

Interactive comment on “Turbulent and Boundary Layer Characteristics during VOCALS-REx” by Dillon S. Dodson and Jennifer D. Small Griswold

Anonymous Referee #1

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Review of Dodson and Small-Griswold: Turbulent and Boundary Layer Characteristics during VOCALS-REx

This manuscript analyzes aircraft data from the VOCALS field campaign in 2008. Its focus is on meteorological influences on boundary layer properties such as TKE. Although it presents results from most flight days, more attention is placed on a period influenced by a synoptic system. The contrast between this period and other days is useful.

The value of the paper is in its broad documentation of data from the campaign. I was surprised to see that other than the Zheng et al. study that looked at the CIRPAS Twin Otter data, no other Twin Otter studies are referenced, so perhaps these data have not been looked at before. That being said, this manuscript is not near a state in which I

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could recommend publication. I was extremely frustrated by its lack of clarity, rambling unfocused explanations, and grammatical and spelling errors throughout. The number of figures is also disproportionate to the information content of the manuscript.

I will provide some specific examples below. I will only review this manuscript again if a very serious effort has been made to significantly improve the presentation and to focus the message(s). I will leave out the very long list of grammatical and spelling errors. It's really not fair to expect reviewers to clean up manuscripts.

1) Abstract needs significant tightening and clarification of message. What is the role of radiative cooling? The last two lines could be written much more simply (“lower pressure allows the BL and entrainment zone thickness to increase” plus an explanation in a separate sentence of why turbulence decreases). Mentioning both in one sentence left me scratching my head.

2) Introduction: Other than the message of “we’re going to look at the turbulence data from this field campaign” I didn’t get a sense of a focused science question. The authors should rewrite this with the benefits of hindsight to provide that focus.

3) Section 1.1, there is a general lack of clarity and synthesis. Please be specific about mixing ratio (of water vapor!) and give it a symbol at the outset so its intuitive. Why is the Sc to Cu transition relevant here? “Buoyancy flux is the primary generator of TKE in the STBL” but what drives buoyancy flux? The reader has to read through to pick out the pieces and figure it out. The description of Bowen ratio is straightforward and the text should be streamlined. Lines 104 through the end of this section ramble. On the other hand, you might explain why larger latent heat flux causes decoupling. Please simplify where necessary and expand where necessary to focus your key questions.

4) Section 2.1: Shortwave absorption doesn’t only occur at cloud top. Line 142: Don’t you mean “on any given day”?

Given the focus on velocities, surely the instrumentation should be described rather

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than completely deferred to Zheng et al.?

5) Section 2.2: You talk about 300-point averaging windows before discussing the sampling time. This is upside-down. Why is linear regression required to get the mean?

6) “Thetav is commonly used as a proxy for density”. Please give a concise theoretical reasoning for this. You mention a structure function method but provide no explanation of what it is. Please give a brief one. Simplify line 188. What are “interactions with the plane”?

7) Section 3.1: What is omega? Surely it should be defined and given a symbol?

8) Section 3.3: although you don't have flight data on consecutive days, you do have reanalysis that I expect would be helpful to address boundary layer height changes. (ECMWF?) Top of pg 10: why does enhanced moisture above the BL translate to higher aerosol? Here and elsewhere you would help the reader a great deal by using symbols like z' for normalized altitude, θ , q , etc – i.e., symbols that are in common use. You mention a secondary cloud layer (line 329). Is this a layer of penetrating cumulus? Or something else?

9) Section 4: Line 332, don't you mean horizontal layers? Line 347: This doesn't make sense. An increase in the Bowen ratio means an increase in SHF or decrease in LHF. Line 378: How can Fig. 11 display the same information as Fig. 10? Perhaps you mean it has the same format. There are similar instances. The use of geopotential height is distracting, and for no good reason. You could make your points much more clearly by talking about pressure. I had to read the text starting from Eq. (9) through to near the end of the section a half dozen times and I still don't know what you are trying to say. Correlations are mentioned and causation is implied. And when it is not, one is left wondering why there is a correlation, and what confounders might be driving the correlation. The summary section might have helped, but it is poorly written, sometimes repetitive, and circular. Why is geopotential height correlated with sensible heat flux. It may be simple, but at least provide a physical explanation. Stating “agreement with

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Palm (1996)” doesn't help. The last 3 lines of this section do make sense, and the ‘could be’ might not be necessary.

10) Section 4.2: Line 441, the variance peak at $z'=0.99$ might simply be because of the strong q gradient. Lines 480-418, you make it sound like the updrafts and downdrafts are meeting in the middle, but they must be spatially displaced.

11) Section 4.3: This entire section should be tightened. I get contradictory messages on the role of precipitation. It can both stabilize the BL (cooling near surface) or destabilize (cooling higher up). I don't have a clear picture of the precipitation/evaporative cooling profile. Line 558, why bring in the skewness with a single sentence? How does it tie into the text above. What do you mean by “the boundary layer has been turned over”? Please be more precise.

12) Conclusions If pressure increased after the passage of the front, why did the BL height increase? The bullet points are helpful. The paper would benefit greatly if the Conclusions contained more synthesis like this – particularly if focused science questions/hypotheses were addressed. I sincerely hope the authors will focus the revised manuscript around science questions. Lines 610-611: This isn't an interesting result. It's an artifact of the sampling. I don't know why it is in the Conclusions. The last lines are so far from the theme of this paper that I wonder why the authors mention these topics.

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