Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., editor comment EC1
https://doi.org/10.5194/amt-2021-181-EC1, 2021

Comment on amt-2021-181

Ad Stoffelen (Editor)

Editor comment on "Aeolus L2A aerosol optical properties product: standard correct algorithm and Mie correct algorithm" by Thomas Flament et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-181-EC1, 2021

The third anonymous reviewer mailed the following assessment to the associate editor for the author's consideration:

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Review of "Aeolus L1A Aerosol Optical Properties Product: Standard Correct Algorithm and Mie Correct Algorithm" by T. Flament et al.

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General Comments
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This paper gives the impression that the evaluation/validation (and maybe development) of the aerosol/cloud products from Aeolus is still in the early stages, in marked contrast with the aeolus wind retrievals1. The paper presents only one example using real data where the lidar ratio results may be plausible. Almost 3 years after launch, I would have hoped for a more advanced state with respect to the aerosol/cloud product evaluation/validation.

It could well be argued that this paper is premature, however, having said that there are also reasons why this paper is potentially publishable at this time. This paper could serve as a point of reference for the lidar community and to serve as an accessible introduction to the instrument and the existing L2 aerosol/cloud retrieval algorithms. With regards to the later point, to be useful, the presentation of the paper must be improved. I found several areas to be more confusing than illuminating and, at times, the presentation seemed geared more towards "Aeolus insiders" rather than the wider lidar aerosol-cloud community.

The paper was also "thin" on examples using real observations imparting on the reader of the paper no real feel at all for the quality of the data. To this end, the authors should include additional examples, for example, showing:

-profiles and 2-D plots of the Aeolus Attenuated backscatter (both before and after cross-talk correction).

-profiles and 2-D plots of the retrieved extinction and backscatters.

-comparisons of the extinction and backscatter retrieval results for the MCA and SCA algorithm.

The above examples should, ideally, span an appropriate number of representative cases (e.g. cirrus clouds, light and heavy aerosol loadings etc..)

My specific comments follow.

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Specific Comments
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First off, I am puzzled by the use of "correct" in the name of the algorithms refered to by this paper. There are other approaches to inverting HSRL signals to derive extinction and lidar ratio that are mathematically valid. What is special about these algorithms that make them "correct" ? It would be useful to the reader if this point was somehow addressed in this paper.

Abstract Line 1:

"Although ALADIN is optimized ....."

Abstract: Line 11:

The last line is badly worded. I suggest "This is illustrated using Saharan dust aerosol observed in June 2020".

Page 1: Line 19:

I find this short description awkward and not accurate enough. I suggest something like: "Two separate main optical detection channels are implemented on-board ALADIN. They are referred to as the Mie and Rayleigh channels. Both channels detect a mixture of particulate and molecular scattering. However, the primary task of the so-called Mie channel is to detect the spectrally narrow (FWHM on the order of 10s of MHz) return from atmospheric hydrometers. The Rayleigh channel primarily detects the spectrally broader (FWHM of several GHz) backscatter from atmospheric molecules."

Page 2: Line 32

Delete the "In" directly after the reference to Winker et al.

Page 2: Line 33

2006 was 15 years ago. I think you can delete the "already"...perhaps "previously" was

meant.

Page 2: Line 34

Please be specific. What is "all the available information" ?

Page 2: Line 46.

This is a very interesting point. Please provide a
reference (even if it is only a tech note or report).

Page 2: line 53

Please mention how can the general community get access to the updated L2A ATBD.

Page 2: Last line

"...followed by a conclusion" ==> "...followed by a conclusion section".

Page 3: Line 68

I am confused by the reference to the "..previous 24 sec cycle of the
burst-mode operation of the laser". Previous to what ? Was this burst
mode used early on in the mission ? If so, why was it no longer used ?
Or, was it something previously planned but not implemented ?

Page 3: Line 75

"Fine bins.." ==> "Finer resolution bins..."

Page 3: Lines 83-94 and Fig. 3

I found that the discussion of the spectrometers to be very confusing
! Only after reading through the L1 and L2 ATBDs, it became clear that
the Rayleigh A and B signals are the result of integrating the images
projected on CCD detectors. So for the Rayleigh channels, for each
time-height bin two spectrally integrated measurements are
available. This should be explained here.

For the Mie channel I found the presentation here to be
misleading. The text and Fig. 3 first had lead me to believe that in
the case of the Mie channel, that the data yieled by the device was a
spectrum such as that iluustrated in Fig.3. It took some time and
iterating between the two documents, to realize that that for the Mie
channel, that the curve shown in Fig. 3 corresponds only to the
central position of the Fizeau wedge !

Only after reading through the L1 and L2 ATBDs I understood that there
are 16 different spectral channels available. Further, the response of
each channel is the result of integrating the spectrometer output
image along the different columns (corresponding to wavelength
shift). Since the central wavelength varies as a function of Fizeau
wedge position, the measurement will consist of the INTEGRATED filter

spectral response (e.g. as shown in the bottom right-panel of Fig. 3) with the center frequency shifted according to its position along the CCD rows.

I understand that the author's would likely desire to keep the explanation concise, however, the presentation here really needs to be more detailed and accurate ! It did cost me some time to understand what was being shown here and how the instrument really functioned and I am sure this would also hold true to many other readers in the general community.

Page 6: Lines 104-109

The description of the "MCA" is likely incomprehensible to anyone not intimately involved with the data processing itself ! What does "some sort of cross-talk correction" mean ? What is the L1B-derived scattering ratio ?

Either provide more details about the MCA (even references to the appropriate sections of the publicly available ATBDs would help) or, if it is deemed not essential, to the paper just skip it.

The same general comments apply to the description of the ICA.

Page 6: Lines 110

"At last.." ==> "Lastly,.."

Section 2.2.1

See my later comment (Page 13: Line 252)

It would be useful for the general reader if it were to be explained what advantages (or disadvantages) the SCA method have compared to the usual method of determining extinction by calculating the log-derivative of the Rayleigh ATB profile ? Off hand. I can think that the low vertical resolution bins dealt with here may be a factor. Is this correct ?

Are any multiple-scattering considerations taken into account in the retrieval. It looks like they are not. Do you expect this to have any impacts on e.g. cirrus cloud retrievals ?

Page 6: Line 118-119

"concision" is rarely used in modern English. I suggest "brevity" or "conciseness".

The sentence is awkward: I suggest something like:

For the sake of brevity, only an outline of the SCA algorithm is presented here. Only the main features of the algorithm, necessary to

understand the subsequent sections, are covered."

Page 7: Line 129

Delete the "(dR(z)=R'(z)dz)" It is trivial and does not add anything to the presentation.

Page 7: Line 144

"..equation (2)" ==> "..equations (1) and (2)."

Page 8: Line 180

"..thermal constraint on the primary mirror..." does not make any sense here. Do the authors mean "thermally induced distortion" or "thermal strain" ?

What is meant by "orbit phase" ? Do the authors mean the "orbit position" ? Does the distortion vary predictably along the orbit or is function of the e.g. solar background ?

Line 183: "...called the Instrument....(IRC) mode,..."

Line 184" "...target with negligible Doppler shift due to the nadir pointing."

Page 9: Line 190

(Also relevant to Eqns. 5 and 6) What is the maximum height given by the AUX_MET product. Is there any account given to the Rayleigh transmission between the top to the AUX_MET product and the top-of-atmosphere ?

Page 9: Line 198

"Constraints" ...see my comment (Page 8: Line 180)

Page 9: Line 210:

It would be useful if the authors could elaborate on this point a bit. For example, what order of magnitude error do they believe background aerosol levels may have on the accuracy of the calibration ?

Page 10: Line 215

See my comment above (Page 6:
Lines 104-109). To the general reader the "L1B scattering ratio" is a meaningless term unless you explain it !

Page 11: Lines 223-229

How is the lidar ratio chosen? Is it fixed or does it vary with altitude, latitude etc..

Section 3.1

It would be useful if the magnitude of the results of only measuring the co-polar return was discussed !

Page 12: Line 245:

"Designed as a wind lidar, ALADIN does not have the ability to measure depolarization". This sentence(along with the text that follows it) implies that this wind lidar do not (can not?) measure depolarization. Is this true in general or only for the specific design of ALADIN ? What design constraint has lead to ALADIN not detecting the co-polar return.

Also, ALADIN transmits and recieves circularly polarized radiation NOT linearly polarized !

Page 13, Section 3.2

The concept of the relationship between the extinction profile and the log-derivative of the Rayleigh attenuated backscatter profile is used throughout this section. From a mathematical view-point, it is certainly true that any approach to retrieving the extinction solely using the molecular backscatter profile (either explicitly or implicitly) involves computing the log derivative of the attenuated backscatter profile. This must be true also of the SCA approach briefly described in Section 2.2.1. It would be useful to guide the reader with regards to this point. For example, outlining how the SCA approach is related to the standard log-derivative method for retrieving extinction would be useful !

Page 16: Line 308

"..are out of the graphics.." ==> "..are off scale in Figure 9..."

Page 16: Lines 229-330:

The naming of the instruments and the platforms they are on are all conflated here ! I suggest, for example, CALIOP on board the NASA/CNES CALIPSO platform.

Page 16: Lines 333:

"...quality with.." ==> "..quality using.."

Page 18: Fig. 11 Caption.

"..from 384 and 354nm spectral bands" ==> "derived using the 384 and 354nm spectral

bands."

Page 18: Line 345

"This allows for the rejection of the low...."

Page 19. Fig 1 and Section 4.2 in general.

The figure is fine. However, it would be useful to also present the retrieved extinction as well as the Aeolus observed attenuated Mie and Rayleigh backscatter images. The absence of such images is conspicuous.

Page 19, Lines 350-360.

There is a well-established relationship between the linear depolarization ratio and circular depolarization ratio that should hold for must circumstances. Given this it would be useful for the authors to give a quantitative number for the expected impact of the depolarization on the Aeolus measured lidar-ratio.

Section 5:

Join the first two paragraphs.

Can you please provide more detail connected with the points being made here ? For example:

-What type of new algorithms are being developed ?

-Can you at least give a reference to the assimilation work ?