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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Physics of Stratocumulus Top (POST): turbulence characteristics" *by* I. Jen-La Plante et al.

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We thank the reviewer for his/her comments. While we will revise the manuscript accounting for his/her suggestions in order to improve the discussion of our results, we cannot agree that the paper is a straightforward extension of the previous one. The previous paper did not provide estimates of turbulent kinetic energy and velocity components variances, TKE dissipation rate and detailed characterization of turbulence anisotropy across cloud top layers. This experimental characterization, obtained on rich statistics of cloud top penetrations in various conditions, documents variability of turbulence from cloud top to free troposphere above in a way never, to our knowledge, done before.

**Specific comments:**



**1)** *"Therefore I feel the authors either need to do some further analysis, or a better job of highlighting what exactly is novel about the current paper, before it can be considered suitable for publication."* -

In order to highlight the new findings mentioned above we will expand the abstract, the introduction and conclusions to make them stand out to the reader.

**2)** *"The previous study (Malinowski et al 2013) considered two contrasting profiles as examples of possible stratocumulus states. I don't see the justification for choosing the additional six that were used here. How were these flights chosen? Were they the ones the method worked best for? If so it would be useful to document the flights where the method didn't work and reasons for this. Are these two sublayers universal features of stratocumulus cloud tops, or only present under certain circumstances? Why not use all POST flights, to give a much larger sample size and allow a more statistical analysis of the results?"*

We already partly answered these questions in our reply to the reviewer 1. After a laborious processing before undertaking the analysis, we selected data for the analysis from all POST flights to cover the whole span of key cloud top parameters: temperature and humidity jumps, wind shear and buoyancy effects of mixing. Despite the fact that we were not always able to distinguish between the sublayers (as briefly explained below) we will discuss flights selection process in the revised text.

**3)** *"It would be interesting to show on Table 1 the total number of cloud top penetrations in that flight, to see how frequently the method is diagnosing these layers. What happens on T007, where it looks like you diagnose layers on less than one-third of the cloud top penetrations? It would also be interesting to have some discussion of the difference between numbers in TISL and CTMSL diagnoses, i.e. what is happening when one is found but not the other?"*

We will add the required info to Tab. 7. Frankly speaking, there are several possible reasons of failure, not related to the method principle: too shallow porpoises (either too low the uppermost point or too high the lowermost point) and small inclination of aircraft trajectory i.e. effects of horizontal inhomogeneities from e.g. superposition of boundary layer turbulence/circulation. After the layer division we performed additional quality control so that only unambiguous cases are included into the analysis. The problem with the discussion is that we have no comparison, i.e. we cannot say which porpoises were too shallow and how much, and there is no way to distinguish between too shallow porpoises and horizontal variability. We will add this information into the text.

**4)** *"One of the clearest reasons (to me) for considering these two sublayers came from the difference in the Corrsin and Ozmidov scales in the two sub-layers, yet very little is made of this result and could perhaps be expanded upon. What does the much larger, and more varied, length scales in the CTMSL tell you about that region of the cloud top?"*

The reasons for considering layer division were identified on a basis of temperature, humidity, wind and LWC time series in porpoises and discussed in Malinowski 2013. Physical reasons include different shear and static stability across the layers, different amplitudes temperature fluctuations and last but not least effects of cloud presence: dry mixing in TISL vs. moist mixing with possible evaporative cooling in CTMSL as well as radiative cooling in CTMSL. In this paper we show that application of such layer division makes additional sense and allows characterization of differences in turbulence properties within the layers, such as velocity variances and TKE, dissipation rate and finally Corrsin and Ozmidov scales. We did not elaborate a lot on Corrsin and Ozmidov scales, since we wanted to provide experimental results, not speculations. We found the contents of the paper already sufficiently inclusive. We presently perform high-resolution numerical simulations we performed to better understand the meaning of these findings. Nevertheless, we will add more discussion on differences between the sublayers and suggest possible consequences.

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