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Comment on acp-2022-734

Anonymous Referee #1

Referee comment on "High-resolution regional emission inventory contributes to the evaluation of policy effectiveness: a case study in Jiangsu Province, China" by Chen Gu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-734-RC1>, 2022

This study focuses on the development of emission inventory in the Jiangsu Province, China, during 2015-2019 based on multiple new data sources. Based on the new inventory, the influence of different policies on the changes of pollutant emissions, meteorology and emissions on the changes in PM_{2.5} and O₃ concentrations were evaluated. Relative conclusions are helpful for further regional-level air quality improvement.

Overall, the manuscript is well written and its structure is well organized. Some clarifications and corrections are needed for the paper to reach the publication standard. The detailed comments are as follows ("Ln" indicates the line number is n):

General comments:

- I highly recommend to add the comparisons of observational and CMAQ-modelling NO₂ and SO₂ concentrations. Good performance of these two species can prove the higher accuracy of the province-level emission inventory than MEIC, especially its annual changes discussed in Section 3.2.1 (L576). Besides, in the analyses of ozone underestimation, a direct evidence can be provided for NO_x emission overestimation (as discussed in L790).
- If possible, it would be better to have more comparisons between all bottom-up emission inventories mentioned in this paper with official emission statistics of China/Jiangsu Province and other top-down emission inventories to make the conclusions more solid.
- In the CMAQ modelling, the temporal and vertical profiles of emissions are also very important for a good performance. In this study, is there any improvement on these profiles, since new data applied may also provide such information?
- Please point out the specific meanings of pollutant concentrations in the identification of meteorology and emission contributions. Are they mean pollutant concentrations in the

monitoring stations? Or geographical mean values? Or population-weighted mean values? For both observational and modelling results, are the annual values both the average concentrations of four representative months of each year?

- For the annual changes of BVOCs emissions, are they counted as the contributions of emissions or meteorology?
- As for the writing, adverbs (e.g. significantly, largely, increasingly) are massively used in this paper. It is recommended to reduce the usage of unnecessary adverbs and be careful with the accuracy of some adverbs. For example, in L553, "biogenic sources gradually became more influential", "gradually" does not agree well the changes of BVOCs/AVOCs ratio. The tenses in some places are not correct. One example is in L571 – "it was probably due to ..." should be "it is probably due to...", since it discusses a general fact, not something happened before. Also be careful with the usage of articles – specifically, "the" should be added or deleted in many places. I pointed out some grammatical mistakes and unclear expressions in the detailed comments, but more careful checks are suggested for the authors.

Detailed comments:

Abstract

- L29: "in China" should be added after "province is an important administrative unit for air quality management", because this is not true for many other countries. The same is for L134 in the introduction section.
- L38: the full names of "NMVOC", "BC" and "OC" should be used or explained.

Introduction

- L79: "the" should be added before "magnitude, spatial pattern, and ..."
- L95: "increasingly" should be "increasing"
- L106: "largely weakened" is unclear. Do you mean along with the increasing diversity of emission sources, the relationships between proxies and emission distributions are weakened recently?
- L140: "relatively" should be deleted, since there is no clear comparison.
- L150: "it comprised" should be "it contributed to"
- L159: "become" can be deleted.

Method

- L191, L197: the number "fifty-five" and "forty-two" can be directly written as "55" and

"42"

- L192: because Table S1 also contains information on third-level emission sectors, "(see details in Table S1 in the Supplement)" can be put in the end as "(details on the first three level sectors are listed in Table S1 in the Supplement)"
- L196: "guidelines for development of national emission inventories" => "the guidelines of national emission inventory development"
- L205-206: "provided" => "provides"; "thus was able to considerably reduce" => "thus considerably reduces"
- L257: "meteorological" => "meteorology"; "and" should be deleted
- L259-260: in "the relatively high temperature" and "the NH₃ volatilization", "the" is not needed; in "NH₃ volatilization for urea fertilizer use", "for" should be "from"
- L261: what is "metrology"?
- L265-274: it would be clearer to put the last sentence "in this work... for multiple years" in the beginning
- L295: "we split the source profiles for some categories into finer ones" is not clear. Do you mean to use more detailed profiles for some second-level sources, instead of the more general ones for the corresponding coarser level source profiles? Also, "for example..." is suggested to be a new sentence.
- L305: "for information of stationary sources" should be "for stationary sources" or "for the information of stationary sources"
- L306: "location, raw material..." => "their location, raw material"
- L308, L310: "database" or "data source" should be added after "the former" and "the latter" to avoid confusion
- L328: "the" should be added before "estimation and spatial..."
- L329-330: "with" => "by using"; for "the average emission factor by city and sector", do you mean the average emission factor of each sector in each city?
- L331: How GDP is used to distribute the emissions?
- L332: "including" => "on"
- L340-347: when introducing the control measures, it is not needed to use uppercase for the first letters. In order to avoid misunderstanding, the numbers or letters can be used like 1), 2), ...
- L349: "the" should be added before "implementation of"
- L354-355: "it was worth noting" => "it is worth noting"; "equal" is mostly used as adjective, thus "did" should be "is"
- L362: it should be pointed out that four months are selected to represent the four seasons
- L365: "the horizontal resolutions at" => "the horizontal resolutions of"
- L375-376: Is the data used for the assimilation in simulations or the evaluation of modelling performance?
- L388-389: "Sp" and "Op" should be used to keep consistency with Eq. 3-4. Does "p" indicate the number of years, or the number of available data pairs?
- L391-395: the discussion on modelling performance comparisons is not very clear. According to my understanding, the authors mean that the d03 modelling performance using MEIC is worse than d02 modelling performance using MEIC, thus a better d03 modelling performance using provincial emission inventory than using MEIC can be expected from the comparisons in this study. Is that correct? Also, only one study is used to support the assumption. Is that universal? Can you provide more reported results of modelling performance comparison in different domains, especially for the modelling in the YRD region?
- L399-414: it would be reader-friendly to use the tables, formulas and only some necessary explanations to state how the contributions of emission and meteorology are modeled and calculated
- L416: "included both from JS and nearby regions" => "is from both JS and nearby regions"

Results and Discussions

- L422: "anthropogenic emissions by sector and their changes" may better summarize the contents in this section
- L423: where can the information on AVOCs emissions be found? (I might be confused of NMVOCs and AVOCs emissions in this study?) The same is for the discussions in L434-436.
- L440: "grew" => "grew by"
- L443: "clearly decoupling" is not clear
- L447: "accounting" => "of which the contribution accounts"
- L471: "the" should be added before "implementation of"
- L488-489: Table S4 can be also introduced in this sentence. I also recommend to introduce the definition of southern, northern and central cities after the sentence like "In further discussions, we classify 13 cities in Jiangsu as the southern cities (xxx), central cities (xxx) and northern cities (xxx) (their distributions are shown in Figure S1)", rather than "see the city definitions in Figure S1".
- L493: "calculated at" => "calculated as"; "for southern, central and northern cities" => "for the southern, central and northern cities" (the same is for other places including L498)
- L496: "were" => "are" if that is the case also for now
- L498: "(Figure 4)" can be deleted or written as "(Figure 4e)"
- L506-512: the structure of this paragraph should be altered — it seems like introducing the conclusions first and then analyzing the data.
- L513: "the" should be added before "spatial distribution of"
- L516: "Figure 5a-c" should be changed into Figure S3 or Figure 4
- L516-521: The sentence is too complex (especially, the subject of "facing" is not "more efforts"). Please express it in a more readable way
- L520: "opposite" is not precise according to the figures —maybe "different" is enough. "the" should be added before "spatial variation of ..."
- L526: "thus" is used in "there is a thus great need for substantial improvement of emission controls...", but I cannot see what is the reason for the need of emission control improvements
- L536: "season" should be deleted
- L537: "existed" => "is" or "was"
- L539-541: the authors mentioned that industrial development might explain lower BVOCs emissions in the south, but what is the influence of meteorological factors? For example, higher precipitations near the Yangtze River in some seasons?
- L542: in Table 1, "%" is used for the unit of ratios, which may be misunderstood as the percentage of BVOCs in AVOCs. Thus, " $\times 10^{-2}$ " is recommended. The same is for other discussions like in L546 and L547
- L543: "the emission trends of both BVOCs and AVOCs" => "the trends of both BVOCs and AVOCs emissions"
- L544: the numbers need to be consistent with what is shown in the table. Thus, "11" should be "11.1", and "16" should be "15.8"
- L563: for this section, the main content is the comparisons between different emission inventories. "Influence of different data and methods on emission estimates" is not so direct
- L573: I suggest to add one sentence in the end, which is like "Therefore, we mainly compared the interannual variability of emissions in the provincial inventory and MEIC"
- L578: "existed" => "are"
- L581-582: "was more optimistic in..." => "describes a more optimistic..."
- L593: I suggest to use "assessment of emission amounts" or similar items. And maybe the orders of two sections in 3.2 need to be changed — introducing emission amounts

first, and then their interannual variability. The authors can consider about it.

- L608: "resulted" => "results"
- L624: when comparing numbers, "significantly" is normally used when there is statistically significant difference. Therefore, "much" might be more precise here
- L627: "an estimation 45% smaller" => "an estimation of 45% smaller"
- L636: "Simaya" => "Simayi"
- L647-648: could you please give more details on "better agreement with ground and satellite observation"?
- L656: what is "thu"?
- L674: the discussion in this section is a little hard to follow. Please add some hints for the readers — for example, here, it should be pointed out that the contributions of policy on SO₂, NO_x and PM_{2.5} emission changes are similar and firstly introduced
- L722: "the" should be added before "implementation of ..."
- L739: "in a summary" => "in summary"
- L741: "have been driving" => "have driven"
- L758: "application of" => "applying"
- L766: "suggested" => "suggests"
- L772: "higher concentrations were found in summer and lower in winter" is not the case for PM_{2.5}
- L777: what does "higher levels" mean? Higher concentrations or higher increase rates?
- L781-783: the authors mentioned that HO₂ uptake might influence ozone changes. Besides, the effects of aerosol on radiation might be the other related to ozone changes. How these two effects are considered in CMAQ, since it is an offline model without the HO₂ uptake mechanism? If the effects of aerosol on ozone changes are not involved in the modelling, is it possible that the increase rates of annual ozone concentrations will be further overestimated when the effects of aerosol are considered?
- L800-808: three sentences in this paragraph discuss different contents with weak connections — please revise it to make it flow. I suggest the discussion like: the annual changes of PM_{2.5} and O₃ -> the contributions of two factors (meteorology and emissions) are identified and discussed in the following -> it should be noted due to non-linearity... the mean goal is to compare the relative contributions of two factors
- L817: "bigger" => "higher"

Supplement

- Figure S2: be careful with the format in the first column to make is more readable