The authors would like to thank the reviewer for his/her valuable comments which helped improving the quality of the manuscript. Our point-by-point responses to the reviewer's comments appear in bold below.

Reviewer 3

General Comments:
This paper describes the different levels of data products from an airborne horizontal pointing aerosol lidar collected during the EUREC4A field campaign. The paper is well written and the data products are well described. However, the preprocessing of the data (Level 1→ Level 1.5) could be concise and some of the figures and tables could be removed without loss of information.

We note this Reviewer's concern, but also Reviewer #1's comment which goes in the opposite direction. As a compromise, we chose not to modify the level of details of the manuscript.

I was not able to access the data from the data archive. The doi s listed in the paper are correct and points to the archive but the data links within the doi pages are invalid or missing.

Yes, there was a problem on the site. It is now fixed. The access is now fine:

https://doi.org/10.25326/58

https://doi.org/10.25326/57

https://doi.org/10.25326/59

Specific Comments:

How were cloud base heights determined for the Phase 2 flight legs?

We have added the sentence:

"It should be noted that prior to the beginning of Phase 2, a best-guess estimate of the CBH, assessed from multiple sources of information (radiosoundings launched from BCO and research vessels, dropsondes released from other aircraft), was provided to the ATR-42 scientists via the onboard chat capability. The flight altitude was then adjusted using real-time lidar echoes, cloud droplets counts from cloud microphysics probes and visual observations by the pilots and the lidar operator through lateral windows."

at the end of Section 4.

What is the typical aircraft speed? I think this information would be useful for future readers.

Agreed, the typical aircraft speed is ~100 ms^{-1}.

We have added this information in Section 4:
"Note that during straight-line flights, the typical speed of the aircraft was ~100 ms^{-1}."

How do you separate the clouds along the flight direction? There is no information about clouds along the flight direction? I think you should be able to calculated cloud size distribution along the flight direction as well. Any reason for not including that as part of the L3 product?

We have added in Section 5.3.1.b the following sentence:

" It is worth noting that owing to the integration/acquisition time of the lidar measurement (5 s) and the aircraft speed (100 ms^{-1}), we are unable to derive a cloud mask along the direction of aircraft motion (the minimum distance we can resolve along this direction is 500 m, which is roughly the upper bound of the cloud chords measured along the line of sight of the lidar). The cloud mask distributed in the Level-2/Level-3 datasets thus corresponds to the cloud detection done along the line of sight of the lidar only."

Cloud cover from 0-4 km range would be another L3 product of interest.

We agree that the distribution of a cloud fraction product would be interesting. However, we feel that the users should better compute this diagnostic (as well as many others) themselves, as it is quite straightforward to compute based on the other distributed products and would make it possible for the users to tailor the diagnostics to their own needs.

What is the time resolution of the lidar profiles? P9, Line 7 would be a good place for this information.

Agreed. The time resolution is ~5s. This information was missing in the text and has been added in Section 5 (p9 line 7):

"The raw sampling of the lidar profiles is 0.75 m along the line of sight and an average over 50 shots is performed during the acquisition, corresponding to about one recording every 5 s (2.5 s averaging time and 2.5 s recording time)."

There is also no information about the horizontal resolution of the profiles. From figure 10, it looks like horizontal resolution is around 20-30 m?

Agreed. A sentence is missing in subsection 5.2.1 to provide the information. Such a sentence has now been added:

"To build level 1.5 data, the raw sampling along the line of sight has been degraded in order to ensure the independence of each point on the horizontal lidar profile. The final resolution is then 15 m. The ALiAS-derived level 1.5 data are then profiles corrected…"

Apparent Backscatter Coefficient (ABC): Why not call it attenuated backscatter coefficient? Or add a statement about how ABC is different from attenuated backscatter coefficient from other lidar (e.g. CALIOP).

The product can be called "Apparent Backscatter Coefficient" or "Attenuated Backscatter Coefficient", indifferently. In our case, we correct for molecular transmission and we preferred the term "apparent" as already used in previous papers. What is more important is how we define the variable ABC in equation (3). Nevertheless, we added to the text: "...Apparent Backscatter Coefficient (also referred to as Attenuated Backscatter Coefficient)".

Please include the range of viewing angle in a typical flight leg and what is the implication of this viewing geometry on the retrieved cloud size?

The effect of roll is taken into account in the quality indicator/flag (subsection 5.3.1.c, Table 4). It is less than 1±0.5° during Phase 2, and tough only very marginally impact cloud size

retrievals. As stated in the text, lidar profiles acquired during ATR-42 turns are discarded all together.

Are the viewing angle, aircraft attitude parameters included in the raw data? It would be also good to include an equation used to calculate the viewing angle in the text.

The field of view of the lidar is ~3 mrad irrespective of the attitude of the aircraft. Nevertheless, the roll can indeed influence the altitude of the area sampled by the lidar at a given distance from the aircraft. That is why there is a quality indicator included in the Level-2 data to flag lidar profiles acquired at non-negligible roll angles. The data also contains the angle between the horizontal and the direction of sight.

Please include values for T0 and T1 since it is mentioned in the text.

We have modified the sentence as:
" They take into account the transmissions of the parallel polarization of the two Brewster plates used: $T_0^{\parallel}$ for channel 0 ($T_0^{\parallel} \approx 0.45$) and $T_1^{\parallel}$ for channel 1 ($T_1^{\parallel} \approx 0.40$)."

It is not clear how the threshold for cloud detection is defined. What is coefficient Ce? How is Ce used for cloud detection? Could you use a single cloud detection threshold?

The cloud detection is performed in 2 steps:

1) Determination of cloud-free profiles during Phase 2 of a flight, to define a baseline clear sky profile and evaluate the noise level (standard deviation of the signal) as a function of the distance from the aircraft.
2) Comparison of each lidar profile to the baseline profile, taking into account the clear sky noise: a point is considered as cloudy if the ABC in this point exceeds Ce times the noise level. It is constant irrespective of the distance to the aircraft.

For the sake of clarity, we have replaced:

"For each lidar profile, it uses a threshold approach as already considered for lidar measurements at Nadir (Chazette et al., 2001; Shang and Chazette, 2014). The threshold is relative to the level of spread on the lidar signals in the absence of clouds. As for the aerosol products, a lidar profile is considered as being cloud-free if the logarithm of the ABC can be considered as linear with a relative error of less than 10% (cf. Section 5.3.2). The threshold is estimated for flight segments performed at a constant altitude (around the cloud base height, where molecular and particle scattering can be considered constant) and when the angle of the lidar line of sight with the horizontal does not exceed 3°. Lidar profiles acquired during ATR-42 turns are therefore excluded from the cloud level 2 data. The threshold varies with the distance from the aircraft. It is proportional (through a coefficient Ce) to the standard deviation of the cloud-free ABC signal determined for the rectangle under consideration."

by

" For each lidar ABC profile, it uses a threshold approach as already considered for lidar measurements at nadir (Chazette et al., 2001; Shang and Chazette, 2014). The threshold is proportional to the standard deviation of the noise of the cloud-free signal during Phase 2 of a given flight. Although the coefficient of proportionality Ce is constant, the threshold varies with the distance from the aircraft owing to the decrease of the signal to noise ratio (due to the increase of the clear-sky noise) away from the aircraft. As for the aerosol products, a lidar

profile is considered as being cloud-free if the logarithm of the ABC can be considered as linear with a relative error of less than 10% (cf. Section 5.3.2). The threshold is then calculated at a constant altitude (around the cloud base height, where molecular and particle scattering can be considered constant) and when the angle of the lidar line of sight with the horizontal does not exceed 3°. Note that the mean value is 1° and the standard deviation is 0.5°. Lidar profiles acquired during ATR-42 turns are therefore excluded from the cloud Level-2 data."

How do you define level of soiling? Is it like the entire flight is soiled or not?

The level of soiling is defined based on a strong attenuation through the aircraft window. This leads to a clear peak at range zero due to scattering, and a limitation of the lidar maximum range to around 4 km from the aircraft. In addition the soiling flag also takes into account the observations made by the operators during the flights and the state of the window after each flight.

How is the uncertainty in AEC for angular deviation calculated?

We have written " It should be noted that an angular deviation of 15° induces an error of 0.01 km^{-1} on the AEC." However, the angle of deviation is smaller than 1°.

Is Level 3 data calculated for each flight segment of a flight or entire flight? P24 Line 1 says entire flight but P9 Line 8 says flight segment?

Level-3 cloud products are calculated for data acquired during Phase 2, as for Level-2. For the aerosol products, it is calculated on all cloud-free profiles during the flight.

For the cloud products we have modified the first sentence as:

"Level-3 cloud products consist of probability distribution functions (PDFs) of cloud chords along the laser line of slight computed during Phase 2 of the flight."

Table 2: I don't think Table 2 is very useful in its current form. Potential data users are very likely not going to be looking for certain flight blocks. They might be more interested in a particular day. Information from Table 2 could be combined with Table 5.

Table 2 gives an overview of all the flights performed with the main flight blocks, while Table 5 presents the main characteristics of these flights. These two tables could be grouped together, but the result would be too imposing. Therefore, we have chosen to make two different tables which intervene at different places in the text.

Technical corrections:

P1, Line 22: add “instruments”
Agreed.

P6, Line 8: Change “Prototypical” to “Typical” ,
We use "Flight strategy"

P6, Line 13: Change “independently” to ‘independent”
Agreed.

P6, Line 17: Change (~9h00) to (~9h)
Agreed.

P6, Line 23: Change “A prototypical” to “An example”. Same for P9, Line 2.
We use "The flight strategy"

P6, Line 24: Change “needs” to “questions”,
We use " scientific requirements"

P8, Line 8 and 9: Complete the sentences between two bullet points
Agreed.
"…the planetary boundary layer.

5. The ATR-42 cruised…"

P9, Line 8: “For level 3 profiles are averaged over flight segments…” might be clearer if that is what it meant to be.
Agreed.
We have modified as:
"The statistics performed on Level-2 data are gathered in the Level-3 data. Statistics are computed for all flights for the aerosol Level-3 products and for the Phase 2 of the flights for the cloud products."

P11, Line 3: subscript of c for clouds would be more intuitive than n.
Agreed.

P12, Line 3: change “clouds” to “data points”
Agreed.

Equation 4 and 5: use parallel and perpendicular symbol for T0 and T1 respectively to be consistent.
Agreed.

P18, Line 1: typo “considered”
Agreed.

Table 4: B1 values for clear and clogged wind should be 0/1.
No, it is the detection or not of a cloud (0 or 1).

P23, Line 2: Separate into two sentences for clarity.

"The Barbados area is a region where a very wide variety of aerosols can be found, the main ones being marine aerosols to which can be added terrigenous aerosols and even biomass burning aerosols."

Has been replaced by

The Barbados area is a region where a very wide variety of aerosols can be found. The main ones are marine aerosols to which can be added terrigenous aerosols and even biomass burning aerosols.

P26, Line 11: Change to “test flight”

Agreed.