

Interactive comment on “An intensive study of aerosol optical properties in Beijing urban area” by X. He et al.

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General comments: The paper analyzes absorption coefficient, scattering coefficient and single scattering albedo (SSA) of aerosol based upon two-year's ground-based observations. This reviewer thinks that the analysis of the paper has seriously problems, and has many misleading conclusions. As a result, this paper is lack of scientific merit for ACP, and cannot be accepted for publication.

Answer (A): Thanks for the reviewer's contribution to this paper. His concern will help us to greatly improve the manuscript. We understand the main concern is about the usage of the conversion factor from black carbon concentration to absorption coefficient (We will reply it in the following specific comment). But we do not agree that the analysis of the paper has seriously problems. The aerosol absorption coefficients data calculated
C3654

from this conversion factor may have 10~20% error in our estimation (P11419_10-18) but it would introduce a smaller relative error of the single scattering albedo (1~3%, we will add detail analysis in the revised manuscript). The conclusions from the diurnal change, seasonal difference and wind dependency based on the observation data should not be misleading. The single scattering albedo is a key parameter in climate modeling and aerosol satellite retrieval (see first paragraph of the Introduction). Many observation results for the variable over China are based on some short measurement campaigns. However, our study is based upon a two-year observation; it is the first time to publish the result from a long period observation for this parameter over an urban site of China. This should be our contribution to the aerosol forcing study and aerosol remote sensing science.

Specific comments:

1)Q:The main focus of this paper is to obtain the absorption coefficient by applying the measured data from Aethalometer. The reviewer thinks it is questionably to use the conversion factor 8.28 for black carbon concentration to absorption coefficient. As a site dependent factor, the factor of 8.28 which obtained in south china in the paper cannot be directly applied in northern China. Thus, the result in the paper is doubtfully and may mis-lead readers.

A: Thanks for the reviewer's comments. The comparison observation between an absorption directly measuring instrument (for example, a Photo-Acoustic Spectrometer - PAS) and an Aethalometer is indeed rarely performed in China. The factor 8.28 we used in the study was obtained in south China by foreign researchers; it is also the only value we can found in the published literatures. The reason is the instrument PAS is more expensive than an Aethalometer; no one operated it and did comparison with the Aethalometer in North China several years ago. We fully agree that this factor is not only a site dependent factor but also a time dependent factor. We have mentioned that its error may introduce 10-20% error on the estimation of aerosol absorption coefficients (P11419_10-18). For an average estimate, when the mean scattering coefficient

is 288 Mm⁻¹, and absorption coefficient is 56 Mm⁻¹ in our study, it will introduce only 1~3% error of the single scattering albedo. This error is significantly less than the current uncertainty in climate modeling or aerosol satellite retrieval. We also cited the paper by Yan et al. (The measurements of aerosol optical at a rural site in Northern China, *Atmos Chem Phys*, 8, 2229–2242, 2008), which used the same value of the factor to get reasonable results about the absorption coefficients in North China.

2)Q: The statement and its citation of “The Beijing aerosol contains a high amount of black carbon...vehicle exhaust particles” (P11416-2_4) are improper. Some citations are based upon very short period observation, and they are not suitable to support this statement. This reviewer thinks that some source appointment literatures should be included to defend this statement.

A: Thanks for the reviewer’s suggestion. We will add some source appointment literatures in the revised manuscript. “The Beijing aerosol contain a high amount of black carbon, dust from construction activities, coal burning particles, factory and vehicle exhaust particles”, we think the statement has no big mistake, many research results can support it.

3)Q: The statement of “The dependence of . . . is rarely studied.” (P11416-22_23) is not true. The author omits a number of Chinese literatures which related to this study.

A: Thanks for the reviewer’s suggestion. A number of Chinese literatures and English literatures which related to this study should be cited, some results about the dependence of aerosol optical properties on meteorology can be found, but no the aerosol single scattering albedo from a long period (2 years) observation. The statement is wrongly used to express our meaning.

4)Q: Without any of observation data regarding boundary layer, the analysis of boundary layer impact on BC concentration in this paper (P11420-18_21, P11425-11_12) is too superficial to be believed.

C3656

A: “Meanwhile, aerosol concentration is also dependent on the stability of boundary layer, which is usually unstable in the daytime while stable at night. Beijing urban boundary layer showed diurnal pattern with low height values at night and much higher values during the daytime (Benjamin et al., 2006)” (P11420-18_21). “Generally speaking, the stable boundary layer in night prohibits the dilution of pollutant, while the unstable boundary layer in daytime is beneficial for mixing of the pollutant” (P11425-11_12). Thanks for the opinion of referee. But we could not find any problem in the above statements about boundary layer effects on air pollution in Beijing. The statements are based on some general knowledge of boundary layer meteorology. We think it is not necessary to present observation data showing the boundary layer is unstable in the daytime and stable at nighttime.

5)Q: The paper attributes the difference between summer and winter scattering coefficient to secondary sulfates formation based upon a previous work conducted in 2000, which is outdated and has a large uncertainty.

A: We will add some new researches from recent literatures to support our analysis.

6)Q: The paper attributes the higher scattering coefficient to the higher RH in summer, which the higher hygroscopic growth of aerosols leads to larger particle size (P11422-8_11, P11422-21_22, P11425-21_23). This statement is conflict to the previous statement that in which the authors claimed that the nephelometer has an auto heater to maintain the RH of inlet flow below 60%. So the scattering coefficient observed in this study just depends on the dry aerosol and should be independent with the RH.

A: No. Although the nephelometer has an auto heater to maintain the RH of inlet flow below 60% to prevent high moisture air going into the measuring tube, it just works when the RH is above 60%. The RH of the air flow in the tube still varies between 0 ~ 60%. The scattering coefficient observed in this study still depends on the RH (0~60%).

7)Q: Based on the two years observation, the author deduces that the scattering co-

C3657

efficient is higher in 2006 than in 2005 (P11422-13_15, P11425-7). Such conclusion has no statistical meaning and is too arbitrary. The variability and trend of scattering coefficient is very complicated, and not be determined by the 2 year result.

A: We just give an observation fact from our measurements and give some explanation for the possible reasons. We found the difference of the yearly mean observation is significant. We agree that the true reason should be investigated from much longer observations. In the revised manuscript we will remove some 'arbitrary' judgments.

8)Q: The explanation of relationship between scattering coefficient, absorption coefficient, SSA and wind is confusion. For example, the analysis on Figure 7 is improperly conducted.

A: We are using the circular maps to present the relationship between scattering coefficient, absorption coefficient, SSA and wind direction and wind speed. Using this kind of maps is a new way to compose the relations between a variable and wind direction and wind speed together. It is possible the referee cannot understand the map. We will improve the English statements in the manuscript, but we insist on our analysis has no problem on Figure 7. To further interpret the meaning what the figure 7 tell us we also have given the Figure 8. They presents when the wind is from different direction the value of single scattering albedo are very different. The one with southeasterly is always higher than the one with northwesterly. We think it is an important finding of our study. It is useful when using a priori of single scattering albedo in climate modeling or aerosol remote sensing from satellite.

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