

## ***Interactive comment on “Lidar temperature series in the middle atmosphere as a reference data set. Part A: Improved retrievals and a 20 year cross-validation of two co-located French lidars” by Robin Wing et al.***

**Anonymous Referee #1**

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General Comments:

This manuscript presents one of the first thorough studies of issues associated with lidar temperature data retrieval using Rayleigh integration technique. Authors have done nice work to come up with systematic methods to improve data screening using various statistical and signal processing techniques. Authors have also spent tremendous efforts in addressing various issues in the data retrieval procedures, such as the seeding temperature/pressure, atmospheric transmission correction, and the determination of starting altitude, etc. Furthermore, authors compared 20 years of Rayleigh temper-

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ature data between two French lidar systems, setting a good foundation for Rayleigh lidar temperatures to be good references for satellite and other missions. As many Rayleigh lidars are being deployed all over the world to make atmospheric measurements, this manuscript just came in time to make people to be aware of potential issues and help people improve the quality of retrieved temperature results.

However, this is a long paper printed with tiny fonts, so it is understandable that there are quite some technical issues along with clarifications needed. I recommend acceptance of the paper for publication after technical corrections.

Technical and Specific Comments (going by page number):

1) Page 6: Lidar equation (1) has dimension mismatch on the left and right hand sides. The first part on the right side has a dimension of energy, but the left side  $N(z)$  is claimed to be count rate per time integration per altitude bin. This equation is not acceptable for publication. Furthermore, beta ( $\beta$ ) is commonly used to represent volume backscatter coefficient, not backscattering cross-section, as the cross-section symbol is usually sigma ( $\sigma$ ). Authors are suggested to consult with a commonly referenced class lecture at the following link, and use the more commonly accepted lidar equations and symbols.

[http://superlidar.colorado.edu/Classes/Lidar2016/Lidar2016\\_Lecture04\\_LidarEquation.pdf](http://superlidar.colorado.edu/Classes/Lidar2016/Lidar2016_Lecture04_LidarEquation.pdf)

2) Page 9: Please provide a reference to Turkey Quartile test, as this isn't a common practice for most lidar people. BTW, it should be “when the signal to noise ratio approaches 1”.

3) Page 12: Please provide a reference to the “one sided non-parametric Mann-Whitney-Wilcoxon rank-sum test” as it isn't common for the lidar field. BTW, what does “a scan” mean in Figure 6? Did you mean one profile?

4) Page 14, how are  $S_i$  and  $N_i$  determined? Please provide a bit more details. Do you do this (equation (2)) for every altitude bin?

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5) Page 16, notations are needed for equation (3).

6) Page 16, after the quadratic fit to the background, how do you handle such background and data? Did you mean to subtract the quadratic fitted background from the raw data? In this case, how do you handle the noise term in calculating SNR? Are photon counts still obey Poisson distribution? Please clarify in the manuscript.

7) Page 20, Figure 11, it's necessary to point out in the manuscript that satellite data aren't the real references as various satellites have their own calibration issues. Rayleigh temperatures around 90 km should be compared with ground-based resonance Doppler or Boltzmann lidar temperatures as these resonance lidars have much better signal to noise ratios at these altitudes.

8) Page 22-23, what do you mean by "misaligned"? A lidar beam was misaligned relative to its own receiver's field of view, or else? How were two lidars misaligned? Authors' writings here are confusing.

Minor comments on English writing:

As this is a very long paper, I strongly encourage authors go over the manuscript carefully to correct grammar and typo issues. For example, on page 24, near line 495, it should be "to initialize the inversion", not "initialized".

The paper title doesn't have good English grammar, for which I suggest to change "a 20 year cross-validation" to "a 20-year cross validation".

Please also note the supplement to this comment:

<https://www.atmos-meas-tech-discuss.net/amt-2018-133/amt-2018-133-RC1-supplement.pdf>

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-133, 2018.