**Response to referee #1**

*This manuscript presents a comprehensive bottom-up inventory of China's NMVOC compounds between 1990 and 2017, including detailed information on sectors and speciation. The causes of trends in total NMVOC emissions and in specific sectors, including economic factors and pollution control strategies, are discussed. The impacts of NMVOC emissions changes on ozone formation potentials in China are quantified. The policy implications of China's NMVOC emissions changes are highlighted.*

*The manuscript is well presented and informative. The datasets presented here will be very useful to the atmospheric research and environmental policymaking communities. The manuscript is a valuable contribution to the literature. I recommend publication after some issues are addressed.*

**Response:** We thank the positive and constructive comments given by the referee #1, which are very helpful to improve the manuscript. Our response to each specific comment is presented below.

<u>Detailed Comments and Responses:</u>

*1. Title: - Suggest changing "dynamics" to "trends". "Dynamics" has a specific meaning in atmospheric science that is unrelated to emissions. I think the authors simply mean the trends in emissions.*

**Response:** Thanks for the suggestion. We change the "dynamics" to "drivers" in the title, to represent the analyses on emission trends and the underlying driving forces.

*2. Methods: - Emissions from open biomass burning were excluded from the inventory. Does this sector include crop burning? How big of a potential source is open biomass burning across China? What are the implications of excluding it from the inventory - Are NMVOC emissions from shipping in ports and near coastal areas included in the inventory?*

**Response:** We exclude open burning of biomass (including crop open burning in the field), and include the combustion of household biofuel (crop residue, wood) in our inventory. Emissions of open biomass burning are always estimated separately from the anthropogenic sector because distinct method and dataset is applied (Wiedinmyer et al., 2011; Huang et al., 2012; Randerson et al., 2018; Yin et al., 2019). Based on the most recent work (Yin et al., 2019), emissions of open biomass burning in China are 1.12~2.16 Tg NMHC, corresponding to 2.90~5.60 Tg NMVOC by applying an averaged OVOC fraction of 61.4% (8753 in SPECIATE 4.5, Andreae and Merlet, 2001) during 2003-2017. Compared to 17.6~28.5 Tg NMVOC from anthropogenic sources during the same period, we capture > 83% of the total emissions when including open biomass burning in the analyses, and the total NMVOC emission will be 32.8 Tg in 2017, with emission decrease for 2015-2016. We add more analyses in the discussion section of the revised manuscript.

NMVOC emissions from international shipping are also excluded in the inventory. We clarify the sources included in the inventory in the revised manuscript.

*3. Results: - Solvent use (including both industrial and residential sources) is now the largest NMVOC sector in China. How certain are the estimated emissions in this sector? McDonald et al. [Science, 2018] recently showed that, for cities in the United States, there are large differences between currently bottom-up approaches for estimating NMVOC emissions from paints, adhesives, and other sources lumped in the "solvent use" category of this manuscript. Should we expect similar uncertainties in Chinese solvent use emissions? If so, what are the implications for uncertainties in Chinese NMVOC speciation from solvent use, and for the resulting ozone formation potentials?*

**Response:** Thanks for the referee's comments. Uncertainties of emission estimates are always difficult to quantify because of the lack of statistics and measurements. For solvent use, high uncertainties are expected, considering the numerous scattered areal sources included in this sector, uncertainties in statistics, complex technologies and emission factors. According to the uncertainty assessment of Wu et al. (2016) using the Monte Carlo simulation, the uncertainty of the solvent use sector is high up to -70% ~ 202% in 2012. This uncertainty in the total NMVOC emissions will propagate to the speciation results and also the ozone formation potentials. For solvent use, the uncertainty in source profiles are estimated as 110% (average, 9.8% ~ 973%, for top 30 chemical species, as shown in Fig. S1). Thus a high uncertainty of 130%~230% can be roughly estimated for the results of speciation and OFPs for the solvent use sector.

*4. Discussion: - P 11, L 24-25: The differences between inventories in the most recent years appears to be greater than 13% (for example comparing the 2014 values from MEIC and Wei inventories). Please change this sentence to more accurately reflect the data presented in Figure 8. - P 12, L 24: There are also large uncertainties for emissions of many compounds emitted from the Waste Treatment sector. Please note this fact.*

**Response:** Thanks for the comments. We revise the sentences as below:

"The emissions estimated by the various inventories for the most recent years, i.e., since 2010, agree relatively well, with variations of 10%~22%."

"The uncertainty matrix shown in Fig. S1 highlights the need for more measurements and further analyses for important sources (species), especially chemical industry (o-xylene, benzene), other industrial processes (toluene, xylenes, formaldehyde, 2-methyl-2-butene), residential biofuel combustion (toluene, xylenes, ethylbenzene, cis-2-butene, butyl cellosolve), and waste treatment (xylenes, ethylene, formaldehyde)."

*5. References: - Liu et al., 2015, is missing from the list of references. Please include it.*

**Response:** Added.

*6. Data accessibility: - For this paper to be useful to the community, the detailed inventory datasets reported here must be publicly available. A clear statement is needed in the manuscript* *about how the community can obtain the annual national and gridded emissions datasets and the sectoral and speciated detailed data presented here.*

**Response:** We thank the referee for the suggestion. We have uploaded the data presented in the manuscript to a public repository and added a statement in the "Data availability" section.

Technical Comments and Responses:

*7. The figures and tables are clear and easy to follow. I have no changes to suggest for these.*

*The manuscript is also generally well written. However, there are numerous small mistakes in English grammar and usage throughout. For example, on the first page alone, I found the following errors: - P 1, L 20: omit "," after "that" - P 1, L 20: omit "been" - P 1, L 22: omit "," after "that" - P 1, L 24: change "offset" to "offsetting" - P 1, L 27: change "form" to "from" - P 1, L 28: change "were" to "was" - P 1, L 31: change "increase" to "increasing" There are similar small errors throughout the manuscript. Please correct them before resubmitting the revised manuscript.*

**Response:** We thank the referee's careful reading and the detailed comments. We carefully correct the mistakes throughout the manuscript.

**References**

Andreae, M. O., and Merlet, P.: Emission of trace gases and aerosols from biomass burning, Global Biogeochemical Cycles, 15, 955-966, 10.1029/2000GB001382, 2001.

Huang, X., Li, M., Li, J., and Song, Y.: A high-resolution emission inventory of crop burning in fields in China based on MODIS Thermal Anomalies/Fire products, Atmospheric Environment, 50, 9-15, https://doi.org/10.1016/j.atmosenv.2012.01.017, 2012.

Randerson, J.T., G.R. van der Werf, L. Giglio, G.J. Collatz, and P.S. Kasibhatla. 2018. Global Fire Emissions Database, Version 4, (GFEDv4). ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1293

Wiedinmyer, C., Akagi, S. K., Yokelson, R. J., Emmons, L. K., Al-Saadi, J. A., Orlando, J. J., and Soja, A. J.: The Fire INventory from NCAR (FINN): a high resolution global model to estimate the emissions from open burning, Geosci. Model Dev., 4, 625-641, 10.5194/gmd-4-625-2011, 2011.

Wu, R., Bo, Y., Li, J., Li, L., Li, Y., and Xie, S.: Method to establish the emission inventory of anthropogenic volatile organic compounds in China and its application in the period 2008–2012, Atmospheric Environment, 127, 244-254, http://dx.doi.org/10.1016/j.atmosenv.2015.12.015, 2016.

Yin, L., Du, P., Zhang, M., Liu, M., Xu, T., and Song, Y.: Estimation of emissions from biomass burning in China (2003–2017) based on MODIS fire radiative energy data, Biogeosciences, 16, 1629-1640, 10.5194/bg-16-1629-2019, 2019.