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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Vertical distributions of aerosol optical properties during the spring 2016 ARIAs airborne campaign in the North China Plain" *by* Fei Wang et al.

Anonymous Referee #2

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This study characterized the vertical distributions of aerosol properties using airborne and ground-based measurements over Xingtai, Heibei Province in north China Plain. Given the importance of aerosol vertical structure, this study presents some interesting scientific results, especially the correlations of the vertical aerosol scattering coefficients and relative humidity, based on first-hand observations. The manuscript is overall well-written but lacks of some important introduction about the vertical distributions of aerosols. Also it needs some more description about the experiment and the definitions of a few important parameters. Revisions are needed to address the following questions before the acceptance of this manuscript:

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Discussion paper

1. Introduction: This study focuses on the vertical distribution of the aerosol properties. However, it lacks of information about the importance of the vertical distribution of aerosols and the uncertainty in the observed aerosol vertical structure. The vertical distribution of aerosols is very important as it modiïňĄes the vertical proïňĄle of radiative heating in the atmosphere and affects the atmospheric stability and convection. It also inïňĆuences the radiative effect at the top of the atmosphere (TOA), particularly when the aerosols have strong absorption of solar radiation. A number of ïňĄeld programs have also been carried out to measure the vertical distribution of aerosols.

Please give a literature review about the research that have been conducted in association with aerosol vertical distribution, such as the following work:

Meloni, D., Sarra, A. D., Iotio, T. D., and Fiocco, G.: Influence of the vertical profile of Saharan dust on the visible direct radiative forcing, J. Quant. Spectrosc. Ra., 93, 497–413, 2005.

Gadhavi, H. and Jayaraman, A.: Airborne lidar study of the vertical distribution of aerosols over Hyderabad, an urban site in central India, and its implication for radiative forcing calculations, Ann. Geophys., 24, 2461–2470, doi:10.5194/angeo-242461-2006, 2006.

Johnson, B. T., Heese, B., McFarlane, S. A., Chazette, P., Jones, A., and Bellouin, N.: Vertical distribution and radiative effects of mineral dust and biomass burning aerosol over West Africa during DABEX, J. Geophys. Res., 113, D00C12, doi:10.1029/2008JD009848, 2008.

Zhang, L., Li, Q. B., Gu, Y., Liou, K. N., and Meland, B.: Dust vertical profile impact on global radiative forcing estimation using a coupled chemical-transport–radiative-transfer model, Atmos. Chem. Phys., 13, 7097-7114, https://doi.org/10.5194/acp-13-7097-2013, 2013.

2. Page 3, line 27: What does NFS stand for?

3. Section 2.1, Figure 1: It's hard to tell where the sites are with such a small map. It would be better to give a larger geographic map, at least for China and the coastal area, and then a zoom-in map for north China Plain and the sites.

4. Section 2: Is this the first time that the ARIAs project is introduced (I didn't see any reference). If yes, I would suggest that a little more information should be given to describe the scientific objective of this project and justify how the super site in Xingtai was chosen.

5. Section 4: What is the definition for clean or polluted PBL, e.g., using a critical value of AOD within PBL? What is the scale height Hp in this study? Normally it represents the height when the aerosol is reduced to 1/e of its surface value. Is it a prescribed value or determined from the observation? And how is PBL height determined from scattering coefficient in this study?

6. Section 4.1 & 4.2: What ambient RH is used to determine the cases as dry/humid conditions, e.g., the average RH within PBL or the RH at a certain level? What is the percentage of the dry and humid cases?

Figs. 6b & 7b are interesting. Since Fig. 7b is done by separating dry and humid conditions, it would be interesting to see Fig. 6b in dry and humid conditions as well.

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