

## ***Interactive comment on “Comparison of Emissions Inventories of Anthropogenic Air Pollutants in China” by Eri Saikawa et al.***

**Anonymous Referee #1**

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Review of Manuscript ACP-2016-888: “Comparison of Emission Inventories of Anthropogenic Air Pollutants in China” by Eri Saikawa et al.

This manuscript presents five different emission inventories that cover the Asian region, specifically, China. It then compares and contrasts the differences in the inventories by air pollutant for China as a whole and broken down into a number of regions. Finally, three of the inventories are used to initiate some model runs to understand the implications of the differences outlined in the earlier sections. Overall, this is an informative paper, but rather straightforward. It would be good if the authors could dig into the differences a bit deeper and aim to understand the reasons behind the differences more than just presenting them. To a certain extent, I’m sure that the reasons behind these differences may not be easily discovered (if at all) since much of what is behind emission inventory construction is often not well documented, however, this paper re-

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ally stays at the surface. Digging deeper would provide information that would be much more useful to modelers and others who will need to make decisions later as to which inventory to use and why, and if they are going to make modifications or not. I would recommend that this paper is published after revisions.

General comments:

-In section 2 each of the emission inventories are presented in a subsection. Please harmonize the descriptions in each of these subsections to cover, which regions are included, why the years were chosen as they were, which gridding/proxies/etc were important for each inventory.

Specifically, in section 2.3 for MEIC, the authors state that information for each Chinese province is included. Is that the same as the 33 sub-regions for REAS? Also there ‘fine spatial resolution’ is mentioned, can this be more quantitative to be able to compare? Later a 0.25x0.25 degree grid is mentioned, but this isn’t even as high res as EDGAR – how does this fit together? How is the gridding for MEIC done?

Furthermore, for the Zhao inventory, why is 2007 used for the disaggregated emissions estimates when data for 2000-2014 are included and EDGAR, REAS, and MEIC provide 2008 data? Or even 2005 which would correspond to GAINS? Why not the whole time series?

-In section 3, can the authors address what is behind these estimates? Are some of them based on the same information? Completely different? When emission factors are discussed, is this information that can be included? Activity data, but same EF?

More specifically, on L249-255, some of these differences are hinted at, but no more detail is given. How do these mentioned EFs differ for the various sources?

-L359-364: can this text/discussion be elaborated a bit? This is exactly the type of understanding that is missing/typically not communicated in emission inventories and would be a very interesting addition.

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-L394-398: 65% vs 38% is a pretty big difference. What is behind this difference? How close are the total amounts of PM10 emissions? Are the differences owing largely to the differences from other countries or the difference attributed to China mainly?

-section 4.1 & L476-477: what is driving these high off-road emissions for CO and NOx in the northwest? yes, the scales are different, but on-road tends to be higher in most other regions.

-section 5: the authors state that they chose 3 of the EI for the model simulations. But 5 were evaluated in the paper. I don't expect model simulations using all the EI, but a justification as to why those 3 were chosen should be added.

-L534-538 & L553-559: Here the authors compare the modeled to the observed values, and they are not even remotely close. Summer is better than winter, but still. I understand that models often over- or under-predict observed values, but this is a factor of 2 or more different. I also understand that model validation is not the point of this paper and it was more to demonstrate the implications of differences in EI, for which one might argue that the absolute concentration comparison to observed is not so important. However, while the models are described earlier, there are no references to model validation for the region, etc. Could something to at least reference this be included? It would be good to also at least acknowledge or try to explain this underestimation beyond just stating that it exists. Is this likely missing sources in the inventory? Poorly captured processes?

Specific comments:

-There are a number of words that are used incorrectly throughout the manuscript and should be replaced. Please do a search and replace, checking to make sure that the phrasing is still correct as written:

-discrepancy (definition: an illogical or surprising lack of compatibility or similarity between two or more facts) is used when difference would be much more appropriate.

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-share; e.g., L333: 'Nationally, it shares 53, 33,... of total SO2 emissions in REAS, ...' The industry sector does not 'share' anything. It should be written that SO2 emissions from industry contribute X amount to the national total.

-trends; this is not a language issue, but rather a scientific one. Trends are typically referring to a long time series of data for which a robust trend analysis has been done (e.g., with p-values, and a percent change per year over a minimum time period of 10-15 years or longer calculated). That is not how it is used here. I would suggest to avoid any confusion, that instances of 'trend' be replaced with 'change' since from what I can tell, it is always a percent change calculated from one year (e.g., 2000) to another year (2008), and that the concentrations of the years in between are not considered in this calculation. If this is not the case and an actual trend is calculated, this should be added to the methods section.

-L144-147: could these points mentioned in the text be added to Figure 3 where the years match to make the comparison easier? Also L173-174/L176?

-L187: The Schwartz et al 1994 reference is fine, but there are papers that would be more appropriate for health impacts of ozone.

-L209-210: This sentence doesn't make sense. The industry sector shares 51% of the difference in the estimates of what? Similarly, L241, '...sharing 43.7% of the difference in 2000 and 34.4% in 2008.' What does this mean? sharing the difference? please clarify.

-L320/Table 3: Are these the number of officially registered power plants? Are all officially registered? Is the data source reliable/are these numbers easy to get or is it likely that they are underestimated?

-In a number of cases, such as L346, percent changes are listed, but in many cases I think an absolute value change would be helpful because for example, in this case, the overall amount for SO2 emissions from residential sector is not high and this can be

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pretty misleading then. -also L376-377: differences in sector listed as %, but how does this relate to the total? -again L479-480, how does this relate to absolute amounts? -L476: very dependent on the absolute values; although 258% seems like a huge amount. Please relate to the total to make it a more informative statement.

-L426-434: in the figure for PM, the REAS inventory shows a number of jumps for some regions. Can these be explained?

-L443-445: The text does not match the figure. The 'rest of gasoline' is not the majority share of any of the species. Nor is SO<sub>2</sub> 'non-existent' in REAS.

-L451-454: It seems odd to say we see significant differences in the CO, PM<sub>10</sub>, and SO<sub>2</sub> emissions and then analyze the differences for different species, CO and NO<sub>x</sub>.

-why is it that in 4.1 and 4.2 that only 3 of the EI are included now? Justification?

-section 5.2: the authors discuss differences in concentration by region throughout this section, it would be good if they could add explicitly what these numbers represent. Are the values monthly average concentrations from all grid cells over the region? Or is it the maximum difference between monthly values for any single grid cell? Please clarify.

-L523-528: absolute amounts would help because the percents and concentration differences listed for CO are so huge, that it is then hard to relate the percents for the other species to concentrations, which are surely not similar to CO. In general, it would be good to mention table 4 which provides many of these concentrations much earlier in the section instead of only in the last 2 sentences.

-L550-551: this statement started out as relevant for NO<sub>x</sub>-VOC balance because of how these regimes affect ozone concentrations, and ended up as a blanket statement about how EI input is important. While the latter is true, it doesn't add much to the paper. Please avoid this and be more specific in the paper to really address the issue at hand.

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-Figure 12b is never referenced or referred to in the text.

Minor edits:

-there are a number of small typos/english errors. I have specifically mentioned some here, but not all of them. Please try to read through this for such errors.

-L21: correct to '...for finding effective mitigation measures for reducing...'

-L25: correct to '...worst air quality countries in the world are located...'

-L44-47: here CO, NO<sub>x</sub>, SO<sub>2</sub>, and PM are mentioned, but NMVOCs are also mentioned in the abstract and subsequent text. Please add.

-L83: correct to '...was developed collaboratively between...'

-L84: correct to 'The inventory comprises emissions data from...'

-L191: correct to '...at the national level compared in Fig. 2 to all other species.'

-L199: correct to '...regardless of which inventory. Industry emissions contribute X, X, ... of the national total....'

-L280: add at the end of the sentence: '...in 2008, were emitted from this region.'

-L313-315: I would suggest to edit as follows: 'Up to this peak, REAS and EDGAR follow similar trajectories, but the SO<sub>2</sub> emissions in the Central and the Northwest start to decrease in 2004, in 2005 in the South, East, and North, and in 2006 in the Northeast and the Southwest in REAS.'

-L317: define FGD

-L392: suggest to consider using 'patterns' or similar instead of 'trends'

-L413: do the authors mean 'reductions in EFs?' or are there reduction factors that are applied to emissions? Would be good to clarify either way.

-L418: replace 'troublesome' with 'difficult'

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-L518: replace 'magnitudes' with 'concentrations' (or mixing ratios)

-Figure 5: there is a typo in REAS in the caption

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