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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A new Description of Probability Density Distributions of Polar Mesospheric Clouds (PMC)" *by* Uwe Berger et al.

Anonymous Referee #2

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General comments:

This is an interesting and generally well written article dealing with probability density functions of various noctilucent cloud (NLC) parameters such as particle radius, cloud backscatter, ice particle density and ice mass density. While the backscatter is found to follow an exponential distribution, this is not the case for the other parameters considered. The NLC parameter database employed is based on the well-known Alomar LIDAR dataset. I do not have major objections against the publication of this article but ask the authors to consider the comments listed below. In addition, I have the following general comment: The LIDAR backscatter measurements, like all other optical measurements, are quite insensitive to particles with radii below a certain threshold. This is related to the finding that radii below about 20 nm are very infrequent in the data

set, despite the fact that there are typically many more small particles than large particles. I think this aspect should be discussed in the paper, because it also (qualitatively) explains some of the differences between the PDFs of the different parameters.

Specific comments:

Page 1, line 1 and line 15: "of Polar Mesospheric Clouds (PMC) and noctilucent clouds (NLC)."

This sounds like the two are different clouds. I suggest changing this sentence.

Page 1, line 5: "previously statistical methods" -> "previous statistical methods" or "previously used statistical methods"

Page 1, line 6: "probability statistic"

Does "statistic" exist?

Page 1, line 12: "that facilitate" -> "that facilitates", because "facilitates" refers to "assessment", right?

Page 2, line 3: "many .. analysis" -> "many .. analyses"

Page 2, line 8: "analysis have used" -> "analyses have used"

Page 2, line 17 and line 18: "statistic" ?

Page 2, line 31: "From each backscatter height profile we estimate a maximum backscatter (MBS) signal which corresponds to mean height of maximum brightness"

I don't fully understand this sentence. It mixes "signal" and "height" in a way, which makes it difficult to understand. Can you clarify, please?

Page 3, line 15: "exponential distributed" -> "exponentially distributed"

Page 3, line 30: "mode" is not a really frequently used term and I suggest briefly explaining it. It is explained on the next page and I suggest moving the explanation

here.

Page 4, line 19: “in a semi-logarithm scale”. I suggest replacing this by “in a semi-logarithmic diagram” (a scale can be linear or logarithmic, but not semi-logarithmic)

Page 4, line 22: “Consequently, the relative error is rather small”

Please explain briefly how this relative error is determined.

Page 5, line 5: “ . . . as expected”

It’s not entirely clear, what you consider to be expected. Do you expect that these other parameters also follow an exponential distribution or do you not? Please clarify.

Page 5, line 6: “in a semi-logarithmic scale” -> “in a semi-logarithmic diagram”

Page 5, line 9: “significant smaller“ -> "significantly smaller”

Page 6, Caption Fig. 2, line 2: “least square fit” -> “least squares fit”

Page 7, Fig. 3: I suggestion mentioning in the Figure caption what the dashed lines are.

Page 7, line 7: “Linearity between maximum backscatter (MBS) and ice mass density (IMD), ice radius r and ice number density n data is a necessary and sufficient condition that also IMD, r and n data samples are exponentially distributed”

I’m not sure you would really expect that MBS scales linearly with, e.g. radius. The intensity of the backscattered radiation does certainly not scale linearly with particle radius, right? Why should the maximum backscatter depend linearly on radius? If there are other indications etc. for that, please discuss. Considering that you use a power law to describe the relationship between two parameters, you don’t really assume linearity, right? I think the term “linearity” should be replaced and then all is fine.

Page 8, line 1: “. . . also relate to the half width of the angle”

Can you mention how the regression points “relate to“ the half width of this angle? To

me this is not obvious, but perhaps I’m missing something.

Page 8, line 5: “criteria” -> “criterion”

Page 8, line 6: “which is far away from unity”

This is not surprising at all, because the backscatter does not scale linearly with radius. But perhaps this is discussed below.

Page 9, last line: Something is missing in this equation. “C” is not defined and it is neither required here. The integral can be explicitly evaluated, but I find that b>1 is a requirement for the integral being 1. Please check.

Page 10, line 10: Meaning of “Only, ” at beginning of sentence not clear, at least to me. Without the comma it would make sense.

Page 12, line 26: “should be here possible too” -> “should be possible here too”

Page 13, line 15: Suggest replacing “, and resulting” by “, resulting in “

Page 16, line 8: “in turns” -> “in turn”

Page 16, line 12: “of an practical example” -> “of a practical example”

Page 16, line 25: “Now the Z-distribution approach offers a more general possibility to derive artificial data samples without any knowledge of correlation and regression coefficients.”

I’m not sure I fully agree with this statement, because information on the power law relationship between the two quantities is required, right? The statement suggests (or may suggest) that no prior information on the relationship between the two quantities is needed, which is certainly not the case, because you assume that a_r and b_r are known.

Page 18, line 19: “of an satellite“ -> "of a satellite”

Page 19, line 7: I think “for r_i > 37.5 nm“ should be "for r_i < 37.5 nm”

Page 19, line 10: “signal result“ -> “signals result”

Page 19, line 11: “of an spherical ice particle” -> “of a spherical ice particle”

Page 19, line 11/12: you assume a fixed relationship between LIDAR backscatter signal and particle radius. In reality, the power will decrease with increasing particle radius. For your estimation this certainly does not have to be considered, but it’s perhaps worth mentioning.

Page 21, last line: “We present two numericalLY stable ..”

Page 21, line 6: “The Z-distribution approach offers a more general possibility to derive artificial data samples without any knowledge of correlation and regression coefficients”

OK, but the approach requires a priori knowledge on the Z-distribution parameters, right?

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