Atmos. Chem. Phys. Discuss., 13, C6759–C6764, 2013
www.atmos-chem-phys-discuss.net/13/C6759/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Emissions of air pollutants and greenhouse gases over Asian regions during 2000–2008: Regional Emission inventory in ASia (REAS) version 2" *by* J. Kurokawa et al.

J. Kurokawa et al.

kurokawa@acap.asia

Received and published: 11 September 2013

The authors would like to thank Anonymous Referee #1 for taking his or her time to review our manuscript and for giving very constructive and informative comments. These comments helped us improve the quality and clarity of the manuscript. We revised our manuscript based on them. Below are our detailed responses to the comments.

First, we found there were trivial errors in the calculations of CO2 emissions in China. We corrected the values in Tables 2 and 3, Figs. 6e and 6f, and Tables S2l and S3a

(Tables 2 and 3 are Tables 6 and 7 in the revised manuscript). Several values in the main text (Abstract, Sects. 3.1.1, 3.1.2, 3.1.7, and 4) were also corrected. However, there is no influence on the discussion and conclusions of this paper.

Reply to major comments:

Comment 1:

Sect. 2.2.5 Seasonal variation and grid allocation: The statistics activity data set used in this study is based on the country and sub-region (e.g. province for China) levels, with geographical areas being much higher than 0.25N $\times$ 0.25E degree. The authors applied higher resolution population data to allocate the emissions from the area sources to such grid cells. This kind of method is reasonable in the emission estimate of some activities, but it may not work for other emission sources, e.g. from large industrial plants. In addition to power plants, other large industrial plans, such as steel and cement plants, should be considered as point sources. The authors have a discussion of this issue in the paper, but unfortunately they prefer to dealing with it in the next version of the inventory. To find a location of a large steel and iron manufacturing enterprise by its name may not be too difficult. It seems that their inventory is not entirely ready for 0.25N $\times$ 0.25E grid cells.

Reply:

We surveyed large plants of steel and cement in Asian region. For some plants, we collected the detailed address with which we could set exact longitude and latitude of their location. However, there are still many plants for which we have only city name where the plants exist. In addition, fuel consumption and actual production amounts in each plant were not available from public sources but only annual capacity data. Therefore, collected information is not enough to develop reliable data sets of emissions from large industrial plants as point sources. However, they are much better than population distributions as proxy to allocate emissions from iron and cement productions. We modified gridded emission data sets for industrial sector using above information which

ACPD
13, C6759–C6764, 2013

improve the grid resolution. In the revised manuscript, descriptions for above modification were added in Sects. 2.2.1 and 2.2.5 and emission maps in Figs. 7 and 8 were updated using modified gridded data. The emission data sets in the data download site introduced in Sect. 3.7 will be updated after the manuscript is accepted.

Comment 2:

Sect. 2.4 Emission factors: In addition to activity data, emission factors as well as removal efficiency are import for accurately calculating the source emission rates Since measurements of emission factors are spares in Asia region, different values for a same emission factor parameter, either from sparse local measurements or from measurements in the US or Europe, have generally been adopted, leading to a great variability of an emission factor in different inventories. It would be nice if the authors could provide a table to summary what emission factor values are used in their inventory, at least for those with great uncertainties and those that are new compared to other commonly used inventories.

Reply:

In the revised manuscript, three tables (new Tables 3, 4, and 5) were added to provide emission factor values and described in Sect. 2.4. In this study, majority of update was done for emission factors of air pollutants in China. Emission factors for fuel combustion in India were also updated and used for other South Asian countries. In general, for most species, the largest contributing source is fuel combustion. Therefore, new Table 3 gives net emission factors of major air pollutants for stationary combustion in China, South Asia and the rest of Asian countries. New Tables 4 and 5 provide emission factors for road transport and industrial process sources in China, respectively.

Comment 3:

Sect. 3.2 Spatial distribution: Except for larger regions (e.g. eastern China and southern India), no discussion on the geographical distributions of emissions at smaller

ACPD
13, C6759–C6764, 2013

scales is given. Since the inventory is at 0.25N × 0.25E grid cells, the emissions from hot pollution sources like megacities should be resolved. The emission estimate for these pollution hot ports might be presented and compared with previous regional emission inventories (e.g. Zheng et al. 2009; Huang et al., 2011; Zhao et al., 2012).

Reply:

Results of regional emission inventories were compared in a new Table 12 and discussed in Sect. 3.5 in the revised manuscript. Comparisons were done with Zheng et al., 2009 (Part of Guangdong, China), Huang et al., 2011 (Shanghai and parts of Jiangsu and Zhejiang, China), Zhao et al., 2012 (Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Shanxi, Henan, and Liaoning, China), and Gurjar et al., 2004 (Delhi, India).

Comment 4:

Sect. 3.6 Uncertainty: The content about uncertainties is far from satisfactory. The authors focused merely on the improvement in the accuracy of their current version of the inventory compared to previous one.The uncertainties of the emission estimates should be estimated based on the uncertainties in emission factors and activity rates as done by Zhang et al. (2009) and Zhao et al. (2011). They could also be estimated by comparing different emission inventories for the same region and period as done by Zhao et al. (2012).

Reply:

Uncertainties of emissions were calculated after Streets et al. (2003) and Huang et al. (2011) based on assumed uncertainties of activity data and parameters such as emission factors. In the revised manuscript, estimated uncertainties by sectors in China, India, and the rest of Asian countries were summarized in new Table 13 and discussed in Sect. 3.6. In the revised manuscript, Sect. 3.6 is modified accordingly.

Reply to comments for technical issues:

> Page 10058, Formula (3): Should (1-beta_i) be added to account for the fraction of

ACPD
13, C6759–C6764, 2013

distance travelled with a hot engine?

Reply:

In the methodology of this study, cold start emissions were calculated as extra emissions over the emissions that would be expected if all vehicles were only operated with hot engines and warmed-up catalysis. Therefore, formula (3) is correct.

> can Table 2 (and Table 4) be shown with 13 columns?

Reply:

Table 2 in the first submitted manuscript (new Table 6 in the revised one) was modified as advised. Table 4 in the first manuscript was deleted considering the suggestion from Referee #3.

> Maybe Figs 4, 5 and 6 can be reorganized to form two figures, one for regions and another for sectors, each having 4 rows $\times$ 3 columns. Similar revisions may be considered for other figures (Figs 7a and 7b as well as Fig. 8)?

Reply:

Actually, this manuscript uses many spaces for tables and figures and thus, your suggestions are very reasonable in order to save the space. However, in Figs. 4, 5, and 6, contributions emissions from regions and sectors were presented side by side because we considered that readers could easily understand the causes which controlled the trend of Asian emissions of each species. As for Figs. 7 and 8, we checked the figures with 3 columns of emission maps but found that they seemed to be too small for readers to catch the features of spatial distributions of emissions in Asian region. Therefore, if possible, it is favorable to keep these figures as the same format in the first submitted manuscript.

Reference

Gurjar, B. R., van Aardenne, J. A., Lelieveld, J., and Mohan, M.: Emission estimates

ACPD

13, C6759–C6764, 2013

and trends (1990–2000) for megacity Delhi and implications, Atmos. Environ., 38, 5663–5681, 2004.

Huang, C., Chen, C. H., Li, L., Cheng, Z., Wang, H. L., Huang, H. Y., Streets, D. G., Wang, Y. J., Zhang, G. F., and Chen, Y. R.: Emission inventory of anthropogenic air pollutants and VOC species in the Yangtze River Delta region, China, Atmos. Chem. Phys., 11, 4105–4120, doi:10.5194/acp-11-4105-2011, 2011.

Streets, D. G., Bond, T. C., Carmichael, G. R., Fernandes, S. D., Fu, Q., He, D., Klimont, Z., Nelson, S. M., Tsai, N. Y., Wang, M. Q., Woo, J.-H., and Yarber, K. F.: An inventory of gaseous and primary aerosol emissions in Asia in the year 2000, J. Geophys. Res., 108, 8809, doi:10.1029/2002JD003093, 2003a.

Zhao, B., Wang, P., Ma, J. Z., Zhu, S., Pozzer, A., and Li, W.: A high-resolution emission inventory of primary pollutants for the Hubei region, China, Atmos. Chem. Phys., 12, 481-501, doi:10.5194/acp-12-481-2012, 2012.

Zheng, J., Zhang, L., Che, W., Zheng, Z., and Yin, S.: A high resolved temporal and spatial air pollutant emission inventory for the Perl River Delta region, China and its uncertainty assessment, Atmos. Environ., 43, 5112–5122, 2009.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 10049, 2013.