Atmos. Chem. Phys. Discuss., 13, C3758–C3761, 2013
www.atmos-chem-phys-discuss.net/13/C3758/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multiannual changes of CO_2 emissions in China: indirect estimates derived from satellite measurements of tropospheric NO_2 columns" *by* E. V. Berezin et al.

E. V. Berezin et al.

konov@appl.sci-nnov.ru

Received and published: 15 June 2013

We are grateful to the Referee for the positive evaluation of our paper. All comments and suggestions are carefully addressed in the revised manuscript. Below we describe our point-to-point responses.

1. Referee: *Page 265, Lines 28-29: The authors should explain the reason about why "such underestimation is likely due to a corresponding bias in NO_x emissions"*.

This is our cautious interpretation of the underestimation in NO_2 columns, which we cannot prove exactly. On the one hand, as it is discussed in Section 5, the emissions

from the EDGAR v4.2 database used in our model can indeed be underestimated for China. On the other hand, our simulations (Konovalov et al., 2010) performed earlier with the same (CHIMERE) model for Europe (where the emission data are probably more accurate) did not show such a significant systematic bias. To avoid lengthy discussion, in the revised version we refer the reader to the analysis of the probable reasons for underestimation of simulated NO_2 columns in other papers cited in our manuscript.

2. Referee: *Page 272, Line 19: The authors should add the explanation about why the uncertainty in spatial distribution causes the differences between the top-down and bottom-up estimates*.

Large errors in the spatial distribution of the emissions would mean that the spatial structure of the rates of many processes driving accumulation, dispersion and removal of emitted NO_2 (depending on spatial patterns of meteorological conditions and atmospheric transport) would be simulated incorrectly. This could result in possible biases in the simulated relationship between the total NO_2 columns and NO_x emissions. However, we do not think that this is one of the major reasons for the differences between the top-down and bottom-up estimates. The corresponding paragraph is revised accordingly.

3. Referee: *Page 273, Lines 9-28: The main part of discussion in this section has already reported by Zhang et al. (2007). I suggest that this section is omitted or shortened*.

We have attempted to shorten this section by referring a reader to Zhang et al. (2007), as it is recommended by the Referee.

4. Referee: *Page 277, Lines 3-27: In this section, the authors explain that the PEHP and MIC sectors to the total NO_x and CO_2 emissions from China are predominant. However, according to Fig. 8, the "residential and other sectors" for CO_2 and "other EDGAR sector" for CO_2 and NO_x are also larger sectors. Especially, the emission*

fraction and annual trend of "residential and other sectors" is different between CO_2 and NO_x emissions. The authors should explain the effects of emissions from these sectors.

Unlike CO_2 emissions from the major sectors (PEHP and MIC), CO_2 emissions from the "other sectors" do not exhibit any strong nonlinearity and therefore that cannot contribute to the strong nonlinearity of the total CO_2 emissions, which is discussed on page 277. The behavior of NO_x emissions from the "other sectors" is similar to that of CO_2 emissions except for a deviation in 2003. This deviation has no impact on the discussed behavior of the total NO_x emissions in the period from 2000 to 2002. The discussion is extended accordingly in the revised manuscript.

5. Referee: *Section 4.3: Fig. 9 shows that the spatial distribution of emission changes from EDGAR v4.2 inventory is almost constant. This result is quite unreasonable and may indicate that there are some reasons or errors in the spatial distribution of EDGAR inventory. The authors should add more discussion*.

We agree that the spatial distribution of emission changes in the EDGAR v 4.2 inventory is unrealistic, but this is not a result of our study. We believe that an important result of our study is elucidating of possible errors in one of the major state-of-the-art global emission cadastres. This result should be taken into account in future updates of the EDGAR inventory. On the other hand, in-detail discussion of methods, data and internal structure of the EDGAR inventory goes far beyond the scope of this paper. The explanation for the unrealistic spatial distribution of emissions changes in the EDGAR v 4.2 is that the distribution of the EDGAR v4.2 emission data is performed with sector-specific spatial proxy datasets that are kept constant over time. This explanation, which was provided by one of the developers of the EDGAR inventory and is mentioned in the manuscript, is, in our opinion, sufficiently exhaustive.

6. Referee: *Line 26 of page 285 to line 11 of page 286: If the multiannual change of sector emission fraction in the EDGAR inventory is not appropriate, the conversion*

factor "F" may vary with year in the period from 1996 to 2008. It may cause the different temporal changes of CO_2 emissions between 2001 and 2003. I suggest the author add the discussion about the uncertainties of the "F" and its effects to the author's results.

To better evaluate possible uncertainties associated with the NO_x-to-CO_2 emission conversion factors, in addition to the conversion factors from the EDGAR inventory, we considered the NO_x-to-CO_2 emission ratio from the REAS (v.1.11 and v.2.1) emission databases. The results obtained with the NO_x-to-CO_2 emissions factors from the REAS inventory are shown as Case IV in Fig.4. The corresponding discussion is also extended.

7. Referee: *Fig. 5: The symbol (red circle) for "(5) NO_2 summer" should be changed to the symbol (red diamond) for data plot*

The requested correction is made.

8. Referee: *Fig. 10: The legend for province is too small to be clearly visible. It should be improved*.

The legend is enlarged.

References:

Konovalov, I. B., Beekmann, M., Richter, A., Burrows, J. P., Hilboll, A.: Multi-annual changes of NO_x emissions in megacity regions: nonlinear trend analysis of satellite measurement based estimates, Atmos. Chem. Phys., 10, 8481-8498, 2010.

Zhang, Q., Streets, D. G., He, K.,Wang, Y., Richter, A., Burrows, J. P., Uno, I., Jang, C. J., Chen, D., Yao, Z., Lei, Y.: NO_x emission trends for China, 1995–2004: The view from the ground and the view from space, J. Geophys. Res., 112, D22306, doi:10.1029/2007JD008684, 2007.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 255, 2013.