Point-by-point responses to two reviewers' comments

We thank two reviewers for their detailed and constructive comments and suggestions. Following these comments and suggestions, we have

- revise the paragraph in Section 2 to better descript the shear term (ST) calculation method;
- revise the abstract and conclusions to better illustrate our ideas;
- added Figure S2 to show the inversion above the PBL and lower RH in near surface layer over the Rocky Mountains;
- revise the unclear Figures (e.g. Figure 4 and 7);

Our revisions are indicated in the revised version with tracked changes. Below are our point-by-point responses (in blue).

Referee #2

General

The paper was improved once more, and the authors answered my questions and did corresponding modifications. But as the text improved I was more able to follow and found now a few more things requiring revision. Nevertheless, although these are also major points, I guess that after improvement the paper might be in a form that can be published. In the following, I again refer to line numbers of the first revised version with marked changes.

Major Revisions

1. In my review of the revised version I asked the following question: The paper by Wang et al. (2020) has a very similar topic. It would strengthen the paper when in the introduction the differences of goals to those of the new paper would become clearer. I guess, the main difference is the comparison with North America, but perhaps there are others?

The authors answered that question well but as far as I can see this did not cause any modification in their manuscript. The answer should occur in the introduction. Only then, the reader is able to understand the novelty of the study at the beginning.

Thank you for your suggestions. We add this key point in introduction.

2. I am still not satisfied with the description of the method between lines 149 and 177. The present form cannot be understood. Once more, I strongly recommend the following:

Write that wind shear is determined from heat flux H and momentum flux τ

obtained from the ERA5 reanalysis data. Namely, according to Monin Obukhov similarity theory wind shear is given as

$$\frac{\partial \bar{u}}{\partial z} = \phi_m(\zeta)\frac{u_*}{kz}, \quad (1)$$

where ϕ_m is the Monin Obukhov stability function for momentum, $u_*^2 = \tau/\rho$. $\zeta = z/L$ with z = height and L = Obukhov stability length defined as in Gryanik et al. (2020) as

$$\zeta = \frac{z}{L}, L = -\frac{(\tau/\rho)^{3/2}}{\kappa(g/\theta_v)(H/\rho c_p)}. \quad (2)$$

ϕ_m is the Monin Obukhov stability function where we used ϕ_m = …. your old equations (5) and (6) for stable and unstable conditions (3)

No further equations are necessary. When you followed the above procedure this must be explained in this way, if something else was done it would need a better description.

Thank you for your suggestion. We revised the description of the determination of wind shear again.

3. Still, the quality of some figures is bad. These are Figure 4 (labels of colour bars in a) and b) almost not readable, labels are not readable of 4 c and d). Figure 6 (text in black boxes very difficult to read, increase resolution). Figure 7a, e,f: all labels should have the same size as in 7b.

Thanks. We have revised all the unclear figures.

Minor revisions

Abstract: the text of the conclusions is much better than the text of the abstract.

We have revised the abstract again.

The minimum modifications are:

Line 24: correct to 'with increasing difference PBLH-LCL'

Sorry for our mistake. We delete this incorrect sentence.

Lines 24-28: I suggest writing: The triggering of convection by boundary layer dynamics is analyzed over TP but also in the Northern Hemisphere over the Rocky Mountains. It is found that ST and BT are strong over both high elevation regions.

Done.

Line 32: write... by inversions above the PBL and to lower RH within the PBL, which further leads

Done.

Line 34: at the Rocky Mountains

Done.

Line 44: It is a dynamic effect caused by the

Done.

line 87: of a cumulus system

Done.

line 88: in the PBL

Done.

line 89: with anomalous

Done.

line 90: processes

Done.

line 118: with a spatial

Done.

line 127: averaged

Done.

line 199: with increasing

Done.

line 232: median

Thanks. But we think “medium” is more suitable word.

line 240: dashed contour

Done.

line 250: from the himawari

Done.

line 255: trend of decreasing LCC

Done.

lines 244-245: Verb is missing in sentence

Thanks. We add it in sentence.

Lines 262-264: I do not understand why 200 hPa is compared with 500 hPa. This needs more explanation. Describe exactly where you see divergence, where convergence.

The average altitude of the TP is 4000 m (~600 hPa). The 500 hPa corresponds to the lower atmosphere layer (or middle troposphere) over the TP, and the 200 hPa roughly corresponds to the upper troposphere. The convergence in the middle troposphere and the divergence in the upper troposphere are usually associated with the deep convection over

the TP.

Line 270: to the middle

Done.

Line 272: the inversion is not really seen in the figure

We add a Figure S2 in supplementary material to show the inversion above the PBL and lower RH within the PBL at both sides of Rocky Mountains.

Line 273: to an increased

Done.

Line 279: one needs a reference with respect to CISK

Thanks. We have added it.

Line 281: the Western TP

Done.

Line 283: in the northern

Done.

Line 285: what's a fake low?

We replace fake with false.

Line 285: in the northern

Done.

Line 299: areas

Done.

Line 306: of the convective

Done.

Line 309: reformulate sentence, that it becomes clearer that BT and ST play a key role (and not the elevation)

Done.

line 317: for the North Sea (or over North Sea)

Done.

line 324; 2015). Thus one might ask the question what is ...

Done.

line 333; which is consistent with

Done.

line 335: low elevation regions.. start new sentence after afternoons

Done.

line 366: to two mechanisms. Now start with The first mechanism ,,, and later the second mechanism ....

Done.

line 364: The blue and red histograms show the surface elevation (blue) and temperature (red) as functions of 2 m air density

Done.

line 373: shows

Done.

line 375: values

Done.

line 383: which reflect special surface characteristics in the boundary

Done.

line 387: shows a conceptual ...of the atmosphere

Done.

line 413: TP plays a

Done.

line 415: found that the difference PBLH-LCL

Done.

line 426: in an unimodal

Done.

line 437: phenomena

Done.

line 483: the name is De Bruin, not just Bruin (see also citation in the text)

Thank you for your comments. We use the old equation for unstable condition, so we delete related content in the main text and References.

line 423: with increasing

Done.

Referee #3

General

Most of my concerns have been addressed, and the authors revised the manuscript according the comments and suggestions proposed by referees properly. I do not hesitate to suggest accepting it for publication as long as the following minor points are considered.

Issues:

1. L29: Please introduce “RH” when it first appears.

Done.

2. L121: himawari-8 -> Himawari-8. Please check the entire manuscript.

Done.

3. L132 and L136: The definitions for shear term are different. Please check which equation is actually used in this work.

Done.

4. L207: “smaller” or “larger”? How did the authors make this argument? Based on which plot?

Sorry for our mistake. It should be “larger ” based on the Figure 3.

5. Figure 4: Please indicate the units of divergence in the colorbars in Figure 4a and 4b. The resolution of the figures needs to be improved, as it is difficult to see the small numbers.

Thanks for your suggestion. We have revised this figure.

6. L254-256: I suggest deleting “compared to eastern China”, as one do not see the decrease trend in LCC in eastern China. Otherwise, the authors should provide a reference or a figure to show the decrease in LCC from late afternoon to evening in eastern China.

Thanks. We delete “compared to eastern China”.

7. L294: “the second Tibet Plateau Experiment (TIPEX II)” -> “the TIPEX II”, and check the entire manuscript for the same issue.

Done.

8. Figure 7: You have two (e)s in the caption. One sub-plot is missing (the first figure 7e)? Please add colorbar for figure 7a, and add units for all color scales.

Thanks. We have revised the Figure caption.

9. L370: “two typical high value regions……”. High positive value, negative value, or absolute value?

Sorry for our mistake that we did not express our ideas clearly. We have replaced “high value” with “large topography”.

10. L425: Use “at low elevations” other than “in eastern China” is more accurate.

Done.

11. L438-: The positive value of PBLH-LCL is only over the TP, not over the Rocky Mountains. And the PBLH-LCL is -101.9 m, not slightly greater than zero. Please revise your conclusions.

Thank you for your comments. We have revised the conclusions.