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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Reactive nitrogen in atmospheric emission inventories – a review" *by* S. Reis et al.

Anonymous Referee #2

Received and published: 15 July 2009

I have read through the manuscript and the very detailed comments from Reviewer #1. The topic of this manuscript is of high interests to both scientific communities and policy makers and this is the first time I have been seen such a review paper discussing reactive nitrogen emission inventories. I agree with Reviewer #1 that this paper omits too many recent inventory studies, and it does not address all objectives claimed in the beginning of the paper. Therefore, I recommend publication after addressing the questions raised by Reviewer #1 and myself.

Specific comments:

I recommend a summary table to list the databases discussed in this paper. The table should include the name and reference of the database, representing year, containing species, as well as the emissions. Summarize three regions in separate tables, if

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necessary.

Although this paper is focused on three regions, an overview of global emissions would be very helpful for understanding atmospheric N budgets. It will add the value of this review paper. I would suggest adding a section to discuss global inventories before the three regional sections. EDGAR is not the only global inventory dataset addressing reactive nitrogen species. Global datasets can be introduced in this section, and comparisons between global inventories and regional inventories can be then discussed in the following sections.

The three regional sections were organized in different way, which makes the structure of this manuscript unclear. The differences between EDGAR data and European inventory were discussed in Sect. 2, and Sect. 3.2, but EDGAR data was not mentioned in Sect. 3.1, 3.3, and the whole Sect. 4. Emission trends were discussed in Sect. 3.2, 3.3, and 4.2, but missing in other sections. I suggest that the authors report each of three regions in a similar way.

As EDGAR 4 is fresh (only GHG gases are available by now) and rarely validated, and previous EDGAR dataset has been extensively used in scientific communities, I suggest that the authors also compare EDGAR 3 or EDGAR FT2000 with regional inventories. It would be also interesting to see the differences between EDGAR FT2000 and EDGAR 4.

NO emissions from soil are now of great concern. These emissions are usually missing from official inventories, but there are several scientific inventory studies addressing this. I recommend the authors be aware of this part because it might be significant to global and regional NOx budget.

I agree with Reviewer #1 that all the units in this manuscript should be converted to Tg or Gg N. It's difficult to me to follow the numbers with different units.

P12419, L8: I am surprising that RAINS and GAINS database were not mentioned

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here. These two databases should be discussed in Sect. 2. In the present manuscript, RAINS dataset was mentioned in Sect. 2.2, but missing in Sect 2.3 and 2.4.

P12419, L25: EDGAR FT2000 should be mentioned here.

P12420, L8: It should be stated that which dataset is used in the comparison (Official submissions or model use).

P12421, L1: I would like to see a percentage difference presented here.

P12421, L9-14: Here EDGAR's estimates were lower than that of EMEP. It's conflict with the previous statement of "EDGAR emissions are (much) higher for all EU27 countries".

P12421, L17: Again, RAINS and GAINS database should be discussed.

P12422, L5: Please compare with IIASA data.

Winiwarter W. (2005) The GAINS Model for Greenhouse Gases - Version 1.0: Nitrous Oxide (N2O) IIASA Interim Report IR-05-55

P12422, L27: which inventory is discussed here?

P12423, L1-3: I would suggest adding GAINS data to this comparison. Also, compare at the sector level if possible, to make this conclusion more convincible.

P12423, L10: Which year is used? 1999, 2002, or 2005?

P12423, L19: How the NEI estimates compared to EDGAR?

P12424, L7: Discussions on regional trend in NOx emissions would be interesting, e.g., Ohio River region, California, etc. . .

P12424, L26: Add the following reference:

Kim, S.-W., A. Heckel, G. J. Frost, A. Richter, J. Gleason, J. P. Burrows, S. McKeen, E.-Y. Hsie, C. Granier, and M. Trainer (2009), NO2 columns in the western United States

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observed from space and simulated by a regional chemistry model and their implications for NOx emissions, J. Geophys. Res., 114, D11301, doi:10.1029/2008JD011343.

P12425, L14: Compare with EDGAR data.

P12426 L3: The authors should revisit this section carefully. Many of recent studies were missing.

P12426, L5: The following inventories should be discussed in this section:

EDGAR;

TRACE-P inventory: Streets D. G., et al., An inventory of gaseous and primary aerosol emissions in Asia in the year 2000, J. Geophys. Res., 108 (D21), 8809, doi:10.1029/2002JD003093, 2003.

REAS inventory: Ohara, T., Akimoto, H., Kurokawa, J., Horii, N., Yamaji, K., Yan, X., and Hayasaka, T.: An Asian emission inventory of anthropogenic emission sources for the period 1980–2020, Atmos. Chem. Phys., 7, 4419-4444, 2007.

Klimont, Z., Cofala, J., Schopp, W., Amann, M., Streets, D.G., Ichikawa, Y., and Fujita, S.: Projections of SO2, NOx, NH3 and VOC emissions in East Asia up to 2030, Water Air Soil Pollut., 130, 193-198, 2001.

P12427, L1: Almost all recent studies are missing in this section. This section should be rewritten carefully.

EDGAR4;

REAS inventory: Ohara, T., Akimoto, H., Kurokawa, J., Horii, N., Yamaji, K., Yan, X., and Hayasaka, T.: An Asian emission inventory of anthropogenic emission sources for the period 1980–2020, Atmos. Chem. Phys., 7, 4419-4444, 2007.

Zhang, Q., Streets, D.G., He, K., Wang, Y., Richter, A., Burrows, J.P., Uno, I., Jang, C.J., Chen, D., Yao, Z., and Lei, Y.: NOx emission trends for China, 1995-2004: The

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view from the ground and the view from space, J. Geophys. Res., 112, D22306, doi:10.1029/2007JD008684, 2007.

INTEX-B inventory: Zhang, Q., Streets, D. G., Carmichael, G. R., He, K., Huo, H., Kannari, A., Klimont, Z., Park, I., Reddy, S., Fu, J. S., Chen, D., Duan, L., Lei, Y., Wang, L., and Yao, Z.: Asian emissions in 2006 for the NASA INTEX-B mission, Atmos. Chem. Phys. Discuss., 9, 4081-4139, 2009.

Gains-China: Z. KLIMONT, J. COFALA, J. XING, W. WEI, C. ZHANG, S. WANG, J. KEJUN, P. BHANDARI, R. MATHUR, P. PUROHIT, P. RAFAJ, A. CHAMBERS, M. AMANN, J. HAO, Projections of SO2, NOx and carbonaceous aerosols emissions in Asia, TellusB, DOI: 10.1111/j.1600-0889.2009.00428.x, in press, 2009 (available online).

P12427, L1: I agree with Reviewer #1 that the satellite observed NOx trends should be discussed in this paper, not only for China, but for all three regions. Therefore, maybe this part can be placed to the Sect. 5.3.

Several additional references for satellite-based NOx emission trends among the world:

Richter, A., Burrows, J.P., Nüß, H., Granier, C., and Niemeier, U.: Increase in tropospheric nitrogen dioxide levels over China observed from space, Nature, 437, 129-132, 2005.

Kim, S.-W., A. Heckel, S.A. McKeen, G.J. Frost, E.-Y. Hsie, M.K. Trainer, A. Richter, J.P. Burrows, S.E. Peckham, and G.A. Grell (2006), Satellite-observed U.S. power plant NOx emission reductions and their impact on air quality, Geophys. Res. Lett., 33, L22812, doi:10.1029/2006GL027749.

van der A, R.J., Peters, D.H.M.U., Eskes, H., Boersma, K.F., Van Roozendael, M., De Smedt, I., and Kelder, H.M.: Detection of the trend and seasonal variation in tropospheric NO2 over China, J. Geophys. Res., 111, D12317, doi:10.1029/2005JD006594, 2006.

Stavrakou, T., Müller, J.-F., Boersma, K.F., De Smedt, I., and van der A, R.J.:

Assessing the distribution and growth rates of NOx emission sources by inverting a 10-year record of NO2 satellite columns, Geophys. Res. Lett., 35, L10801, doi:10.1029/2008GL033521, 2008.

Konovalov, I. B., Beekmann, M., Burrows, J. P., and Richter, A.: Satellite measurement based estimates of decadal changes in European nitrogen oxides emissions, Atmos. Chem. Phys., 8, 2623-2641, 2008.

P12427, L23: Bai, 1996 and Ma and Zhou, 2000. These two references are not appropriate. They did not address NOx emission trends over China.

P12428, L12: Discuss the following studies:

EDGAR;

Yan, X., Akimoto, H., and Ohara, T: Estimation of nitrous oxide, nitric oxide and ammonia emissions from croplands in East, Southeast and South Asia, GBC, 9, 1080-1096, 2003.

REAS inventory: Ohara, T., Akimoto, H., Kurokawa, J., Horii, N., Yamaji, K., Yan, X., and Hayasaka, T.: An Asian emission inventory of anthropogenic emission sources for the period 1980–2020, Atmos. Chem. Phys., 7, 4419-4444, 2007.

Gu, J., Zheng, X., and Zhang, W.: Background nitrous oxide emissions from croplands in China in the year 2000, Plant and Soil, 320, 302-320, 2009.

P12430, L2: NARSTO assessment report should be mentioned in this section.

P12434, L13: Satellite observed trends can be discussed here. Also, add the following references:

REAS inventory: Ohara, T., Akimoto, H., Kurokawa, J., Horii, N., Yamaji, K., Yan, X., and Hayasaka, T.: An Asian emission inventory of anthropogenic emission sources for the period 1980–2020, Atmos. Chem. Phys., 7, 4419-4444, 2007.

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Gains-China: Z. KLIMONT, J. COFALA, J. XING, W. WEI, C. ZHANG, S. WANG, J. KEJUN, P. BHANDARI, R. MATHUR, P. PUROHIT, P. RAFAJ, A. CHAMBERS, M. AMANN, J. HAO, Projections of SO2, NOx and carbonaceous aerosols emissions in Asia, TellusB, DOI: 10.1111/j.1600-0889.2009.00428.x, in press, 2009 (available online).

P12438, L20: This section looks weird to me. I could not understand the means of "uncertainties" here. Uncertainties in emission projections? Also, historical emission trends have been discussed in Sect. 5.3. This section and Sect. 5.3 should be restructured.

P 12450: I suggest merging Table 2, 3, and 4 into one table.

Fig. 2, Fig.3 and Fig.7, add IIASA's data.

Fig. 8, Some references are not complete, (Klimont et al., Tian et al.). Re-draw this figure after including the missing studies mentioned above.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 12413, 2009.