and refractive indexes for the CALIPSO aerosol types is not a straightforward task, mainly due to inaccuracies in the CALIPSO classification scheme” is hard to understand what this statement really means. There seem to be two issues involved – modeling aerosols and identifying aerosol type, which do not seem to necessarily correlate each other. Why the definition (modeling) of size distribution and refractive indexes are impacted by the CALIPSO classification. More explanations is needed.

6. Page 2257, line 9: “Although the proposed classification is assumed to correspond to the independently derived CALIPSO aerosol types, this is not true for all cases, mainly due to the different nature of AERONET sunphotometer measurements versus CALIPSO lidar measurements used for the categorization.” Once again, two issues – how to develop aerosol models that are most representative of the natural aerosol types and how to identify these aerosol types, which should be discussed separately.

7. Page 2258, line 22: “more than 500 aerosol layers. . .” correspond to how many CALIPSO orbits?

8. Page 2260, line 23: “We considered that the non-spherical particles of dust and polluted dust have the same aspect ratio distribution . . .” for the coarse mode only, non-spherical particle only, or entire size range?

9. Page 2261, line 14: “The dataset is not constrained with ESA-CALIPSO as in the AERONET-Omar approach.” it would be useful to clarify for what wavelengths here or

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somewhere in this section.

10. Page 2261, line 18: OPAC Section, it would be useful to refresh readers' memory about why this approach is necessary and for what wavelengths it is applied.

11. Page 2262, section 3.1.3: in this section, the LIVAS aerosol models (which appear to be the AERONET-CALIPSO models) are evaluated again ESA-CALIPSO database and AERONET-Omar aerosol models. One sentence on page 2262 states "We believe that the discrepancies in backscatter spectral dependence observed for most of the aerosol types in the AERONET-Omar approach are most likely due to the fact that AERONET lacks the capability to directly measure in the backscattering direction." I am confused here. Were the AERONET-CALIPSO approach by Schuster also based on the AERONET retrieval? Was there any other retrieval and/or measurement used in the development of AERONET-CALIPSO models? It would be helpful to clearly point out the difference between the AERONET-Omar and AERONET-CALIPSO approaches (models).

12. Page 2263, line 2: "..., we choose the AERONET-CALIPSO approach for the calculation of their conversion factors. The approach shows a relatively better agreement with ESA-CALIPSO compared to the AERONET-Omar approach, especially for the backscatter-related conversion factors (Fig. 2)." better agreement for backscatter only, isn't it? Should the selection of the model/approach be based on backscatter or extinction? It is useful to discuss this somewhere in the paper.

13. Page 2263, line 8: "ESA-CALIPSO provides intensive properties for mixtures of dust with polluted continental, smoke and marine aerosol separately" I think this is really interesting and the right way to go!

14. Page 2263, line 21: "These findings indicate that the CALIPSO smoke classification may not correspond to real smoke presence, thus the properties of this CALIPSO classification category may not be comparable with real smoke detections by ESA-CALIPSO. Thus, we prefer to use the calculations for CALIPSO smoke coincidences

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(AERONET-CALIPSO approach), ignoring the ESA-CALIPSO smoke statistics." confusing. Is this because the classification of the ESA-CALIPSO database is based on the CALIPSO standard classification which can be wrong for smoke? Note that even though CALIPSO can misclassify smoke, it does not mean the CALIPSO smoke model is not acceptable. The logic here is not very convincing.

15. Page 2264, section 3.1.4: please see my general comments. This section discusses intensively on the spectral properties calculated and measured. It should also discuss in more detail about the lidar ratios calculated at 532 nm and explain why the AERONET-Omar approach can produce lidar ratios at 532 nm closer to the measurement than LIVAS does. Also simulations should be done to examine the dependence of the scattering calculation on the refractive index.

16. Page 2267, line 26: "In brief, we classify stratospheric features as Polar Stratospheric Clouds (PSCs) when the temperature is lower than 198 K, while features of higher temperatures are classified as stratospheric aerosols. The separation is applied only for stratospheric features at latitudes greater than 54N and less than -54S, while for the latitudes in between, the stratospheric features are considered as aerosols." I think it is highly risky to classify stratospheric aerosol this way. I would expect more cloud layers than aerosol layers in the stratosphere that can be detected by the CALIPSO feature finding algorithm.

17. Page 2271, line 13: "The map provides only positive biases (absolute values)" can be changed to "The map provides only the magnitude of biases" or something like that.

18. Page 2273, line 16: "This can be attributed to errors introduced due to the extrapolation of the AERONET AOD in the IR (note that we use AERONET AOD measurements at 440, 670, 860 and 1020 nm), and/or to uncertainties introduced by the LIVAS conversion scheme in the IR." What about the AERONET-Omar models? It would be interesting to take a look.

19. Page 2275, line 3: "However, the LIVAS aerosol model found to be more consistent

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with ESA-CALIPSO but also the relative literature than the one used by CALIPSO for the VIS-UV spectral region." Is it only true for backscatter conversion factors?

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 2247, 2015.