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Atmospheric Measurement Techniques Discussions

Interactive comment on "Analyzing the Atmospheric Boundary Layer by high-order moments obtained from multiwavelength lidar data: impact of wavelength choice" *by* Gregori de Arruda Moreira et al.

Anonymous Referee #1

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General Comments:

The manuscript presents an assessment of three-wavelength lidar measuring PBL turbulence, particularly for the wavelength comparison in term of the high-order moments analysis. Two cases studies are investigated. The physical fundamentals of this study are from the previous work by Pal et al (2010); and by using aerosols as tracers, the PBL turbulence information is illustrated. The current paper needs further information about the methodology and the discussions on the results. There are some typos or grammar errors.

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Specific comments:

1. Please give the main specifications of lidar, e.g. laser pulse energy, beam pointing stability, laser pulse repetition rate, detectors and data acquisition. Can you please show the range-corrected signals or images at 1064-nm and 355-nm as Fig.2A?

2. Page-3, Line-12, ". . .from July 2018 to July 2018. . ."? The manuscript only shows two cases studies, not the dataset or measurements from July 2018 to July 2018.

3. Page-4, Eq.(2) and Line 1-3 about the relationship between the aerosol backscatter and number density. Please mention the Mie-theory and aerosol hygroscopic properties with the relative humidity (RH). Under what value of RH, the aerosol hygroscopic properties may be ignored.

4. Page-4, What is the difference between the Eq.(2) and Eq.(3)?

5. Page-4, Eq.(6). Please describe or give the condition(s) or assumption(s) for deriving this equation.

6. Page-6, Line-24, ". . . same type of aerosol is present in the entire atmospheric column . . .". You may assume it for the PBL aerosols, but please note that aerosol type generally depends on both the size distribution and chemical compounds. Thus, it is much different in the near surface, PBL, free troposphere and stratosphere.

7. Page-7, Line 2-4 about the Fig.A3C. The aerosol angstrom exponent can help classify aerosol type in term of aerosol size information. However, it is generally not enough for the different species of aerosols. For instance, both urban aerosols and smoke aerosols are fine-mode particles (i.e. large Angstrom exponents), but they are different types with the different backscatter and extinction properties.

8. Page-7, Line 10-12, the sentence is confused. Why talked about the Figure A2 here? How can you get the first height situated below the top of CBL and the last one at FT from Fig.A2? "As expected tau increases with height for all the wavelengths due to reduction of aerosol load with height. . .."? I can't find it from the figure.

9. Page 8, Line 31-35. Why do you choose the value of 3 as a threshold ("lower than 3 representing a well-mixed region and larger than 3 representing a low degree of mixing")? Figure A5 (28-35) shows the wavelength dependence of the kurtosis profile (KRCS), thus a single threshold seems so arbitrary.

10. Page 10, Line 15-18 about the high-order moments of lidar backscatter signals (skewness and kurtosis). A negative ScorrRCS represents the downdraft while a positive value represents the updraft. Are there any other vertical wind measurements to demonstrate it?

11. Page-10, Line 19-20, "The Scorr RCS(z) obtained from the wavelengths 1064 and 532 nm presents identical pattern of behavior, demonstrating the occurrence of same phenomenon." However, in the Figure A10., they show different and altitude-dependent positive or negative values at 1000-1500-m. For instance, the values at 1064-nm are negative ("downdraft") at 1500-1000m while the values at 532-nm are near zeros. They show different patterns. Why do you call "identical pattern of behavior"?

12. With the low clouds or residual aerosol layers, can the methodology (high-order moments) in this study be applied? Are the high-order moments sensitive to the time window length (e.g. 1-hour long in this paper, 17:00-18:00 UTC for the 1st case, and 18:00-19:00 UTC for the 2nd case)?

Technical corrections or typos:

Page-1, Line-6, "aerosol layers moviments (skewness). . .". moviments or movement?

Page-2, Line-5, "air surface temperature", surface air temperature?

Page-2, Line-8, the meaning of this sentence is confused.

Page-3, Line-14, ". . . located at installed "", some typo.

Page-3, Line-17, "SPU"? full name?

Page-3, Line-18 and 19, please add the unit for the wavelength "387 and 407".

Page-4, Line 16-17, “we can considered. . .”. The “considered” should be “consider”.

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