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 #1

Received and published: 8 February 2018

Overall comment: This manuscript presents a study of aerosol optical and vertical distribution over the NCP region using aircraft measurements and ground based data obtained from 2016 ARIAs airborne campaign. Among many recent research on the Chinese air pollution, this manuscript provides a new insight on the linkage between PBL structure and aerosol optical properties in vertical prospective. Although the instruments and methodology is not new, the integrational efforts on a suite of instruments equipped to Y-12 aircraft and cooperating with surface measurements should be recognized its importance. The group have rich experiment (many papers published) on aerosol observations as well as airborne measurements, turns out some descriptions on the methodology have been simplified, and scientific discussions tend to draw con-

clusions quickly without strong statement. For example, there is lots of room for the Table 3 SSA comparison discussion, especially the main goal of this paper is to discuss the consistency of airborne and surface-based measurements (Page 3, line 8). The paper is generally well-written and the reviewer does not have difficulty to follow the context. Following comments are provided where I think the paper needs improvement, especially at some places more clarity and insights are needed. My summary recommendation to the Editor is that this paper be major revision, and that the paper be recirculated for secondary review after revision.

General Comments: (1) The aerosol inlet system on the aircraft should be discussed in the manuscript. It strong related to how to evaluate the accuracy of airborne aerosol measurement. (2) SSA is a very sensitive and unstable parameter. Authors should provide the detail descriptions on how to calculate the columnar SSA from airborne measurement data and their uncertainties? When different aerosol types or multi aerosol layer in vertical, how authors apply to the calculation? (3) Expending the discussion on the Table 3. Why only 28 May, 2016 case shown in the table? Maybe the scatter plot of AERONET SSA vs Aircraft in situ for each flights can provide more strong conclusion. (4) How to calculate AOD for different layers (Fig 5) should describe in the manuscript. (5) In figure 5(b), it is not clear how authors define the PBL height? Although in the manuscript, the authors say they determined by aerosol scatter profile (Page 9, line 28), does that quantitatively define PBL height? In figure 5(b), how does authors apply the normalization? Does use 1400m PBL height or individual PBL height from each profiles? (6) It is not clear why the authors use the scale height (eq 6 and 7) here? Is that only to calculate the mean profile (or Fit mean in Fig 6)? (7) RH and scattering coefficient have strong correlation. Does mean that the PBL aerosol is well mixed and the different in aerosol scatter is due to aerosol hygroscopcity?

Specific Comments: (1) Figure 2a: why the large discrepancy between airborne and sounding data? In the airborne T profile, one can not easy determine the inversion layer. (2) Equation (1): what is the r value? (3) Equation (2): what is the C value? B

is beta right? (4) Does adjusted Beta sca (Beta sca_adj) use in the follow analysis? If yes, author should maintain the symbol consistency. (5) Page 5 line 4: for loading? (not clear) (6) The equation should better insert in a paragraph, not like equations (4) and (5). (7) Equation (6): what is Hp value used? (8) Equation (7): What is k value? (9) Page 10 (lines 5-6): The correlation. . .. ...is suitable, please remove since not necessary (not relevant) to discuss here. (10) Page 10, line 21: Why affected by the long-range transport? (11) Page 10, line 23: Figure 9c, 9d.