Review of “LIVAS: a 3-D multi-wavelength aerosol/cloud climatology based on CALIPSO and EARLINET” by V. Amiridis et al. published in ACPD 15, pp 2247-2304, 2015.

The authors present an aerosol/cloud ‘climatology’ based on EARLINET, AERONET and CALIPSO retrievals of wavelength dependent aerosol properties. The main emphasis is on the spectral dependence of the extinction and backscatter of representative aerosol types which can be used to convert CALIPSO profiles to other wavelengths (Figure 9, but not referred to in the text). The CALIPSO aerosol classification is the basis for LIVAS. For those aerosol types for which no information is available from EARLINET or AERONET the information is provided through other sources. The LIVAS ‘climatology’ is developed for use in the development of satellite instruments, in particular lidars, working at wavelengths from the UV/VIS to the SWIR. The ‘climatology’ is developed to replace the current ESA reference atmosphere model (RMA) which was developed for a limited region using data from a limited period. The LIVAS data base seems very useful and the MS is in general well written and suitable for publication in ACP. However, reading in detail, there are some questions arising which require correction, see my suggestions below.

General comments.

I object to calling this data base a ‘climatology’ because it is based on data sets which are too short to be of climatological relevance: EARLINET since 2000, only over Europe and for only three observations per week at scheduled times; CALIOP since 2006. Should LIVAS be called a ‘data base’?

Following the title, an aerosol/cloud climatology is provided, but the paper is for 99% on aerosols and clouds are mentioned in only 3.5 lines in section 3.5. Should clouds be in the title?

The main focus is on the spectral dependence of extinction and backscatter coefficients through the Ångström relation (eq. 1). However, the Ångström Exponents, usually referred to as AE, are called here ‘conversion factors’. Why confuse the literature with inventing new names for the same parameters? I strongly suggest to replace ‘conversion factor’ with Ångström Exponent or AE throughout the MS. In this review I mostly use AE rather than conversion factors, except where I refer to conversion factors for clarity in connection with the MS

I also miss the starting point for conversion, or are only CALIPSO data used? When we have the AOD or other aerosol properties at a certain wavelength we can use the AE to convert to another one. Although references are given to the aerosol models used, it would be useful and convenient for the readers if a table would be provided with the parameters describing the size distributions and the optical properties, as well as an example of the occurrence of aerosol types across the world, which was the first driver to extend the ESA RMA and develop LIVAS.

Furthermore, the evaluations of the different results show the large discrepancies with other approaches. To evaluate these discrepancies, please provide uncertainties in your results, in particular in table 1.

For some aerosol types no data are available from EARLINET and models are used from the literature. Could the authors evaluate what the consequences are, i.e ., what uncertainties are associated with this approach? If literature values are good enough for certain aerosol types, why is it then needed to analyse the experimental data? My preference would be to provide the results based on EARLINET etc., rather than the model results. The use of the models seems to be beyond the scope of providing this data base, although I understand that they need to be included for completeness and to provide info for future satellite instrument development. However, the model results do not seem to be in any way related to the original aim of the work which is observational based. I think that the authors should make that clear in the discussion.

Detailed comments

2256, 2: Methodology for the derivation of AE is schematically illustrated in Figure 1. However, the starting point in Fig 1 is the LIVAS AE data base which feeds into EARLINET measurements and / or models and does not go anywhere from there. Likewise for IR conversion factors feeding into AERONET data from which ‘conversion factors’ (are these again AE?) are derived which are validated with EARLINET measurements and then ... (do these AE determine the aerosol type?) : I really don't understand, should the direction of the arrows be inverted so that we end with LIVAS AE? Where does CALIPSO come in? (line 10)

2256, 10: aerosol models with typical microphysical and optical properties are derived for each CALIPSO aerosol type: as in my general comments, why are these results not reported? The title of S3.1 is 'aerosol model for the derivation of spectral conversion factors', but I see no description of any aerosol model, please provide. Instead the AE are mainly derived from multi-wavelengths EARLINET measurements (line 13-14). Only for the IR AE the models are used, based on CALIPSO definitions, and this is not a straightforward task (line 26). So please share the results with the readers.

The CALIPSO aerosol type properties are listed to some extend in Table 1 which however is referred to only on p. 2258: could these properties be provided here, and also a reference? This would invalidate several of my comments in this review where I continue to ask for the provision of the parameters describing the aerosol physical and optical properties. In the last para of p. 2256 some more is said, and a reference is given, but since this is the core of the paper, some more detail would be appropriate.

2257, 25 a summary of what was said in this S3.1, but I still don't know what the characteristics of the aerosol types are and at the end of the para I am referred to the next sections.

2258, 3: header: use UV-VIS consequently, rather than VIS-UV, when you refer to the spectral region;

2259, 15 For the VIS-IR conversion aerosol models are used. Have the authors evaluated this method versus the use of experimental data? I suggest to do this for the UV-VIS region and compare the model vs EARLINET results to have some ideas of the validity of the method. As mentioned on 2260, 12, the results should be consistent at the UV-VIS range

2260, 3: AERONET microphysical retrieval is restricted to AOD values higher than a certain threshold. How does that influence the current results? As reported a few lines below, the results may be not reliable and all data which are not within the range of typical ESA-CALIPSO values are rejected. The constrained data set is subsequently used to produce size distribution and refractive index: what are the results?

2260, 14: define size parameter

2260, 27: summarize criteria for AERONET/CALIPSO collocation

2261, top: how do AERONET and CALIPSO classification criteria compare? What are the differences?

2261, 18: what are the consequences of the use of OPAC: suggest to compare OPAC results versus some cases for which experimental data are available. A comprehensive evaluation of OPAC is clearly not the scope of this MS, but when different methods are used in different cases, the consequences should be evaluated for at least a few example cases.

2262: Section 3.13 header: LIVAS aerosol model still has not been provided, so how can it be evaluated?

2262: Figure 2: fonts are quite small, esp along the y-axes: please enlarge

2262, 26: replace reinforce with support

2264: section 3.1.4 : Here the microphysical properties are graphically presented, but it is hard to reconstruct the size distribution from the figures: this could be a good place to represent the parameters, and then also the optical parameters in the same table.

Considering that CALIPSO is used as a reference (2262, 3) the large discrepancies between both the size distributions and the optical parameters used in LIVAS from those in the CALIPSO reference is a big concern. The discrepancies and disagreements are discussed but I miss a conclusion as regards the consequences.

2266, 27: the authors criticize that the effective radius is not provided by Omar et al., but they do not give such numbers either, why not?

2268, section 3.2: the use of discrete conversion factors leads to jumps in the extinction profiles since they are used on discrete and well-defined layers.

2269, 6: suggest to consequently use either CALIOP or CALIPSO, depending on whether the mission or the instrument is meant

2270, 5-6: add 'aerosol'

2271, first para: when averaging LIVAS extinction profiles and averaging AERONET data (for the same 4 years?) for comparison, was an attempt made to use only collocated data? Figure 12 shows quite large discrepancies for some regions across the world, and an example is given of the effect of elevation (but what is here the AERONET AOD in comparison with that derived from CALIPSO? Is the problem the exact collocation of CALIPSO and AERONET?). Figure 15 shows biases, but these are hard to see. The colour scale does not allow for easy discrimination of green from blue dots: suggest the use of warm (red) colours for positive biases and cold (blue) colours for negative biases, in a gliding scale.

2273, Figure 16: the high Pearson correlation coefficient and the slope smaller than 1 reveal a very good agreement and a slight underestimation. I disagree with that conclusion: looking at the data in Figure 16, almost all data are below the equality line, for both wavelengths. The authors ascribe the LIVAS underestimation at 532 nm to CALIPSO and provide references. However, the lower left panel of Fig 16 shows that for 355 nm the underestimation is about twice as large and thus the conversion factors amplify the differences. This seems strange since the conversion factors are derived directly from observations using EARLINET. What could be the reason? And what are the consequences for the use of LIVAS in instrument development and evaluation?

I would ask the same question for the IR, for which the authors acknowledge that the results are not encouraging. The main reason seems to be the choice of aerosol models used in the conversion. Would it be possible to use experimental data also here, for instance from multi-wavelength transmission measurements extending into the infrared, over relevant areas with different aerosol characteristics?