Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2020-1273

Anonymous Referee #2

Referee comment on "Lidar vertical observation network and data assimilation reveal key processes driving the 3-D dynamic evolution of $PM_{2.5}$ concentrations over the North China Plain" by Yan Xiang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1273-RC2, 2021

General Comments:

Xiang et al. report on using three-dimensional variational data assimilation to refine WRF-Chem simulations of PM2.5 transport throughout the North China Plain based on surface and lidar observations. This paper extends on a number of other recent studies from this region by incorporating aerosol vertical profiles from a network of 13 lidars located along the main corridors for air pollution transport. The resulting three-dimensional characterisation of PM2.5 concentrations and fluxes allows characterisation of the inflow and outflow pathways for this region and the vertical structure of heavy aerosol pollution events. Furthermore, the authors were able to identify altitude-dependent differences in flux rates and direction.

The manuscript is well written and within the scope of Atmospheric Chemistry and Physics. While only examining a single heavy aerosol pollution event, the method may significantly enhance aerosol transport models in this region and could be particularly valuable in assessing air pollution control strategies. The study is presented in a clear and engaging manner and should be considered for publication after addressing the following minor comments:

Specific Comments:

Page 6, Line 33: Are the quoted root-mean-square errors and correlation coefficients calculated from the combined data at the four selected heights (surface, 0.2, 0.5 and 1 km)?

Page 11, Line 14: Although elevated concentrations are briefly visible at approximately 1km over HD and XX in the removal phase (Figs 6f & 6g), it is not immediately clear that this corresponds to north-south transport from BJ. Perhaps some elaboration is required or at least the upward wind vectors shown in Fig 8 could be mentioned here.

Page 15, Line 9: As suggested by the other reviewer, some reasoning should be included to explain why the TFI was calculated up to a height of 1.5 km, rather than some other limit.

Additional Comments:

Figure 3: For clarity, the episode numbers should be centered over each episode

Figures 4 & 5: Figure 5 should be inserted before Figure 4 since it is discussed first in the text (page 10)

Page 13, line 11: Change "come from" to "coming from"

Page 15, line 13: It is not clear what is being compared against the ground surface flux. What are the height of these fluxes? Or is this sentence providing ground surface fluxes for comparison against the maximum values across the 0 – 1.5 km range, as given in the previous sentence?

Page 16, line 10: "On the contrary" implies that the TFI value for EP contradicts the value for RP. Perhaps "In contrast" or "In comparison" would be more appropriate.