

## ***Interactive comment on “Planetary Boundary Layer variability over New Delhi, India, during EUCAARI project” by Konstantina Nakoudi et al.***

**Anonymous Referee #2**

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### General comments

The paper presents the results of one year long ground-based lidar measurements used to analyze PBL height variability over Gual Pahari, New Delhi. PBL heights are obtained utilizing the modified Wavelet Covariance Transform (WCT) method. These results are firstly compared to four independent datasets: radiosonde data, CALIPSO satellite observations and ECMWF and WRF atmospheric models. Secondly, statistical and seasonal analyses are performed. The study highlights that for the detection of PBL height, the modified WCT method can be applied under different meteorological and aerosol load regimes. The comparison between the different datasets shows high discrepancies for nighttime PBL height estimation and a relatively good agreement for daytime estimation (e.g. lidar vs rds).

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Whereas the study does not reveal significant new findings about the PBL height estimation, the main results are of interest. However, some sections of the paper lack of an accurate and more detailed description and needs to be completed. In particular, due to the small number of the considered samples, statistical significance should be added in the data analysis (e.g. lidar vs CALIOP comparison). Scientific significance of the study needs to be clarified in the paper. Comparison results should be discussed in more details taking into account the impact of different factors such as: the choice of proper WCT threshold and cut off values, differences in the ECMWF and WRF model vertical and horizontal resolution, lidar instrumental configuration (overlap and daytime vs nighttime configuration), error sources analysis, etc. . . Overall, to significantly strengthen the paper, these issues should be addressed. Thus, I recommend the publication of the manuscript after major revisions, according with the following observations.

### Major comments:

#### Introduction

- Lines 45-47, I suggest adding more details about the detection of PBL height using radiosonde measurements and other instruments (e.g. microwave radiometers) with the appropriate references.
- Lines 47-54, not all the lidar systems can provide continuous, systematic and quantitative measurements of atmospheric aerosol profiles. Please clarify this aspect and expand this section, adding strengths and weaknesses between space-borne and ground-based systems and between lidar ceilometers and research lidars.
- Lines 73-76, please add more details on each section of the paper.

#### Section 2

- Lines 93-104, to understand if the anomalies in temperature and precipitation are significant, you should also report in the discussion and in figure 1, the standard deviation

C2

of the measured and climatological values.

### Section 3

#### 3.1.1

- Lines 121-122, please specify the differences between nighttime and daytime configurations and the corresponding vertical sounding ranges.
- Lines 125-127, please add more details about the overlap factor of the system. Is a correction applied? Which is the height of full overlap? Since incomplete overlapping could hamper the PBL height detection, this characteristic should be well specified.

#### 3.1.2

- Lines 143-145, and 151-154, see the comment for lines 125-127. The overlap characterization should be discussed in details in section 3.1.1.
- Lines 148-150, the WCT method was also applied for the detection of cirrus clouds height base (Dionisi et al., 2013, ACP) where a sensitivity study was made to fix a proper threshold. Please add this reference.

#### 3.3

- Line 220, please specify the CALIOP version dataset used in this study.
- Lines 225-227, please specify if the used CALIOP overpasses are nighttime or daytime measurements.

### Section 4

#### 4.1

Please specify the impact of the WCT threshold on the results. A sensitivity study could be of help to interpret the results. Which is the associated error to the estimated PBL height? Is there any correlation between the magnitude of this error and the agreement between the different datasets? The effect of the different model horizontal and vertical

C3

resolution should be also added in the discussion.

- Lines 313-317. Please explain the difference on PBL heights retrieved by radiosonde and WRF model.

#### 4.2.1

- Lines 384-386. The results of the PBL height comparison between lidar and rds during daytime seems due to the sum of two opposing effects: the overestimation and underestimation of PBL height by rds, respectively. In fact, few points are along the 1:1 black line of figure 6, with two clouds of points on the right and on the left of the 1:1 line. This is confirmed by a significant but not very satisfying correlation ( $R^2 = 0.46$ ). Please explain this effect and rephrase this section. Please add the statistical significance of the comparison
- Lines 386-390. The impact of the different technical setups of the lidar system on the results should be quantified.

#### 4.2.2

- Lines 405-409. Please add the statistical significance of the comparison.
- Lines 409-413. The number of considered cases is probably too small to generalize these results. Is there any noticeable difference between the different aerosol type of detected layers or between nighttime and daytime comparisons?

#### 4.3

Is it possible to add in this analysis the mean diurnal PBL evolution estimated through WRF simulations?

4.3.1 Is there an explanation for the ECMWF overestimation (Polly underestimation) of PBL top height during convective hours for Winter and Pre-monsoon seasons and the ECMWF underestimation (Polly overestimation) for Monsoon season? The good agreement found at 12 UTC should also be highlighted.

C4

4.3.3 The considered cases for this analysis are only 44 whereas for the previous section the number is higher (72). Please explain this difference. Statistical significance should also be specified. The measured differences in the growth rates between pre-monsoon and monsoon season can be attributed to a real signal or the poor significance of the sample does not allow any physical explanation? Please clarify these aspects.

Section 5

I'm not sure that this section is bringing any relevant information. Please motivate this comparison with further details and results or remove the section.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-342, 2018.