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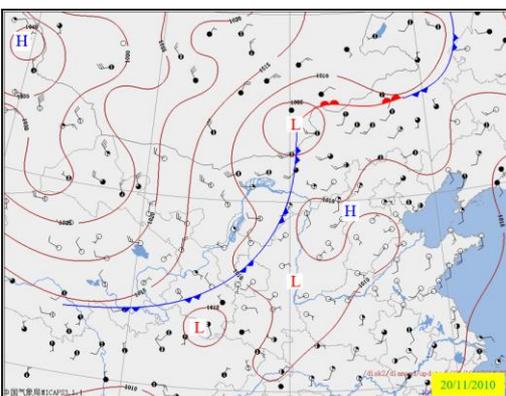
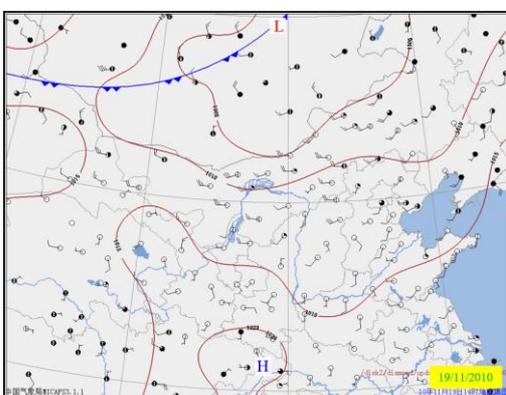
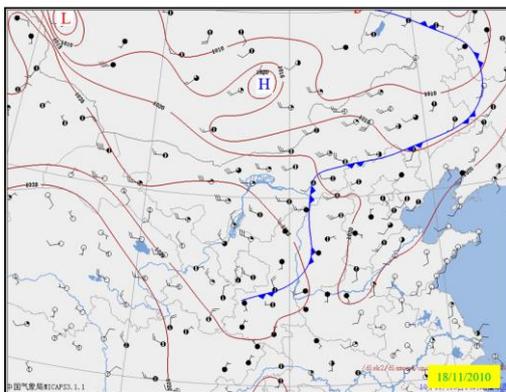
## **Rapid formation of intense haze episodes via aerosol–boundary layer feedback in Beijing**

**Yonghong Wang et al.**

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1. Synoptic conditions during this intense haze episode (these Figures will be revised tonight)



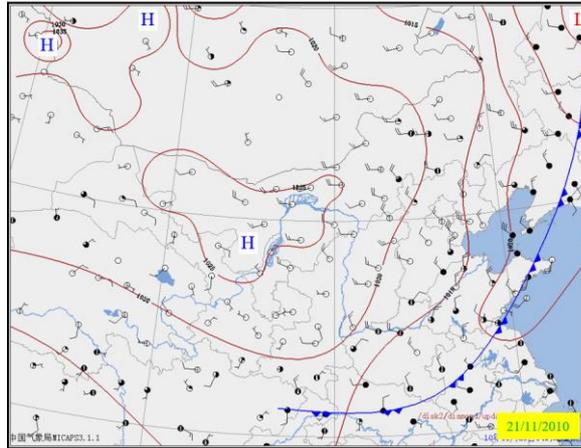
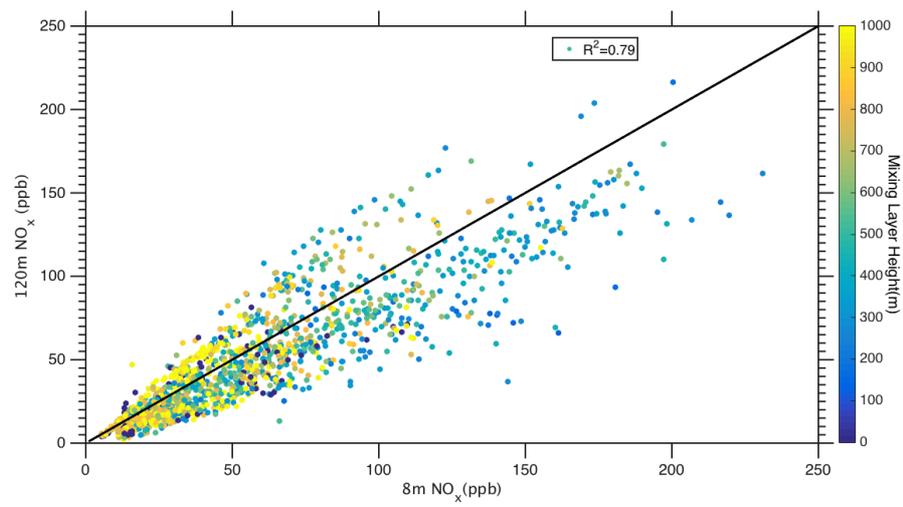
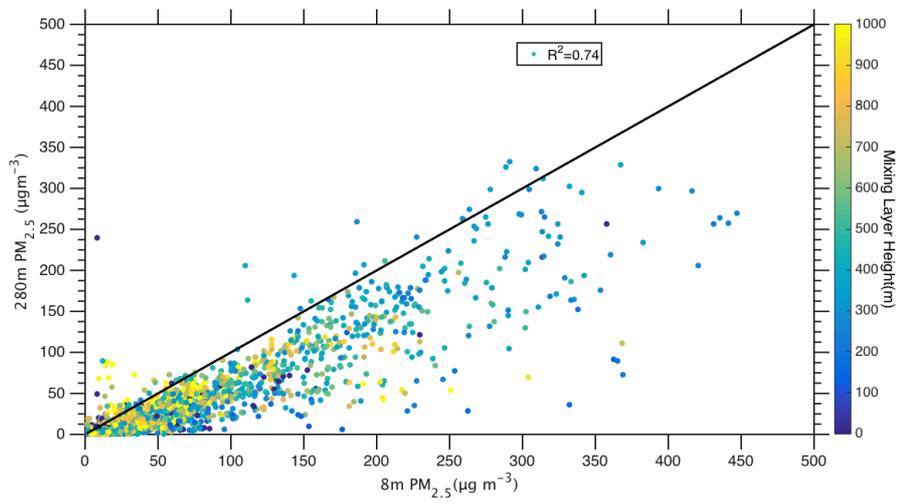
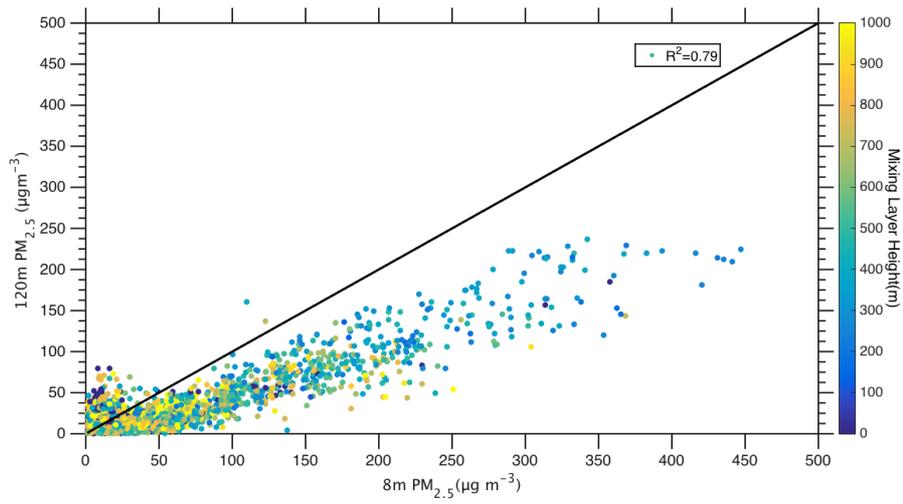


Figure s1. Synoptic weather situation during the air pollution episode. Figures are produced from MICAPS software. The red five star represents the observation site. The red 'L' stands for low pressure system, while blue 'H' stands for high pressure system. The blue line with triangle represents the movement of cold front. The meteorology conditions on the surface were characterized as high solar radiation and high ultraviolet radiation, which results in a warm temperature around 0-10 degree Celsius. The synoptic weather situation was characterised by a cold front during 16th and 17th of November in Mongolia so the surface wind speed is quite small and the wind direction is unregularly. (Figure S1). As shown in figure s5, the variation of mixing layer height can be explained mostly by variation of buoyancy flux carried out on 47m observation platform during this air pollution episode.

## 2. Characteristic of air pollutants vertical distribution in Beijing



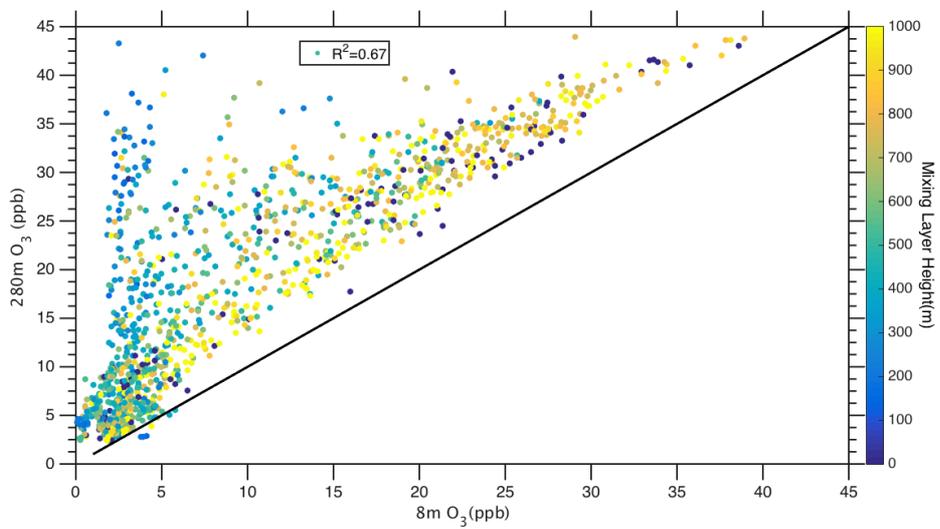
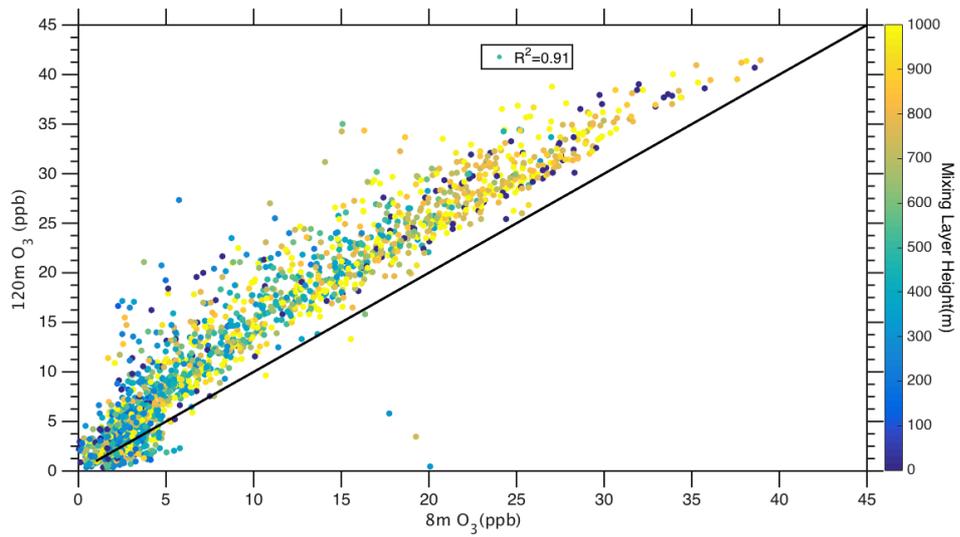
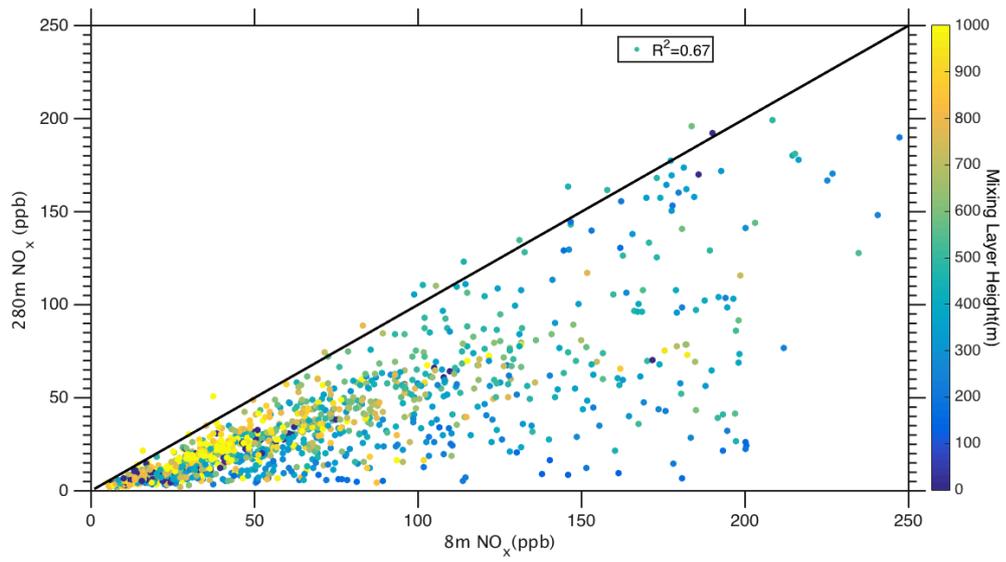


Figure s2. Vertical distribution and correlation of PM<sub>2.5</sub>, ozone and NO<sub>x</sub> in 8m,

120m and 280m Beijing meteorology tower during day time (10:00~17:00) with solar radiation values. The rainy hours were deleted.

3. Decreased solar radiation and increased  $PM_{1-2.5}$  with decreased mixing layer height

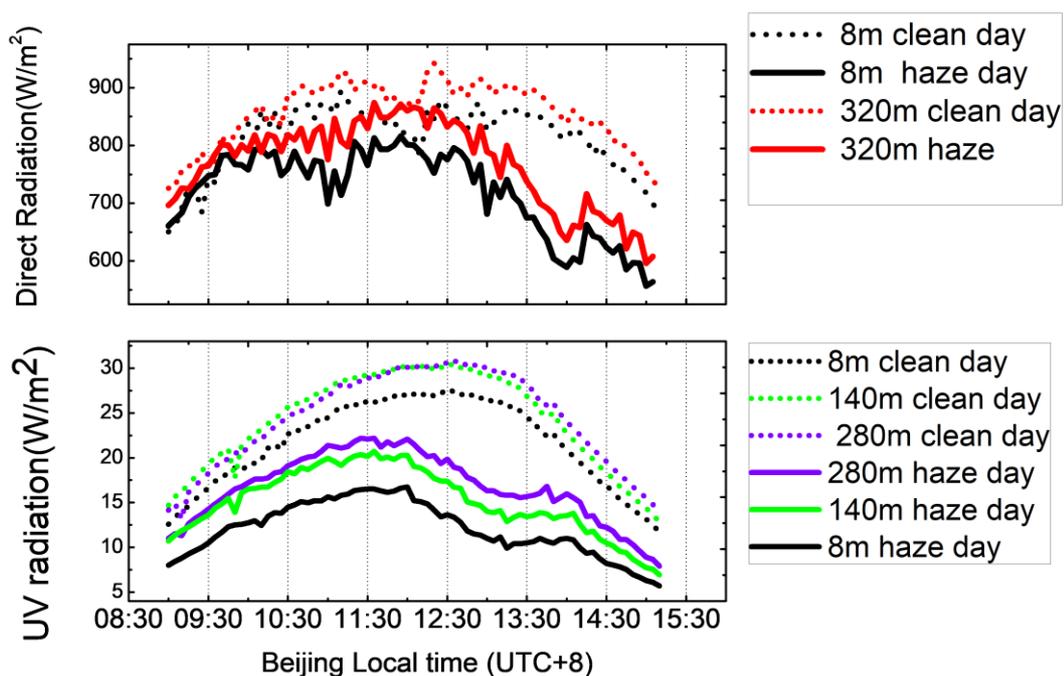


Figure s3. Vertical variation of direct radiation and UV radiation during a clean day and haze day. The direct radiation measurements were conducted at 8 m and 320m height of the tower. The UV radiation measurements were carried out at 8m, 140m and 280 observation platforms, respectively.

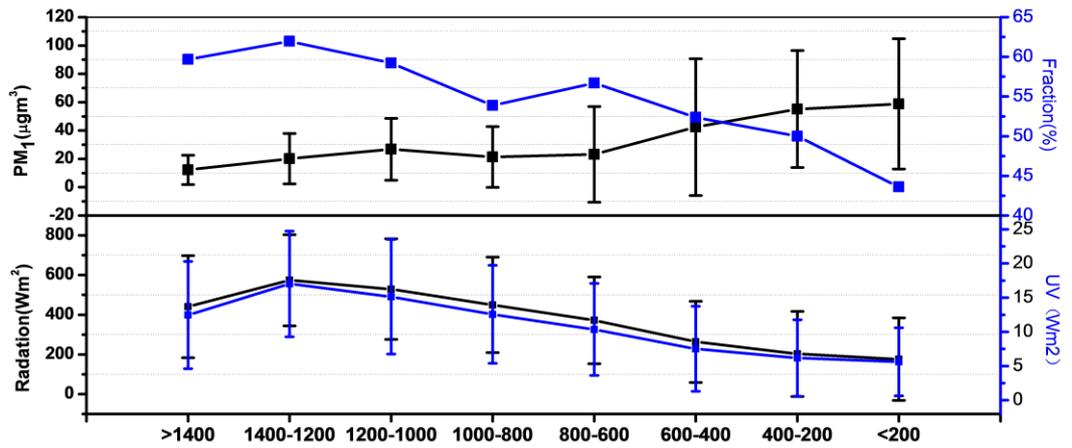


Figure s4 Variation of PM1 mass concentration and mass fraction of PM1 in PM2.5 with decreased mixing layer height (up figure) in winter, variation of net radiation and UV radiation during daytime in winter

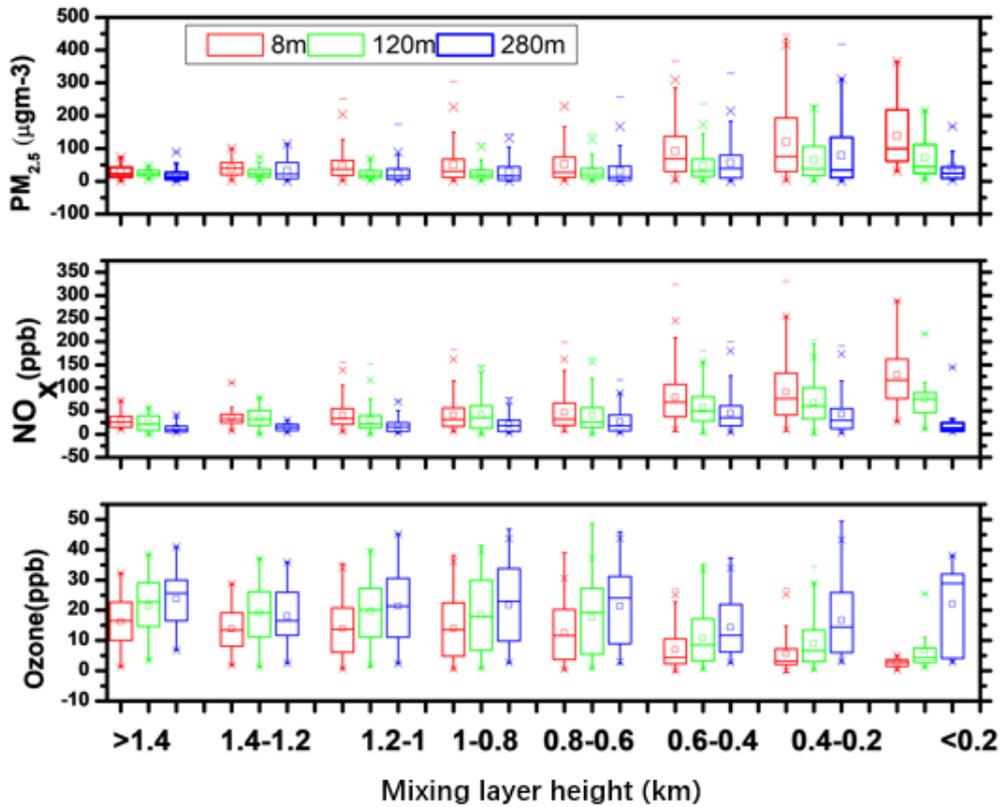


Figure s5. Statistics of variation of air pollutants at 8m, 120m and 280m with mixing layer height.

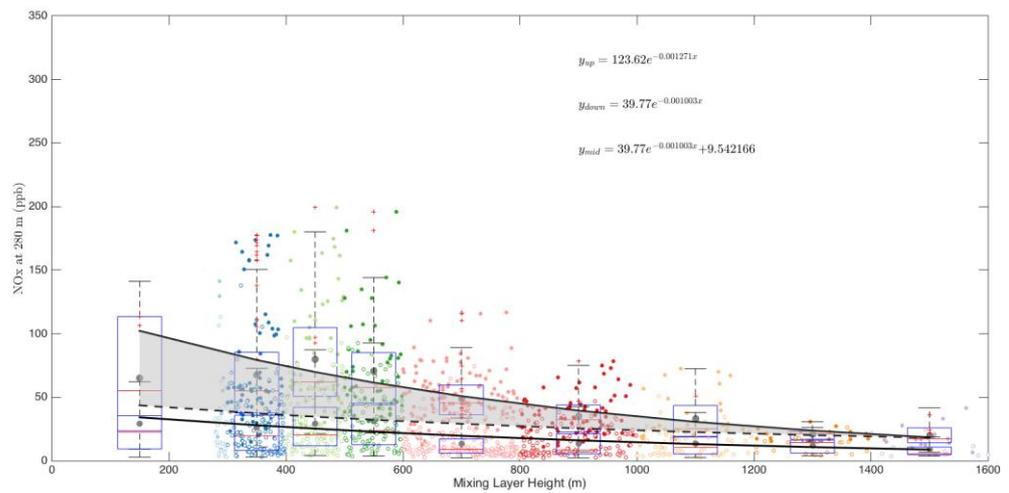
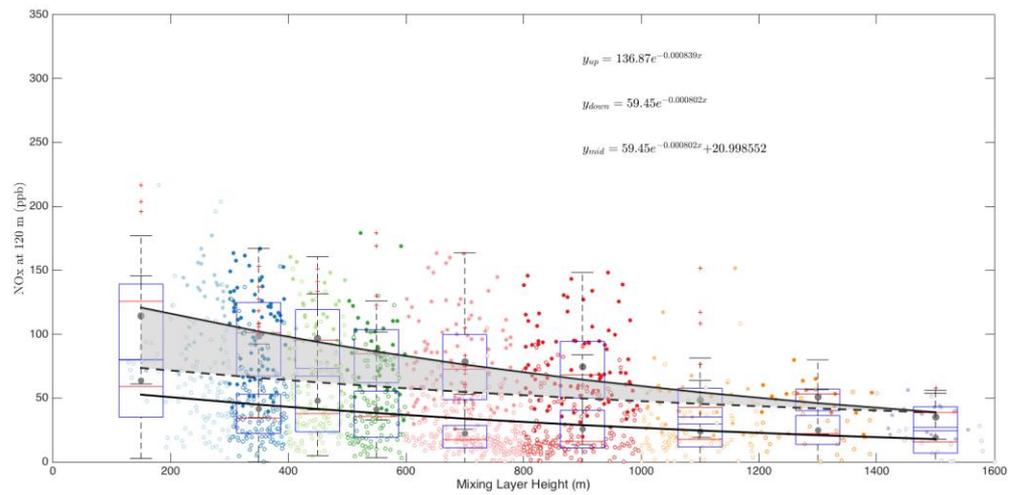
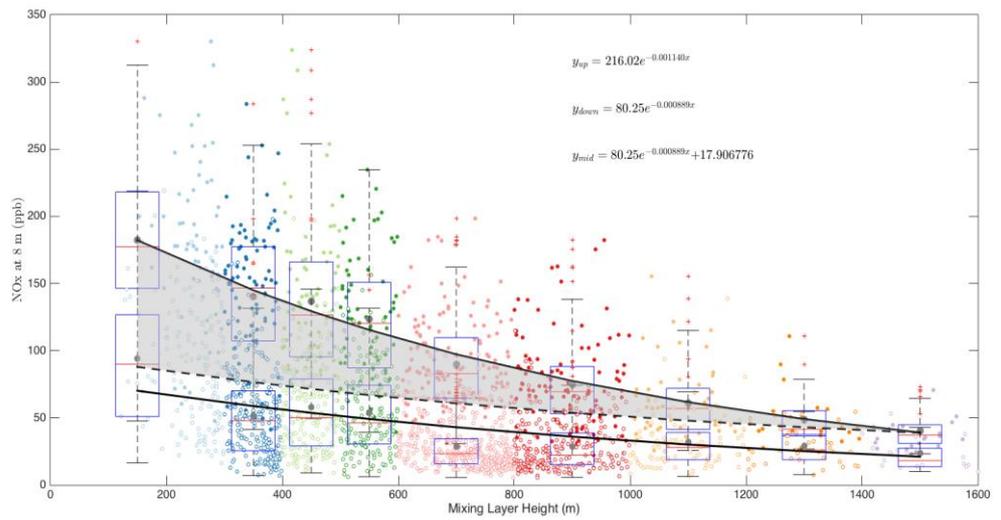


Figure s6. The variation of NO<sub>x</sub> mixing ratios with variation of mixing layer height at 8m, 120 m and 280m observation platform. The concentration of NO<sub>x</sub>

was divided into each bins according to corresponded  $PM_{2.5}$  concentrations. The solid points represent  $NO_x$  concentrations as the corresponded  $PM_{2.5}$  concentrations large than  $75 \mu g m^{-3}$  under a fixed mixing layer height. The grey points represent mean values; the red line represents medium values. The shadow area corresponding to increased amount of  $NO_x$  with decreased mixing layer height.

#### 4. Increase of secondary aerosol formation with decreased mixing layer height

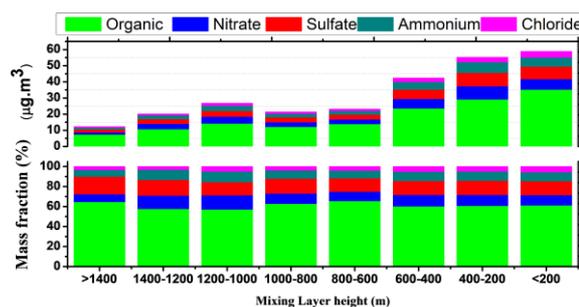
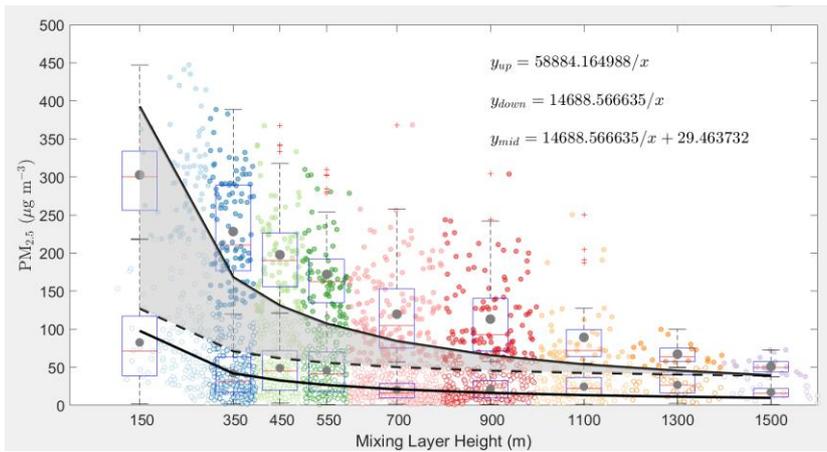
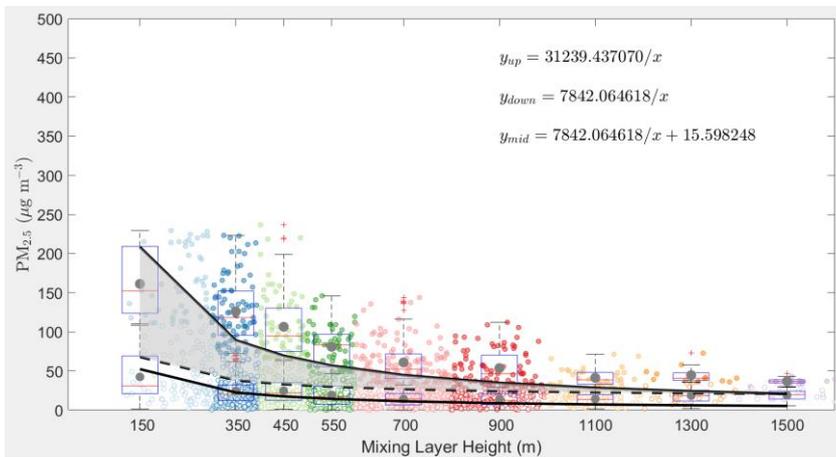


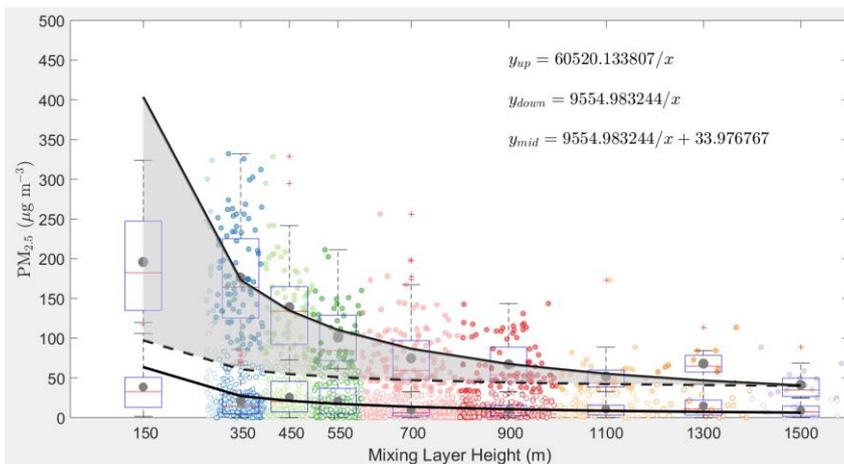
Figure s7. Chemical composition of organic, nitrate, sulfate, ammonium and chloride with decreased level of mixing layer height. The mass fraction of each composition with variation of mixing layer height are also presented. The mass fraction of nitrate, sulphate and ammonium increased, as mixing layer height decreased from over 1400m to 1000~1200m. However, the mass fraction of organic also increased with decreased mixing layer height from 1000m to less. The data was selected during daytime (10:00~17:00).



8m



120 m



280m

Figure. S8 The variability of the PM<sub>2.5</sub> mass concentration as a reciprocal function of the mixing layer height at 8 m, 120 m and 280 m.

Table S1: The root-mean-square error (RMSE) in the unit of  $\mu\text{g m}^{-3}$  between fitted functions and measured data.

Fitting function	Pollution intensity	At 8 m	At 120 m	At 280 m
reciprocal	High	53.5589	27.8437	69.7236
reciprocal	Low	12.0393	8.2159	9.3756
exponential	High	9.2853	11.4142	19.0527
exponential	Low	10.4951	6.2643	6.6181