

## ***Interactive comment on “A high-resolution inventory of air pollutant emissions from crop residue burning in China” by Xiaohui Zhang et al.***

**Anonymous Referee #1**

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General comments:

Zhang et al. reported an emission inventory of crop residue burning based on the annual yield of crop at city level published in yearbook and the related parameters (e.g., EF, proportion of crop residue burned) without distinction in domestic and in-field burning. The monthly and 1-km spatial variation were obtained based on the farming practice in different regions and land use data, respectively. Currently, there are several papers about the biomass burning emission inventory, including domestic burning and in field burning for different species with high temporal (e.g., daily) and spatial resolution (e.g., 1km). From the abstract and conclusion of this study, this is no difference or new finding compared to the previous studies, such as the main contributor of the emission, the temporal and spatial distribution characteristic. The new information presented in

C1

this paper is not obvious and should be described clearly and in detail. Here I placed several publications for the reference. I hope it will helpful for you to improve your work.

Chen, J., C. Li, Z. Ristovski, A. Milic, Y. Gu, M. S. Islam, S. Wang, J. Hao, H. Zhang, C. He, H. Guo, H. Fu, B. Miljevic, L. Morawska, T. Phong, Y. L. A. M. Fat, G. Pereira, A. Ding, X. Huang & U. C. Dumka (2017) A review of biomass burning: Emissions and impacts on air quality, health and climate in China. *Science of the Total Environment*, 579, 1000-1034. Gao, R., W. Jiang, W. Gao & S. Sun (2017) Emission inventory of crop residue open burning and its high-resolution spatial distribution in 2014 for Shandong province, China. *Atmospheric Pollution Research*, 8, 545-554. Zhou, Y., X. F. Xing, J. L. Lang, D. S. Chen, S. Y. Cheng, L. Wei, X. Wei & C. Liu (2017) A comprehensive biomass burning emission inventory with high spatial and temporal resolution in China. *Atmospheric Chemistry and Physics*, 17, 2839-2864. Qiu, X., L. Duan, F. Chai, S. Wang, Q. Yu & S. Wang (2016) Deriving High-Resolution Emission Inventory of Open Biomass Burning in China based on Satellite Observations. *Environmental Science & Technology*, 50, 11779-11786. Sun, J., H. Peng, J. Chen, X. Wang, M. Wei, W. Li, L. Yang, Q. Zhang, W. Wang & A. Mellouki (2016) An estimation of CO<sub>2</sub> emission via agricultural crop residue open field burning in China from 1996 to 2013. *Journal of Cleaner Production*, 112, 2625-2631. Ni, H., Y. Han, J. Cao, L. W. A. Chen, J. Tian, X. Wang, J. C. Chow, J. G. Watson, Q. Wang, P. Wang, H. Li & R.-J. Huang (2015) Emission characteristics of carbonaceous particles and trace gases from open burning of crop residues in China. *Atmospheric Environment*, 123, 399-406.

Specific comments:

P1, L11, “Emissions were firstly estimated for each city and then redistributed using 1-km resolution land use data”. P2, L9, “However, almost all existing studies focused only on provincial emissions across China, without considering the detailed distribution within a province”. Actually, the preliminary resolution of biomass burning emission has been improved into county-level resolution even into grid resolution without spatial distribution (such as the estimation based on fire radiative power data with 1km

C2

resolution). The paper need more serious and comprehensive literature review.

P2, L10, "However, almost all existing studies focused only on provincial emissions across China, without considering the detailed distribution within a province." The emission of crop residue burning were estimated through the satellite remote sensing data such as MODIS data with grid resolution directly in recent studies, such as Qiu et al. (2016).

P2, L13, "A spatial distribution with finer resolution based on more detailed data of agricultural activity and land use is therefore expected." Actually, there is large uncertainty during the emission distribution process using the land use data as the only proxy (He et al., 2015).

P2, L14, "Meanwhile, previous studies either did not consider the temporal variation (e.g., Chen et al., 2015; Zhang et al., 2017; Zhang et al., 2013) or considered it in a simple way; e.g., Gao et al. (2017), Huang et al. (2012) and Peng et al. (2016) described the monthly distribution of the total regional emissions according to Moderate-resolution Imaging Spectroradiometer (MODIS) fire count." Several studies have researched the daily variation of the crop residue burning, such as Huang et al., 2012, Qiu et al., 2016, Zhou et al., 2017.

P3, L1, "Compared with previous studies of the same kind, our work has placed more emphasis on spatial and temporal variations." Currently, there are many studies about the biomass burning emission inventory with highly temporal (e.g., daily resolution) and spatial resolution (e.g., 1km resolution). How to describe your results are more accurate?

P3, L3, "MODIS Thermal Anomalies/Fire products were applied to verify the spatial and temporal variations of the emissions." If you think the MODIS data "have many disadvantages such as a limited detection period, great uncertainty due to cloudy weather, and the inability to include household burning (P2, L18)", why you choose MODIS data to verify the spatial and temporal variations of the emissions you studied.

C3

P3, L5, "This study improves our knowledge of the pollutant emissions from crop residue burning in China" In fact, few new knowledge could be found in this study compared to previous research. The author should describe it clearly and in detail.

P3, L17, " $E_{i,j}$  is the total yearly emission of pollutant  $j$  in city  $i$ ", "yearly" should be changed to "annual"

P3, L19, " $B_i$  is the proportion of crop residue burned in city  $i$ " There is no difference in cities from the table S2. It should be changed into " $B_i$  is the proportion of crop residue burned in province XXX".

P3, L25, "SGRs for different crops used in this study are listed in Table S1." The SCR of different crops is different. How to determine the SCR of the "Others" in Table S2. P3, L27, "They were determined in this study according to the utilization rates of crop residues in different provinces reported by the NDRC (2012), which are listed in Table S2" Current report showed that the EF of the crop residue domestic burning and in-field burning have great difference (e.g. EPD, 2014). The emission estimation should consider the proportion of domestic burning and in-field burning, respectively. Moreover, the EF selection and emission estimation result also should be given separately according to domestic burning and in-field burning. EPD: Guide for compiling atmospheric pollutant emission inventory for biomass burning, Environmental protection Department, available at: [http://www.zhb.gov.cn/gkml/hbb/bgg/201501/t20150107\\_293955.htm](http://www.zhb.gov.cn/gkml/hbb/bgg/201501/t20150107_293955.htm), 2014 (in Chinese).

P4, L1, "According to the above studies, we simply assumed the burning efficiency to be 90 % for all kinds of crop residues." Actually, this treatment is inappropriate. There is different parameter for various crops (He et al., 2015). He, M., Wang, X. R., Han, L., Feng, X. Q. and Mao, X.: Emission Inventory of Crop Residues Field Burning and Its Temporal and Spatial Distribution in Sichuan province, Environmental Science, 36, 1208–1216, 2015 (in Chinese).

C4

P4, L5, “It is noted that crop residues are burned not only in open fields but also as household fuels. Because most experimental studies have focused on field burning, and the reporting of EFs for household burning has been limited, differences in EFs between the two burning modes were not considered in this study.” As mentioned above, the EF should be considered in domestic burning and in-field burning separately because of the great difference of EF (EPD, 2014). Actually, there are several reports about the EFs for household burning, such as EPD, 2014, Tang et al. (2014) Wei et al. (2008) Li et al. (2016) Wei et al. (2014).

EPD: Guide for compiling atmospheric pollutant emission inventory for biomass burning, Environmental protection Department, available at: [http://www.zhb.gov.cn/gkml/hbb/bgg/201501/t20150107\\_293955.htm](http://www.zhb.gov.cn/gkml/hbb/bgg/201501/t20150107_293955.htm), 2014 (in Chinese). Tang, X. B., Huang, C., Lou, S. R., Qiao, L. P., Wang, H. L., Zhou, M., Chen, M. H., Chen, C. H., Wang, Q., Li, G. L., Li, L., Huang, H. Y. and Zhang, G. F.: Emission Factors and PM Chemical Composition Study of Biomass Burning in the Yangtze River Delta Region, *Environmental Science*, 35, 1623–1632, 2014 (in Chinese). Wei, W., Wang, S. X., Chatani, S., Klimont, Z., Cofala, J. and Hao, J. M.: Emission and speciation of non-methane volatile organic compounds from anthropogenic sources in China, *Atmos. Environ.*, 42, 4976–4988, doi: 10.1016/j.atmosenv.2008.02.044, 2008. Li, Q., Jiang, J. K., Cai, S. Y., Zhou, W., Wang, S. X., Duan, L. and Hao, J. M.: Gaseous Ammonia Emissions from Coal and Biomass Combustion in Household Stoves with Different Combustion Efficiencies, *Environ. Sci. Technol.*, 3, 98–103, 2016. Wei, S., G. Shen, Y. Zhang, M. Xue, H. Xie, P. Lin, Y. Chen, X. Wang & S. Tao (2014) Field measurement on the emissions of PM, OC, EC and PAHs from indoor crop straw burning in rural China. *Environmental Pollution*, 184, 18-24.

P4, L11, “As mentioned above, spatial distributions were firstly determined on the city level and then redistributed within a city using land use data. For this purpose, an approach based on a geographical information system (GIS) was adopted to perform the redistribution for 296 prefecture-level cities.” As mentioned above, there is large

C5

uncertainty during the emission distribution process using the land use data as the only proxy (He et al., 2015)

P4, L14, “At present, it is difficult to know exactly the ratio of crop residue burned in the open field to that burned as household fuel. According to limited investigations (Cao et al., 2006; Streets et al., 2001; Zhang et al., 2008; Zhou et al., 2016), we assumed the ratio to be 50 %.” The ratio of crop residue domestic burning and in-field burning in different regions is very important parameters to estimate the biomass burning emission accurately. This treatment is very inappropriate.

P4, L18, “The temporal distribution of emissions was determined according to the harvest time of different crops for each of six agricultural regions in China.” This is a helpful treatment to determine the monthly variation of the emission. However, current studies (e.g., Qiu et al., 2016) could provide daily variation of the emission based on the MODIS data. If the author think the MODIS data will miss several data (P2, L18), why use it for verification (section 2.3)?

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C6