Dear Professor,

Thank you very much for your comments on our paper! Your review and comments are very helpful to our paper, and we have learned a lot from them. We reply to your comments one by one as follows.

Comments 1: Only in the beginning, a definition of the ABL and the different layers should be helpful, e.g. Mixing Layer, Surface Inversion Layer, Capping Inversion, Convective Mixed Layer, Residual Layer.

Response： We have added the definition of the Mixing layer, surface inversion layer, capping inversion, convective mixing layer and residual layer in the latest revised paper:

"Because of the Earth's rotation, the ABL presents strong diurnal variation, leading to the formation of many different layers in the boundary layer. The mixing layer accounts for a large proportion of the ABL in the deep convective boundary layer, and at present, the height of the mixing layer is equivalent to the height of the ABL. Pollutants emitted into the ABL can reach a certain height through turbulent vertical mixing processes (Emeis and Schäfer, 2006), making it possible to determine the ABL height from the concentration of pollutants. The top of the mixing layer exhibits capping inversion. Due to a change in the surface net radiation occurring at night, a stable boundary layer begins to form at night because of the cooling effect of the ground surface, and the surface inversion layer is nearest to the ground. The nocturnal stable boundary layer is often accompanied by a residual layer that maintains the characteristics of the daytime mixing layer (Stull, 1988)." (Page2 Line7-15, revised paper).

Comments2: Usually the ABL is the turbulent layer with winds influenced by the earth surface. Within this definition the Wind Profile Radar (WPR – the full word should not only be used in the abstract) gives the best result of the ABL height. In the air quality community the mixing layer and inversion layers are more common to use in the context of air pollution concentrations. These terms are explained at the beginning of chapter 3.2. But this could be done some more concisely., perhaps extracting one day of Fig. 3 and explaining it. In Fig. 3 the heights Hc and Hu should be marked which are reffered to later.

Response： We have added the full word of WPR (wind profile radar) not only in the abstract, and wind profile radar (WPR) appeared first in the introduction (Page2 line19, revised paper) and the all the abbreviations are used later in the paper. We recalculated the ABL height determined by WPR for distinct "nose" profiles. And the

new ABL heights are exhibited in Fig.4 in latest revised paper. In addition, the heights Hu and Hc are marked as shown in revised paper. The definition of mixing layer and inversion layers have also been added in the revised paper. (Page2 Line7-10, revised paper)

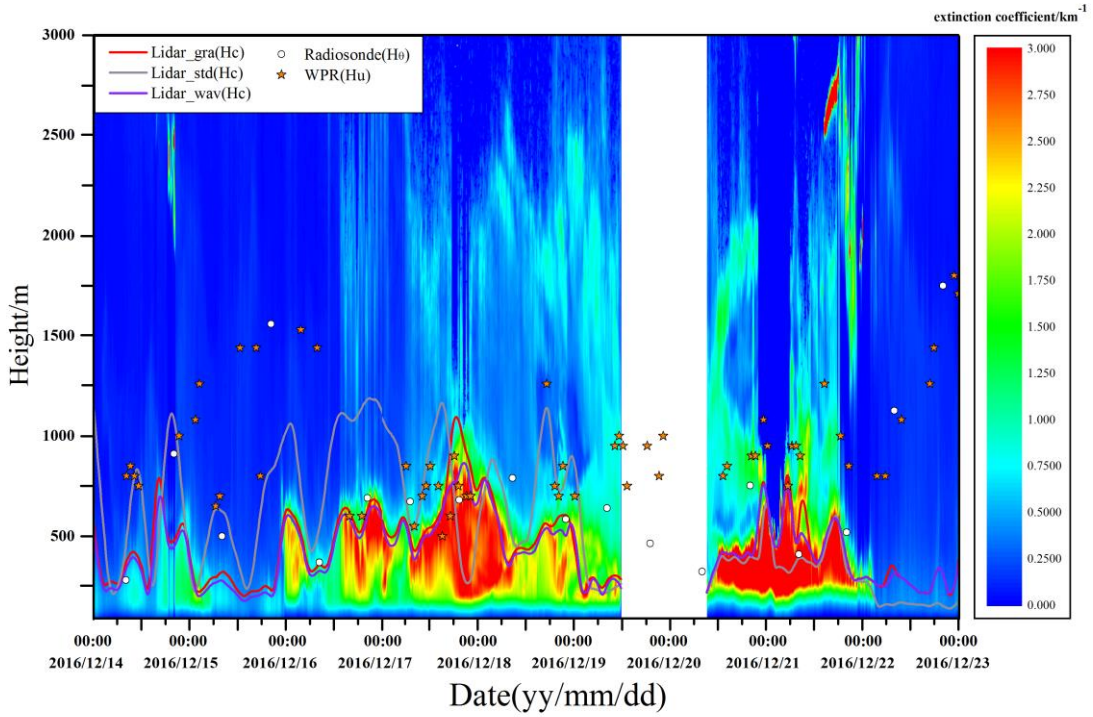

Fig.4 Temporal and spatial variations in the extinction coefficient (shaded, unit: km^{-1}) from 14 to 23 December 2016 and ABL heights (m) determined with different instruments. The red line (Lidar_gra), grey line (Lidar_std), and purple line (Lidar_wav) represent ABL heights determined by the Lidar using the gradient method, the standard deviation method, and the wavelet method, respectively. White points: ABL height determined by radiosonde; Five-pointed star: ABL height determined by WPR. It should be noted that the blank part
of the extinction coefficient can be attributed to a technical failure, and lidar data for 11:00 on December 19 to 09:00 on December 20 are missing.

Comments3: Table 2: The first column shows the air quality, I think these are PM2.5 concentration ranges. It should be mentioned. There is a general influence of humidity. But not so clear. That is why the humidity depends on the origin of the advected air (more wet or more dry). Important is the decrease jump at the inversion layer, shown in Fig. 4 and not the abolute value of the humidity. Page 13 line 5… "Hc is even heightened lightly but Hu (not Hc) reduces by…"

Response: For table2, we have explained the $PM_{2.5}$ concentration of the corresponding air quality in the table1 head, and we also accept the idea of reviewer to reexplain it in the table2 header (Page19, Table2, revised paper). As for page13

line5, “Hc is even heightened slightly but Hu (not Hc) reduces by…” thank you very much for your carefulness and we have corrected this error (Page20, Line12, in the revised paper).

Comments4: In the conclusion the role of the mixing layer and the inversion layers should be higlighted in the context with air pollution concentrations. And these layers are best determined by radiosonde soundings and lidar. The tower measurements are also helpful to determine the surface inversions height, if the inversion layer is lower than the tower height. With the Wind Profile Radar (WPR) the height of the Atmospheric Boundary Layer (turbulent) can be well determined. But for the air pollutant concentrations (PM 2.5) the inversion Layers and the Mixing Layer are relevant which is shown in this paper.

Response: In revised paper, we have highlighted the relationship between mixing layer, inversion layer and pollutant concentration in the conclusion.

“The inversion layer is closely related to the concentration of pollutants. Pollutants emitted in the ABL generally accumulate under the inversion layer. The inversion layer’s height decreased significantly during the pollution period, and the lowest value was measured at below 500m.” (Page20, Line8-10, revised paper).
