Summary

Macatangay et al investigates the determination of planetary boundary layer height from lidar measurements with the specific aim to demonstrate how the boundary layer and simultaneously present decoupled aerosol layer can lead to overestimation of the boundary layer height. They demonstrate this decoupling by presenting data from two sites in Thailand, and in one of the sites this decoupling occurs frequently and should thus be considered when estimating the height of the boundary layer.

Overall comments

The manuscript is rather well written and describes and important processes for less-studied region of the world. Topic-wise the work is a good fit to ACP. In some parts the descriptions of the analyses come across rather complex and thus difficult to understand in the way they are currently written. Some of the subheadings in the manuscript should also be changed to better describe the following text. In addition, some figures need adjustments to clarify their messages, and to comply with ACP's policy of considering readers with colour vision deficiencies. A key issue I have spotted regards the data and code sharing policy. ACP strictly states (ACP - Data policy) that "*The data needed to replicate figures in a paper should in any case be publicly available, either in a public database (strongly recommended), or in a supplement to the paper.*". Currently the authors only state that "The data underlying this article will be shared on reasonable request to the corresponding author." and this is not possible with ACP. However, if the authors intend to share the data to at least replicate the figures, that should be stated. Therefore, if the authors can reach the minimum data sharing required, I can recommend major revisions to address the other points mentioned above and detailed below.

Detailed comments:

line 15 (abstract): the sentence "Results are interpreted within regime-based framework rather than as climatology." does not make sense to me. I feel it is also redundant so maybe just remove it?

line 17: "quantified using…" The list here is extensive and cannot be understood without explanation. For abstract, I feel this also could be left out as the key here is the definition of the decoupling itself.

line 18: the percentage number, is that like 53% of cases? should be clarified. Following, the Richardson number diagnostic is also an abstract term at this point, so better not to mention at all. You can instead say that Most of the decoupled strong-wind events (83%)… Also please explain here what is the "strong-wind event".

line 18 and 22-23: is the autocorrelation timescale same as persistence? If so, better use term persistence as it is self-describing. Also without explanation autocorrelation timescale does not tell much.

line 23: “Decoupling frequency uncertainty…” The sentence needs clarification, ists very abstract. Maybe “Uncertainties in the decoupling frequency were 10-times higher in XXX than in XXX, highlighting the contrast between the sites?”.

please add residual aerosol layer to the keywords

line 64: “aerosols layers tend…” I think there is a verb too much or something wrong. tend to remain more… is confusing. Please clarify the sentence as now its meaning is not clear

line 66: please explain what the maritime continent is or explain differently. It is not official place so why capitalization? Also, the full sentence would need references as you state “studies over the…”

line 73: Maybe break into two questions as now the sentence is very long… “This raises two questions regarding the interpretation”…

line 90: “we introduce…” Are these completely new metrics or already used somewhere? If they are completely new, you should say “we propose”. Also may be better to say that you “introduce these metrics which can be used to quantify the degree to…

Figure 1: you should have the upper limit in the colorbar noted. Also if possible, for globally distributed readers it would be greatly beneficial to have a larger map showing the location on the sites. Then the current figure could be “zoomed in” version. The actual topography you can only show as it is now but larger map would give better context.

Sect 2.2 Could you reorganize this section into 2.2 Data, under which you have justification for the measurement period, then followed 2.2.1 for the lidar measurements and 2.2.2 for other meteorological data? Having this in smaller pieces would clarify a lot. Also, you describe satellite data etc, so some reorganizing would help the reader to gasp better what data is actually used and how.

line 123: what does the word elastic mean in this context?

line 140: … representing a 53% below-average burning season relative… I do not understand what is meant by that, please reword for clarity.

line 155: ALT and BLT abbreviations come here now but have not been really used since the abstract. Better spell them out here still and only leave them for the Sect 2.3 where you nicely explain them.

line 168: “below 4km AGL” is unclear when read out (below 4km above ground level I assume, but also AGL is not explained. Please reword and clarify

Sect 2.4 This section would really benefit from a flowchart or similar visualising all the analysis steps taken. Another option would be also organizing the text into smaller pieces. One suggestion: 2.4 Statistical analyses, line 185 onwards 2.4.1 Definition of decoupling and descriptive metrics. line 203 onwards 2.4.2 Complementary process-level analyses and finally line 222 onwards 2.4.3 Airmass trajectory analysis. This is just a suggestion and of course needs adjustments in the text too. Also, currently it is unclear where the text describing the correlation analysis (line 216-221) belongs. In this section, and possibly elsewhere, please also separate the formulas into their own lines and number the equations.

line 180: is this definition coming from somewhere? It sounds like so but would need a reference. Also you note RMS but I do not see explanation for that abbreviation.

line 183: …the nature and persistence…" I think the end of the sentence is redundant and could be removed.

line 187: what do you mean by instantaneous height difference? Do you refer to data resolution? if so, should be stated

line 188: please also give a number for the "expected entrainment zone thickness under tropical convective conditions", maybe a range of values if giving single one is not possible

line 206: please explain what the Richardson number is and what it can be used for. If someone is unfamiliar with it, it is very difficult to follow.

line 211: ERA5 has not been mentioned before I think. Please note it also in the data section with an appropriate reference.

Figure 2: Colour scheme needs to be changed as the rainbow scale is not suitable for colour vision deficiency. Have a look here, for example: The misuse of colour in science communication | Nature Communications and Scico and the Colour Conundrum – Data Imaginist

Figure 3: Same here as above, red and green are not good combination.

line 276: "reflecting persistent mechanical forcing". If this was explained somewhere I might have missed it. Could it be noted again what is means

line 285: "displaced toward positive.." displaced to me means moves more towards wrong place or similar. Maybe better use word "shifted"?

line 286: here you note 400 m but what was the 500mm limit for separation? So you still use the 500m for separation but here analyse full data in order to point out how different the ALT and BLT are? Please clarify

line 294: What does the partial converge between sites mean? I do not understand how the different sites can converge / what is meant here so please clarify.

line 320 coupling is different, this is already establishes so maybe reword to say a bit differently. like how in the diurnal differences are also there when averaged thi way etc. basically, this is obvious also from the previous figure no?

Figure 4: Please add (a), (b) etc for the subplots. It is then easier to refer to them. Adjust caption accordingly. The caption could be shortened by removing the details of what IQR means (…where IQR is the…). It is very basic statistics so should be understandable to ACP readers.

line 332: temperature dependent but you note correlation I assume (please add correlation as a text to the brackets here as you use it first time in this section). Better say strong relationship with temperature etc because correlation is not causality even though in this work they are very likely also causally related.

line 333: wind speed correlations -> correlations with what? Please be specific so reader does not need to guess what you mean.

line 337: …thermodynamically controlled…mechanically regulated… I am not sure I understand what these now mean. Could you explain what these now mean?

Sect. 3.5: You suddenly start using abbreviations CM and SK here when until now you spelled out the site names. If abbreviations can be avoided it is always better, so please use full site names also here and later, including Table 1 and its caption.

Line 340: Here you should refer to the methods section where these metrics were introduced.

Table 1: So what are the values gives for Daytime and Nighttime? Are they also frequencies? Same for low and high wind. If it is frequency, that should also be stated in the table. The point of the autocorrelation timescale could be mentioned in the caption, I do not understand what it tells in this context so please clarify also the methods

Line 364: you give percentage here, but table has fractions (also refer to the table). Better stick with either one. Also “is nearly invariant” is unclear, you can simply say “has little difference between low and high wind”, also note if you mean wind speed or something else here?

Line 366: Here the autocorrelation comes again. I know what autocorrelation is, but I really don’t understand what it tells you here and how I should interpret it.

Sect 3.6: The title is very complex in the sense none of the terms were mentioned before. Please consider rewording to make this simpler. You can always explain terms used later in the text. Text here (lines 372-376) is also redundant as you should describe it in the methos. If some of this was missing from the methods, please move it there. You can keep one very short

sentence stating what is presented next if you like but currently especially lines 374-376 definitely belong to the methods.

3.6.1: here comes the explanation for the Ri I was missing from the methods, please move it there (lines 378-382)

line 390: “too stably”? There seems to be misspelled words here, please correct and clarify. Do you mean too stable or too stratified?

Figure 6: the grey text is way too small. Also I think all these statistical indicators like p-values you can have in the caption

Sect 3.6.2: the subheader sounds like it belongs to methods. Please revisit all of your subheadings in this results section and adjust them to better describe the actual results and not the analysis strategy as that you should have in the methods.

Figure 7: in (b) you have the statistics. These could be in the caption and in text (give p value in caption, and all the rest + p value again in the text) so you can remove (b) from the figure. Could you consider making (a) into 2 subplots instead showing LAT and BLT trajectories separately. Now they are on top of each other so impossible to distinguish. Also please consider making this into a trajectory frequency plot instead of plotting just lines. Please increase the size of (e) as it is now very small.

Sect 4: Maybe just Conclusions? If you have direct recommendation(s), you can still mention them. But if you say that in the header you should make the recommendations very clear and at the moment I was not able to spot them. Please iterate the whole conclusion section as now it possesses multiple very long sentences which are hard to understand. You should not present any more statistics in conclusions (e.g. line 453) as they should be in the results. Also, for conclusions I think it is good practice to write out all abbreviations once more—the fact just is that many readers go to conclusions directly and thus the text should be independent.

Data/code share: see my overall comments in the beginning.