Response to Editor

Many thanks to Editor for take in time to evaluate and improve this manuscript. Please find below point by point responsive to comments.

1) p.4 L98. Please provide a reference related to the "conventionally a square-shaped pulse" as I am not familiar with this formalism. If the reference of interest is Paschotta 2008 you can disregard this comment but I expect that more than one reference would support a well established convention.

The sentence has been modified and we have added a reference (p.4. line 98-99): $P_{p,\lambda}$ *is a rectangular-shaped pulse in volumic lidar equation (Measures, 1992) viz. the ratio between the pulse energy and* τ_{λ}.

2) p.6 L150. I think that just looking at the equations, I can understand how to go from Eq (12) to Eq (13) but the revised comment confuses me even more than the previous statement. The right hand side of the subtraction means βb(r) ? I think that it would be helpful to clarify the sentence or add more explanations.

The sentence has been modified (p.6 line 150): *"Multiplying the numerator and the denominator term of the fraction by* $D(r_s, 0)$*, this expression becomes:"*

3) p. 14 Fig. 6 Typo in "Theoritical"

It is corrected. We have replaced *"Theoritical"* by *"Theoretical"* in legend graph Fig.6 and Fig. 7.

4) p. 16 L270. I'm not sure I follow exactly what is done here so I elaborate on my understanding. When you occult the laser beam but the whole lidar is still on, then you measure both the background from the sun/artificial lights and the electronic noise. Consider that you could be in a dark room and switch bright lights on and off. When the light is off, you would measure the electronic noise (identical in principle to signal 2). When you switch the lights on, the electronic noise would not disappear. The way to combine electronic and background illumination could probably be the topic of a full technical report but considering an addition is acceptable. However, if you remove signal 1 and signal 2 from signal 3, you remove the electronic noise twice.

Please elaborate on this section and if necessary correct the data analysis procedure and the results.

We estimate the electronic noise from signal 2. The measurement of signal 1 allows us to estimate the passive contribution from signal 1 and signal 2 by (signal 1 - signal 2).

In lidar measurements, we subtract the dark noise and the passive contribution from signals 1 and 2 by: signal 3 - (signal 1- signal 2). Thus, the dark noise is not subtracted twice. We have modified our paragraph to make this clearer.

The paraph has been revised p16. Line (274-276): "*The averaged signals of the background radiation and the* dark *noise (signals 1 and 2) are then subtracted from the signal 3 such as: signal 3 - (signal 1 - signal 2)"*

5) p. 16 L272. You may consider to change "electronic noise of darkness" into "electronic noise" or "dark noise".

The sentence has been revised (p.16 line 272): We have replaced "electronic noise" into "dark noise".

6) p. 17 L280 – L281. Everything you say is true but this sentence could lead the reader to believe that the resolution of the system is 5 cm. The system can definitely detect the position of the plume within 5 cm, however the pulse duration will create correlations between the measurements in the order of 25 cm inside the plume. It's not a key point of your study but I would suggest to modify this sentence.

The sentence has been modified (p17. Line 280-282): *“Combined with a short pulse duration of the laser source (1.7 ns), this makes it possible to highlight local variations concentration in the order of 25 cm inside the plume with the presence of two maxima at 38 m and 39 m from lidar.”*

7) p. 18 Table 4 L1. Unit should be sr not sr-1."

Exactly, it is corrected.