

Referee comment on “Coupled and decoupled stratocumulus-topped boundary layers: turbulence properties” by Jakub L. Nowak, Holger Siebert, Kai-Erik Szodry, and Szymon P. Malinowski, Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-214>, 2021.

Anonymous Referee #2

This paper presents high-resolution turbulent flux measurements obtained by the helicopter-borne platform ACTOS during the ACORES campaign. The focus of this study lies on the comparison of the stratification and turbulence properties in a (1) coupled and (2) decoupled marine stratocumulus-topped boundary layer. The paper is well written and the results are nicely related to previous work. I think that this study contributes to our understanding of turbulence in marine boundary layers. I recommend publication after addressing the comments below.

General comments

1. The paper provides interesting insights into the stratification and the turbulent properties of coupled (CP) and decoupled (DCP) marine stratocumulus-topped boundary layers. It would be interesting to have additional CP/DCP cases to investigate whether the same pattern is also observed in other cases. Are you planning to extend the analysis to more cases? It would be in particular interesting to have more data in the stratocumulus layer.
2. In Sect. 2.2, you introduce the different instruments that have been used in the study. I would like to see further discussion regarding the uncertainties of the measurements. Currently, uncertainties are not discussed and the error bars only include the variability of the data. This makes it difficult to assess the conditions inside the different sublayers in the CP and DCP case (e.g., add error bars in Table A1 and A2).
3. The paper contains many abbreviations (e.g., for the different sublayers). I understand that it makes sense to introduce these abbreviations, as they are frequently used in the paper. However, for the readers that are not familiar with these abbreviations, it can be hard to remember the definition of the different acronyms and to follow the text. Please check if all the abbreviations are necessary. For example, “ENA” and “CTEI” are only used 2-3 times and could be removed. Furthermore, I would suggest including the abbreviations of the different sublayers in the figures, in order to make it easier for the reader to identify them (see specific comments).

Specific comments

4. Page 5, caption Fig. 1 and caption Fig.3: Please add date and time of satellite image.
5. Page 5, Fig. 2 and Fig. 4: In Fig. 2 and Fig. 4 you show the time series of the ACTOS altitude. I think it would be beneficial to include more information regarding the cloud/BL structure. E.g., At what altitude is the cloud top/cloud base? You could indicated the different sublayers on the right side of the plot.

Furthermore, you often refer to the different profiles (PROFs 1-5) and legs (LEGs 1-5) throughout the paper. You could consider adding the labels of the profiles and legs on top of the plot.

In addition, the line style of the profiles is not evident in the figure due to the low contrast between the black line in the background and the black dotted line. I would suggest to remove the black line in the background or to change the color to get a better contrast.

6. Page 6, equation 1: You defined 'ql' as the liquid water content on page 4, line 103. The liquid water content is usually defined as mass of liquid water per volume of air (i.e. g m^{-3}). However, in equation 1 the liquid water mixing ratio (i.e. mass of liquid water per unit mass of air) should be used and not the liquid water content (see Betts 1973 or the following link: https://glossary.ametsoc.org/wiki/Liquid_water_potential_temperature). Please review your definition of 'ql' in the manuscript.
7. Page 7, line 150: According to J11, 'qt' should be the total water mixing ratio, which is defined by the sum of the liquid water mixing ratio and the water vapor mixing ratio (see also comment 6). Please review your definition of 'qt' in the manuscript.
8. Page 9, Fig. 5 and Fig. 6: As mentioned already in the general comment section, it is hard to remember the abbreviations of the different sublayers. In order to make it easier for the reader to follow and identify the different sublayers, I would suggest adding the abbreviations of the sublayers (color shaded areas) on the right side of the subplots (for all figures of this type; i.e. Fig. 5, 6, 9-16, 19-20). Furthermore, I would plot the lines on top of the shaded area to avoid any change in the line color (for example for LCL, qv).
9. Page 9, line 207: So are both the upper and the lower BL portion internally mixed? If yes, you could change the structure of the sentence as follows: "This suggests that both the upper and lower BL portion are internally mixed."
10. Page 14, line 113: You applied a moving window of 2 s to the profiles. How was the moving window of 2 s determined? Did you conduct sensitivity tests with different time windows?
11. Page 20, Fig.13: Why is there such a large discrepancy between some of the PROFs and LEGs properties (e.g., S_u , R_u , R_w) in the FTL?
12. Page 24, Fig. 17 and Fig. 18: I would use the same scale on the y-axis for Fig. 17 and Fig. 18 for better comparison between the coupled and decoupled case. Furthermore, I would suggest adding the sublayer in brackets next to the altitude.
13. Page 25, line 506: "Lengthscales" should be changed to "Length scales" throughout the paper.
14. Page 25, line 512 and line 524: One of the " λ_u " in the ratio should be replaced by " λ_w ".
15. Page 32, line 669: Change "imortant" to "important"
16. Page 32, line 670: Change "proprties" to "properties"