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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Fossil fuel combustion and biomass burning sources of global black carbon" *by* Ling Qi and Shuxiao Wang

Anonymous Referee #1

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As one of the most important absorbing aerosols in the atmosphere, black carbon (BC) does play crucial roles in regional and global climate change. Both fossil fuel combustion and biomass burning contribute significantly to atmospheric BC, but its emission attributions are still not fully understood and are of great uncertainty. This work aims to quantify the contributions from different factors to sources of global BC in the atmosphere and in deposition by conducting global transport model and comparing it with the observations.The strength of this work is comprehensive observational data in multiple typical regions across the world.However, the authors jump to the conclusion several times in the interpretation of gaps between observational data and model results, and some bias are not clearly presented or fully investigated. Thus, more in-depth analysis ought to be provided. Here are some issues that need to be addressed

for further improving this work.

Section 2: The descriptions of simulation design and observations are far too simple. All the model configuration and simulations need to be introduced in detail. It is very confusing to understand EXP. A-D in Figure 4 without any introduction of these experiments in this part. And also, why these experiments are designed should be well documented.

As presented in Fig. 1-2, there does exist substantial gaps between model simulations and observational fbb in magnitude, seasonal variation, as well as spatial patterns. The authors generally describe the model bias and possible factors. However, more validation and detailed comparison may provide further in-depth information on model performance and uncertainties in related processes.

1. In addition to observed and GEOS-Chem simulated fraction of biomass burning of BC, information on the model performance on BC magnitude in different seasons may be helpful to understand the causes of the biases. Fig. S1 compared the Observed and GEOS-Chem simulated annual BC concentration but missed its seasonality and regional discrepancies. Since this work gathered carbon isotope analysis of BC at dozens of sites across the globe in different seasons, I do think detailed comparison and analysis on seasonal and regional bias of model simulation worth to be conducted.

2. As pointed out by the author, the bias in model results of fraction of biomass burning of BC can be greatly attributed to the lack of seasonality of existing fossil and biofuel combustion since that biomass burning emissions feature substantial temporal variations. To avoid the systematic bias caused by crude treatment of emission sources, monthly global emission inventory like EDGAR or HTAPv2 data or the monthly profile therein can be used as emission input of the model.

3. Since BC is one of typical primary pollutants in the atmosphere, transport process is of great importance besides emission sources. The relatively coarse spatial resolution (4° latitude $\times$ 5° longitude) is not capable to capture some subtle meteorological con-

ditions, which is vital for BC's transport and diffusion. Additionally, the coarse resolution make us to reconsider the representativeness of these observational sites, especially those near the complex terrain or mixed land cover. Applying fine spatial resolution in GEOS-Chem model may help reduce the bias of the model.

Minor issues: Page 6,Line 2 and Line 19-20: Please list the reference here. Did the authors get this conclusion based on emission inventories or existing publications. Anyhow, this statement should be supported by data or references.

Page 3,Line 8: change to "3 nm"

Page 10,Line 1: “leaded” should be “led"

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