

## **Response to Referee (H. Liu):**

We are grateful for your constructive comments. Our itemized responses are as follows:

### ***Major comments:***

1. *“Abstract: Improvement is needed. Overall the statements are too general. There are more interesting points and results (in the text) that are worth being included here. Mention GEOS-Chem and the meteorological data set (GEOS-5 DAS) used to drive the model; both are important to the results presented. Avoid citing references in the abstract. “model results of both surface BC and BC in snow are statistically in good agreement with observations (biases < 15%)” – is this conclusion for the whole region studied? If so, say so. “Model results are in general agreement with observations...” —this is vague.”*

Agreed. We rewrote the abstract.

2. *“Introduction, p7309: In this section, the readers would be interested in knowing which paper in the literature used the same model (GEOS-Chem) and studied what aspects or properties of black carbon over the Tibetan Plateau or other regions of the world. This is currently lacking in the text. Also lacking is a specific list of what’s new in this study, in terms of science questions to answer, approach taken, observational data sets used, and/or application of GEOS-Chem.”*

Excellent points. We added discussions.

3. *“Summary and conclusions: This section is too brief and appears even shorter than the abstract of this manuscript. The first paragraph of this section needs to state the scientific objectives of the study, what model with what meteorological data set used, observational data sets used, etc. The rest of the section can be organized in terms of BC in surface air (section 3.1), BC in snow (section 3.2), BC AAOD (section 3.3), and sensitivities (sections 4 & 5). Some of the questions raised above for Abstract also apply here. “The retrieved AAOD has a positive bias” — this was not mentioned in previous sections. “... This implies that the modeled BC AAOD probably should be scaled to AERONET observations ...” — I don’t understand why “this implies...probably...”. In a word, this section needs rewriting and should summarize what’s presented in the results sections with some discussions on uncertainties, implications, and recommendations for further research. For the latter, most has actually been discussed in the results sections, but they just need to be briefly summarized here.”*

Agreed. We rewrote the summary and conclusions.

4. *“p.7349 (Fig.5a): It looks like Fig.5a presents the total BC deposition in unit of kg*

/ month / gridbox. If so, correct the unit in the caption (note that "kg/month" indicates gridsize dependency). Actually, it's more appropriate to plot the total BC deposition in unit of kg/month/area (e.g., kg/month/m<sup>2</sup>), which would be more useful to those readers who may want to make comparisons."

Good point. We revised the figure.

**Minor comments:**

1. "p.7312, L24: better use "GEOS-5 DAS" here (DAS: data assimilation system). Also see p.7320, L26."

Fixed.

2. "p.7313, L7 (and elsewhere): cite older references first."

Fixed.

3. "p.7316, L27: mention that 5.5 days is at the lower end of the 5-11 days range. On the other hand, "wet scavenging in the model is too weak" (p.7321). Any comments on the impact of such uncertainty on the results of this study?"

Fixed. Additional discussions were included.

4. "p.7318, L1: If these are "urban" sites and a global model is used, do you need to include Fig.2 in the first place?"

Good point. We rearranged the text and figures.

5. "p.7319, L1-2: "Fig. 3e" should be "Fig.3g" and vice versa."

Fixed.

6. "p.7321, L6: check wordings."

Fixed.

7. "p.7323, L12-14: It appears worth showing a figure for the case of "50% increase in BC absorption", where the model-observation discrepancy would be largely reduced."

Agreed. We added a panel in Fig. 9 for the case (50% increase in BC absorption).

8. "p.7339, Table 1 (and elsewhere): footnote - "See text for details"."

Fixed.