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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Arctic aerosol life cycle: linking aerosol size distributions observed between 2000 and 2010 with air mass transport and precipitation at Zeppelin station, Ny-Ålesund, Svalbard" *by* P. Tunved et al.

P. Tunved et al.

peter.tunved@itm.su.se

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First of all the authors thank referee #1 for the assistance and time invested in improving the quality of this manuscript. The main concerns of referee # 1 relates to the English used in the MS. We do agree that the text did contain a large number of unnecessary language bugs and grammatical errors. After having the MS proof-read by a native speaking Englishman, we do however now believe that the quality of the MS meets the standards of ACP.

Referee #1 also had a number of minor comments, to which we answer in detail below.

Detailed comments

p.29969, line 6-8: The authors made alterations to the sentence by removing " . . .is not fully understood, but likely.."

Sentence now reads: "The reason for this "Arctic amplification" relates to both the complex feedbacks that are active in the Arctic environment as well as the overall environmental conditions that are characteristic of the Arctic environment. This increased warming results in for example an earlier onset of sea ice melt and ice loss in general, through which positive feedback further impacts the radiative balance via reduced surface albedo (Hudson, 2011;Robock, 1983)."

p.29970, line 27: ". . .larger sized. . ." replaced by ". . .accumulation mode sized. . ."

Figure 1: This is clarified in the revised MS.

p.29976, line 10: Wording of sentence changed for clarity:

". . .one mode in Aitken and one mode in accumulation. . ."

p.29977: We added "Bates et al., 2000" to support the statement.

p.29978: The authors do completely agree that the role of precipitation should be acknowledged already here: We rephrase the sentence on P. 29978 to:

"Instead, this transition is likely strongly linked to increased wet removal (e.g. Garrett et al., 2011) together with increased photochemical activity due to increased solar radiation. Wet removal and change of source areas reduce the condensation sink which allow for new particle formation to occur."

P.29979: As we are not sure about the true density we choose to use a density (admittedly unrealistic) of 1 g/cm3 for ease of scaling. The makes it easier for the reader to recalculate our estimate of submicron mass using any other density. It is also men-

tioned in the text that this density is less likely to be true, and we instead suggest a density of 2g/cm3.

p.29980, lines 6-7: "...Smaller sized particles..." replaced by "...sub-60 nm particles..."

p.29980: References added as suggested.

p.29981, line 12: The rage of the percentiles have been replaced by a more conventional counterpart; "percentile ranges"

p.29981, line 16: Sentence changed accordingly.

p.29984, lines 23-25: "The maximum concentration of sub-60 nm particle (as indicated by the 95th percentile does seem to have a clear diurnal variability during Arctic summer, in particular June, July and August." The y-axis in the figure was further changed to linear scale.

p.29984, lines 23-25: We agree and reformulate the sentence to read:

"We will investigate how different source areas potentially influence the aerosol observed at Mt Zeppelin, and show how precipitation and associated wet removal shape the aerosol number size distribution and mass concentration during transport into the Arctic."

P29986, lines 10-19: We re-wrote the sentence according to:

"Although not directly comparable, a recent study (Hirdman et al., 2010) where the importance of source regions in characterizing some key SLP's at three Arctic sites (Barrow, Zeppelin and Alert) showed that the dominating sources of sulfate aerosols and equivalent black carbon in the Arctic during winter were argued to be northern parts of Eurasia. Hirdman et al. (2010) further show that large contributions from sources in Siberia and North America dominate during summer time."

Section 3.5: The results presented in figure 17 and 18 reflect the effect of precipitation

history on the aerosol size distribution during the last several days of transport. This means that we cannot directly link precipitation at the site with the aerosol evolution, as the effect of precipitation will be visible only downstream of the actual observation if assuming a Lagrangian framework which makes approaches utilizing "on site" precipitation uncertain, why we will have to rely on model calculated precipitation along the transport routes. The authors do however agree that more efforts should be put in analyzing the role of wet deposition for subsequent new particle formation. This however is a large undertaking and deserves a dedicated study.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 29967, 2012.