Response to referee comment #1:

In this article, the authors present a study of burning emission in China using MODIS inputs and an empirical fire radiative energy method. The fire emission issue in China is an important one due to its complexity caused by the rapid social development. This paper is well written. But There are still some issues to be discussed.

Response: We appreciate the review's comments, which indeed help us to improve the manuscript much.

1. The land cover

Globcover 2009 is used in this study. However, during the study period, China experienced dramatic changes, including urban expansion brought about by rapid urbanization, as well as returning farmland to forests and grasslands. The emission factors are dependent on the type of vegetation. Therefore, at 1km resolution level, large emission uncertainties may occur due to the biases in land cover data. Maybe annual land cover data is a better choice.

Response: Accepted. MODIS land cover product (MCD12Q1) provide annual land cover data, but the spatial resolution (500 m) is relatively coarse. The open fire size is often small in China, we used GlobelLand30 dataset with 30 m resolution (covering year 2000 and 2010) instead of GlobCover2009 in the revised manuscript. The land cover types are characterized by GlobeLand30-2000 for years 2003-2005 and GlobeLand30-2010 for years 2006-2017.

Revisions: (Page 6, Line 9) "The GlobeLand30 dataset maps global land cover at 30 m spatial resolution in two base years (2000 and 2010) (Chen et al., 2017b), as shown in Fig S1. GlobeLand30 data are generated by multispectral images derived from Landsat TM, ETM+ and Chinese Environmental Disaster Alleviation Satellite (HJ-1). The result of accuracy assessment shows that the overall accuracy of GlobeLand30 reaches 83.5 %. GlobeLand30 dataset consists of 10 land cover types, namely cultivated land, forest, grassland, shrubland, wetland, water bodies, tundra, artificial surfaces, bareland, permanent snow and ice. In this study, the land cover types are characterized by GlobeLand30-2000 for years 2003-2005 and GlobeLand30-2010 for years 2006-2017. We combined the land-cover map of China and the latitude and longitude data of fire count in MOD14/MYD14 to determine the biomass fuel types. For instance, if a fire count locates in cropland area, it will be considered as a crop residue burning event."

2. Seasonal patterns

The authors did not show much about seasonal patterns of the results, which is very effective in evaluating the results. Due to the impact of the monsoon climate, the meteorological conditions that trigger the fire are extremely seasonal. Meanwhile, the agriculture schedules are very stable in the eastern and northeast plains, and fires from cropland only occur in and after the harvest seasons. For example the results shown in

Fig.2, based on personal experience, I am very worried about the confusion of grassland and cropland fires.

Response: Accepted. Seasonal patterns were introduced in Section 3.2 and Fig.4. The spatial distributions of grassland and cropland fires shown in Fig.2 are reasonable. Grassland fires are mainly distributed in the mountains and hills in northeastern China and southern China. Cropland fires are concentrated in central China and northeastern China due the burning of winter wheat residue in the North China Plain and corn straw in the Northeast China Plain.

Revisions: (Page 9, Line 17) "Seasonal variations of CO_2 emissions from each source were presented in Fig.4. In terms of total emissions, spring (March, April and May) contributed the most emissions due to the impact of dry weather. The lowest emissions occurred in rainy season including July, August, and September, producing 2.1,1.7, and 1.8 Tg CO_2, respectively. From the perspective of source-specific emissions, forest and grassland fires exhibited similar temporal variation, i.e., higher emissions in winter and spring, and lower emissions in summer. The highest emissions from forest and grassland fires occurred in the period of January to May. This pattern was strongly affected by favorable fire conditions such as low vegetation moisture content and high wind speed (Song et al., 2009). In addition, Li et al. (2015) found that a large portion of forest fires in spring were induced by sacrificial activity in Tomb-sweeping Day (April 5). Forest Fires in winter were concentrated in southern China due to the impacts of low precipitation and mild temperatures. In contrast, boreal forests rarely burned because of the low temperatures and moist snow cover. This result was consistent with the that reported by Chen et al. (2017a). The temporal distribution of shrubland fire emissions is also similar to that of forest and grassland fires, but emissions from bush only account for a small fraction of total levels (approximately 1 %). Emissions from crop burning were closely related to agriculture activities. Different main crops and sowing/harvest times in different areas lead to multiple emission peaks (Jin et al., 2018). Highest emissions occurred in summer, and small peaks were detected in spring and autumn. Emissions from agriculture fires contribute 84 % to total emissions in summer, which were concentrated in June due to the large amount of winter wheat straw burning in the North China Plain. From March to May, as large amounts of crop residues were burned to clear the cultivated land for sowing, fires were scattered throughout the country. In autumn (especially October), corn straws burning in the Northeast China Plain and late rice residue burning in southern China were primary contributors, and small areas of maize residue burning could be found in northern China (Chen et al., 2017a). During winter, crop burning mostly occurred in southern China due to citrus harvest and orchard clearing activity."

3. Monte Carlo
Please explain more details in the Monte Carlo simulations, which (how many) independent variables are fitted and randomly sampled.

Response: Accepted. More details could be found in Section 4.

Revisions: (Page 12, Line 6) "In this study, we considered errors of three independent variables, namely FRE, conversion ratio and emission factors. According to the error budget suggested by Vermote et al. (2009), we assumed that the relative error of FRE and the conversion ratio was 31 % and 10 %, respectively. The uncertainty of the EF is species dependent and we applied the uncertainty suggested in Huang et al. (2012), as shown in Table S2. We ran 20,000 Monte Carlo simulations to estimate the range of average annual fire emissions in 2003-2017 with a 90 % confidence interval. In Monte Carlo simulation, random number are selected from normal distribution of input variables."

4. Double check the words, including CO2 (2 subscript). Use "dry season" rather than "arid season", different meanings.

Response: Accepted.

Revisions: (Page 1, Line 20) "Forest and grassland fires are concentrated in northeast and south China, especially in dry season (from October to March of the following year)."