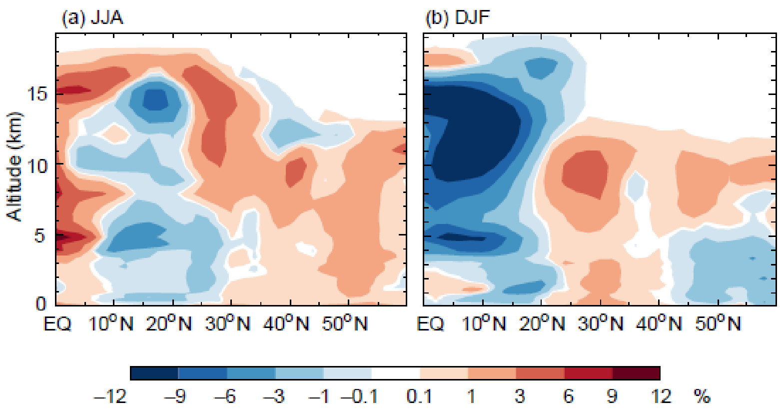
We would like to thank the referee for the thoughtful and insightful comments. We have addressed all of the comments. Our responses are itemized below.

In this work authors attempted to study the impacts of the interannual variation of Eastern Asian summer and winter monsoon on variations of black carbon (BC) mass concentrations and direct radiative forcing (DRF) in Eastern China during 1986-2006. Overall this paper is quite lengthy and reads more like a technical report. The results presented in the paper solely rely on model simulations lack of any observational evidences or cross-validation with previous modeling studies of BC. Some issues with respect to the method descriptions sound vague. The clarification of these issues is critical to understand comprehensive results presented in this study. I recommend the major revision of the paper before the possible acceptance of ACP by addressing my following comments.

Major comments:
1. The methodology used in this study simply followed previous studies [Zhu et al., 2012; Yang et al. 2014]. That's fine. The results of BC are not surprising to me at all since BC is one of important fine aerosol types (i.e., PM2.5) discussed in Zhu et al. [2012]. It might be more interesting to emphasize the change of special characteristics of BC (e.g., whether or how the change of cloud layer between weakest and strongest Eastern Asian monsoon impacts on the BC absorption and DRF).

Thanks for the suggestion. We compare differences in JJA (DJF) cloud fraction (%) between the five weakest and five strongest EASM (EAWM) years during 1986–2006. Plots are averaged over longitude range of 110–125 °E based on MERRA. Compared to the five strongest EASM years, larger cloud fraction exists in northern China and also above ~7 km in southern China in the five weakest monsoon years. For winter monsoon, we find increased cloud fraction in southern China but decreased cloud below ~5 km in northern China in the weakest monsoon years. However, the impact of changes in cloud layer due to the monsoon on BC DRF is not as significant as that of changes in BC distributions due to the monsoon.



Added discussions in Sect. 5 "It is also worth to point out that the BC DRF is also dependent on factors such as cloud and background aerosol distributions (Samset et al., 2011), which can be influenced by the strength of the EAM (Liu et al., 2010; Zhu et al., 2012)…These aspects should be further investigated in future studies".

2. The results presented in the paper solely rely on model simulations lack of any observational evidences or cross-validation with previous modeling studies of BC. This makes me wonder how the modeled BC mass concentrations in this work compare with historical observations available in Eastern China, especially during JJA and DJF (i.e., the seasons authors focus on in this work).

Added discussions in Sect. 2.1 "We have systematically evaluated the BC simulations for 1980-2010 in China from the GEOS-Chem model (Li et al., 2016; Mao et al., 2016).

3. Authors presented major results based on the difference between weakest and strongest Eastern Asia summer monsoon in Section 3 (covering Fig. 1a, Fig. 2a1, 2b1, Fig. 3a, . . .) and then from the difference in winter monsoon in Section 4 (covering Fig. 1b, Fig. 2a2,2b2, Fig. 3b, . . .). However, no discussions (linked to changes in winds or circulation patterns, etc) were made on the difference between summer and winter monsoon, which makes two sections sound like separate stories.

Thanks for the suggestion. Added discussions in Sect. 5 "Different patterns of atmospheric circulation between summer and winter monsoon lead to the different distributions of BC in southern and northern China."…"In addition, the strength of the EAWM would influence the following summer monsoon via changes in the factors such as circulation and precipitation (e.g., Chen et al., 2000), and further affect the aerosols concentrations and radiative forcing. These aspects should be further investigated in future studies.".

4. Majority results in this work (i.e., Fig. 4-12, Table 2-5) highly reply on the difference between weakest and strongest Eastern Asia summer monsoon (in Section 3). The selection of five weakest and strongest years in this work is slightly different with previous studies [Zhu et al., 2012; Yang et al. 2014] that used the same GEOS-4 met fields of 1986-2006 without any explanations. Please explain why authors choose different monsoon years as adopted in Zhu et al. 2012 and Yang et al. 2014.

Added discussions "we examine the differences in the JJA mean surface BC concentrations between five weakest (1988, 1993, 1995, 1996, and 1998) and five strongest (1990, 1994, 1997, 2004, and 2006) EASM years during 1986–2006"… "We select these weakest (or strongest) monsoon years based on the five largest negative (or positive) values of the normalized EASMI in both GEOS-4 and MERRA within 1986–2006. The selected monsoon years are thus slightly different with those from previous studies (Zhu et al., 2012; Yang et al. 2014) only based on GEOS-4 (weakest monsoon years (1988, 1989, 1996, 1998, and 2003), and strongest monsoon years (1990, 1994, 1997, 2002, and 2006))."

5. On Page 5 Line 26, should 1980-2010 be 1986-2006, which overlaps the period between GEOS-4 and MERRA?

Revised as suggested.

6. On Page 8 Line 5-6, authors mentioned numerous studies have shown that the intensity of EAWM. . .. . .but they only cited one reference of Yan et al. (2009). It sounds contradictory.

Added references "Guo et al., 1994; Ji et al., 1997; Chen et al., 2000; Jhun and Lee, 2004".

7. In Section 3 and 4, authors enclosed values in the parenthesis but did not describe how they calculate these values, for instance the range of percentages on Page 8 Lines 22-23. Please add the clarification.

Added clarification "the deviation from the mean (DM)".

8. On Page 10 Lines 19-20, what is the cause of the different pattern of BC concentration between GEOS-4 and MERRA shown in Figure 5a?

*Added discussions "*The different patterns of BC concentrations between GEOS-4 and MERRA in Fig. 5a are likely because of the different convection schemes used in the two meteorological data (Rienecker et al., 2011).*"*

9. On Page 11 Lines 2-3, how does the convergence cause the increase in BC concentration and anticyclone wind pattern cause the decrease in BC concentration?

Added discussions *"*Relative to the strongest EASM years, anomalous northerlies over northern China and anomalous northeasterlies over the western North Pacific in the weakest EASM years prevent the outflow of pollutants from northern China. In addition, southerly branch of the anomalous anticyclone in the south of the middle and lower reaches of the Yangtze River and nearby oceans strengthens the northward transport of aerosols from southern China to northern China.*"*.

10. On Page 11, Lines 8-10, I understand the convergence accompanied with the descending air prevents surface BC to the upper troposphere, causing the increase in surface BC. But I don't understand why the upward mass flux of BC also increases under the condition of convergence. Could you explain it?

Added discussions "Compared to the strong monsoon years, the increased surface BC concentrations in northern China lead to higher upward mass fluxes of BC concentrations north of 25 ° N in both MERRA and GEOS-4. In southern China, the lower surface BC concentrations in the weakest EASM years result in the decreased upward fluxes south of 25 ° N. The pattern of the anomalous vertical transport of BC concentrations thus confirms the anomalous convergence in northern China and anomalous divergence in southern China in the weakest monsoon years."

11. On Page 11 Line 13, please describe the method you calculate horizontal mass fluxes at the four lateral boundaries in details. Clearly, the net effect does not equal to the fluxes summed with values from four lateral boundaries. How do you calculate the net effect of horizontal mass fluxes over the specific region?

The horizontal mass flues and the net effect is summarized in Table 3. Added details "The net effect is a larger inflow of BC by 1.01 (1.27 larger inflow + 2.40 larger inflow + 0.62 lower outflow − 3.28 larger outflow) kg s^{-1} in GEOS-4 and 1.60 (1.01 larger inflow + 1.21 larger inflow + 0.67 lower outflow – 1.29 larger outflow) kg s^{-1} in MERRA".

12. On Page 11 Lines 23-25, why is there larger inflow at the east and north boundary and smaller outflow at the south and east boundary?

Added discussions "The differences in winds between the weak and strong monsoon years lead to differences in horizontal transport of BC."

13. On page 11 Lines 27-29, where do these two numbers (i.e., 0.09 and 0.27 kg/s) come from? Do you average them over the entire domain? Please specify the region your numbers are based on?

Revised to "As a result, the weakest monsoon years in southern China have larger outflow fluxes of 0.09 (0.81 larger inflow – 0.91 larger outflow + 0.09 lower outflow – 0.08 lower inflow) and 0.27 (0.35 larger inflow – 0.72 larger outflow + 0.09 lower outflow + 0.01 larger inflow) kg s^{-1} than the strongest monsoon years in GEOS-4 and in MERRA, respectively."

14. On Page 13, Lines 4-5, could you clarify what is the direct radiative forcing efficiency of BC? BTW, did you notice that the shift of the center of the highest BC DRF from weakest to strongest? Could you explain what is the cause of the shift?

Added clarification in the parentheses in Sect. 3.4 “radiative forcing exerted per gram of BC”. Added discussions “We find largest BC-induced forcing at the latitude of 30–40 ° N in the weakest monsoon years and 35–40 ° N in the strongest monsoon years. The shift of the center of the highest BC DRF is likely due to the different vertical distributions of BC concentrations between the weakest and strongest monsoon years (**Fig. 5a**).”

15. On Page 13, Lines 18-21, please add quantitative metrics to quantify the change of BC DRF in northern and southern China.

Added in Table 4.

16. On Page 13, Lines 26-27, how do you distinguish the DRF of BC between non-China emission and local sources? Did you offline run the radiative transfer model? If yes, please describe it in the section of method.

*Added discussions in Sect. 2.1. “*We also conduct simulation (VNOC) to quantify the contributions of the non-China emissions to BC. The configurations of the model simulation are the same as those in VMET, except that anthropogenic and biomass burning emissions in China are set to zero.*”*

17. On Page 14, line 22, could you show PBLH in the supplement? Also explain how PBLH changes surface BC concentration.

Now included the PBLH in Figure S2. Also added discussions “The lower PBLH in MERRA suppresses the convection and thus leads to higher BC concentrations in the surface .”.

18. On Page 15, Lines 23-24, what is the cause of the different response of BC concentration to the summer and winter monsoon in southern china?

Added discussions in Sect. 5 “Different patterns of atmospheric circulation between summer and winter monsoon lead to the different distributions of BC in southern and northern China.”

19. On Page 17, lines 21-24. I cannot tell the lower column burden of tropospheric BC from your Figure 5b. It appears that the BC profile increase at all altitudes. Is it related to the change of clouds?

Added discussions in parentheses "Figs. 5(b2) and 10(b2)" and also in the following paragraphs.

20. On Page 17, Lines 24-27, why is DRF lower in the weakest monsoon years in southern china even though both BC surface concentration and column burden are higher, compared with the strongest monsoon years?

The possible reasons are discussed in the following paragraphs.

21. On Page 20, besides simply reporting what you conclude in this work, could you add some discussion about why eastern Asian summer and winter monsoon change BC concentration and DRF in northern and southern China differently? Is this difference important to contribute to the air quality regulation in different regions of China?

Added discussions in Sect. 5 "Note that these different changes in BC concentrations and DRF between northern and southern China due to the EAM would be useful for proposing efficient air quality regulation in different regions of China."

22. On Page 5 Lines 17-18, BC is assumed externally mixed with other aerosol species in this model. Could authors discuss the uncertainties of your results based on this assumption? How do results change if BC is partially internally or internally mixed with other aerosol species?

Thanks for the suggestion. Added discussions in Sect. 3.4 "Note that the estimated DRF is associated with large uncertainties due to the BC mixing state used in model, which assumes external mixing of aerosols and gives a lower-bound estimate of BC DRF. Internal mixing of BC with scattering aerosols in the real atmosphere likely increases the estimates of DRF (e.g., Jacobson, 2001).".

Minor comments:

1. *Page 11 Line 12, change "summary" to "summarize".*

   Revised.

2. *Figure 1, add the description of r31y and r21y.*

   Revised as "*r*_1980-2010" and "*r*_1986-2006".

3. *Figure 4, please move the row of a2 above b1 since you discussed a2 ahead of b1 in the context.*

   Revised.

4. *Figure 10, please label a1, a2, b1, and b2 in Figure.*

   Revised.

5. *Figure 12, How do you distinguish BC concentration attributed to non-China emissions and local China sources in the model? Please specify in the description of the model.*

Added discussions in Sect. 2.1: "We also conduct simulation (VNOC) to quantify the contributions of the non-China emissions to BC. The configurations of the model simulation are the same as those in VMET, except that anthropogenic and biomass burning emissions in China are set to zero.".