

# ***Interactive comment on “What controls the formation of nocturnal low-level stratus clouds over southern West Africa during the monsoon season?” by K. Babić et al.***

## **Anonymous Referee #1**

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Review of “What controls the formation of nocturnal low-level stratus clouds over southern West Africa during the monsoon season?”

The topic of this paper is the formation (and not formation) of low level stratus clouds at night over West Africa. Low level clouds, not only in this region but in general, are an important research topic as they are one of the largest uncertainties in climate projections. In this paper measurements from a campaign in a region which is otherwise not covered very well by operational measurements have been performed and analyzed. The new data is compared to older observational and modeling studies and improves the understanding of the physical processes. A rather weak point of the manuscript is

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the small number of analyzed days. On the one hand, this is understandable, as longer campaigns in remote areas are difficult to carry out and to finance. On the other hand, the results should be seen with caution because the number of cases considered is too small for robust statistics.

This paper should be published after comments listed below have been addressed.

**MAJOR COMMENT 1:** Backward trajectories have been calculated from ERA5 reanalysis data to investigate how air parcels evolve until the formation of stratus clouds. The method used does not seem to be applicable in the boundary layer or least requires further explanation:

1.1 Data: The data used is not specified well. ERA5 consists out of a high-resolution run and a lower resolution ensemble. Non of these has a resolution of  $0.5^\circ$  as mentioned in the text. That means data has been up- or down-sampled. The question is, when the high-resolution data set has been used, why was it interpolated to a lower resolution (which makes the method even more questionable)? If the low-resolution ensemble has been used, why is there no uncertainty shown? The data is available hourly, why was 3-hourly data used (reducing temporal resolution is not good for trajectories)?

1.2 Does the model IFS, which is used for ERA5, belong to the state-of-the-art models mentioned in the abstract, which have issues representing boundary layer clouds? If so, is it reasonable to believe that small differences in the conditions between stratus and stratus-free are well represented within this model? Reading Page 10, Line 5, I would guess that this is not the case. Related question: have observations from the campaign been sent to ECMWF for assimilation?

1.3 The main problem I see with the method of calculating backward trajectories is really the temporal and spatial resolution of the model. Time-scales in the boundary layer range from minutes to maybe an hour. To resolve that, you would need LES simulations. The content of air parcels you try to track is completely replaced by vertical

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turbulent mixing within 3 hours. This process is not resolved by a model at the given resolution. That means, already after the first time step of your backward trajectory, you don't know anymore where your air parcel went and you also don't know where the air parcel you are looking at instead is coming from. Statements like "... situations when air parcels originate above the marine boundary layer ..." (Page 11, Line 4) are just impossible to make as you lose track of your parcel much too fast.

#### MINOR COMMENTS:

Page 2, Line 31: Typo: "otuput" instead of "output".

Page 4, Line 20: Microwave radiometer are usually not able to distinguish multiple vertical layers. What does high resolution mean in this context?

Page 6, Lines 33-35: How does the presence of LLC keep TKE up? I would expect the reverse connection: Continuous high values of TKE keep LLC forming.

Page 7, Line 12: The term "vortex period" shows up a few times, but the first time it is explained is in the summary.

Page 7, Line 28: With one measurement at Savè, you should not talk about pronounced differences.

Figure 3: The map is hard to read, especially but not only for color-blind people. You could think about using traditional display of octas in meteorological charts.

Figure 4 and 6: How are the 25th and 75th percentiles calculated from six values (six cloud free nights)?

Figure 5: What is the source of the potential temperature? Radiosondes? Microwave?

Figure 9: Is this a composite of multiple stations or is it just Savè?

Data availability: - Does the "KASS-D" data belong to the campaign data? - The web page mentioned for measurements from the campaign offers data sets from a number

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of projects, but the page for "DACCIWA" is completely empty.

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