

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: This manuscript describes optical properties of aerosol particles from a long-term measurement period (2 years) in Beijing. Scattering and absorption coefficients were measured and single scattering albedo was calculated. These results were correlated with wind direction and wind speed. The seasonality differences of the optical properties are very interesting as what can be learned from these long term (compared to month long intensive measuring campaigns) measurements. However, there are three major issues with this manuscript that must be addressed before acceptance to ACP.

Answer (A): Thanks for the reviewer's comments. We will improve our manuscript according to the following 3 issues.

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1)(Q):Put their results in context of earlier studies. The authors state in the introduction that "the dependence of urban aerosol optical properties on the meteorology in Beijing is rarely studied." However, that is not true. There was a recent intensive campaign in Beijing (CAREBeijing) in 2006 that studied many aspects of the Beijing aerosol, including the impact on meteorology. Garland et al., "Aerosol optical properties observed during Campaign on Air Quality Research in Beijing 2006 (CAREBeijing-2006): Characteristic differences between inflow and outflow of Beijing city air," JGR 2009 investigates the relationship between wind speed and direction, and aerosol optical properties in Beijing. In addition to this work, there is the modeling work of Streets et al., 2007 and Chen et al., 2007 as well as many other studies measuring the aerosol optical properties in and around Beijing. This current manuscript does not adequately build upon the current state of knowledge of this subject because it does not acknowledge much of the work that has already occurred on this topic. Thus, the author's should expand their discussion of previous work in the introduction as well as compare their results to this previous work throughout the paper.

(A): Thanks for the reviewer's comments. We indeed missed some important references. In the revised version, we will add the new important literatures related to this study. We fully agree that the statement "the dependence of urban aerosol optical properties on the meteorology in Beijing is rarely studied" is wrong. Our meaning is "the dependence of urban aerosol optical properties, especially for aerosol single scattering albedo, on the meteorology from measurements of a long-term period not from month long intensive measuring in Beijing is rarely analyzed in a statistic view". We will expand the discussion of previous work in the introduction as well as compare our results to previous work.

2)(Q):Increased rigor of data interpretation. The authors make many statements in this paper that are very strong and not supported with additional data. In particular are the statements about the diurnal cycle of the scattering coeff in the summer being due to production of secondary aerosol formation. While their data may be consistent with

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that, the authors show no evidence that would lead the reader to this same conclusion. The same is true with the statements surrounding the direct emission of BC. For the increase in scattering during the day in summer, the changes in RH most likely have a larger impact than aerosol formation; however the authors do not delve any deeper into this subject other than to say that both are a possibility. This lack of proper interpretation of their results is the major weakness in their manuscript and must be fully addressed before this manuscript should be considered for acceptance.

(A): Thanks for the reviewer's comments. Our some statements are not clear we will improve them in the revised manuscript. It indeed includes the contribution of the averaged higher relative humidity in summer that the mean scattering coefficients in summer are higher than in winter. However, for the diurnal change, from 5'o clock to 10'o clock (local time) in the morning there is a gradually increasing process on the scattering coefficients and a peak at 10' o clock, and it is more significant in summer than in winter. We concluded this is mainly due to the production of secondary aerosol formation with the increasing shortwave radiation and temperature. Humidity effect can be excluded because the relative humidity is decreasing in the morning time with the increasing temperature. Meanwhile, the decreasing after 10' o clock is due to the increasing relative humidity and some contribution from increasing mixing layer. We should give more clearly interpretations in the revised manuscript.

3)(Q):Proper treatment of RH. In general, the reporting on the optical coeff in this manuscript does not pay close enough attention to relative humidity. In the experimental set-up the authors seem to state that the nephelometer has a threshold value of 60%RH (?). I assume that means the RH in the nephelometer can range from 0-60%. Such a set-up is incompletely thought out and does not lead to comparable data. As the scattering coeff can change greatly with RH, it is not acceptable to measure and compare the scattering coeff at different RHs without somehow accounting for the changes in RH. The authors must try to account for these changes in RH and how it may impact the scattering coeff (it seems as if the nephelometer was run at a constant

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RH, if that is not true, then the same sensitivity must be done for the absorption coeff). This changing RH will also impact the single scattering albedo. Both the absorption and scattering coeff must be at the same RH to correctly calculate single scattering albedo; it does not seem as if this is the case with the current manuscript.

(A): Yes. The RH in the nephelometer can range from 0~60%. Higher moisture air is heated to prevent rain or fog water going into the measuring tube of the nephelometer. The main purpose of this study is to present the environmental status of the aerosols over urban area in Beijing. If the relative humidity threshold is set to above 60% rain drops and dew water over aerosols will come into the nephelometer in raining or foggy days and in cooling nighttime. Most measurements of scattering coefficients by nephelometer in literatures are operated in this way and get results of scattering coefficients with changing RH (0~60%). From the current statics results of diurnal change we can see the total effect of relative humidity and emission source and secondary formation (see above question 2). The variation of scattering coefficients would give useful information on satellite remote sensing to set a suitable value of single scattering albedo by considering its vertical profile. We will prepare another paper to study the RH effect on the scattering coefficients with the measurements of Tapered Element Oscillating Micro-Balance (TEOM) measuring mass concentration and forward scattering visibility sensor measuring scattering coefficients in absolute environmental status.

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