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Interactive comment on "Evaluation of anthropogenic CH$_4$ emissions over China using bottom-up inventories" *by* Xiaohui Lin et al.

Anonymous Referee #1

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Review of "Evaluation of anthropogenic CH4 emissions over China using bottom-up inventories" By Lin X. He et al., submitted to Earth System Science Data

GENERAL COMMENT The authors present a comparison of different bottom-up estimates of methane emissions over China. They discuss the differences in the spatial distributions and temporal changes in methane emissions for total anthropogenic emissions and some sectoral emissions. They use both global and regional data set to feed the discussion. They conclude on methane emission changes in China over the past decade and on the uncertainties on estimating methane emissions.

The manuscript is readable and intelligible. However English polishing would be welcome (use of past tense during the discussion of the results seems odd). The figures are hardly legible (small font, pale colours) and need to be revised. Also, the study is

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Discussion paper

lacking more detailed information on the data set used, and on the differences between inventories explaining discrepancies in methane amount or changes. Some information is provided in the supplementary but never mentioned or used in the main text. Some data sets are not introduced properly (sources of data/methods). The title could suggest that the BU estimates are evaluated, which is not the case. They are only (poorly) compared to each other. The reader would expect to gain insights on which data set provide the best estimates (depending on the sector maybe). Are some data sets out-dated for some reason (REAS?)? Why? What kind of activity data / emissions factors are the best to be used to properly represent Chinese emissions? At the end of the manuscript, the reader has learned a bit on Chinese emissions (sector contribution, trends, some uncertainties) – assuming he did not know anything, but he doesn't know what to do with these different data sets, nor what is the best suited for any specific sector. However, such inventories comparison could be useful to the community, especially to highlight existing regional/sector specific data sets, under the conditions that thorough presentation, analysis and evaluation of the inventories are performed. Lastly, evaluation of inventories could be done using regional modelling of methane concentrations over China. For the above reason, I would recommend publication in ESSD but only after major revisions addressing the general and specific comments highlighted in this review. Below are some comments to help improving the manuscript and study, but more comments could have been risen.

SPECIFIC COMMENTS

Section 1 – Introduction

Line 36. Might be worse specifying that the value is a global mean average over remote marine stations (I guess. . .)

Line 48-49. The reasons are not well explained here. Please detail. There are numerous estimates of methane emissions (as used in this study), the (small?) number of estimates is not the reason of the challenge of methane compared to CO2. The

challenge comes from the processes leading to methane emissions (leaks, biogenic emissions, ...) that are far much uncertain and difficult to estimate than emissions from combustion of fossil fuels – LULUCF standing aside.

Line 53. This sentence is omitting regional inversions at higher resolution (for example, Thompson et al., 2015, https://doi.org/10.1002/2014JD022394). If inversions are discussed here broader and appropriate literature needs to be added.

Line 58. "the quality" of activity data. The sentence seems to say that the activity data are of good quality – positive; while they are known to be quite uncertain.; the whole sentence is too long and lacks of specific criticism against activity data and or emissions factors. Are they both uncertain in space and time? Split the sentence and rephrase to explain better why "the use of BU is challenging " (I guess "challenging in modelling studies"... not specified).

Line 62. I do not agree. Many studies have discussed Chinese methane emissions. Many of them are cited in this ms, and probably many other exist. Most of the global methane studies do mention Chinese emissions, their amount, spatial distribution, changes over time, and even uncertainties on emissions factor, specifically related to coal. This sentence is not above China, but more about the attention given to methane compared to carbon dioxide. Please rephrase or delete or move up.

Line 66. Sort sectors by order of importance: energy is first with 45%!

Line 67-68. "large part of the variability". Variability of what?

Line 72. What could be the reasons explaining these differences? Paddy areas? Parametrization? Cultivation practices hypothesis?

Line 74. Meaning that there is none on solid waste?

Line 78. What is meant by "systematic"? is it regularly? Or with common procedure across sectors?

Line 79 "Further mitigate climate warming": not clear, please rephrase

Lines 80-81: The author state that they collect most of the existing data sets. This means that some are missing? And could have been included as well? It is stated here that 12 global and regional inventories have been gathered? Do they all covered all sectors? Table 1 lists only 4 global inventories. . .

Section 2 – Data and Methods

Lines 89-100. Following the previous comment. Table 1 lists only the 4 gridded data set. No detail is given regarding the 8 so-called "statistical data sets". What is "statistical datasets"? After stating the number of inventories, sectors are introduced, then we go back to the inventories. Please reorganize the section. The PKU inventory includes all anthropogenic sectors apparently and is not just a " fuel combustion inventory" The Global Methane Budget is based on EDGARv432- EPA- ECLIPSE v6 – FAO (agriculture) – CEDS - / so there is some overlap with the other datasets used here. The reader has no idea about the "published literature Yue, Huang, Zhang and Chen and Zhang2016 Zhang2018. A table and/or text are needed to explain these data sets: sectors/methods/ specificity. Why are this specific dataset are included? What is their added-value? How do the reader access to them? (it is mandatory to have this information)

Line 102. Why 3 and not gridded data sets here? this sentence is true for any inventory, gridded or country based.

Line 104. What is the point stating that some inventories are used in inversion? It's really depending on the group doing the inversion (global..?).

Section 3 Results and discussions.

Line 111-112. This is not really surprising as the Global Methane Budget is based -approximately on the same data set.

Section 3.1 is entitled "temporal variations of anthropogenic emission" but half of it

compares the magnitude of the inventories emissions or the relative contribution of the sectors. Please organize the discussion.

Line 115 – Energy sectors dominates (27-60%) but then agriculture activities contribute to 27-50%... is the relative contribution varying across inventories? Over time? does it means that the splitting is much different from one inventory to another? a stacked bar plot could be more explicit. Fig 1 – revised the colors and font size of the fig. FAO data are shown for all sectors. The authors have to acknowledge the source of FAO data for other sectors than agriculture. FAO produces only agriculture emissions; other sectors are from third party.... After digging a bit, it comes from PRIMAP hist. dataset v2.1 (Gutshow 2016)... using EDGARv42 for the recent period. No information is given regarding this dataset.

Line 119-121: what is the link between REAS and GOME data? Here again lack of description of the data set prevent the reader to understand the suggested conclusion.

Line 123. "these results may be due .." such a study need to be more persuasive and provide better and thorough explanations on the differences or discrepancies between inventory?

Line 124/125. What is NCCC? Is there any ref to cite "proving" what is stated about lower emissions factors?

Line 128. Here and elsewhere, when discussing EDGAR please specify the version, the trend will differ from one version to another. FAO other sector being based apparently on EDGARv42... EPA is EPA2012 (projection form 2005?) this need to be specified somewhere

Line 131: "may be caused by". See previous comment, the readers need to be more confident in the results. Data/publication that could strengthen this suggestion/conclusion? Line 132 : subsectors are discussed but no plot are shown in the main text nor in the supplementary, how the reader can check the findings?

Line 147: The authors states that the gridded emissions are limited. But some are missing here. CEDS (based on EDGARv42) is missing. There are other version of EDGAR that could have been integrated (V432) for comparison.

Line 148-150. Again relative contribution of sector at national scale is discussed here... reorganize please. (Are the number in agreement with the previous ones?)

Line 150 and following. Discussing province differences could be difficult to follow for non-specialist of Chinese province. Please add a map (in the supplementary) of the provinces.

Line 164. Emissions factors control more the magnitude than the spatial distribution, which is more related to activity data used to spatialized the emissions.

Line 169 : What is NBS?

Line 170 and below: Here the reader is waiting for information on the sources of emission factors, activity data and specialization hypotheses that may differ between inventories explain the discrepancies in different sectors. Could the different resolution of the inventory different induce visual spatial differences?

Fig2 and 3. The figures are hardly ligible. Color scale/ names of the inventories too small. Fig 2 right panels: the reader cannot read this. When is this useful? What is the grid resolution of these plots? EDGAR spatial distribution (and trend in Fig3) for energy is really different from the other inventories. Is such a distribution realistic?

Line 190-195. Trend in agriculture emissions. Why EDGAR is so different from the other? Are this conclusions in agreement with FAO ? with more specific agricultural?

Line 225-230. Here the authors state that rice cultivation areas (emissions have increased) ; while previously (line ca 190), a decrease in emission from rice cultivation was presented. How is that consistent?

Line 230. Livestock includes enteric fermentation+ manure management? There

is a recent paper on enteric fermentation that could be useful (Chang et al., 2019, https://www.nature.com/articles/s41467-019-11066-3)

Line 232; "REAS underestimates emissions" compared to what? Is there a reference/preferred inventory taken as reference?

Line 235(around). Here a discussion is needed on the sources of activity data used in the different inventories. Most of them use FAO, aren't they? So why such differences?

Lien 247. This could be easily avoided by plotting the maps on the same resolution. See also a previous comment.

Fig 4. Same comments as for other figures. What are the horizontal resolutions of the maps? Do they differ from one inventory to another?

Line 253 and following. "considering the comparability of different inventory"; This is not clear. REAS seems to have been excluded from the mean calculation. Is there a reason? EPA is included while this seems to be EPA2012 data set, which is a projection from 2005 onward. How such a data set is valid? These mean/SD calculations seem to be the concluding numbers of this study, though they use a subset of the dataset discussed. What are the selection criteria? Is that the "best guess for Chinese methane emissions"? are the considered inventories the best ones for all categories?

Line 268-272. Two groups of inventories are formed based on waste emissions. Which group is the most realistic? Can we conclude on this?

Section 4 Conclusions. The end of the conclusion mentions the used of default emissions factor instead of province specific emissions factors. This is the first time this point is mentioned and more discussion is needed on that throughout the paper. Are inventories using default emissions factor as reliable as others? More constructive criticism of the methodology used in the different inventories is needed to assess which inventory fits the best the reality.

TECHNICAL COMMENTS

Line 37. Remove "However" Line 48 Change to "contribute the most to global . . .." Line 61 Change "area" to "country" Line 135 : substantial variability. Do you mean increase?