remote sensing

# Supplementary Materials: Advanced Study of PBLH and Its Correlation with Particulate Matter from One-Year Observation over Nanjing, Southeast China

**Yawei Qu, Yong Han, Yonghua Wu, Peng Gao and Tijian Wang**

As verified by the comparison with other two methods without the 2500 m limitation, they agree well. We further compared the PBL-height or PBLH between the lidar and radiosonde measurements for a summer case on Aug.15, 2016. The PBLH can be determined from the height of inversion temperature measured by the radiosonde at the Nanjing meteorological station. As shown in Figure S1 below, both the PBLH results from lidar and radiosonde agree well, with the value of around 1.4 km.

On the one hand, the lidar overlap area is around 255 m and the data collected under 255 m is not accurate enough for PBLH detection, so we chose 255 m as the lower range. The information about the overlap area was added in the manuscript in lines 83-84. On the other hand, in addition, this lidar has the capability to measure the PBL-height above 2500-m altitude because the signal-to-noise ratios are still good, the lidar detection behaves better under 2500 m. The PBLH in China is generally limited between 200 m and 2000m according to previous studies (Deng et al. 2016; Du et al. 2013; Fan et al. 2008; Huang et al. 2017; Wang et al. 2016).

The maximum of PBLH is 2433 m, which had been miswritten as 2500 m in line 169 and line 181. We revised them accordingly.

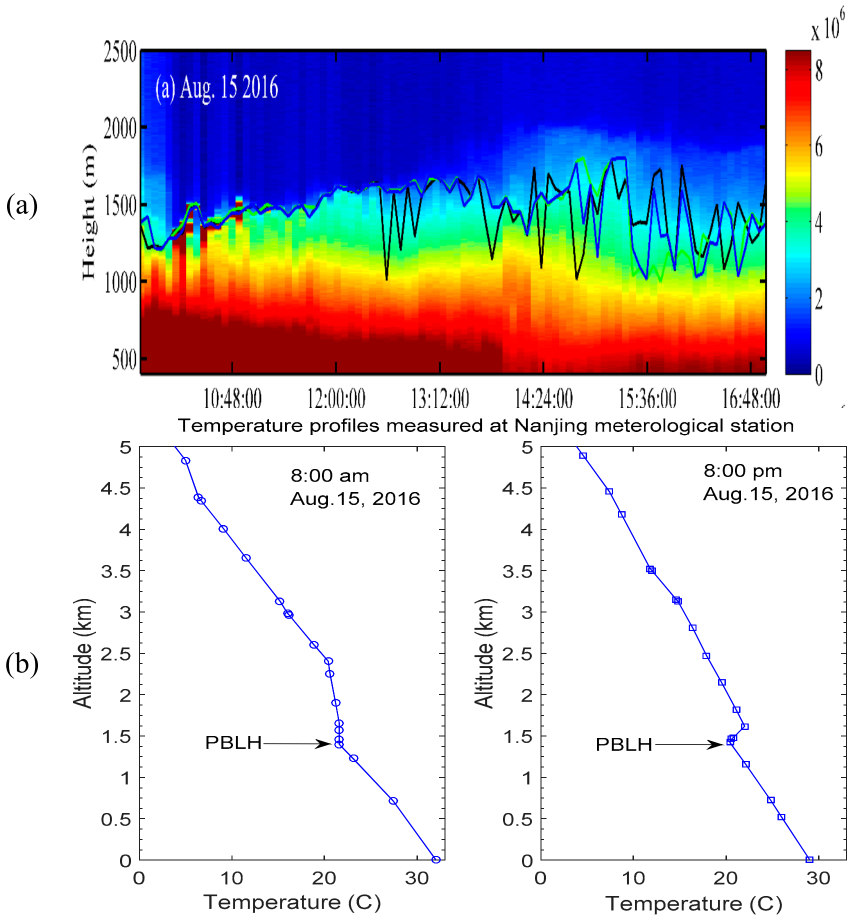


**Figure S1.** Comparison of PBL-height between the (a) Lidar and (b) radiosonde measurement on August 15, 2016.

Below we show a case analysis in summer. "The negative correlation between the PBLH and $PM_{2.5}$ concentration can also be found in the summer case study. The hourly averaged PBLH, $PM_{2.5}$ concentration, wind speed, visibility, temperature and relative humidity from Aug. 14 to Aug. 17, 2016 are displayed in Figure S2. In the morning of Aug. 14, the concentration of $PM_{2.5}$ is as low as 10 $\mu g/m^3$ and the wind speed is high. After 13:00, with the declination in wind speed, $PM_{2.5}$ concentration grows higher and reaches the top at 16:00 and remains the higher value until the morning of Aug. 15. The wind speed and PBLH on Aug. 15 is the lowest among the observation days whereas the $PM_{2.5}$ concentration is the highest. The daily averaged PBLH on Aug. 15 and Aug. 16 are 1450 m and 1733 m, respectively, and the daily variation of PBLH are shown in Figure S3. With lower PBLH, the wind speed on Aug. 15 is 2.5 m/s, 0.5 m/s lower than that on Aug. 16, which is not conducive to the dispersion of pollutants. The negative correlation in summer between PBLH and $PM_{2.5}$ is not as obvious as winter because the $PM_{2.5}$ concentration is too low. Thus the variation of PBLH in different PM pollution condition is hard to detect. The PBLH in summer may have more effect on gaseous pollutants, such as $O_3$ and $NO_x$, rather than PM, and this will be further studied in our future work.

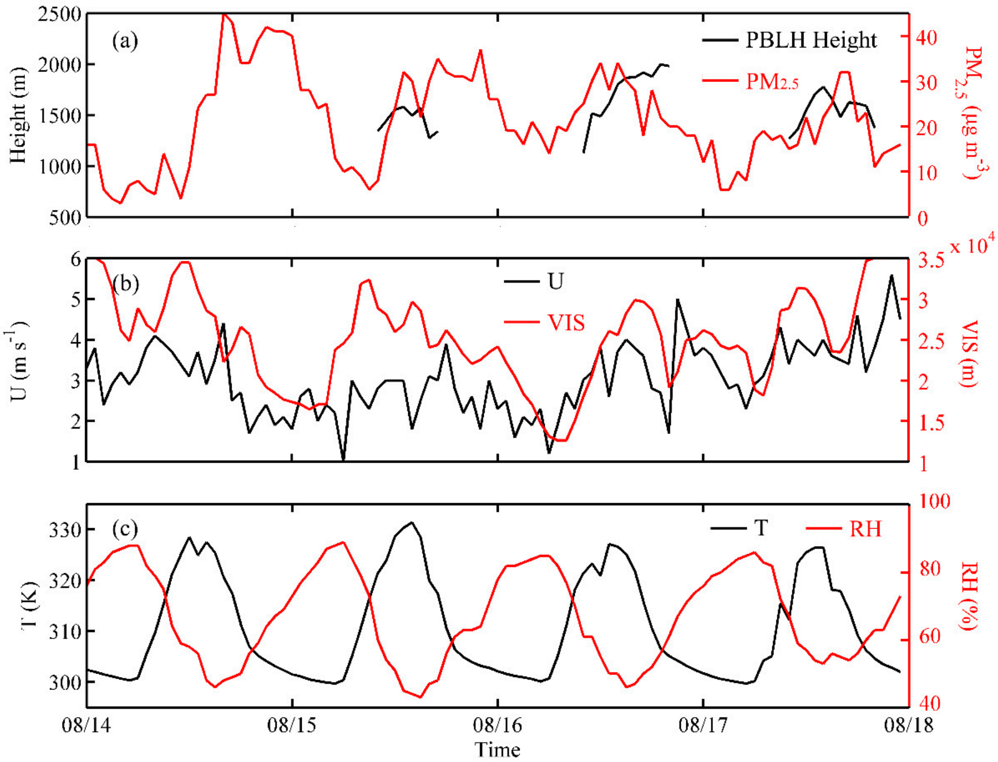


**Figure S2.** Time series of (a) PBL height and PM2.5 concentration, (b) surface wind speed (U) and visibility (VIS), and (c) temperature (T) and relative humidity (RH), respectively, from Aug. 14 to Aug. 17, 2016.

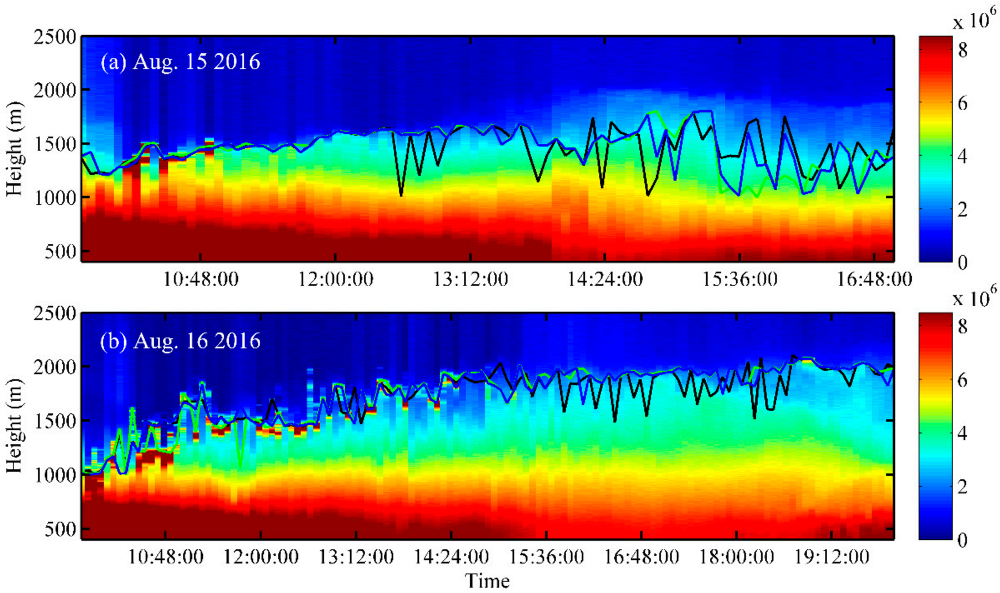


**Figure S3.** The diurnal variation of RCS and PBLH (calculated by three methods: black, blue and green lines represent GRA, STD and WCT method, respectively) in Aug. 15, 2016 (a) and Aug. 16, 2016 (b).

## References


1. Deng, T., Deng, X., Li, F., Wang, S., & Wang, G. (2016). Study on aerosol optical properties and radiative effect in cloudy weather in the Guangzhou region. *Science of the Total Environment*, 568, 147-1542.
2. Du, C.L., Liu, S.Y., 2. Yu, X., Li, X.M., Chen, C., Peng, Y., Dong, Y., Dong, Z.P., & Wang, F.Q. (2013). Urban Boundary Layer Height Characteristics and Relationship with Particulate Matter Mass Concentrations in Xi'an, Central China. *Aerosol and Air Quality Research*, 13, 1598-1607
3. Fan, S.J., Wang, B.M., Tesche, M., Engelmann, R., Althausen, A., Liu, J., Zhu, W., Fan, Q., Li, M.H., Ta, N., Song, L.L., & Leong, K.C. (2008). Meteorological conditions and structures of atmospheric boundary layer in October 2004 over Pearl River Delta area. *Atmospheric Environment*, 42, 6174-6186
4. Huang, M., Gao, Z., Miao, S., Chen, F., LeMone, M.A., Li, J., Hu, F., & Wang, L. (2017). Estimate of Boundary-Layer Depth Over Beijing, China, Using Doppler Lidar Data During SURF-2015. *Boundary-Layer Meteorology*, 162, 503-522
5. Wang, C., Shi, H., Jin, L., Chen, H., & Wen, H. (2016). Measuring boundary-layer height under clear and cloudy conditions using three instruments. *Particuology*, 28, 15-21