

Interactive comment on “An investigation of processes controlling the evolution of the boundary layer aerosol size distribution properties at the Swedish background station Aspövreten” by P. Tunved et al.

Anonymous Referee #2

Received and published: 11 October 2004

The paper is sound and present important long term data and interprets it in the context of aerosol processes using a novel multi variate analysis. The data is used to show the life cycles of aerosols in terms of their classifications derived from data. The analysis is sound and offer clear insight into aerosol transformation. I have some minor comments which need to be addressed below but welcome the publication of this paper in ACP. However, there are many typographic and grammatical errors and inconsistencies in the manuscript. To help future readers I have tried to make suggestions as to how the use of English in this paper can be changed to improve clarity.

Comments

S2034

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Discussion Paper

On Pg 4510 in line 7, you state that rate of deposition decreases with size. This isn't usually the case unless the surface area distribution increase with decreasing size. What is true is that the rate of change in aerosol particle diameter decreases with increases in particle size as a result of a condensation sink from the as phase.

Pg 4511: You should state the humidity of the aerosol during its measurements, were the SMPS systems run under dry conditions, fixed RH or under ambient conditions?

Pg 4512 section 2.2.2: In your description of the back trajectories you should include the length of the back trajectory used. Further in the text you state its 72 hours but this needs stating here. You imply that the position of the air mass was calculated every hour along the trajectory, but you need to state this more clearly. Furthermore, why did you choose 3 day back trajectories when the aerosol lifetime can often be longer than this? Did you test to see if longer trajectories made any difference to the clustering and if not do you have reasons for this?

Pg 4515 line 20: I am sure I see your arguments for the groupings of trajectories. Surely these are several trajectories in one meteorological system that look similar because they are causally linked. There may not be any statistical grouping of trajectories in each cluster

Pg 4521 line 28: you should also make the point that the effect of cloud processing by oxidative uptake decreases with size in the accumulation mode.

Minor comments

Normal brackets “(and)” are used to denote the suggested insertion of text and square brackets “[and]” are used to denote the removal of text.

Pg 4508, Abstract

Line 5 “. . .aerosol was. . .” should read “. . .aerosol were. . .”

Line 6 “. . .aged type. . .” should read “. . .aged types. . .”

Line 6-7 unclear what “and different magnitudes thereof means” rephrase

Line 10-11 better to write “Processing by clouds and precipitation is shown to be especially crucial. . .”

Line 12: “. . .present features (that are) likely (to be) related. . .”

Line 14: “. . .by means of measured variability” it isn’t clear in the abstract what you mean by this. A lot of the data you use is derived from NCEP analyses and is not measurement. Try “. . .are discussed by considering variation in the distributions and key meteorological parameters.”

Line 18: “ageing (of the distribution) may proceed. . .”

Introduction

Line 25 “The aerosols. . .” should read “Atmospheric aerosols. . .”

Pg 4509

Line 1 “. . .size distribution(s). . .”

Line 5: “The(se) climate effects. . .”

Line 9 Better to write “In order to improve the representation of aerosols in models we need to understand what processes determine the temporal evolution of the aerosol”

Line 11: “. . .(2003),. . .” insert comma

Line 11: “. . .typical size distribution (that is) representative. . .”

Line 13: replace “initializing” with “to initialize”

Line 15: delete “is a process that”

Pg 4510: Line 10 “are very small” should be replaced with “occur slowly”

Pg 4511: Line 18: I assume the four distributions per day were calculated between 0-6, 6-12, 12-18 and 18-24 hours but you should say this.

Pg 4512

Line 1: “. . .are partitioned in(to). . .”

Line 4: a reference to the mathematics involved in your cluster analysis method would be useful at this point, otherwise the reader requires MATLAB to repeat the analysis on

their data

Line 8: “. . .as well (as) two. . .”

Section 2.2.2

Line 12 “Trajectory data were. . .”

Line 17: You should state that the trajectories were calculated to arrive at the midpoints of the averaging times for the size distributions (I assume they were).

Line 19-20: This sentence is confusing. I assume you mean that “. . .additional meteorological variables were calculated by HYSPLIT from the NCEP analyses for each point at which the trajectory coordinates were calculated.

Page 4513

Line 11 replace “were” with “was”

Line 16 and line 21 please can you check the density and loading for cluster A, they both have values of 1.5. Also in cluster B the mass loading and the percentage both have a numerical value of 3.3. I hope this is just a coincidence

Page 4514: Line 1: the fraction of occurrences in cluster E is not given but it is for all the others, insert.

Line 16: “More global. . .” change to “Increased global. . .”

Line 17: “. . .increases the speed of. . .” should read “. . .increases the rate of. . .”

Line 20: in figure 2. Whilst clusters A, B, C and to a lesser extent D show late spring and late summer maxima in their frequency of occurrence F shows a broad summer maximum and winter minimum. The seasonality appears different to the other clusters

Pg 4515

Line 7 “. . .with the different clusters (in this paper),. . .”

Line 12: “If the trajectory reside(s). . .”

Line 20 “. . .transport come(s). . .”

Line 24: “. . .figure 5 by trajectories belonging to cluster C” yet the figure caption refers

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to cluster H.

Pg 4516

Line 4: “Seinfeld[t]”

Line 19: “. . .is less, close to the. . .” insert a comma as shown

Pg 4517

Line 8: rewrite as “It is thus clear that certain differences in precipitation history exist between the different. . .”

Line 10: delete “The issue of”

Line 11: replace “later on” with “in section ***”

Line 11: “. . .attention towards [the] clouds”

Line 14: replace “by mainly” with “mainly by”

Line 18: “. . .as they (are) rather quickly [are] scavenged. . .”

Line 23: “. . .to address the issue of [the] cloud processing. . .”

Line 25: “. . .above 94% [is] (are) considered to correspond to [an in-cloud situation] (to the presence of cloud in the air parcel)”

Line 27 “. . .or more specific(ally). . .”

Pg 4518

Line 1 “There are especially two occasions worth noticing” I don’t know what this means? Do you mean? “Two features are worth particular attention” but then you make more than 2 points. Be clear here

Line 10: “(Here we are [here]. . .”

Line 15: “Cluster(s) G and H (are) associated (with) air (that) is likely to (have) been exposed to a large number of cloud cycles (and) are relatively similar in shape, having low number. . .”

Page 4519

line 11: “Cluster B[have] (shows) similar. . .”

Line 12: "Cluster(s) C..."

Pg 4520

Line 11 "...re-emit[s]..."

Line 18: delete "analysing the dataset"

Line 21: rewrite the sentence, suggestion: "This study derives to what degree ..."

Pg 4521

Lines 4-5 last line in paragraph. I have no idea what this sentence means, make it clear or delete it

Line 15-16: rewrite as "This behaviour is to be expected since smaller particles are removed..."

Line 23: rewrite as "...oxidation of SO₂, mostly by ozone and hydrogen peroxide, within..."

Pg 4522

Line 10: This sentence is in the discussions part. I do not know to what it is referring. It needs rewording or deleting

Line 14: "From the simplified three stage[s] aerosol lifecycle..."

Line 15 rewrite "...we may assume (that) each cluster [as] represent(s)[ing] a..."

Line 18 replace true with truly

Line 22 "...and precipitation[s]), cluster B lags cluster A by approximately half a day."

Line 26 "...the cluster types are thus..."

Line 27: "From this point the evolution may proceed in two directions: through continuous growth by condensation and coagulation; but more importantly through in-cloud process(ing) the..."

Line 29 "If the cloud precipitates then the size distribution is likely to evolve into that given by cluster H"

Page 4523

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line 2 “process(ed)”

Lines 3-5: I don’t understand this sentence, rewrite or remove

Line 12: “. . .to be regarded (as) a daylight[-] phenomenon, (this is) also illustrated by the high dependence on increased solar radiation, indicating. . .”

Line 15 “. . .during several hours (in these studies. . .”.

Line 16: “agreed” replace with “accepted”

Line 25 “wet deposition(,) as a controlling mechanism fro reaching a state where nucleation can occur(,) is also. . .”

line 29 “. . .high concentration in (the) nuclei. . .”

page 4524

line 5 “If one compare(s). . .”

Line 7: “. . .rather high frequenc[y](ies). . .”

Line 8 “. . .precipitation (occurs) during the time [of around where] when . . .”

Lines 9-10 “where the wet deposition (provides [govern] a. . .”

Line 12 “. . .from (the) free. . .”

Line 15 “. . .could also [by dilution] reduce the pre-existing aerosol surface (by dilution). . .”

Line 19 replace “may” by “can”

Summary and conclusions

Pg 4524

Line 23 “. . .using (a) novel. . .”

Line 26: “. . .phase of the size distribution [is] (are) present. . .”

Page 4525: Line 9 “. . .become(s) clear. . .”

Page 4526

Line 3 “. . .distribution(. This is) most. . .”

Line 5 rewrite as “. . .lower limit of activation of aerosols in clouds is approximately 100

nm in this type of environment.”

Line 10 “...this point(s) to...”

Line 14 “...during situation(s)...”

Line 18: “...properties (that are) likely...”

Figures

Fig 1: state what the dash lines are in the caption

Fig 8: The caption is unclear, what do you mean by diurnally averaged in this context

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 4507, 2004.

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