

Interactive comment on “Ground-based lidar measurements from Ny-Ålesund during ASTAR 2007: a statistical overview” by A. Hoffmann et al.

Anonymous Referee #1

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Review of “Ground-based lidar measurements from Ny-Alesund during ASTAR 2007: a statistical overview” by Hoffmann et al.

This paper reports on retrievals of cloud and aerosol properties using a micro pulse and a Raman lidar at Spitsbergen during Spring 2007. Statistics are based on backscattering ratio and volume depolarization dependence on altitude. A number of case studies present more details on the scattering properties and particle types. Back trajectories are computed to determine source regions. Overall this paper makes a contribution to our ongoing need to learn more about cloud and aerosol properties in the Arctic where measurements are sparse. The total number of measurements and the length of campaign are really both too small to claim that this is a representative statistical overview so perhaps that phrase should be removed from the title. This lidar study suffers from a

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lack of in-situ confirmation of particle types requiring aircraft over-flights which I thought was done as part of ASTAR 2007.

I recommend acceptance into ACP once the authors have addressed the following major and minor issues.

Major Issues

1. Page 15455, Line 24. It is stated that aerosol removal processes depend critically on the amount of water vapor and atmospheric trace gases. This sentence should be made more scientific accurate. Aerosol removal occurs by dry and wet deposition. Dry deposition depends on turbulence transfer and proximity to the ground, while wet deposition depends on cloud nucleation and precipitation scavenging.
2. Page 15457, Line 22. Cases with multiple scattering were removed. The number of removed hours or cases should be stated. Also indicate how many of these cases were thick cirrus compared to water clouds. What is the optical depth cut-off used to reject cases based on multiple scattering? This value or something similar should be provided.
3. Page 15458, Line 22. Low level Arctic temperature inversions are described as “complicated to describe”. Why do you say that? The classical Arctic inversion is forced by strong radiative cooling of the surface. Also in Figure 1 it is not possible to see the inversions using the temperature contour plot. It might be better to show a contour plot of the temperature lapse rate since that it the main function of the figure. Also I would say that defining a surface temperature inversion by a temperature difference of only 0.25 K is too weak. Why did you use 0.25 K? Also the contour interval should be stated in the figure caption.
4. Figure 2. Wouldn't it be more useful to show a contour plot of the relative humidity with respect to ice? Also the contour interval might be too small which is resulting in a “crushing” of the lines. Also state the contour interval in the figure caption.

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5. Page 15460, Line 10. The PEP-Tracer model is used for computing back trajectories, but later in the paper the HYSPLIT model is used. Why are two models in use? I like the idea of using both models but they should be run for all cases and compared to access variability caused by the model type.
6. Section 3. I found it confusing keeping track of which lidar is used in all the results and retrievals and why. The beginning of section 3 should have a short introductory paragraph clearly stating how the two lidars are being used, how they complement each other, what are the shortcomings of each lidar. Also there should be some comparison of perhaps the BSR from each lidar separately for a given profile to see how they compare. I realize that some of this information is scattered throughout the paper, but it would help the reader to have it all together at beginning of this section.
7. Page 15462, Line 6. It is stated that the quotient in Eqn. 2 is normalized in clear air in 14 km altitude. This is confusing sentence that should be better explained.
8. Page 15463, Line 17. It says "For each altitude interval beginning at the surface, values above 0.1". What is this 0.1? It seems to be referring to BSR but BSR needs to be greater than 1. Please clarify.
9. Section 3.1.1. What is meant by "Comparison with radiosondes"? The lidars and radiosondes are giving different variables. It is not a comparison unless the Raman channels were being used to determine a temperature and water vapor profile which is not the case in this paper.
10. Page 15466, Line 25. Why is it expected that the backscatter ratio is decreasing with altitude?
11. Page 15466, Line 29. It is not clear how you expect to use BSR to verify a climate model. Either explain this fully or leave it out. Perhaps it should go into the conclusions section.
12. Page 15468, Line 5. Why is it not possible that water clouds could decrease the

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VD to below 1.2?

13. Page 15468, Last Paragraph. There is no discussion in this paragraph about the particle type associated with the C4 category even though C4 makes up about a third of the cases below 5 km. There is some speculation about C4 in the Conclusions on page 15477 but this should be moved forward to this section.
14. Page 15469, Line 7. It says here that the fraction of clear sky measurements is lower from the Canadian Arctic while on page 15461, line 5 it says that trajectories from northern Canada are very clean. Explain this contradiction.
15. Page 15470, Line 7. It is stated that in one of the cases there is indication of a "subvisible water cloud layer". I am not aware of this type of cloud being reported in the literature. For a water cloud to be subvisual it would require quite an extraordinary situation of limited condensation which does not seem possible. The authors should remove this phrase or provide a detailed account of this new type of cloud and strong evidence that it truly is a subvisible liquid cloud and not a haze layer. This is also referred to on page 15471, line 21 and page 15476, line 19.
16. Page 15473, Line 25. The inversion of lidar data from 2 wavelengths is used to retrieve the real and imaginary part of the refractive index, the number concentration, the effective radius and the modal width. It seems that this result is not possible from only 2 wavelengths. Boeckmann (2001) whom they cite states that at the very minimum one requires 3 backscatter wavelengths and one Raman channel. The retrieval algorithm inputs need to be explained in more detail.
17. Did the lidar operate at the same time as aircraft over-flights as part of ASTAR 2007? Is so would it be possible to validate the particle types by using aircraft measurements?

Minor Issues

Page 15455, Line 1. This sentence has awkward grammar.

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Page 15455, Line 15. "Haze" should read "haze".

Page 15456, Line 6. "a manpower" should read "manpower".

Page 15456, Line 15. "Gulf Stream and hence warmer" should read "warm Gulf Stream".

Page 15456, Line 18. "differing" should read "different".

Page 15456, Line 19. "low" should read "less".

Page 15456, Line 20. "higher values" should read "more".

Page 15456, Line 22. "Even" should read "Also".

Page 15457, Line 8. "parameters as" should read "parameters such as".

Page 15457, Line 25. "inter annual" should read "interannual".

Page 15458, Line 6. Only 71 weather balloons were analyzed for a two month period. With twice daily launches there should be closer to 120 soundings. Why are there fewer sounders?

Page 15458, Line 13. It is stated that relative humidity from the soundings are less reliable at cold temperatures. State at what temperature this becomes a major concern.

Page 15464, Line 3. "temporally following" should read "subsequent".

Page 15464, Line 13. "can not" should read "cannot".

Page 15465, Line 10. "fraction were" should read "fraction when".

Page 15469, Line 18. Does the low and medium depolarization also include cases C3 and C5?

Page 15470, Line 1. There are no balloon soundings in Figure 10.

Page 15470, Line 10. Typically water droplets can exist if the temperature is warmer

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than about -40C. Below 210K must be a misprint.

Page 15474, Line 2. "insecurity" should read "uncertainty".

Page 15475, Line 12. "approved" should read "confirmed".

Page 15475, Line 19. "hydrophil" should read "hydrophilic".

Page 15476, Line 8. "A statistics" should read "Statistics".

Page 15476, Line 14. "As never clear super saturation in clouds has been observed" is a confusing phrase. Please rewrite.

I suggest the word "statistical" be removed from the title.

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