Response to reviewer 2#

We thank the reviewer #3 for his/her valuable and constructive suggestions, which led to significant improvements of the quality of our manuscript. Below we detailed how his/her comments are addressed in the revised version of the manuscript. The corrections made in the manuscript and cited in this document appear in italic.

Interactive comment on "Low Level Cloud and Dynamical Features within the Southern West African Monsoon" by Cheikh Dione et al.

Anonymous Referee #2
Received and published: 8 January 2019
Review of the study "Low level cloud and dynamical features within the Southern West African Monsoon" by Dione et al.

General comment: This study aims at analyzing the dynamic and the variability of the nocturnal low level jet, the maritime inflow and their connections to the low level clouds thanks to high resolution wind profiler, observations and cloud monitoring. This study is correctly written and the results are clear and well presented. The only main comment is on the main objectives and the contribution of this study with respect to the DACCIWA project and the others studies/papers that should be better highlighted.
I recommend minor revisions with the list of detailed comments below.

We thank greatly the reviewer for his/her feedback. We have addressed them all below.

Abstract: I recommend to the authors to improve the abstract by removing some descriptions and better identifying and emphasing the main objectives and results of this specific study. The main contributions of this study to the DACCIWA project should be clearly mentioned. This is also true for the introduction.
We rewrote the abstract and introduction as suggested by the reviewer #2.

P2 l33, P3 l23, P3 l31 . . . Nested brackets.
This has been corrected.

Fig 1: Please clarify that the colors show the mean dew point temperature for all the period or only during the DACCIWA campaign. Also why the ITD is only displayed for June (P3l3).
The ITD is displayed for June because this month corresponds to the transition between pre-onset and onset phases of the monsoon flow. The objective was simply to show that the area of interest, Savè supersite in Benin, remains always in the southern side of the ITD, that is within the monsoon flow.
We improved the label of the figure in several ways and it is now: "Dew point temperature obtained from the ECMWF re-analyses at 2 m over Southern West Africa during June 2016, and (black solid line) mean intertropical discontinuity (ITD) position during that month. The ITD position is deduced from the dew point temperature isoline of 15° C. The stars indicate the location of the three supersites of DACCIWA ground campaign and, among them, Savè supersite where the dataset analyzed in this study has been acquired the period that the ITD mean are computed."

P5 l19 I am not used to using terms like “Ten Hz . . .”, does it mean a high frequency measurement?
Ten Hz is actually a high frequency measurement for in situ measurements. We reworded the sentence to make it clearer: *“High Frequency measurements of air temperature, specific humidity, and three components of the wind were obtained (at 0.1 s time interval).”*

P6 l2: The justification of the increase of the cloud base definition is not clear. The reason mentioned is to also detect shallow convection during the morning. But this is not indicated in the objective of the study. Please clarify.
We agreed with you that this sentence is not clear. We rewrote it in the revised manuscript as *“However, a 1500 m height limit allows us to extend our detection of LLSCs during daytime when the stratus cloud base height rises due to the growing convective boundary layer.”*

P7 l3 and Figure 2: this sentence is not clear. To avoid confusion, I recommend to change the color when the data are missing.
We thank the reviewer for his remark. We changed the color when the data are missing. Please refer to the new figure (Fig 2) in the revised manuscript.

P7 l27 and Fig. 3: Because there is a strong seasonal cycle during this period (according to Fig 2, it seems there is a thickening of the monsoon layer from the beginning of July, around the 10th), what is the results of a composite study when splitting before and after the 10th of July?
We agree with the reviewer #2 that such an analysis would have been interesting over the whole monsoon cycle to show pre-onset and post-onset periods. Big differences would then be expected. We think that the DACCIWA ground campaign is too short (one month and half) and mainly focused on the post-onset period to show the seasonal cycle with composite figures. Furthermore, the post-onset period includes some very peculiar sub-periods (wet westerly regime for example) which would strongly impact the composite figure because of the already limited days in the statistic.

Figure 4: Please clarify what the vertical lines represent.
We thank the reviewer for noticing the uncompleted label of figure 4. The label is now*: “Time-height sections of (color) wind speed and (arrows) direction from the UHF wind profiler, on the nights of (a) 2-3 July, (b) 7-8 July, and (c) 9-10 July 2016. The black open circles indicate the jet core height detected with a maximum wind speed of at least 5 m s^{-1}, the magenta rectangles indicate the height of the minimum wind speed above the jet core and pink open circles indicate the monsoon flow depth. The black, blue, and red lines indicate the three fuzzy logic functions of the wind speed, temperature and their mean, respectively. The dashed vertical lines indicate the MI arrival time with two different criteria: (1) FLFmean > 1 criteria (red), (2) 302K isentropy criteria (black). The vertical black line indicates the NLLJ onset. The horizontal dashed line stands for the zero km height.”*

P11 l2: How do the authors explain the delay in between the FLF derived from the wind and the temperature?
It is not easy to answer this question. The MI arrival is naturally supposed to be manifested by both a change in wind and a change in temperature. However, by the time it gets to Savè, 180 km from the coast, it has possibly undergone several influences by the MCS activity, local processes, larger scale forcing,… so that the “front” is not so much of a “front”, there is no strong gradient in temperature or wind, and they finally may both alter. We believe that this remains an open question.

Figure 6a: It is difficult to distinguish the black and brown bars, please change the colors.
We changed the colors and have now a new figure 6a.

P11 l9: Why not using the new ERA5 reanalysis with hourly resolution to detect and analyze briefly the large scale detection of the MI and to better understand these difficulties at local scale?
We had studied this aspect before with ECMWF re-analyses. But the gradients turned out to be very slack and not well marked. So that it was not an easier technique, although well appropriate due to its spatial point of view.

P11 l13 and Fig. 7: Could you add and discuss the impact of the dates by adding colors for each dot? The monsoon strength and the MI arrival time should be related to the seasonal cycle. Isn't it?

Since all the arrival times of the MI are given in table 1, it is easy for the reader to find the date and all the characteristics of the day. Therefore, we preferred not to load the figure with the dates. We did not find any trend of the MI arrival time (as can be seen in Figure 10) and monsoon strength along the DACCIWA campaign, certainly because of the "short" observation period and the two interruptions due to peculiar regimes (as discussed previously). However, we revised our discussion in this paragraph, also following Reviewer 1# comment: *"However, the MI arrival time as detected by the fuzzy logic function FLF_{mean} is clearly linked to the mean monsoon flow in the afternoon (Fig.7): the stronger the monsoon flow strength in the afternoon between 1200 and 1500 UTC, the earlier the MI arrival time. The two exceptionally early arrivals at 1600 and 1630 UTC shown in Figure 7 and put in Table 1 are associated with unusually strong monsoon flow all day long (e.g. the nights 10-11 and 11-12 July)."*

P11 l21 and Fig. 8: same comment as previously. Is there any difference between June and end of July?
As explained in the response to previous comment, we think that the period is too short to notice a trend. The intra-seasonnal variation is mainly due to special regimes or MCS perturbations.

P11 l21: The authors do not discuss the intensity of the wind that is maximum at 2.00 am. I expected later as shown by Ruchith and Raj (2015). Ruchith, R. D., & Raj, P. E. (2015). Features of nocturnal low level jet (NLLJ) observed over a tropical Indian station using high resolution Doppler wind lidar. Journal of Atmospheric and Solar-Terrestrial Physics, 123, 113-123..
We agreed that the median of the wind speed of the jet presents a local maximum at around 02:00 UTC, but we didn't discussed it because the increase of the median is very small before this time.

P13 paragraph starting l27: The authors suggest the impacts of the difference phases of the monsoon. Why this is not taken into account this when calculating the composite studies?
We didn't take into account the intra-seasonal variability of the monsoon. This paper focuses on a statistical analysis of phenomena observed over the lowest troposphere of the southern part of West Africa during a specific period. The phases, we are talking about are: pre-onset with 3 days, post-onset with the largest period (23 days) but interrupted by the vortex phase (4 days) and the wet westerly regime (5 days) (figure 2). It seems difficult to make comparable composite figures with such different statistic representations.

P14 l29: The authors mention other sites in introduction but it seems they are not used in that study. So it is not necessary to mention them and to put them on the map Fig.1.
We agree and corrected the figure 1 accordingly.