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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Conceptual model of diurnal cycle of stratiform low-level clouds over southern West Africa" *by* Fabienne Lohou et al.

Anonymous Referee #3

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Review of the article titled "Conceptual model of diurnal cycle of stratiform low-level clouds over southern west Africa" by Fabienne Lohou and coauthors for publication in the Atmospheric Chemistry and Physics.

The authors have used data collected during the DACCIWA field campaign along the African coast to characterize the diurnal cycle of boundary layer and clouds in the region. The article is essentially a summary of several other articles that have used data collected from this field campaign, as the data were collected at several sites. Based on the limited number of observations, the authors have classified the diurnal cycle into four phases, i) marine intrusion, ii) low level jet, iii) stratus, and iv) convective. They have then calculated the energy budgets for the first two phases, and have done some diagnostics for the second two. The idea of classifying the evolution in four

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phases, doing budgets, and probing coupling with the surface are useful and worthy. However, the article falls short in several ways. I believe that the issues listed below need to be addressed for the article to be relevant for wider community. The main issue is lack of concrete motivation for and conclusions drawn from some of the analysis. Hence, I recommend this article for major revisions.

Major Issues

In Figure 6 you have shown the scatter plot of degree to decoupling (Bretherton and Wyant, 1997; Jones et al. 2011) and the bulk Richardson number. Maybe you can show the same plot colored by the different phases of the boundary layer mentioned in table 1, or color code them with the cloud fraction. This will show if the stratus clouds are coupled to the surface or not and whether the shallow cumulus form due to surface heating or shear (Zhu et al. 2001 JAS). Consistent with previous studies mentioned above, maybe you can calculate the ratio of cloud top cooling and surface heating, and contrast that with decoupling index.

Figure 8 and associated text: Please mention some previous studies that have shown any relationship between the “integrated flux” and “LLC breakup time”. It is unclear what you mean by integrated flux and how it was calculated. Also, why do you choose to calculate integrated flux rather than the average flux itself like that has been done by numerous studies? This is especially crucial as the measurements are made in a Eulerian setting and there is no way of knowing the “history” of the parcels. Also, how do you define the LLC breakup time, what is the objective criteria for determining it? Thanks.

Similarly, in Figure 9 you have shown a scatter plot between surface flux and LCL. Under high surface flux conditions due to stronger mixing, the mixed layers are deeper than those under weaker surface flux conditions. Not sure if this is something worth showcasing in a paper. However, it is puzzling to see that in Figure 9b that a lower LCL results in a later breakup. Do you have any physical explanation of this? The text only

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describes the figure without drawing any conclusions. Thanks.

Line 17 on page 12 says that “the stratus reduces the NLLJ strength because of turbulent mixing in the cloud layer”. It is unclear to me where in the manuscript have you have shown this, or any other manuscripts that have shown this? The Stratus clouds can surely modify the boundary layer turbulence, but the LLJ is a meso-gamma scale phenomenon (∼200 km), much greater than the typical scales of stratocumulus clouds. Please show evidence of this or remove the sentence.

The moisture advection can bring saturation at the top of the boundary layer causing cooling. Thereby forming clouds and not needing surface moisture. This seems to be the case scenario 2 (Figure 7c and 7e). In other cases, it seems that the clouds are coupled to the surface even at night (Figure 7a). It is unclear to me how you objectively defined the three scenarios.

Page 6, Line 14: you calculated the stratus cloud fraction by using the cloud base height values below 600 m, however in schematic shown in Figure 2 it is apparent that stratus clouds can exist with bases above 1 km. Would it be possible to re-do the figure with bases below 1 or 1.5 km? this also contradicts the text on Page 13, line 13 that uses 1 km threshold.

Minor Issues Abstract, page 1 line 14: Insert “surface” before buoyancy. Thanks. Page 2 line 1: I would say “form” rather than “appear”. Page 2, line 15: Insert “the” before “daytime”. Figure 1: The thick circle denoting it to be a super-site at Ile-Ife doesn’t line up with the other filled circles in both panels. Page 6 line 25: use “at which” rather than “when”. Page 7 text: It doesn’t have line numbers so difficult to point out, but it needs to be revamped for grammar. Thanks. The UTC time is same as Local time. This needs to be mentioned somewhere in the text. Thanks. Table 1: Would it be possible for you to mention in a column the average and standard deviation of surface fluxes, cloud fraction, cloud top height and cloud base height for each phases? Thanks. Page 13, Line 7: Change to “between this level and the bases of cumulus clouds forming

in the afternoon". Page 13 Line 12: Please change "summit" to "cloud top". It is also elsewhere like caption of Figure 7. Figure 3: There are no "red numbers" in the figure. Figure 4 and 5: Please mention the significance of the dashed line.

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