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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Increase of the aerosol hygroscopicity by aqueous mixing in a mesoscale convective system: a case study from the AMMA campaign" *by* S. Crumeyrolle et al.

Anonymous Referee #1

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The manuscript on aerosol processing by Mesoscale Convective Systems (MCS) presents important material from the AMMA campaign. It focuses on the influence of transformation processes on microphysical and chemical properties of the aerosol of the monsoon layer and of the Saharan air layer. Particular emphasis is put on the modification of the cloud condensation nuclei (CCN) activation of the aerosol particles by processing during the MCS passage. Applied tools are in situ observations of aerosol properties aboard the French ATR-42 research aircraft, chemical analyses of particle samples, and mesoscale atmospheric modelling combined with backtrajectory analyses. The presented material fits well into the focus of ACP and deserves publication after minor revisions are considered which are specified in the following.

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GENERAL COMMENTS

There are three more general points of criticism.

1) In the experimental strategy, the authors claim that before and after the passage of the MCS, the air masses were the same so that any changes in aerosol properties can be attributed to the influence of the MCS. This assumption is never evaluated. Moreover, the trajectories plotted in Figs. 12 and 13 demonstrate that the air masses came from different regions and that even another air mass was advected which was not present before. The authors should carefully revise these contradictory statements. For comparing aerosol vertical profiles in different air masses it is more appropriate to plot the vertical distribution of number concentrations for standard conditions (273 K. 1013 hPa) which eliminates effects of air temperature and pressure changes (Fig. 5).

2) The authors quantify the modification of CCN properties by analysing the ratio of CCN number concentration to CN ($D > 3$ nm) number density. Since it is known that preferably particles larger than about 80 nm may act as CCN, this ratio might be misleading. It seems more appropriate to look at the ratio of CCN to larger particles either from the SMPS data or from the GRIMM counter in order to exclude the possibility that the difference in the ratio of CCN to CN as shown in Figure 6 can be associated to a variation in the nucleation aerosol mode. If this is the case, the change in the ratio CCN / CN is meaningless since nucleation mode particles are too small to act as CCN.

3. The time sequences for the modelling study are different from the time when the measurements were performed. This time shift adds some speculative elements to the interpretation of Fig. 11. The interpretation would be clearer if the modelled periods agree with the time sequences of the measurement flights. It the current version of the manuscript it is not clear whether the modification of CCN properties is associated with aerosol particles in different air mass or indeed, as claimed by the authors, with chemical mixing/processing during the MCS passage. The authors are requested to revise this approach carefully.

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SPECIFIC COMMENTS

1. Table 1: please add the total number concentration measured by the CPC TSI 3025. This additional information permits the assessment of the log-normal fit and/or an estimate of the nucleation mode.

2. Please add the results of the single particle analysis in another table. This provides valuable information to the reader. Please add also the criteria which you used for the identification of particles. How do you identify biomass burning particles from EDX spectra which do not give a C signal?

3. Page 10068: You state that dust is not a good CCN because it is mostly insoluble. However, it is known that dust can act as good CCN because of its size which exhibits a weak curvature of the particle-water interface in contrast to smaller particles. Please comment.

Typographic errors:

Page 10058, Abstract, line 17: modify to "and washout of particles".

Page 10058, Abstract, line 18: modify to "through the coating by ".

Page 10059, line 4: modify to "(or on ice crystals)" since heterogeneous chemical processing usually occurs on particle surfaces.

Page 10062, line 20: change to " provided particle size ".

Page 10062, line 21: delete "also".

Page 10067, line 21: change to "correlates well with the ".

Page 10068, line 13: change to "with freshly emitted dust".

Page 10073, line 14, 15: the sentence seems incomplete, please rephrase, e.g. by inserting "the MCS was triggered ".

Page 10075, line 14: modify to "On the other hand,".

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Page 10076, line 27: Ill phrased sentence, change to e.g. "Harmattan flux is a desert region with".

Page 10077, line 13: Rephrase to "one of the air masses descends by 4500 m ".

Page 10079, line 9 ff: change to "Levin et al. (1996) who ". Please rephrase the processes which involve cloud processing.

Page 10083, line 19: change to Thermodynamik".

Figure 5: change X axis title to CN (cm-3).

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 10057, 2008.

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