

## Authors' Responses to Reviewer Comments

Manuscript: Estimating the open biomass burning emissions in Central and Eastern China from 2003 to 2015 based on satellite observation (Ref. No.: acp-2018-282)

We are very grateful for your careful and insightful comments, which contributed greatly to improve this manuscript. We carefully answered them point-by-point as below and corrected the corresponding parts in the manuscript (in red color).

This manuscript discussed the open biomass burning emissions in Central and Eastern China including several provinces with different vegetation and also the emissions in different years and seasons. The authors also estimated the pollutions from open biomass burning in this area from 2003 to 2015. The spatial and temporal distribution of open biomass burning provides a high resolution result to relevant researchers and could be meaningful in policy making. And there are some technical questions that need the authors to clarify (see additional comments).

Response:

Thanks a lot for your positive comments on this manuscript. We have improved this manuscript by answering the reviewers' comments and advice.

Additional comments:

1. Line 27: The initialism needs to be explained for the first use, i.e. OC, EC and NMVOC.

Response:

Thanks for this suggestion. We have corrected it in the manuscript (in Line 30-32): “...organic carbon (OC), elemental carbon (EC), methane (CH<sub>4</sub>), nitric oxide (NO<sub>x</sub>), non-methane volatile organic compounds (NMVOCs), sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>) and fine particles (PM<sub>2.5</sub>)...”

2. Line 100-101: “”. Please review the structure of this sentence.

Response:

We have polished it as shown in Line 106-107.

*“One is the burned area product, which provides fire burned areas of the whole month. It is limited by the lower pixel resolution.”*

3. Section 2.3: Although the author set different CE values for different vegetation, the CE was set as a constant during each open burning process. Please discuss about it and provide a reasonable explanation, because the CE should not be a constant during burning and the pollution emissions were not uniform in different phase.

Response:

We really appreciate for this comment. We highly agree with you that the CE should not be a constant during burning and the pollution emissions were not uniform in different burning phase. However, the emission inventories in this research and currently published papers were estimated for a long time period or a whole year with the time scale as month, instead of hour. Therefore, the “CE” values used here reflected the average biomass burning condition for the whole open burning processes, which can not reflect the different combustion phase (like smoldering and flaming, etc.).

It is the research hotspot in developing emission inventory with high time resolution, which needs both the high time-resolution activity data and emission factors for different burning stages. It is also now being considered in our research group.

We accepted this suggestion and added corresponding discussion in the manuscript (Line 212-219).

Line 219-221: The contributions presented in this part were with different significant figures or decimal digits. Please explain why you use different significant figures or decimal digits for different contributors?

Response:

Thank you very much for this comment. We are truly sorry for the confusion in the use of different significant figures or decimal digits. We have made the revision in the manuscript, by using the same decimal digits for different contributors (Line 254-256).

4. Line 257: Please explain the increasing trend of OBB emission from 2003 to 2008. It seems that the explanation in Line 269-280 was not convincing enough.

Response:

Thanks for this suggestion. In Figure 6, we found that the emissions of PM<sub>2.5</sub> from crop burning significantly increased from 2003 (228 Gg) to 2008 (294 Gg), due to the increase of crops production and deficiency of strict control policies in this period (Table S1). Emissions from forest, shrubland and grassland burning exhibited an obvious declining trend from 2003 to 2006 and then increased from 2006 to 2008, which maybe related with the different weather conditions and human forestry activities. Although

emissions from forest, shrubland and grassland burning fluctuated markedly during this period, the obvious increase of crops residue burning dominated the total growth of OBB emission from 2003 to 2008.

Corresponding revision and discussion has been added in the manuscript (Line 323-327).

5. Line 452-460: Please specify how much do your research improve the uncertainties in OBB emission and contribution estimation.

Response:

Thanks for this query. In this study, we improve the uncertainty estimation method based on reliable multiple satellites data. In addition, the uncertainties of active data sets (biomass loading data and local EFs) were improved. Multiple satellites can better obtain burned area data; different active data were more suitable because they could better reflect the actual situation in Central and Eastern China. Meanwhile, the field survey also helped to improve the uncertainty and reliability of our emission results. Through these improvements, the uncertainty of pollutant emission was improved.

As shown in Table 1, the uncertainty ranges of different pollutant emissions were narrowed.

**Table 1.** Uncertainty ranges of different pollutants in emission estimation.

Pollutant	Uncertainty ranges		
	Our study	Wang et al., 2008	Qiu et al., 2016
OC	±30%	±148%	-72% - 213%
EC	±48%	±132%	-67% - 204%
CH <sub>4</sub>	±20%	±77%	-32% - 81%
NO <sub>x</sub>	±20%	±80%	-36% - 92%
NMVOCS	±45%	±71%	-24% - 78%
SO <sub>2</sub>	±45%	±108%	-47% - 121%
NH <sub>3</sub>	±35%	±137%	-61% - 152%
CO	±18%	±86%	-52% - 105%
CO <sub>2</sub>	±3%	±60%	
PM <sub>2.5</sub>	±36%	±142%	-77% - 213%

**Response**

Wang, S. X. and Zhang, C. Y.: Spatial and Temporal Distribution of Air Pollutant Emissions from Open

Burning of Crop Residues in China, *Science paper Online*, 3, 329–333, 2008 (in Chinese).

Qiu, X., Duan, L., Chai, F., Wang, S., Yu, Q. and Wang, S.: Deriving High-Resolution Emission Inventory of OBB in China based on Satellite Observations, *Environ. Sci. Technol.*, 50(21), 11779-11786, doi:10.1021/acs.est.6b02705, 2016.