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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol distribution around Svalbard during intense easterly winds" *by* A. Dörnbrack et al.

Anonymous Referee #2

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The paper presents an interesting analysis of release and transport of aerosols from the soil and snow surfaces at Svalbard and the ocean surrounding it during strong winds. It is surely worth publishing but I think some clarifications would make the audience a bit larger.

I would still classify these suggestions as "minor revisions" even though there seem to be many of them.

GENERAL ABOUT THE LIDAR

I am a basic "in situ" aerosol researcher, dealing with number and mass size distributions and also light scattering and absorption but I am not very much familiar with Lidars. I would like to be able to relate the Lidar measurements with something in SI

units that I get from my own measurements. For instance, I would like to know, what is the particle size range that you detect with your lidar, even very very roughly. There is nowhere in the text the word "diameter" or "size". So, even if the instrument does not measure the size, you should explain and discuss this with a couple of references. The other basic concept: "concentration" is also missing. Intuitively it seems that the backscatter ratio is the higher the higher the particle concentration is. But do you have even a rough idea, what kind of concentrations – in mass, volume, or surface concentrations – result in the presented R532 values?

The third concept is the depolarization. Would you please explain that a bit more with a few lines. For instance, what does it tell about the particles, what is the range of values, ...? I found only one piece of text explaining what the depolarization gives, this one on P16447L21 "Thus, the backscattering aerosol particles were aspherical and consisted most likely of mineral dust mobilized at the ground of the Adventdalen." By the way, the Lidar is described in appendix A but there is no explanation of how it measures depolarization. What is the "noise level" or "detection limit" of the depolarization?

OTHER DETAILLED COMMENTS

P16443L8" The background aerosol load was exceptionally low at the time of the observations." How low? Number concentrations, mass concentrations?

P16442L20 "...observed aerosol distributions are utilized ..." It might be good to mention at least once, probably here that you talk about "aerosol geographical distributions" or "vertical and horizontal distributions" and not size distributions.

P16444L14 You mention here for the first time Adventsdalen and Isfjorden. Please show them also explicitly on a map. You mention them so often in the text that it would make sense to add one figure with the names of the places and some scale in kilometers and no data. Except perhaps the flight routes.

P16446L17 "On 18 May 2004, significant loads of mineral dust were mobilized by the

strong winds blowing through the snow-free Adventdalen". Are there any in situ data to show (not in a figure but in text), how high the mass or number concentrations were?

P16447L6 "R532nm>100 near the surface and an exponential decrease towards the ambient value of R532nm = 1.4 above 400m over ground." Where does this 1.4 come from? Is it always about 1.4 at clean, dustfree background air?

P16447L16 "Inside the Adventdalen the vertical distribution of aerosol particles exhibited a different characteristics (Fig. 4c, d):" Weren't also Figs 4a and 4b from Adventsdalen?

P16448L10 "However, the exceptionally large R532 nm-values at the location of profile No. 9 might tell a different story. This particular profile resulted from six overflights in a region which was impacted by the outflow of the Adventdalen, the strong flow past the mountain ridge north of it, and the glacier winds blowing over the Isfjorden further north of the mountains." Why is profile 9 so different: 8 and 10 are very close, why wouldn't the same air come to them?

P16450L1 "Prins Karls Foreland" is mentioned. Where is it? Put it in a map.

P16450L2 "Increased surface values R532nm = 4.0 were observed in two distinct areas: in the vicinity of the northernmost way point at 10:15UTC and near the mouth of the Isfjorden at around 11:15UTC." The figure 6 I see on my screen has no values at all between 10:15 – 10:25, just white, also at 11:25. For sure not values about 4.0. Is this an error or what? Does white mean missing data?

P16450L5 "Both the triangular shape of the aerosol distribution and of the clouds (enhanced Svalues) in the altitude-time cross-section constitute the prominent mesoscale feature of this flight segment." I don't clearly see anything triangular in Figure 6a. Maybe it is just a matter of the color scale? In figure 6 b I see two white triangles, the first one starting from 15:15 and ending at 15:50 and the second starting at 16:00 and ending at 16:40 but both of them are white – no data?

P16453L3" ro = 3.2 10−3 kg" ro is density but kg is the unit of mass, not density. Where does the 3.2 10-3 kg come from?

P16457L23 "mineral dust and soot particles were mobilized from the surface" Dust ok but soot... Soot is the result of incomplete combustion, not by wind blowing over bare Arctic soil – unless there is some coal mine just there, is there? You mention soot here for the first time. I doubt that the Lidar can detect soot. If it can, explain how?

P16457O28 – P16458L1 "The high backscatter values and the volume depolarisation greater 10% in this layer confirm that most of the backscattering particles consisted of mineral dust". Well, don't all particles scatter light also in the backward direction? Even the smallest ones do, even though the backscattering signal is very weak. If you write "most of the backscattering particles consisted of mineral dust" you claim that the number of dust particles was higher than for example nucleation or Aitken mode particles – which you cannot say with Lidar measurements only. You should reformulate this somehow.

FIGURE 2. I cannot find Svalbard in these figures. Please add one more with a drawing of the map or add a drawing in each of the subfigures. Add a scale of distance in the figures.

FIGURE 3. Some profile numbers are larger, some smaller. What does the symbol size mean? Add a scale of distance in the figures.

FIGURES 4b, 4d, 5b, 5d. The depolarization seems to make quite interesting vertical profiles, there are clear minima going to about 0.01 and about 100 m higher to 0.05 and then again about 100 m higher to 0.01 ... Is this real or some artefact? If you think it is real, do you have some hypothesis for an explanation?

Then a final comment about figures. There are a lot of figures with a lot of information, perhaps even too much. If possible, you could split some figures into two so that they would become more readable. But one thing is missing: wind direction – I don't find that

except in the figure 8 and even there it is hard to see where wind was really blowing. Wouldn't you make a vector map?

And please, don't use yellow for any lines - it should be forbidden to plot yellow lines, they are almost white. In surface plots yellow is ok but lines not.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 16441, 2009.