General Comments

This manuscript has systematically developed a carbonaceous aerosol emission inventory for five overlooked types of human activities (namely burning, sacrificial incenses, joss paper burning, fireworks, cooking, and barbecue) in China from 2000 to 2018, filling a gap in most existing emission inventories. It also contributes plenty of experimental emission factors of carbonaceous aerosols from these sources. The author analyzed the trends, characters, and drivers of these FMS emissions. The findings and datasets are unique and informative for the academic community, however, there are some essential issues requiring further clarification. And the released emission datasets need careful double-checking, especially their fluctuation trends, spatial and temporal distribution patterns. Besides, as a first-hand emission inventory and dataset, more comprehensive validations and uncertainty analyses should be conducted and discussed. Detailed comments are listed as followings.

Specific Comments

1. In the methods section 2.3, the author adjusted the per capita consumption of sacrificial incenses, joss paper with statistical temple numbers, population, and forest fires. I noticed the temple numbers and forest fires have the same weights in the adjustment (both 0.5, in equation 9). Is there any reference or principle for the adjustment methods, and what about the extent of the impact such adjustments may have on the activity data? Similar issues also apply to equation 10.

2. According to the author's analysis, firework plays an important role in FMS emissions, thus its activity trends should be carefully checked. In Figure3, there is an obvious peak in fireworks in 2014, and it also leads to a peak in $BC/EC/ACS_{BrC}$ emissions in 2014 (Figure4). I did not find any interpretation of this peak throughout the manuscript. The author should check this peak value to figure out whether it makes sense. The author could also try to use other datasets, such as the variation of $PM_{2.5}$ concentrations, and satellite-retrieved NO_2, in the Chinese Spring Festival during 2013-2018 to offer some supporting validation.

3. In the results section 3.3.1, the author analyzed the multi-year FMS emission variations. However, it is mostly the description of the emission results, rather than the driver analysis or explanation. For instance, there is no explanation of the emission trends of firework, which is the most important contributor to FMS emissions. On the other hand, the author focused on the analysis of RC emission trends in this section, however, RC contributes little to BC and EC emissions, thus the driver analysis of RC emissions might not be able to represent the driver of FMS. Besides, in Figure4, I noticed the BC and OC emission of RC show different trajectories. Given the same emission source and similar control efficiency, what causes such differences?

4. The explanation of the spatial distribution methods is not clear or sufficient, and it makes me confused about some spatial variation analyses in section 3.3.2. First, whether the location of temple and restaurant points are used as the spatial allocation proxy? And the author pointed out that "High emission regions of sacrificial incense and joss paper overlapped with the areas with large numbers of temples" in Line378-379, however, I noticed several mismatches between sacrificial incense emissions (Figure S10) and the temple distributions (Figure S3), as showed in the following red labels. Besides, I suggest the author make some statistical analysis between different FMS emissions and their related activity data distributions, such as at the grid level or city level, to further evaluate their spatial correlations, as well as the spatial accuracy

of the developed emission datasets.
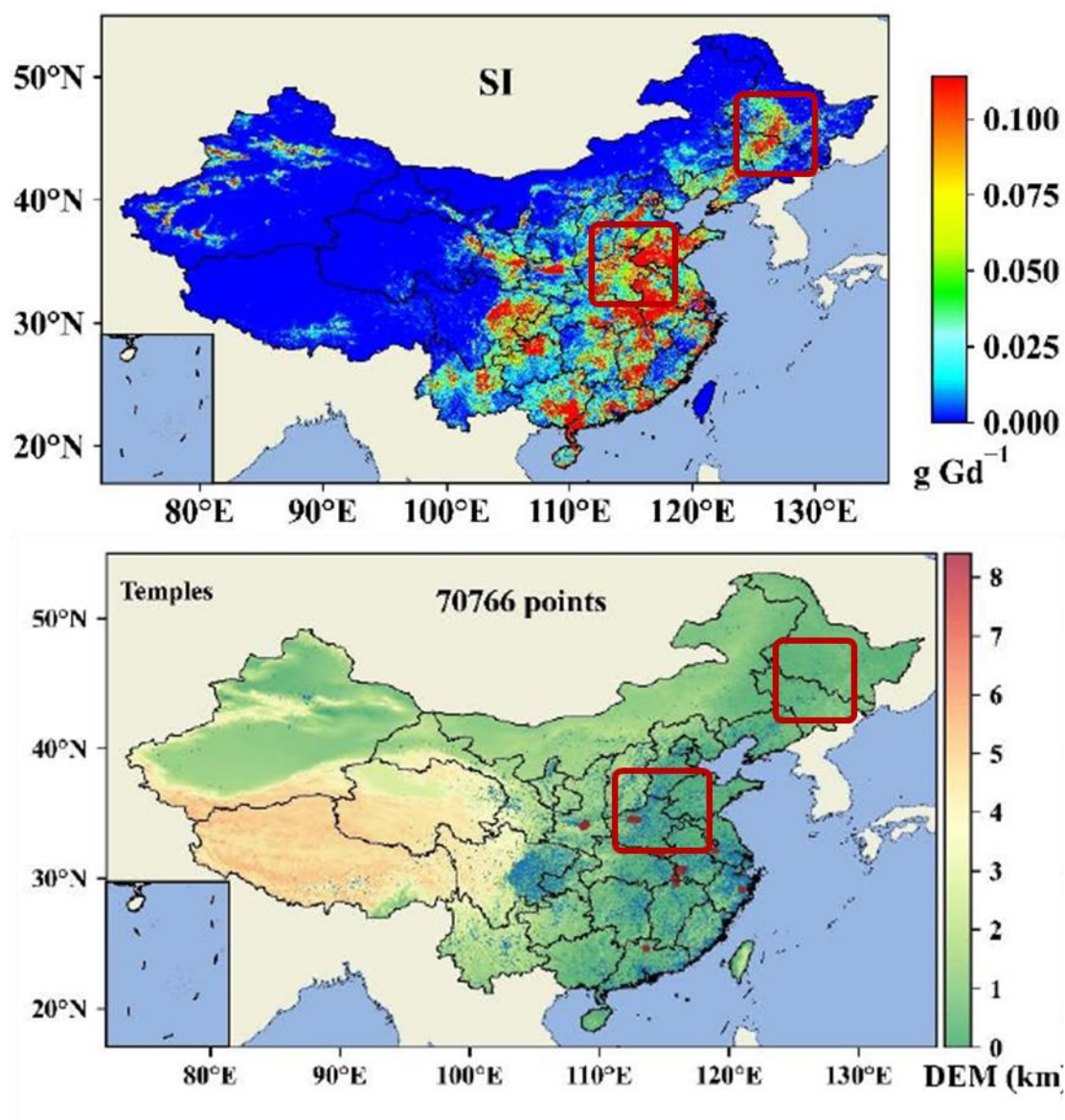
5. Following specific comment 5, another major confusion is about the spatial allocation of firework emissions. As the author pointed out, some cities, particularly the urban regions in Beijing city, have released a series of policies to forbade fireworks. However, I noticed the urban area in Beijing still shows high-level BrC emissions (which are majorly contributed by fireworks based on Figure S8) in 2018 (Figure 5). Given the spatial-temporal specialty of firework emission characters, as well as its domination of total FMS emissions, I think the firework forbidden policies should be fully considered in this dataset, both on emission calculation and spatial-temporal allocations. Besides, I simply downloaded the released dataset and compared it with the Figure 5 in the manuscript (BrC in 2018). I found some inconsistencies in the following red labels. I suggest the author double-check the released emission datasets.
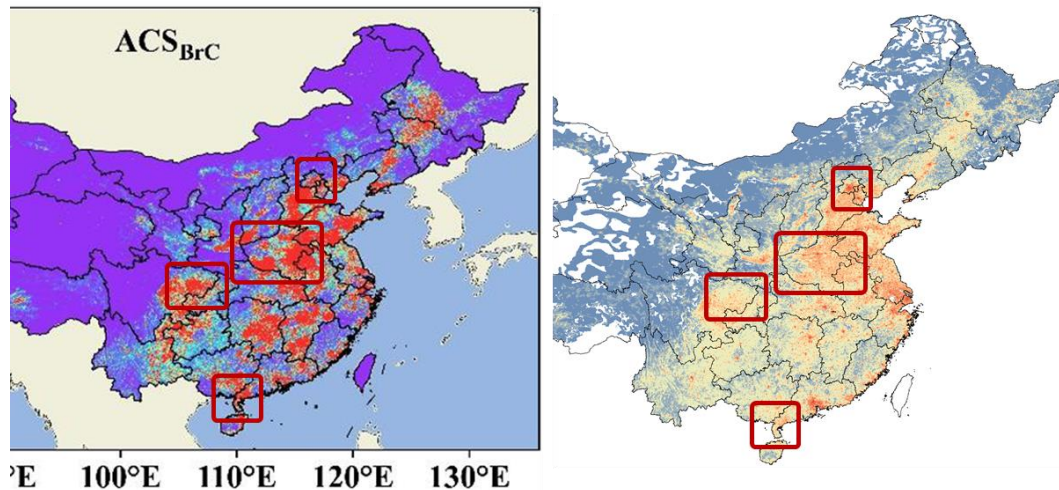
6. The author should carefully double-check the monthly variation of FMS CA emissions. In Figure 6, OC emissions in Jan/Feb are nearly high as twice as other months on average from 2000-2018; however, in Figure S13, OC emissions of Jan/Feb seem more than three times higher than other months in most years.

7. In the summary and conclusions sections, the author suggests raising residents' income to reduce FMS emissions, such as fireworks. However, in section 3.3.4, only the relationship between residents' income and OC emissions is discussed. FMS-related OC emissions mainly come from residential cooking sources, with little from other sources (Figure S8). As the author figured out that various FMS emission sources have widely different characters, thus whether such a relationship also works for other FMS emission sources, especially the dominated firework sources?

Other Comments

1. On Page3, Line70, 'Till,' means 'Till now'?

2. On Page7, Line166, the author pointed out they got the per capita consumption of various FMS activities of each province from household investigations; while in SI TextS2, the author said the survey covered only 27 provinces. Then where does the consumption data of other provinces come from? Any assumptions were applied?

3. On Page17, Line 388-389, 'Emissions from urban regions were near 388 zero, while emissions from suburbs and rural regions were much higher' It is hard to recognize in Figure 5. I suggest the author highlight or zoom in on some typical regions on the map.

4. On Page20, Line421-422, what does 'to improv air pollution' mean?

5. On Page25, Line491-492, incomplete sentence.

6. On Page28, Line583, is the datasets of 'the annual and monthly restaurant sales' on a national level or a province level?