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

Anonymous Referee #1

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General Comments:

The atmospheric boundary layer (ABL) is the lowest part of the atmosphere in which a variety of complex motions, characterized by turbulence, may be present. In a diurnal cycle, the different manifestations of an ABL are generated by distinct forcing mechanisms that originate from mechanical and thermal effects which impart different depth scales and characteristic velocities to the ABL. For instance, a convective boundary layer (CBL) is defined by its depth zi, which is usually taken as the height of the lowest inversion, by a convective velocity scale w* and by a friction velocity scale u*. On the other hand, a stable boundary layer (SBL) is characterized by the depth of the nocturnal

surface inversion (NSI), usually denoted by hi, and u*. During daytime, the positive turbulent heat flux establishes the structure of the CBL. Conversely, in a night-time stable ABL, the negative turbulent heat flux and clear-air radiative cooling, on average, control the development of the NSI layer. Relevant periods occurring during the existence of an ABL concern transition situations, in which the turbulent heat flux switches sign and assumes positive and negative magnitudes. Over land and after sunrise the surface is warmed and heat is transferred upward by updrafts of warm air. Such a mechanism generates a deepening of the primitive CBL. In late afternoon, during sunset when the external forcing, such as the upward sensible heat flux and geostrophic forcing, varies rapidly, clear-air radiative cooling occurs and the turbulent heat flux decreases and becomes negative. In consequence, the convective turbulence decays with an accelerating rate and starts the formation of the NSI. Above the NSI, the convective energy-containing eddies start to lose their strength and mixing capacity, and the CBL begins to decay. This deep and near-adiabatic vertical region, which is the remnant of the daytime CBL, is known as the residual layer. The use of precise information on this residual layer in numerical models is of fundamental importance when describing the evolution of the diurnal CBL. Generally, experimental campaigns are important when used to describe the physical characteristics of the ABL. These observational studies usually employ automatic meteorological stations and radiosounding to measure the distinct characteristic parameters that allow for an understanding of the turbulent patterns occurring in a diurnal cycle of the ABL. The present article is basically an observational study in which the authors estimate the height of the ABL at different times of the day on the Tibetan Plateau. To carry out this investigation they employ routine operational data and detailed measurements obtained from programmed vertical probes. From the scientific point of view and for practical applications in distinct branches of meteorology this study is important and has meaning. In addition, knowing the height of the ABL allows the environmental impact of polluting sources to be evaluated. However, the study exhibits some deficiencies that need to be corrected so that the results presented and discussed by the authors can be better enjoyed and used by the readers. Based on what was written above, the authors should better describe the existing types of the atmospheric boundary layer. Thusly, it is necessary and indispensable that the manuscript contains a detailed description of the formation and evolution of the planetary boundary layer. 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. Furthermore, 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. Associating these vertical profiles with the types of ABL is very important in observational studies. The set of suggestions proposed above will allow readers to accept the observational results with greater reliability.

Major comments

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 manuscript is basically observational data analysis, is not enough for the readers the citations presented.

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.

Minor comments

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.

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

Line 154: Please correct the hour "00:80 BJT"

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