

Interactive comment on “New particle formation events in semi-clean South African savannah” by V. Vakkari et al.

Anonymous Referee #2

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General comments

I recommend the paper for publication upon minor revisions. If the other comments by other reviewers are not too extensive, the paper needs no further review from my own side.

The current paper presents statistical results and characteristics of new particle formation events in Southern Africa on the African continent, where there is previously a limited amount of data. Formation events have a potential to significantly affect the global radiation balance of the earth-atmosphere system, since these events are a source of cloud condensation nuclei. Regional and global models however, have a difficulty in predicting where and when new particle formation takes place and how strong these formation events are since the mechanism behind it and what is required

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to observe them is still not known. Therefore, every new measurement in a new environment, such as in this study is extremely valuable to validate modeling attempts to predict the events and how they can affect the aerosol population, and hence the climate. The overall quality of the paper is excellent. There are not too many messages, which makes the paper rather short and to the point. The paper is also extremely well structured, very easy to understand and the line of argument is very good. I have only some minor language remarks, and a few other points that need to be answered as outlined below. Finally, I think that there are too many figures in the paper.

Specific comments

Page 30778, lines 12-14. Voluntary correction: Consider removing this sentence to make abstract shorter and to the point.

Page 30778, lines 14-25. Voluntary correction: Consider rephrasing to make abstract shorter and avoiding repetition. It is mentioned twice that VOC emissions are important for growth rates.

Page 30780, lines 9-17. “In this study, supporting the EUCAARI project South African component (Kulmala et al., 2009), we give a more detailed analysis on the new particle formation observed on background savannah (Laakso et al., 2008).” Should read: “In this study, supporting the EUCAARI project South African component (Kulmala et al., 2009), we provide a more detailed analysis and an extension on the new particle formation observed at Botsalano (Laakso et al., 2008).” This helps the reader to understand that you are talking about the same measurement site in the second last and last paragraph respectively in section 1.

Page 30781, line 9. Please include in the same sentence where the Karoo region is situated.

Page 30783, line 2. Please remove “and the aerosol particle growth rate”, since the current paragraph and formula (1) do not include the growth rate explanation.

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Page 30783, lines 17-18. “The actual growth rate is obtained by tracing the maximum of the log-normal fit to the nucleation mode as it grows from 10 to 30 nm and making a linear fit to the obtained data points”. Consider replacing with for example: “The actual growth rate is obtained by tracing the increase of the geometric mean diameter of the log-normally fitted nucleation mode as it grows from 10 to 30 nm diameter and making a linear fit to the obtained data points”.

Page 30784, last paragraph. I don't understand this paragraph. Is it possible to explain it better without having to read Manninen et al. (2009b), or is this reference necessary for understanding? If the reference is not crucial for the understanding, then please rephrase.

Page 30786, last paragraph of chapter 3.5. I don't understand this paragraph. Please rephrase.

Page 30788, line 28. Please consider replacing “was” with “is”. You use the present tense in all other places.

Page 30789, lines 10-12. Do you mean that if DMPS/SMPS data is missing, then the only way to calculate J10 and GR10-30 nm is to use AIS data? However, to be able to use AIS data for this, you first need to know if the AIS data method works? Is this what you are trying to say? If so, then please explain it more clearly.

Page 30789, lines 27-28. Do we expect based on the size dependent charging efficiency of the ambient aerosol that the ratio between DMPS and AIS J10 should be close to 6.6? If so, please add a one or two sentences explanation regarding this and the value of 6.6.

Pages 30791-30792, lines 25-28, and 1-9 respectively. If I understand it correctly, the SO₂ concentration values are calculated using the SO₂ data at the Botsalano site and by examining where the back trajectories came from when these SO₂ values were measured? In any case, it is hard to understand this. Please explain more thoroughly.

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It is also hard to understand the part with the Highveld blue polygon area. Please explain also this more thoroughly.

Page 30795, lines 2-4. I don't fully agree. To me it looks like the hot spots of the high growth rates of all size ranges in Figure 19 look more like the hot spots of SO₂ and H₂SO₄ rather than like the hot spots of VOC emissions.

Page 30809, figure caption of Figure 7. Please try to incorporate the text “The GR10–30 increase slightly with increasing condensation sink, but the observations are too scattered for a linear fit” in the first paragraph of page 30789 and remove it from the figure caption. We want to avoid discussion of results in the figure caption.

Pages 30816-30820, Figures 14-18. Please avoid writing about the results in the figure captions. Please also consider removing as many figures as possible, since there are too many already. Especially the results from figures 15-18 can be based on figures 13 and 14, where the minimal differences between the figures can be explained by words rather than figures in the manuscript.

Technical corrections

Page 30779, lines 16-17. “The concentrations of climatically important aerosol particles are due to their different sources and sinks.” Suggested correction: “The concentrations of climatically important aerosol particles depend on their different sources and sinks.”

Page 30779, lines 26-28. “On the other hand, the number of long-term continuous measurements of aerosol particle properties in Europe and North America, observations are increasing (e.g., Manninen et al., 2010).” Suggested correction: “Conversely, the number of long-term continuous measurements of aerosol particle properties in Europe and North America are increasing (e.g., Manninen et al., 2010).”

Page 30779, line 28. “For instance, the only reported . . .”. Please delete “For instance”, and place the text in a new paragraph. Otherwise it feels as if the Botsalano measure-

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ments have got something to do with the European and American measurements.

Page 30780, line 26. “north of”. Should read: “north of the”.

Page 30781, line 7. “Highveld”. Should read: “Highveld area”.

Page 30783, line 10. “was taken to equal”. Should read: “was set to zero”.

Page 30784, line 9. “polarity 1.5-3 nm”. Should read: “polarity for 1.5-3 nm”.

Page 30784, equation (2). No explanation is made regarding the difference between $N_{(<3\text{nm})\pm}$ and N_{\pm} .

Page 30784, line 24. “the period when the first term in Eq. (2) was defined.” Should read: “during the period when the first term in Eq. (2) was calculated.”

Page 30784, line 25. “a sum of recombination”. Should read: “the sum of the recombination”.

Page 30785, lines 13-14. “to the Eq. (4) by Petäjä et al. (2009)”. Should read: “to Eq. (4) in Petäjä et al. (2009)”.

Page 30786, line 15. “to a 0.5”. Should read: “in a 0.5”.

Page 30787, line 1. “continental”. Should read “the continental”.

Page 30788, line 17. “with mean”. Should read: “with a mean”.

Page 30788, line 25. “for period 09:30–10:30 LT, which is the hour following the median observed new particle formation onset.”. Correction suggestion: “for the period 09:30–10:30 LT, which is one hour later compared to the median hour of the onset of new particle formation events.”.

Page 30789, line 3. Please consider replacing “defined” with “calculated”.

Page 30789, lines 19 and 24. Standard errors of what?

Page 30791, line 5. Please consider to remove “However” in the sentence, since it

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gives the impression that the results are not consistent with what you discuss in lines 3-4.

Page 30791, lines 10-12. Please rephrase sentence, since it is hard to understand.

Page 30791, line 23. Please consider reversing “air” and “polluted”.

Page 30792, line 18. “show a same kind”. Should read: “show the same kind”.

Page 30793, line 24. “in semi-“. Should read: “in a semi-“.

Page 30794, line 15. “did not have seasonal variation”. Should read: “did not have a seasonal variation”.

Page 30795, lines 7-8. Consider replacing “The seasonal variation and the source areas suggest the growth to originate in VOC emissions following from biological activity” with “The seasonal variation and the source areas suggest that occasions with high growth rates are connected to areas with high VOC emissions following from biological activity”.

Page 30802, Table 2. Please reverse the order of the GR (1.5-3nm) and GR (7-20nm) for better readability.

Page 30805, Figure 2 caption. Please reverse the order of “formation” and “growth”.

Page 30806, Figure 4 caption. Please delete “The formation rate does not have a seasonal dependence.” to avoid discussion of results in the figure caption.

Page 30807, Figure 5 caption. Please delete “The differences between the polarities are negligible.” to avoid discussion of results in the figure caption. Please also explain average period and the numbers in the left panel.

Page 30808, Figure 6 caption. Please change the caption text to something like: “The monthly averaged condensation sink calculated during 09:30 and 10:30 LT for all days, i.e. including event and non-event days”.

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Page 30809, Figure 7. Please consider to remove the figure. There are too many already, and the relation is anyway not linear. It is enough to describe the findings using written words in the manuscript.

Page 30810, Figure 8 caption. "is mean". Should read: "is the mean".

Page 30810, Figure 8 caption. Please reverse the order of "formation" and "growth".

Page 30810, Figure 8 caption. Please add a text explaining the fitting depicted with the red curve and the equation of the fit.

Page 30812, Figure 10 caption. Please add that it is monthly averages

Page 30813, Figure 11. Please consider to replace figure with a table. There are too many figures, and there are so many values in the figure, that a table might be more suitable.

Page 30816, Figure 14. Please reverse the order between the left and the right panel in the graph.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 30777, 2010.