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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Analysis on the impact of aerosol optical depth on surface solar radiation in the Shanghai megacity, China" *by* J. Xu et al.

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We want to appreciate the referee for providing the meaningful comments for this paper. We are benefited a lot from the specific comments and technical corrections to improve the paper for publication. According to comments of the referee, we revised the manuscript as detailed in the following replays. (1) On page 6, line 11, the introduction on MODIS as "... 0.4 um to 14.4 um" is referred to the MODIS website http://modis.gsfc.nasa.gov/about/design.php which has been supplied into the related content of the paper. (2) On page 8, line 26-27, we mentioned "The secular variation of DfSR under all-sky and clear-sky conditions show less coherence than that of DiSR from 1961 to 2008". It is because during the secular variation of DiSR, the three periods as indicated in Fig.1 and Fig.2 are very clear both in clear-sky and all-sky

conditions. The situation is quite different for DfSR, because DfSR clearly showed the three periods as "brightening", "stabilization" and "Re-brightening" during 1961-2008 in clear-sky conditions, while abovementioned characteristics are not significant in all-sky conditions as indicated in Fig.2. (3) In Sect. 3.2, we complemented a new paragraph to put forward the possible reasons for the seasonal difference of AOD in Shanghai megacity as following. The difference of the correlations between AOD and SSR among spring, summer, autumn and winter indicates the seasonal variations of the aerosol optical properties. Based on the MODIS AOD measurements from 2004 to 2007, the mean Terra AOD in Shanghai megacity is 1.00, 1.06, 0.73, 0.66, and the mean Aqua AOD is 1.10, 1.00, 0.73, 0.72 for spring, summer, autumn, winter respectively. It is worth note that the AOD in Shanghai megacity show obvious seasonal difference, in spring and summer AOD is much higher than that in autumn and winter. This is possibly attributed to the regional climate which has an important role on the dynamical and chemical processes of aerosol such as the peripheral aerosol transportation, mixing layer height which impacts the aerosol vertical distribution, as well as the gas-particulate transformation [Li et al., 2003]. In spring, frequent dust storm originated from North China can affect east of China significantly [Li et al., 2003]. The migration of the dust storm transports large number of coarse particulate matters from north to south in China, thus enhancing the aerosol level and leading to high AOD in the Yangtze Delta region including Shanghai megacity. In summer, the weather in Shanghai is typically hot and wet, which is beneficial for the gas-particulates transformation process and generates largest size of water-soluble aerosols. On the other hand, the mixing layer height is highest and the convection activities are most frequent in summer during a whole year, which efficiently promote the vertical transportation of aerosol from the surface to high level. The above dynamical and chemical processes tend to mutually result in high AOD in this season. In autumn and winter, AOD in Shanghai decreases dramatically compared to that in spring and summer, and usually reaches the minimum value in winter. In these two seasons, Shanghai is always controlled by the cold high pressure. The westerly and northerly prevail in

this area with high velocity both on surface and high level, leading to good dispersion condition for airborne pollutants. Therefore in autumn and winter the AOD is quite lower than that in the other two seasons. As pointed out by Li et al. [2003], besides regional climate, there are some other elements can influence the vertical distribution of aerosol significantly such as Land Use/Land Cover Change (LUCC), local emission, etc. So detailed investigations on the seasonal variation of AOD in Shanghai megacity should be performed in the future studies. (4) Only under the condition that there is no cloud during the satellite passage, AOD can be measured by MODIS. Thus we could not obtain the valid AOD measurement in each day. Based on above reason, we chose an untraditional method for AOD weekly analysis [Xia et al., 2008; Quaas et al., 2009], that is, during a week cycle, the AOD percentage departures ranging from Monday to Sunday from the weekly average are calculated. This method pays more importance to the relatively AOD contrast rather than the absolute AOD quantity during a week period. Moreover, in this study the AOD data used for weekly analysis must meet the following requirements: AOD should be observed at least 2 days per week, of which at least 1 day among the weekdays (Tuesday to Friday) and 1 day among the weekends (Saturday to Monday). As pointed by the referee that in Fig.7 Terra-AOD is lower on Saturday than the weekly average but not obviously lower. The result indicated in Fig.7 for Terra-AOD is based on the analysis by 105 weeks records. We agree that more AOD data with longer time series need to be collected and investigated to achieve more accurate results because statistical result is closely related to sample quantity. On the other hand, AOD is notably impacted by local emissions, chemical reaction, as well as regional climate. In addition to human activities, the AOD weekly variation can be significantly affected by some physical and/or chemical processes, which are capable of weaken or enhance the AOD weekend effect notably. In general, the weekly analysis method is suitable for the comparison of relative magnitude between weekend and weekdays, but is not very sufficient for quantify the exact value especially for AOD which could not be observed in each day. (5) In sect. 2.2, we define the weekend effect to quantify the AOD difference between weekend and weekdays.

The weekend effect is defined as the percentage difference of averaged departure of weekdays and that of weekend, namely using the percentage of weekdays minus that of weekend while not weekend minus weekdays. This is for the purpose to be consistent with that implemented in several recent studies about AOD weekly analysis [Xia et al., 2008; Quaas et al., 2009]. Thus, according to Fig.7 and Fig.8, on weekend both AOD and DfSR are lower than their weekly average, while corresponded by the positive percentage. (6) All the technical corrections providing by the referee have been performed in the updated manuscript and figures.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/11/C486/2011/acpd-11-C486-2011-supplement.pdf

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 627, 2011.

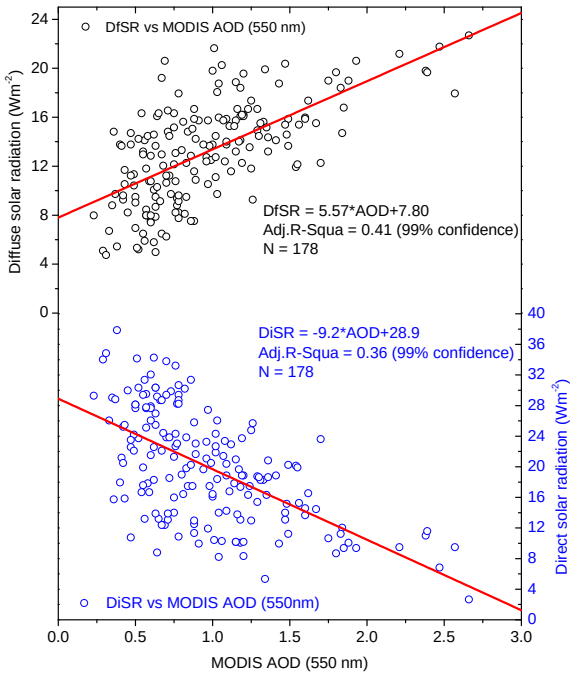

Fig. 1. figure 4

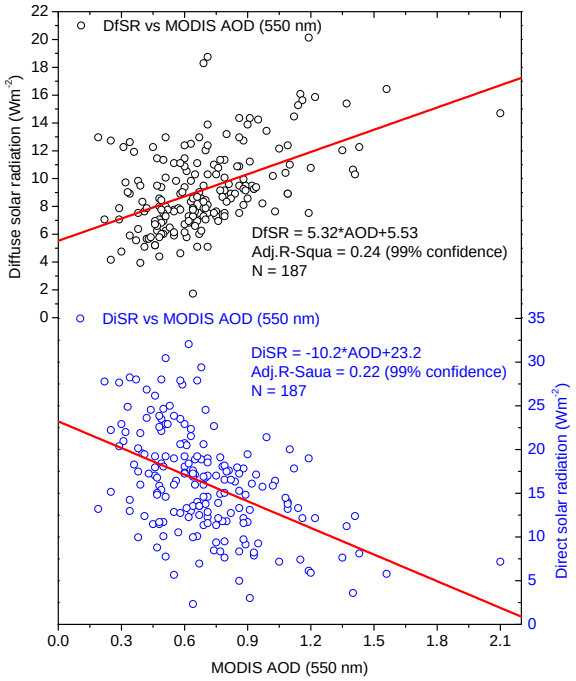

Fig. 2. figure 5

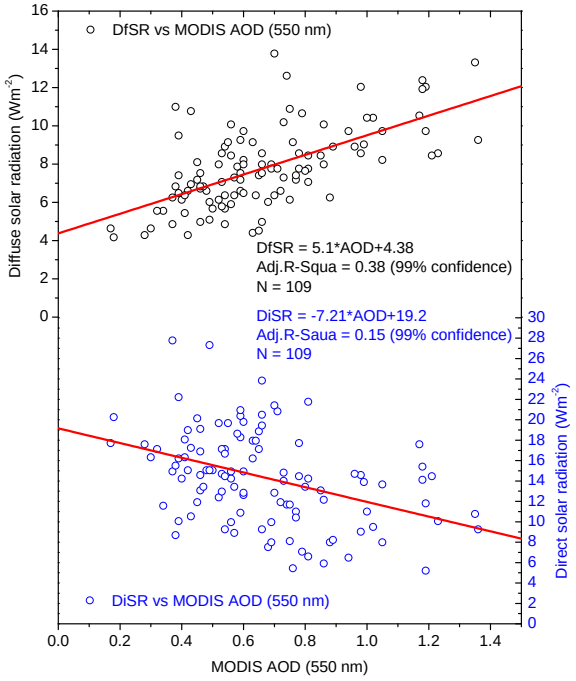

Fig. 3. figure 6