Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Aerosol liquid water content in the moist southern West African monsoon layer and its radiative impact" *by* Konrad Deetz et al.

Anonymous Referee #1

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Hygroscopic growth could alter the optical properties of aerosol. This manuscript reported the follow up simulation study based on Deetz et al. (2018) setup within the COSMO-ART modeling framework for a summer monsoon event in Southern West Africa and estimated the aerosol liquid water content (ALWC) and its impact on radiative transfer. The process was separated into three characteristic phases during commonly Atlantic Inflow event over this region to detailize the ALWC-radiation interactions. It was shown that the accumulation mode particles are the dominant contributor to aerosol liquid water and aerosol growth led to the increase of aerosol optical depth from 0.2 to 0.7. The increased aerosol optical depth can lead to around 20 W/m2 decrease in shortwave radiation. Bootstrapping technique was used to derive the linear

relationship between ALWC and radiation and found a stronger correlation for in-cloud conditions. This modeling study highlight the importance of including the relationship of RH dependency of aerosol optical depth in atmospheric model, which can significantly impact the local radiation balance, especially over moist tropical environment. The whole manuscript is well structured and the modeling discussion is adequate. I recommend publishing this work as a valuable component of the DACCIWA special issue in ACP after the authors address the following comments.

Page 1, Line 23: ALWC = aerosol liquid water content?

Page 4, Line 26-27: the "coarse modes of marine origin" should be (7-9) and the following "coarse modes of mineral origin" should be (10-12)?

Page 5, Line 5: ISORROPIA II does not include fresh soot for calculation. Did the model assume aged soot is internally mixed with sulfate in the calculation of optical properties and radiative transfer?

Page 5, Line 30-32. It is better to mark down the approximate area of "Ivory Coast" (7.5 W – 3W, 4N-10N, should be a subset of 2.5km modeling domain) in Figure 1(b) since nearly all the Figures follow on (e.g. Figure 2, . . .) are focus on this area.

Page 6, Line 21: Where is the geographic location of radiosounding site at "Lamto", please provide the locations in Figure 1. Also, look at the Figure B1-B3 in the Appendix, why there is no sounding comparison for location at "Lamto" for July 2-3. The radiosounding for RH vertical profiles at the two sites are not synchronized and with different time interval? Also, the Figure B2, may be due to the compress the the aspect ratio, the grey shading regions at certain place are not consistent with the description of uniformly 4% uncertainty assigned for radiosondes.

Page 7, line 22-23: ALWC was influenced by aerosol types and RH. Are the aerosol type and RH all the same in North China plain and southern West African, so they are comparable? The authors refer this study with China campaigns (e.g. HaChi,

PRIDE-PRD) heavily in the introduction section and the following discussion, maybe in some place in the introduction section, the author need to point out the similarity of this DACCIWA campaign with China campaigns such as aerosol loading, RH conditions, atmospheric oxidation capacity, cloud coverage.

Page 8, first paragraph: any explanation why OC dominate the aerosol mass composition? was it a biomass burning event? Also, for Figure D1, is the July 6-7 aerosol component vertical profiles similar to the July 2-3 shown here?

Page 8, Line 15. In contrast, AIT particles are lacking in size and COARSE particles are lacking in number.

Page 8, Line 30-31. Can you also provide the boxplots for median aerosol number concentrations for Aitken, accumulation and coarse mode in Figure E1?

Page 9, Line 8: the total water column is the full integration of model layer (e.g. 30km in Table S1) or below 1500m AGL that this study focused?

Page 9, Line 13-15: where is the location of the model realized NLLS and convective clouds in the fouced Ivory Coast region? In Figure 3 and Figure 4, the authors showed the double peak of ALWC during phase 2 period, one near coast and the another one in hilly terrain to the north. Are the peaks for ALWC at different locations also strictly correlated with the model simulated clouds?1

Page 10: Line 9-10. "... sharpen condition substantially decrease selected area", can you provide the percentage instead of the subjective description on simulated clouds grids versus non-cloud grids in the Ivory Coast area? From page 9, line 18-19, I may know only 3%-9% of total grids realized the clouds in July 2-3. So between the two sensitivity runs, the "ALWC" and "no-ALWC" case, how many percentage were excluded from further radiation analysis due to the model simulated the displacement of clouds?

Page 10, Line 28-29: where is the fixed SST value from COSMO-ART coming from?

Page 11, Line 24. The AOD is higher -> the difference of AOD is higher

Page 11, Line 33-34. In what percentage are the outliers for ALWC-radiation linear fitting (e.g. "less data, large spread, extra low ALWC ...")?

Page 12, Line 3-7. What the total size n for the linear fitting based on the grouping of ALWC versus radiation difference with the increment of 0.01 g m-2. If there existed similar linear reasonaliship either derived from observation or model from other regions, it is worthing mentioning here and discussing the possible reason for the difference considering during the DACCIWA campaign the aerosol components are dominated by OC (Figure D1) and the water uptake are most significant for coarse mode (Figure 6).

Page 14. Line 1-5. The authors mentioned before the RH underestimation may suggest the model derived ALWC value from this case study is the lower bound (Page 6, line 28-29), how it compared with the double counting of aerosol activate in the model, which tends to overestimate the AWLC, and the uncertainty for the corresponding radiation change calculation?

Page 18, Figure 4. The caption. "Same ass for Fig. 3"??

Page 34, in the row of "vertical levels", sometime in the main content the notation is "AGL" but here it is "ASL". make it consistent.