

Interactive comment on “Long-term historical trends in air pollutant emissions in Asia: Regional Emission inventory in ASia (REAS) version 3.1” by Junichi Kurokawa and Toshimasa Ohara

Anonymous Referee #2

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The authors developed a new version of the REAS emission inventory, presented the trends in Asian air pollutant emissions, and analyzed the regional and sectoral drivers. The comparison with the up-to-date regional inventories presents broadly consistent emission trends, and the uncertainties in the REAS v3.1 estimates are quantified according to the errors in each parameter. This is quite important work, because the REAS inventory has been widely used in the modeling of climate and of air quality. This new version extended the emission time series to 1950-2015 and made necessary updates in both the methods and the data input. My major concern is that the method part is not well structured and is very difficult to follow, and the comparison with the previous emissions data lacks the top-down inversion estimates, which should

C1

be included.

Major comments:

1) Method. The method section should put more focus on the new features of the new REAS version 3.1 compared to the last version 2.1. Please summarize the new data development process and give a detailed table to show the new methods developed and the new data sources used in the REAS v3.1. Part of the REAS v2.1 emissions data are directly adopted by the REAS v3.1, such as the agricultural sources in Japan, which should be described clearly in this table. The REAS inventory relies on plenty of other emission inventories to provide the emissions data or the spatial proxies used in the emission distribution. The data dependencies across different inventories would better be clarified specifically in a new table, which would benefit the users of different inventories.

2) Data sources. The manuscript briefly describes the sources of the input data, but the values of parameters are not given. I understand that it is difficult to present all the detailed input data of a large-scale emission inventory. However, knowing the exact values of some key parameters can help the audience understand the drivers of emissions changes. I suggest the authors present some key parameters that determine the curve of emission changes, show their values, and discuss why such values are adopted (e.g., due to more stringent emission legislations). I noticed that the authors used many proxy data to calculate the “trend factors” when the activity data of the past years are not available. This method needs to be justified. Please show the relationship between the proxy data and the associated activity data using the historical values when they are both available.

3) Results. The results section mainly focuses on the emissions of SO₂, NO_x, and BC. Please add CO₂ in each plot of the results to reflect the energy consumption trends. It is difficult to understand the drivers of emission changes from the text now. Please quantitatively estimate the contributions of the energy consumption growth and of the

C2

air pollution control progresses on the emission changes over each region discussed in Sect. 3. For the comparison with other inventories, the authors only compared their emission results with other bottom-up emission inventories, while did not consider top-down emissions data constrained by satellite observations that have developed very fast in recent years. In my opinion, different bottom-up emission inventories commonly share the same sources of input data, which are not completely independent of each other. It would be better to evaluate the long-term emission trends with top-down information from previous literature. For the uncertainty assessment, I cannot understand why the uncertainties of CO₂ emissions are so large, particularly $\pm 28\%$ for China and $\pm 23\%$ for Japan, which are much higher than the typical uncertainty range ($\pm 10\%$) of country CO₂ emissions.

Minor comments:

- 1) Line 47 on Page 2. The GAINS model not the GANS model.
- 2) Line 318 on Page 10. For spatial distribution not the special distribution.
- 3) Lines 354 and 355 on Page 12. Please clarify how the information of large plants is used for developing allocation factors for corresponding emission source sectors.
- 4) The caption of Figure 3. During 1990-2015 not 1950-2015.
- 5) Figures 10 and 11. The colors of some curves are close to each other and are difficult to distinguish. And please also add the uncertainty range of REAS v3.1 in the plots.

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