Comment on acp-2020-1306

Anonymous Referee #1

Referee comment on "Sensitivity of low-level clouds and precipitation to anthropogenic aerosol emission in southern West Africa: a DACCIWA case study" by Adrien Deroubaix et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1306-RC1, 2021

Review of Deroubaix et al, Sensitivity of low-level clouds and precipitation to anthropogenic aerosol emission in southern West Africa: a DACCIWA case study

DACCIWA case studies in the monsoon season of July 2016 are simulated with WRF-CHIMERE, focusing on aerosol effects on low clouds and precipitation.

The authors have produced a very well-written paper and there are opportunities for valuable scientific insights. I have some minor comments, below, that should be addressed prior to publication. In particular, if the authors can elucidate the processes in their model that are responsible for their results in more detail, in line with my suggestions in bold text below, I think this will be a very useful and well cited study.

Minor comments:

A few more details on model description would be useful:

What is the vertical resolution of the WRF model at the level of the clouds? How does the Thompson and Eidhammer microphysics scheme do aerosol activation? What are the mechanisms by which aerosols can affect cloud lifetime in this scheme?

Page 3 line 29: is the aerosol size distribution a single variable, or are all 10 bins transferred to WRF? Is there a hygroscopicity for each bin, or does "bulk" mean that is just a single number for each grid cell? Why are deliquesced aerosols treated separately? I didn't find the reference to Tuccella et al very helpful to figure that out. Does deliquesced

aerosols refer to aerosols dissolved in cloud water (referred to as cloud-borne aerosols in the MAM aerosol microphysics schemes)? Also, via the coupler, what fields come back from WRF to CHIMERE, to handle aerosol scavenging for example?
Would be better to introduce the models before describing the coupling.

Is there a sub-grid cloud fraction scheme? If so how does it work?

Page 7: I would say "the nitrate and ammonium concentrations are a factor 100 higher" rather than "are multiplied by 100" as "multiplied" implies you fixed these concentrations deliberately, while in fact, if I understand correctly, it is a model result.

Page 11 line 6 "denote" is the wrong word here.

Line 22: "the processes involving supersaturation to create liquid water are not represented in the model" - -might make sense to rephrase – in the model, the RH is always below 100% because clouds form at 100% RH? (presumably the model produces clouds somehow, even if this is via saturation adjustment).

Page 15 line 3: this is just a phrasing issue, but comparing cloud base height to liquid water mixing ratio doesn't make sense: maybe you compare the cloud base height and LMWR in the model to the observations, or between two time periods?

Page 15 line 8: what processes in the model lead to increased LWP and cloud cover? Are they indirect effects or semi-direct effects? Are there missing processes in the model that could lead to the opposite effects? Like evaporation/entrainment or sedimentation/entrainment feedbacks for example (see e.g. Hill et al (2009), https://journals.ametsoc.org/view/journals/atsc/66/5/2008jas2909.1.xml)?

Figure 8a: would be really nice to put MODIS or AMSR or SEVIRI liquid water path data on this plot, for times when you have the retrievals.

Page 20: did Menut et al 2019 give reasons for the low bias in precipitation? Do you have insights from this study?

Page 22 line 16 and page 23 line 6: I think it is necessary to add a caveat "aerosols emitted from anthropogenic activities have a regional scale influence on LLC and precipitation IN OUR SIMULATIONS, both…." Modeling these aerosol-cloud interactions is

not so easy, and there is no guarantee the model is right!

Figure A3, A4 can you add horizontal snapshots of the cloud cover in the simulations at the same times over this area, or a subset of it? Ideally for both AE1 and AE10?