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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characteristics of the summer atmospheric boundary layer height over the Tibetan Plateau and influential factors" *by* Junhui Che and Ping Zhao

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Dear reviewer,

We are grateful for your insightful comments that help us to improve this manuscript. We carefully address issues in your comments. Please see below our point-to-point responses to your specific comments.

General Comments

Question 1: It is necessary and indispensable that the manuscript contains a detailed description of the formation and evolution of the planetary boundary layer.

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Response: Based on your comments, we have concluded a detailed description of the formation and evolution of the planetary boundary layer in lines 41-61.

Question 2: The equation for the potential temperature difference (PTD) on line 115 is very vague and poorly understood. Authors should make a greater effort to characterize the physical criteria that allow choosing and safety to identify the types of the atmospheric boundary layer. It is important to consider that buoyancy effects make the convective and stable ABLs strikingly distinct.

Responses: Firstly, according to your suggestions, we have added statements to characterize the physical criteria that allow choosing and safety to identify the atmospheric boundary layer height. Secondly, we have added some explanations for the physical criteria of the PTD method to identify the types of the atmospheric boundary layer. The PTD method identifies the stable and convective boundary layers by judging the stability of the near surface layer atmosphere considering that buoyancy effects make the convective and stable ABLs strikingly distinct. Thirdly, we have added a detailed procedure for calculating the ABL height, the illustration of idealized atmospheric boundary layer (ABL) regimes and ABL height determination procedure, and some examples of the derived potential temperature (PT) profiles from soundings for the three types of ABL. The associated statements are in lines 137-172 and Fig. 2.

Question 3: the authors should consider in their analysis the fact that “The neutral ABL is rare because small virtual temperature differences in the ABL can cause large buoyancy patterns”. How the authors identify this particular type of ABL? The authors also need to build vertical temperature and wind profiles and display them in the study.

Response: We have added the discussion for the physical criteria of the PTD method to identify the NBL and provided some examples of the derived potential temperature (PT) profiles from soundings for the three types of ABL (in lines 137-172 and Fig. 2).

Major comments

1. Line 115: The PTD classification is a fundamental criterium for the present manuscript. As a consequence, the authors must provide a more detailed discussion of the employed methodology to obtain the heights of the distinct ABL types. As the manuscripts basically observational data analysis, is not enough for the readers the citations presented.

Response: Following your suggestion, we have added a detailed description of the employed methodology to obtain the heights of the distinct ABL types and provided some examples of the derived potential temperature (PT) profiles from soundings for the three types of ABL. The associated statements are seen in lines 137-172 and Fig. 2.

2. Line 155: How a SBL can occur at noon (14:00 BJT). In this daytime period, there is a CBL. How the CBL height is near to the NBL height? The authors need to clarify.

Response: Our result shows that the SBL mainly occurs in the early morning, while the CBL mainly occurs at noon and in the late afternoon. The NBL does not show a remarkable diurnal variation. Nevertheless, the daytime SBL and the night-time CBL may also occur with low frequencies in the TP, which is likely due to the 'abnormal' forcing associated with certain synoptic conditions or cloud coverage (Medeiros et al., 2005; Poulos et al., 2002; Stull, 1988). See lines 230-235.

Stull (1998) and Blay-Carreras et al. (2014) revealed that the NBL often occurs in the transition periods between the CBL and the SBL. Since these transitions occur rapidly, the NBL may have the same characteristics in the state variables as the CBL prior to the transition although the dynamic forcing in the NBL maybe weaker compared to the CBL. Our result also shows that the CBL and NBL heights display the similar character. This result is consistent with those from Zhang et al (2017). See lines 254-258.

In addition, the similarity between the CBL and NBL may also be related to the ABL type identification scheme. The neutral stratification condition (σ = 0) is rare in nature. In our calculation, the threshold value of the NBL is set to -1.0 to 1.0, which is consistent

with Liu and Liang (2010). Consequently, some SBLs and CBLs with weak stratification will be identified as NBLs. See lines 150-152.

Minor comments

1. abstract “The SBL accounts for 85% of the TP ABL. At noon, there is a wide distribution in the ABL height up to 4000 m. The CBL accounts for 77% of the TP ABL, with more than 50% of the CBL height above 1900 m.” Please rewrite more clearly this statement. For this reviewer the above statistics are confused.

Response: Thanks. Indeed, our statements should add the time frame to avoid any possible misunderstanding. According to your comments, we have changed (in lines 19-23).

2. Line 24: The authors need to present a better definition of the ABL.

Response: Based on your comments, we have modified the definition of the ABL (in lines 31-35).

3. Line 154: Please correct the hour “00:80 BJT”

Response: We have corrected (in line 224).

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