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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Rapid formation of intense haze episode in Beijing" *by* Yonghong Wang et al.

Anonymous Referee #2

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This paper characterizes the interactions between atmospheric mixing layer dynamics and fine particulate matter pollution using long-term measurements of vertical distributions of PM2.5 and NOx, atmospheric mixing layer height, vertical meteorological parameters, energy flux, etc. in an urban site in Beijing. Based on the relationship between PM2.5 concentration, mixing layer height, solar radiation, and turbulent kinetic energy, the authors claimed that they found a feedback mechanism between mixing layer height and fine particulate matter pollution that could explain the rapid formation of severe haze pollution episodes in Beijing.

This work addresses an important topic that are of interest to many of the readers in atmospheric science community. However, many data presented in the paper are not thoroughly analyzed and discussed, and the evidence claimed by the authors are

not strong enough to support their conclusion about the aerosol pollution-mixing layer development feedback mechanism. There are many important issues that need to be addressed before the publication of the paper in ACP can be considered.

Major comments:

The authors claimed that the fine aerosols can reduce the solar radiation reaching the surface, resulting in a decrease in the turbulent kinetic energy (TKE) and a suppression of atmospheric mixing layer development, which further increase aerosol concentrations from direct emission and secondary formation (i.e., the feedback mechanism). However, they did not provide clear evidence that fine aerosols play a non-negligible role in regulating TKE and mixing layer heights. As shown in Fig 1, the TKE decreases dramatically from 8:00 to 20:00 on 21 November 2010, while aerosol loadings are pretty low during this period. This suggests that the variation of TKE is largely driven by non-haze related factors. Therefore, to claim the feedback mechanism, it is important to quantify to what extent fine aerosols can reduce or regulate the TKE and the development of the mixing layer in severe haze episodes.

Other specific comments:

In the Introduction, the review of literatures is too brief. A summary of the current knowledge and remain issues regarding the interactions between boundary layer dynamics and aerosol pollution should be included, and the novelty of the present study should be clearly pointed out.

P4, Sect. 2.3 and 2.4. Please specify the altitude at which the measurements of O3, NOx, radiation, and aerosol chemical composition were performed.

Line 111. Remove "to", and "ratio" should be "rate".

Line 121-123. The HR-ToF-AMS was used to measure aerosol chemical composition. However, the data were not discussed in the paper, though a figure (Fig. S6) was included in the supplementary martial.

Line 138-141 and Figs. S2 and S4. The decoupling of the 280-m platform from the other two lower ones for O3 was shown to be much smaller than that for PM2.5 and NOx. What is the reason for this difference?

Line 171-173 and Fig. S3b. Was the PM1 measured by HR-ToF-AMS? If so, the authors should point out that measured PM1 mass concentrations do not include the refractory components such as soot and dust, whereas the PM2.5 concentrations include these components. In addition, compared to PM1-2.5, the origin of PM1 is generally more secondary. Therefore, the increase of PM1 concentration but decrease of its mass fraction in PM2.5 (as the decrease of mixing layer height) may offer insights into the contributions of primary emission and secondary formation to the haze pollution. This merits further discussions in the paper.

Line 184. “bot” should be “both”.

Some references in the reference list do not follow an alphabetical order.

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