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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Measured and modelled cloud condensation nuclei concentration at the high alpine site Jungfraujoch" *by* Z. Jurányi et al.

Anonymous Referee #3

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Juranyi et al. present a one-month data set of polydisperse CCN measurements recorded at the remote high alpine research station Jungfraujoch in Switzerland. Additional measurements with other aerosol instruments like SMPS, AMS, MAAP, and HTDMA provide information about the aerosol particle number size distribution, chemical composition, and mixing state, which is helpful to interpret the CCN data set.

The authors thoroughly discuss the prediction of CCN concentrations using different assumptions (constant/variable size distribution/chemical composition) and compare the modeled concentrations with the measured ones. A detailed sensitivity study of the prediction methods clearly shows that the variation of the chemical composition is less important than the variation of the particle number size distribution.

The results of this study re-confirm and complement the findings of related earlier studies and provide important knowledge on how the CCN activity can be described and implemented in detailed process models as well as in large-scale atmospheric and climate models.

I recommend publication in ACP after the following comments and suggestions for correction/improvement have been addressed.

Major comment:
Structure of the manuscript:
While reading the paper I had the impression that not all the information about one issue (e.g., AMS derived κ) can be found at one place of the text. I rather had to scroll up and down and dig up the pieces to fully understand your results. (You will find some of these cases in the specific comments.) I think that it would help the readers to structure your paper more clearly for example by adding subsections to Sect. 2. Another improvement (but this might be only a personal preference) would be to merge the Results and the Discussion section into one section, and then divide this into several subsections.

Specific comments:

- p.8866, l. 18: From which measurement results or references do you derive the mass absorption efficiency of 6.6 $m^2\,g^{-1}$? Please explain where this value comes from.
- p.8867, l. 20-22: It would be illustrative to show your calibration line (SS vs. dT) in a figure.

- p.8868, l. 16-17: As far as I know, NaCl is known to have a κ value of 1.28 (Petters and Kreidenweis, 2007). In your statement, however, it sounds as if the κ of NaCl is 1.4. Please correct that accordingly.
- p. 8869, l.11: It would be helpful to add also a statement how you calculate the volume fractions in order to obtain κ with Eq. (3). It is mentioned only in the next section but would be good to know already at this point.
- p.8870, l.28 ff: Since you are showing the results of the AMS data here it might be good to mention already here that you did not observe a size-dependent particle composition.
- p.8871, l. 16: Maybe you should mention the campaign average κ value at this point. You need that value later in the Discussions for your sensitivity analysis (p. 8874, l. 7 ff) but do not mention it anywhere.
- p. 8873, l. 8-9 (Fig. 6): I do not find that the three differently derived κ look similar to each other (κ_{AMS} is much higher than the other two κ almost at all times; κ_{CCNC} and κ_{HTDMA} are sometimes close to each other, sometimes not; even the trends of the three κ are not always similar, especially in the beginning of the measurement period). You should specify the similarities/differences a bit.
- p.8874, l. 7 ff: As I wrote already above, you are discussing the CCN predictions here using a constant average κ, but you have not mentioned the average value so far.
- p.8877, l.8-11: You should include the results of the CCN prediction using the HTDMA derived κ (figure or text) to prove this statement. I am wondering if this CCN prediction would be as good as using the AMS derived κ. Fig. 6 shows that there are sometimes large differences between κ_{AMS} and κ_{HTDMA} (e.g. more than 100% on 20.5.). From Fig. 8 one can see that this difference would result in a 40% different CCN concentration.

- Fig. 2b: A logarithmic scale for the particle diameter might be better as usually used for this kind of plot.
- Fig. 4: You should mention in the caption that the CCN concentrations were predicted using κ_{AMS} in these plots.
- Fig. 8: Why does the x-axis not start with 1 May like in the other figures? For better comparability it would be good to have consistent axes for the time.
- Fig. 9: Why are the plotted lines not symmetric for a negative and a positive $\Delta\kappa$ (e.g., for a positive $\Delta\kappa$ the difference between predicted and measured CCN concentration is larger for SS=0.47% than for SS=0.59%, but for a negative $\Delta\kappa$ it is smaller for SS=0.47% than for SS=0.59%)? Is this plot showing the sensitivity as an average over the whole campaign?

Technical corrections:

- p. 8865, l. 7 and l. 8: write "L min^{-1}" instead of "L/min"
- p. 8867, l. 8: the word "supersaturation" is missing before "(SS)"
- p. 8867, l. 23: write "L min^{-1}" instead of "L/min"
- p. 8871, l. 2: write "μg m^{-3}" instead of "μg/m^3"
- p. 8872, l. 17: write "kappa" as a Greek letter
- p. 8875, l. 25: this is shown in "Fig. 9" instead of "Fig. 8"
- p. 8875, l. 28: a bracket is missing before "0.12%"
- p.8878, l. 9: a bracket is missing after "Fig. A1"

- Tab. 1: write "kg m^{-3}" instead of "kg/m^3"
- Fig. 2: panel labels "(a)" and "(b)" are missing
- Fig. 3, caption: write "kg m^{-3}" instead of "kg/m^3"
- Fig. A1: in the x- and y-axes labels it must be "N_{12-30}" and "N_{12-570}" instead of "N_{18-30}" and "N_{18-570}"

Reference: Petters, M. D. and Kreidenweis, S. M.: A single parameter representation of hygroscopic growth and cloud condensation nucleus activity, Atmos. Chem. Phys., 7, 1961-1971, doi:10.5194/acp-7-1961-2007, 2007.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 8859, 2010.