Response to Referee #2

"Direct radiative effect of carbonaceous aerosols from crop residue burning during the summer harvest season in East China (acp-2016-759)"

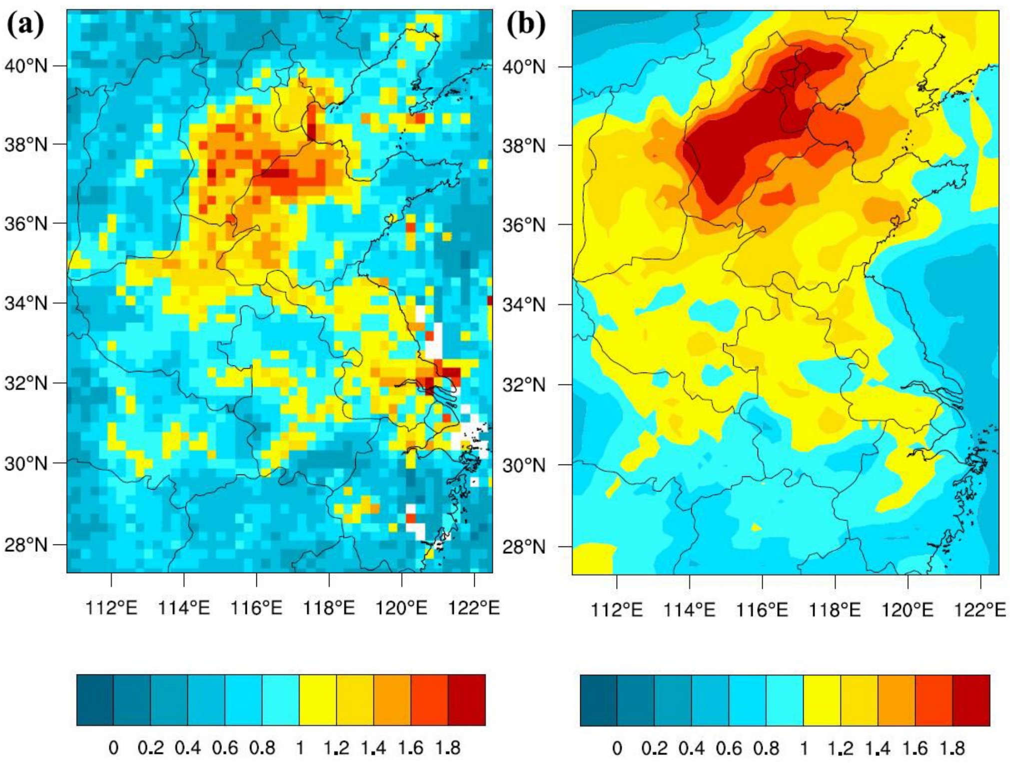
This is a well-written manuscript focusing on the timely subject of DRE of carbonaceous aerosols emitted by crop-residue burning in East China. I believe that the manuscript is suitable for publication in ACP. Below are a few comments:

1. Line 245: AOD calculations. Instead of doing linear interpolation to obtain AOD at 550, it is more appropriate to use a power-law fit – i.e. calculate the Angstrom Exponent from the other wavelengths.

Response: Accepted. We recalculate the AOD and AAOD at 550nm using the power-law fit. Please see lines 341–343, Fig. 5b, 5c and S4.

Revision in Lines 341–343 on Page 16: "We calculated the AOD at 550 nm from that at 400 nm and 600 nm using the ångström exponent, as aerosol optical properties were computed only at four wavelengths in the model (Nordmann et al., 2014)."

Revision in Fig. 5b, 5c and S4:



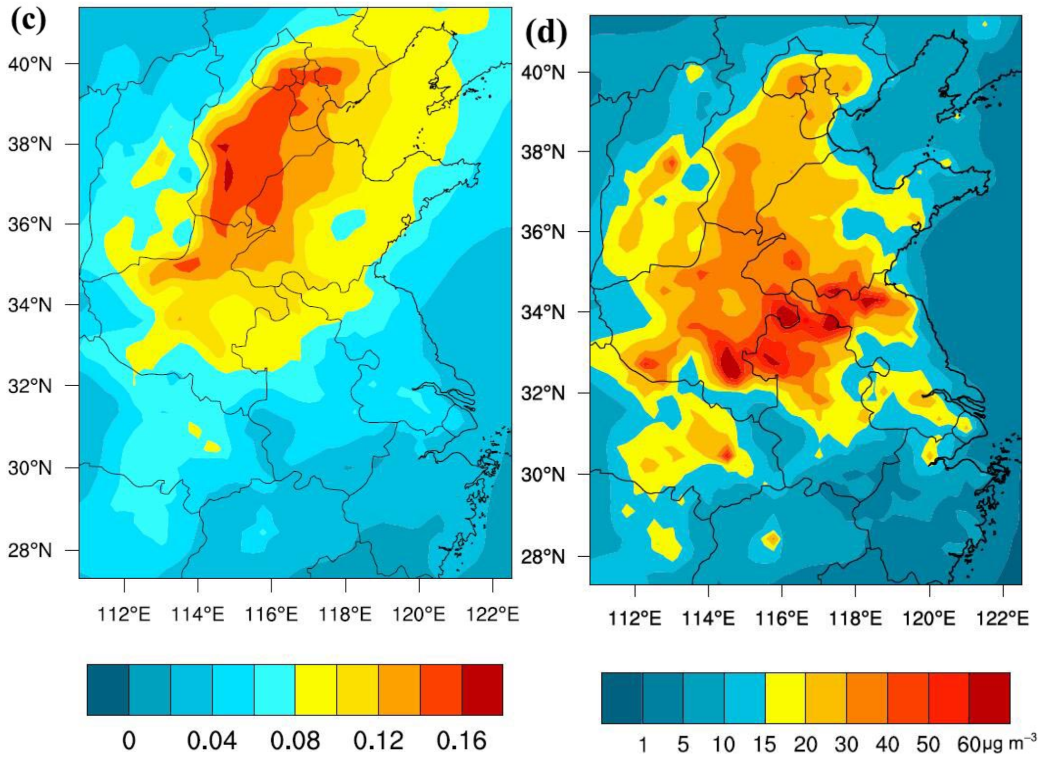


Fig. 1. Spatial distribution of mean (a) 550-nm aerosol optical depth observations from MODIS, (b) 550-nm aerosol optical depth from WRF-Chem, (c) mean absorption aerosol optical depth from WRF-Chem and (d) mean carbonaceous aerosols concentration (μg m^{-3})

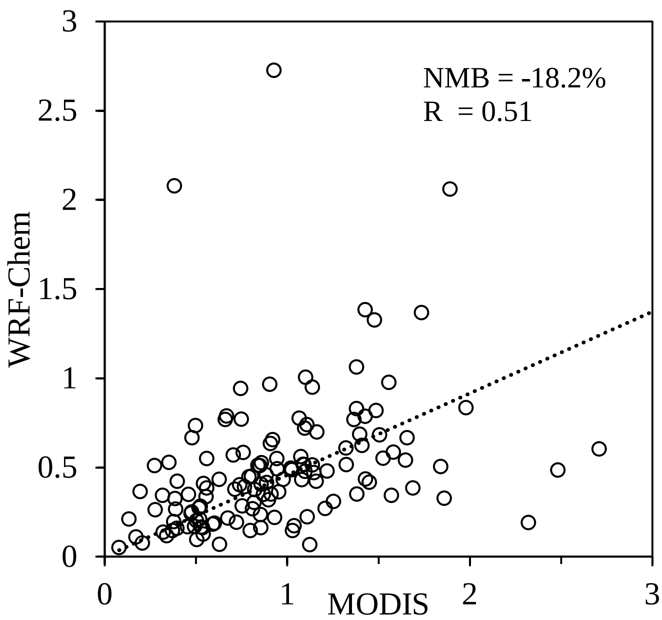


Fig. S4. Scatterplots of simulated hourly AOD and corresponding MODIS AOD at 23 sites in June 2013. Normalized mean bias (NMB) and the correlation coefficient (R) are given in the scatterplot.

2. Line 314: the cited studies present global maps of DRE due to BrC absorption. It would be informative to compare results not with the global means, but with the DRE in East China from those studies (as could be inferred from the maps). I expect this to actually yield a good comparison.

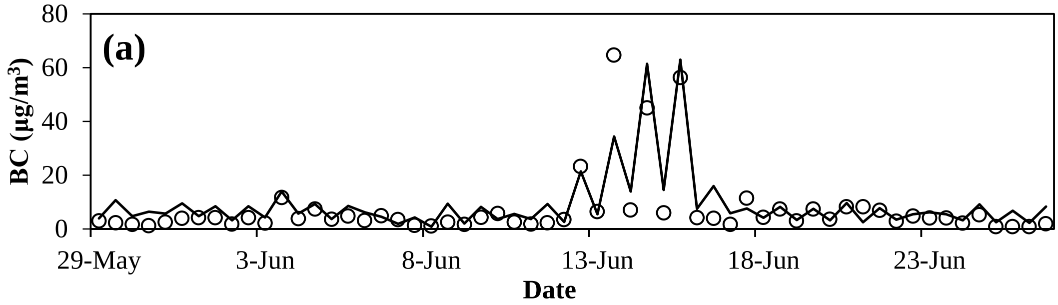
Response: Accepted. We have compared our results with those studies in East China (Park et al., 2010; Feng et al., 2013) and reword that in the revised paper. Please see lines 422–428.

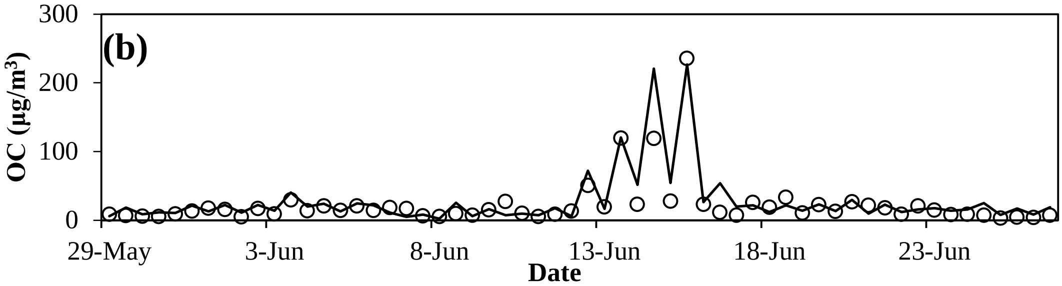
Revision in Lines 422–428 on Page 20: "The DRE of OA absorption during summer harvest in East China in our study was within the global annual mean DRE ranges of OA absorption, of +0.04 to +0.57 W m^{-2} (Feng et al., 2013; Saleh et al., 2015; Wang et al., 2014), and higher than the estimates in East Asia for the spring of 2011, of +0.1 to +0.2 W m^{-2} (Park et al., 2010). Feng et al. (2013) estimated an upper limit of annual mean DRE of OA absorption to be +0.25 to +0.5 W m^{-2} in East China."

3. Figure 3: It would be useful to also show scatter plots of modeled vs observed with a 1:1 line.

Response: Accepted. The scatter plots of observations and modeling results of BC and OC with the calculated normalized mean bias and correlation coefficient have been added in Fig. 3.

Revision in Fig. 3:





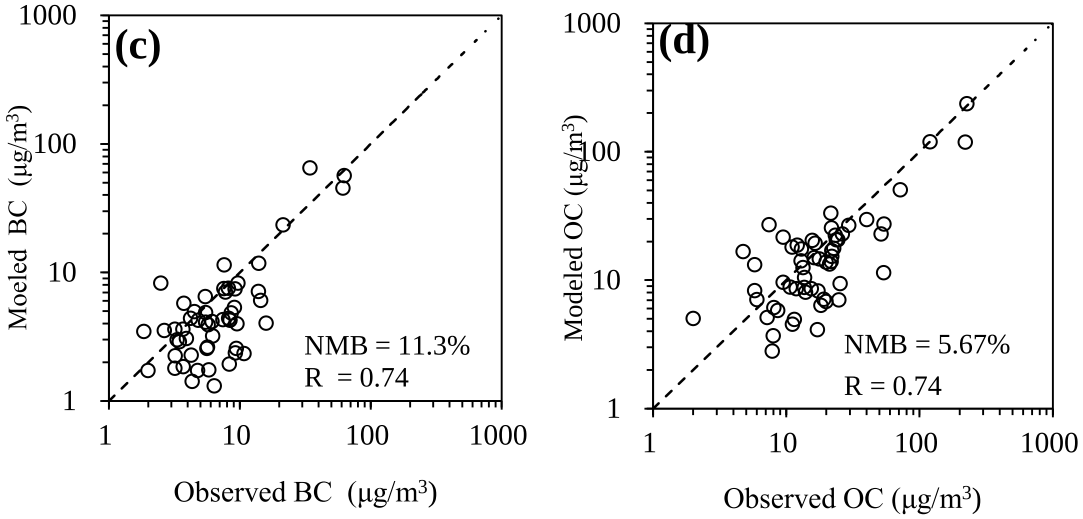


Fig. 2. Time series of the observed (dots) and simulated (line) (a) black carbon (BC) and (b) organic carbon (OC) mass concentrations (μg m^{-3}) at the Suixi site. Scatterplots of simulated (c) BC and (d) OC mass concentrations (μg m^{-3}) and corresponding observed values. NMB and R represent normalized mean bias and correlation coefficient, respectively.

4. Figure 6: Why are there negative values for BC DRE and DRE due to BrC absorption? Those should be strictly positive.

Response: Accepted. There are no negative values for BC DRE and DRE due to BrC absorption in our revised paper, because we have adopted an igorous calculating method of DRE by adding double-radiation calls to radiation drivers, following the radiation diagnostic module of Ghan et al. (2012) and Archer-Nicholls et al. (2016) et al. (2016). Please see lines 402–410 and 433–440.

Revision in Fig. 6:

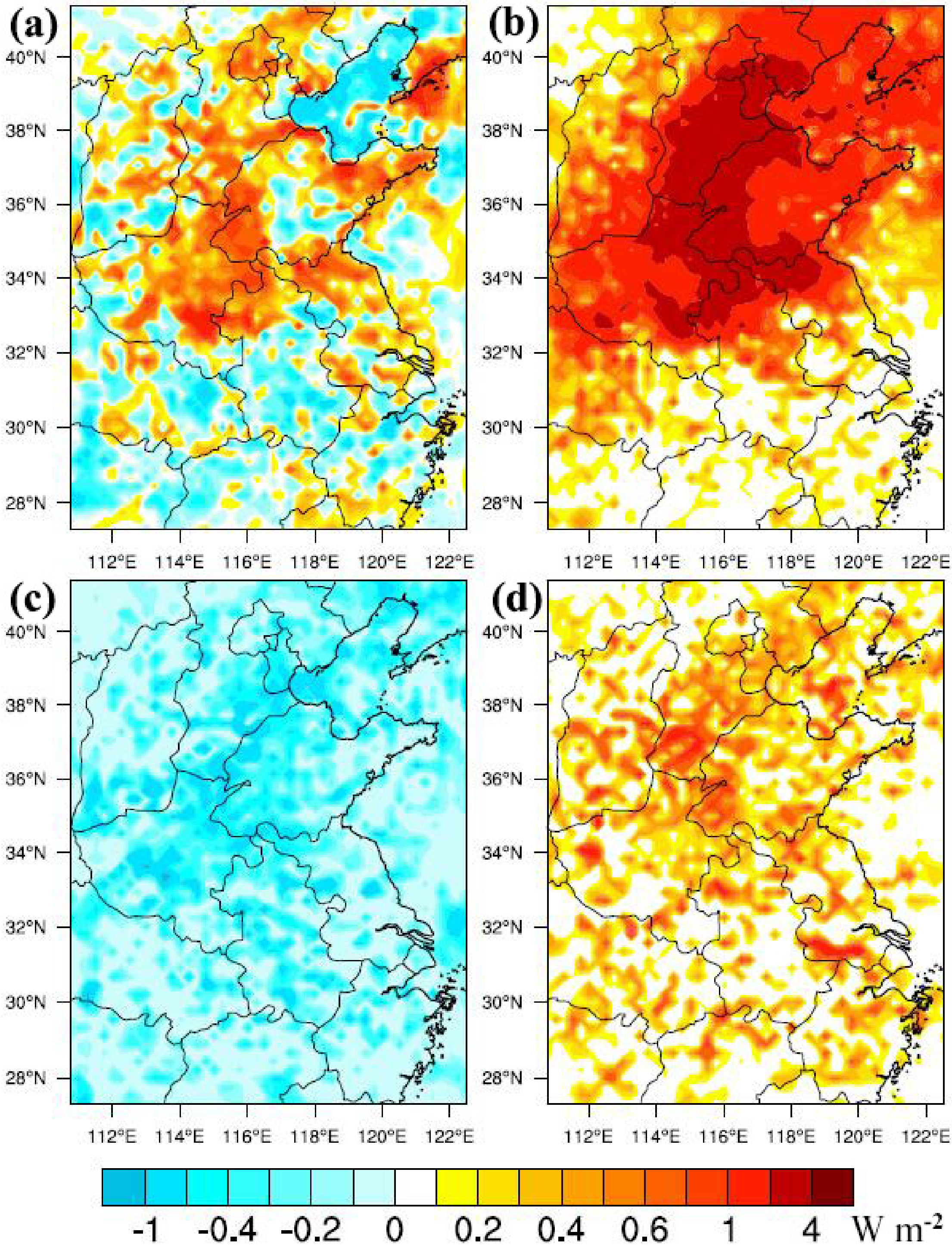


Figure 3. Spatial distribution of simulated direct radiative effect (DRE) introduced by (a) all aerosol from crop residue burning and (b)BC from crop-burning, (c) OA from crop burning, and (d) the absorbing component of OA from crop-burning emissions, calculated from WRF-Chem simulations during the summer harvest (1–21 June).

Revision in Lines 402–410 on Page 19: "Figure 6b illustrates that the high values of BC DRE (above +2.0 W m^{-2}) during the summer harvest mainly appeared in the western Shandong, Tianjin Municipality, eastern Henan province, northern Anhui and northern Jiangsu Provinces, similar to the spatial features of >20 μg m^{-3} carbonaceous aerosol mass concentration (Fig. 5d). The hotspot was in the north of the intensive crop fire-affected area (Fig. 2b), as the dominant southeastern wind in June transported carbonaceous aerosol to the north (section 3.1). With the carbonaceous aerosols mass concentration exceeding 30 μg m^{-3}, the junction of Anhui, Shandong, Henan and Hebei Provinces witnessed the highest BC DRE in our domain of over +3.0 W m^{-2}."

Revision in Lines 433–440 on Page 21: "Figure 6c and 6d show a negative DRE of OA (< –0.2 W m^{-2}) and positive DRE of OA absorption (>0.2 W m^{-2}) over the North China Plain, respectively. Like the spatiotemporally averaged estimates of OA DRE and its absorbing part (–0.22 W m^{-2} and +0.21 W m^{-2}, respectively), the OA DREs in most grid cells have equal magnitude to the corresponding DRE of its absorption but show opposite sign. This implies that the negative DRE of OA scattering is roughly double the positive DRE of OA absorption in magnitude. The consideration of OA absorption therefore reduced the negative OA DRE estimates from crop burning by half."

References:

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