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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Diurnal variability of the Atmospheric Boundary Layer height over a tropical station in the Indian Monsoon Region" *by* Sanjay Kumar Mehta et al.

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Response to Referee #2

Thank you very much for reviewing our manuscript and providing potential comments.

Review of the article titled "Diurnal variability of the atmospheric boundary layer height over a tropical station in the Indian monsoon region" by Mehta and co-authors for publication in the Atmospheric Chemistry Physics.

General comment: The authors have used data collected by the radiosondes over a tropical station and deduced the boundary layer height. The data were collected over 3-year period during various field campaigns. They have shown the diurnal, and

seasonal cycle of boundary layer depth. Further they have classified the boundary layer structure into different categories like convective, stable and residual and have reported the statistics of those as well. The authors have made a good attempt to report the statistics but they fall short in deriving any scientific conclusions from them, leaving the reader with a feeling that no manuscript is simply a collection of statistics. I suggest the manuscript to go through a thorough revision before being published. Below I have listed my major and minor concerns.

Reply: We have taken all these suggestions and incorporated into the revised manuscript.

Major Concerns:

Comment1) As I mentioned earlier, the paper seems like a collection of statistics. You have mentioned in the abstract that various studies have reported the boundary layer depth from that station. So I am not sure of the purpose of this paper is to validate them, or to report them again or to gain some scientific insights on the causes of the changes in the boundary layer depth. It will be good if you can clarify it in the introduction section.

Reply 1: There have been several case studies over the station, but none of them has classified the ABL into different regimes such as CBL, SBL and RL and has not been dealt separately during different seasons. The effect of the cloud on the diurnal structure of the ABL is also has not been attempted yet before this study.

Comment 2) As you have radiosonde data, I suggest you calculate the lifting condensation level (LCL) and also report its variation for the different boundary layers. Please refer to Bolton (1980) regarding the calculations. Add the LCL to Figure 8 and 10.

Reply 2: We have added the lifting condensation level (LCL) in the revised manuscript.

Comment 3) You can calculate the equivalent potential temperature and saturation equivalent potential temperature from Bolton (1980) and then further calculate the con-

vective available potential energy (CAPE) and Convective Inhibition (CINE). These are very important quantities and will make the article very robust.

Reply 3: Certainly appreciate the helpful suggestion; however, carrying out this is beyond the scope of the present work. We will take up these works in the future as follow-up studies.

Comment 4) You have reported the Cloud top heights (CTH) from the satellite measured TBB. It will be great if you report the cloud base height and cloud top heights from the radiosondes themselves. The RH measurements will tell you when the sensor is passing through cloud layers. The derived cloud base height then can be added to figure 8 and 10. You can then classify the thermodynamic structure based on cloud thickness rather than cloud top heights.

Reply 4: Following the method of Wang and Rassow (1995), the cloud base height is obtained from the relative humidity (RH) measurement as shown in the Figure below. The time series of the cloud base height whenever detected using RH in general agree with the cloud top height obtained using TBB data except during deep convection events. However, as the criteria for fixing the cloud base and top heights using the RH data has not been finalized for the tropical clouds occurring over this region, we have preferred satellite derived CTH data in this study. For instance, during December 18-21, 2013, when deep convection occurred, RH has never exceeded 60% and indicates no cloud based on the RH measurement. The detailed study pertaining to the identification of the vertical structure of cloud using RH and its comparison with one identified using satellite brightness temperature data we plan to carry out in the future.

Figure: Time series of the Cloud base height obtained from RH measurement and Cloud top height obtained using satellite measurements.

Wang, J. and Rossow, W.B.: Determination of cloud vertical structure from upper-air observations. Journal of Applied Meteorology, 34(10), pp.2243-2258, 1995.

Comment 5) You have made a very good attempt at classifying the BL structure as convective+residual, stable, stable+convective etc. It will be very nice if you can make a cartoon similar to Figure 9.21 of Wallace and Hobbs book with actual values you have for the summer and winter seasons. Thanks.

Reply 5: We have added a cartoon representing the diurnal evolution of the ABL during summer and winter seasons similar to Wallace and Hobbs (2006).

Wallace J.M., Hobbs, P.V.: Atmospheric science an introductory survey, second edition. International Geophysics series, Acadamic Press 92, 483 pp, 2006.

Minor concerns:

1) The shades are not visible in the Table.

Reply 1: Changed to italic font along with shades

2) Line 15: Please add MSL after lat, lon

Reply2: Added

3) Line 22: I would say “constant” rather than “steady”.

Reply 3: Changed

4) Line 36: You mean Stull 1988 not 1998.

Reply 4: Corrected

5) Line 39: You mean to say “convective” and not “convection”

Reply 5: Changed

6) Line 45-60: what about the role of shear and radiation.

Reply 6: Added to L59 in the revised manuscript

7) Line 65-70: Might be good to refer to Schmidt and Niyogi.

Reply 7: Cited Schmid and Niyogi (2012)

8) Line 74: You mean to say “remote sensing” not “remote sounding”.

Reply 8: Corrected

9) Line 90: “launches” and not “launchings”

Reply 9: Corrected

10) line92: “has” and not “have”

Reply 10: Corrected

11) Line 97: Please list the full-form of the acronum CAWSES

Reply 11: Added

12) Line 165: It might be good to mention that the reported drift is below 4km.

Reply 12: mentioned

13) Line 425-426: Please rephrase. “Attains” is misleading.

Reply 13: Changed

14) Figure 3 legend is incorrect.

Reply14: Corrected

15) Figure 4: I believe you have listed the lines for sunset and sunrise backwards.

Reply 15: Yes, Corrected

16)Figure 6a: Why do you have two black bars surrounding the yellow bars.

Reply 16: As black bar is wider than yellow bar, appears as two black bars. Black bar is kept back of yellow bar.

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