

Interactive comment on “Decadal changes in global surface NO_x emissions from multi-constituent satellite data assimilation” by Kazuyuki Miyazaki et al.

Anonymous Referee #1

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General comments

The paper analyses the changes in NO_x polluting emissions, by assimilating different constituents from different satellite instruments in the chemistry-transport model. The manuscript is clear and it has nice logic flow. Because there are several works dealing with emission estimation using satellite-based observations, I would recommend stressing the added value of this approach (for example already in the abstract and in the trend calculation in Sect. 5.4), i.e. the assimilation of non-NO₂ observations as compared to previous work where only NO₂ is assimilated in the system. I recommend publication after addressing the following specific and technical comments.

Specific comments

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P9 L17 The larger pixel size for GOME-2 and SCIAMACHY could indeed produce a dilution effect (lower NO₂ level for larger pixel) compare to the smaller OMI pixel and thus, in principle, partially reduce the difference due to the different overpass time. Could you comment about that in the text?

Figure 2: It is quite difficult to distinguish the differences in these maps. It could be useful to show the differences compared to the observations in the second and third row, instead of the absolute tropospheric NO₂ columns. It should help in highlighting the differences.

P11 L19 Are there any known/expected differences in the ways of reporting, that you could mention here between the a priori and the EDGAR-HTAP emission databases?

P11 L29-30 Again, is there an expected reason to explain the similarity between EDGAR_HTAP and a posteriori emissions, relative to the a priori?

P18 L18 You might want to refer here to this work about in plume chemistry effect: Vinken, G. C. M., Boersma, K. F., Jacob, D. J., and Meijer, E. W.: Accounting for non-linear chemistry of ship plumes in the GEOS-Chem global chemistry transport model, *Atmos. Chem. Phys.*, 11, 11707-11722, doi:10.5194/acp-11-11707-2011, 2011.

P18 L32-33 It is unclear for me what do you mean for “overcorrect”. Do you mean that NO₂-only gives too high emission values? According Table 3, the NO₂-only data assimilation almost always (except South America) gives smaller values than the full assimilation. Could you clarify?

Table 4 and section 5.4: Do these emission trends change when NO₂-only assimilation is taken into account? I would include in Table 4 also the trends with NO₂-only assimilation if the differences are sizeable.

How your results reported in Table 4 and Fig.8 compare with those reported as NO₂ tropospheric columns (OMI Standard Product not DOMINO as in your study) by Krotkov et al. (2016) in their Fig. 8?

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It could be interesting also to compare your results in China and US to the results by Liu et al. (2016) in Table S2 of their supplement. Those results are not based on data assimilation but are based on satellite data only. Liu, F., Beirle, S., Zhang, Q., Dörner, S., He, K., and Wagner, T.: NO_x lifetimes and emissions of cities and power plants in polluted background estimated by satellite observations, *Atmos. Chem. Phys.*, 16, 5283-5298, doi:10.5194/acp-16-5283-2016, 2016.

Technical corrections

P1 L6 biased -> biases

P2 L23 add reference Krotkov et al. 2016 here too

P2 L22 Kalam -> Kalman

P6 L32 GOME-II -> GOME-2

P7 L18-19 This needs reference

P7 L25 You might want to mention that those resolutions are valid in nadir direction only, but get bigger on the side of the swath and actually since 2008-2009 OMI row-anomaly doesn't allow complete daily global coverage.

Table 2 Australis -> Australia (and in the other tables too)

P14 L20 Los Angels -> Los Angeles

P20 L30 There are two dots at the end of the sentence

Table 4: Caption: OM -> OMI

Table 4 Is there a reason you put Table 4 before 5 and 6 but then you refer to Table 4 only in section 5.4, after mentioning 5 and 6? Please, clarify.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-529, 2016.

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