

## **Review of “Breakup of nocturnal low-level stratiform clouds during the southern West African Monsoon Season”**

By: Zouzoua et al., Atmospheric Chemistry and Physics

### **General Comments**

This is my second review of this manuscript. The authors have done an excellent job of addressing the majority of my comments and recommendations from the 1<sup>st</sup> review. I believe the authors have done a very good job of thoroughly addressing the other reviewer’s comments as well, which further strengthened this manuscript. This manuscript tells a much clearer story, the results naturally flow from one to the next, and conclusions made throughout the paper are supported by the results and figures shown and also appropriately stated. I am especially impressed by the quality of the figures, and the addition of the new Figure 13 is particularly excellent. As with my original review, the scientific quality of this manuscript merits publication in ACP.

My only major concern with this manuscript remains its readability. This is a very long and highly detailed manuscript, and compared to other manuscripts of similar length and detail, this again took me several hours to read and re-read due to several English and grammatical-related issues. In my opinion, this is not a reason to hold this manuscript back from full publication, but I would highly encourage the authors to review my recommendations and seek an independent re-read and English/grammar check prior to final publication. The results and science contained within this manuscript are more than worthy of publication in ACP, however, I fear the readability of this manuscript in its present form will discourage and frustrate readers from reading this in its entirety. The vast majority of these issues were contained in Sections 1-4. Sections 5 and 6 were mostly fine.

I noticed many unnecessary uses of the word “the”, and noted many instances in my specific comment suggestions where these extraneous words can be eliminated. This is ultimately minor from a writing standpoint, but this remains *highly* distracting as a reader. Please read through the text carefully and take care to improve the readability of this manuscript. I have made several suggestions as specific comments.

### **Specific Comments**

P2, L12: “... (LLSC) are Earth’s most common cloud type (Wood 2012).” I would rephrase this to say “... (LLSC) are one of Earth’s most common cloud types (Wood 2012).” because cirrus clouds arguably cover more of the surface at a given time.

P2, L19: Drop “Indeed” from the beginning of the sentence. Also drop “the” before “the numerical simulations”.

P2, L20: Drop “the” in front of “the meteorological conditions”.

P2, L22: Drop “the” in front of “the forecasts of West African”.

L2, L24: Do you mean to say weather observations over West Africa are scarce? A “weather monitoring network” on its own cannot be “scarce”, but rather “limited”. Please clarify.

P2, L28: “cold air associated to West African monsoon” change this to “cold air associated with the West African monsoon”

P2, L30: “However, the LLSC after the sunrise received little attention.” change to “However, LLSC evolution after sunrise has received little attention by previous literature, and further motivates our present study.”

P3, L4-5: suggested re-write: “A joint measurement campaign took place using airborne and ground-based platforms (Flamant et al., 2017; Kalthoff et al. 2018)”

P3, L6: I think you mean “example of” and not “overview of”.

P3, L8: change “in order to conduct detailed study of the LLSC” to “for highly-detailed study of the LLSC”

P4, L6-8: I am very confused what this sentence means. What are the exact “roles” of horizontal advection and vertical wind shear in what exactly?

P4, L8: “after the sunrise” change to “after sunrise”. Also add commas around “ sunrise, which leads to the transition towards shallow convective clouds, has not...”

P4, L9: change “...this transition by the mean of idealized...” to “...this transition by using idealized...”

P4, L13: change “Our study aims at analyzing...” to “Our study analyzes...”

P4, L14: you can probably drop everything after “...DACCIWA experiment,” as this information is already implied.

P4, L15: rewrite: “This study should provide complimentary guidance...”

P4, L16: change “follow” to “follows”

General comment: I did my best to track and suggest changes for wording changes. There are still far too many stylistic choices through this point of the manuscript that make it a chore to read through. The content is good otherwise, but I would encourage the authors to more thoroughly scrutinize and improve upon their writing style for more effective communication of these important scientific results.

P4, L20: change “... just before the sunrise, at...” to “...just before sunrise at...”. The comma is not needed here.

P5, L5: I think you mean to say “typically characteristic” and not “typical characteristic”.

P5, L8: minor addition, you should say “LLSC deck” instead of just “LLSC”.

P5, L10-11: “... and ends at the cloud layer breakup...” just say “... and ends upon LLSC breakup...”. There also appears to be extra spaces in your  $W \text{ m}^{-2}$  units... check this before submitting your final proof.

P5, L12: I would reframe “... on the stratocumulus dynamic is presented by...” as “... on stratocumulus properties and dynamics...” to better encapsulate the breadth of both studies you cited here. Also,

“Such a cloud...” is strange wording to me; I would just start the next sentences as “LLSC are regulated through...”

P5, L18: “... than they receive from the drier air above” could be improved to say “... than they absorb downwelling longwave radiation from the overlying atmosphere.” Also replace “It is modulated...” by “Longwave cooling is modulated...” unless “It” is referring to something else?

P5, L20: “the” is used four times in this sentence. Please cut down on unnecessary uses of this word.

P5, L24: Suggested rewrite: “Precipitation formation, large-scale subsidence and entrainment typically warm and dry out the LLSC layer....”

P5, L31: “The processes-analyzed studies, ...” I have never heard of “processes-analyzed” studies... I believe you mean to say “These process-level studies...” which is more commonly used within the cloud modeling community. I would also add that that the aforementioned citations you listed included a lot of data analysis from field campaigns, so saying “essentially based on numerical simulations” undermines the larger breadth of results within those studies. Please modify this part of the text to properly acknowledge this or clarify which studies do not have a field campaign or observational data-based analysis component to it.

P5, L33: Begin with “Over land, the main driver...”. I would also recommend adding a citation at the end of this sentence.

P6, L1: Say “The LES developed by” rather than “The LES made by”. Also change “prove an insight” to “provides insight”.

P6, L3: do you mean to say cloud top radiative cooling is the “sole source term to the LWP budget”? The present wording is strange. I also presume you mean “the primary factor” instead of “the factor”.

Sentence beginning at the end of P6, L3: full rewrite suggestion: “The breakup of the LLSC deck ~5 hours after sunrise is primarily due to a co-occurring decrease of cloud-top cooling and increase of cloud-top entrainment.” No need to mention the effect on the LWP budget here, as this is implied.

P6, L8: do you mean the LES “is *initialized* with atmospheric and surface conditions”?

P6, L17: drop the word “undisturbed”

P6, L19: Whereabout in the troposphere was this anticyclonic vortex? “low troposphere” could imply near the surface, 700 mb or somewhere in between. Be more specific.

P6, L21: hyphen consistency – here you say “low-troposphere” but a few lines earlier you state “low troposphere”. Take care to ensure this here and throughout the manuscript.

P7, L1: Surround “upon which our investigation is based” with commas. Also note “on” should be replaced with “upon”.

P7, L2: You can remove the sentence beginning with “The instrumentation and the data...” and weave those references elsewhere in this section where you actually discuss the instrumentation and dataset.

P7, L7 “i.e. less than 1 mm” put this in parentheses and remove the commas.

P7, L17-20: You can probably shorten this sentence for clarity. Also, is the ceilometer capable of measuring multiple cloud layers when the underlying layer contains high liquid water path?

P8, L1: There is no need to mention that the radiosondes are “reusable”. Also, is there a reason these soundings only achieved a maximum height of 1500 meters above ground level?

P8, L14: “the water deposition” just say “water deposition”. Also, I think you mean to say “neither of these” rather than “neither these”.

P9, L2: “corresponds to the convective time scale”. Time scales for convection, at this point in the text, are not previously defined nor may they be well known to the reader. I would state here or earlier in the text what time scales are typical for a full convection life cycle. Alternatively, you may want to state that the time averaging is done to better resolve processes throughout the process of convection.

P9, L25: You can eliminate “So that,” and say “... may then be assessed...” later in this sentence.

P9, L27: change “by the use of” to “by using the”

P11, L10-11: Suggested rewrite: “The PREC term is typically near zero because no...”

P12, Equation 2: This equation seems out of place. Was this intended to be somewhere in the paragraph on P11, L8-14?

P12, L16: “lack of precise estimate” I would say “lack of a precise estimate”

P12, L25-26: I understand what you are trying to convey, but I would highly discourage saying there is “no possibility” of accurately estimating SUBS. I suggest rephrasing these sentence a bit, e.g. “...we cannot accurately estimate large scale subsidence...”. Also I recommend rephrasing “consider evaluations” to “compute estimates”.

P13, L11: Get rid of the word “Moreover,” and change “consequently” to “thus”.

P17, Figure 5: The grey edges are a bit difficult to see. I would make these thicker, or choose a different color that more easily contrasts with both the pink and black colors.

P18, L4: changes “decreases down to” to “decreases to”.

P19, L8-9: Eliminate “In the next paragraph” and merge this sentence with the next paragraph.

P19, end of line 25: Will this be a topic of future study?

P20, Figure 7: Should the label in the figure read “08 July 06:21 UTC”?

P21, L1: Switch “In order to deepen the analysis,” to “In this sub-section,”

P21, L14: change “... especially at the exit of the cloud.” to “... especially near cloud top.”

P21, L17: I recommended swapping “correct” with “accurate”. Also, drop “measurements”, this is implied in this sentence.

P22, L12: you can eliminate the words “in absolute.”

P23, L4: What do you mean by “humidity jump”?

P23, L14-15: Is the "cloud layer" referencing the DACCIWA cases? Make this clear – the writing of this sentence implies the cloud layer refers to the van der Dussen case study. Also: say "on average" instead of "in average".

P23, sentence beginning on L15: You can eliminate this sentence. The discussion of the standard deviations here doesn't seem very important, especially considering it is "lower than 3% of the median".

P24, L1: I think you mean "falls" instead of "fits".

P24, L3: clarify "no particular difference" as "no significant difference".

P24, L15: change "this discussion shows" to "we show"

P25, L24: double check " $20.10^{-5} \text{ s}^{-2}$ ". Should the decimal point be a "x" sign? Also see L26.

P26, L15: change "by its own" to "on its own"

P26, L18: I think you mean to say "hypothesis cannot be fully tested".

P26, L23: I think you mean "warm air advection" rather than "warmer advection".

P26, L26: I would say "horizontal advection of colder air"

P26, L30-31: "maintains Rh constant" --> "maintains constant Rh". Also I could rephrase "the cases D" to "the decoupling cases". Finally, "temporal tendency" is redundant. Tendency implies time, so you can probably drop temporal, unless you mean to say "temporal variability" which could also make sense here.

P31, L5: just say "In the next sub-section,"

P34, L11: I would re-word the beginning of this sentence. Suggestion: "We define two periods,  $T_i$  and  $T_b$ , based on ..."

P35, L2: I think you mean to say "objective of this study" and not "object of this study".

P36, L26: Given the area of focus for your study, you may be interested to read about the recent ORACLES field campaign that took place over the southeast Atlantic Ocean. The following reference offers an exhaustive description of the campaign with some preliminary analysis about aerosol types over this part of the world. The final two ORACLES deployments took place on the nearby island of Sao Tome.

Redemann, J., Wood, R., Zuidema, P., Doherty, S. J., Luna, B., LeBlanc, S. E., Diamond, M. S., Shinozuka, Y., Chang, I. Y., Ueyama, R., Pfister, L., Ryoo, J., Dobracki, A. N., da Silva, A. M., Longo, K. M., Kacenelenbogen, M. S., Flynn, C. J., Pistone, K., Knox, N. M., Piketh, S. J., Haywood, J. M., Formenti, P., Mallet, M., Stier, P., Ackerman, A. S., Bauer, S. E., Fridlind, A. M., Carmichael, G. R., Saide, P. E., Ferrada, G. A., Howell, S. G., Freitag, S., Cairns, B., Holben, B. N., Knobelspiesse, K. D., Tanelli, S., L'Ecuyer, T. S., Dzambo, A. M., Sy, O. O., McFarquhar, G. M., Poellot, M. R., Gupta, S., O'Brien, J. R., Nenes, A., Kacarab, M. E., Wong, J. P. S., Small-Griswold, J. D., Thornhill, K. L., Noone, D., Podolske, J. R., Schmidt, K. S., Pilewskie, P., Chen, H., Cochrane, S. P., Sedlacek, A. J., Lang, T. J., Stith, E., Segal-Rozenhaimer, M., Ferrare, R. A., Burton, S. P., Hostetler, C. A., Diner, D. J., Platnick, S. E., Myers, J. S., Meyer, K. G., Spangenberg, D. A., Maring, H., and Gao, L.: An overview of the ORACLES (ObseRvations of Aerosols

above CLouds and their intEractionS) project: aerosol-cloud-radiation interactions in the Southeast Atlantic basin, Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-449>, in review, 2020.