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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Satellite measurement based estimates of decadal changes in European nitrogen oxides emissions" *by* I. B. Konovalov et al.

Anonymous Referee #1

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The manuscript presents a detailed analysis of the trend in nitrogen oxide emissions over Europe as determined using satellite observations of nitrogen dioxide coupled to a chemical transport model. The authors use inverse modeling techniques to show a negative trend in NOx emissions over much of eastern and central Europe, consistent with recent bottom-up emissions estimates. In contrast, the authors show strong disagreement between their top-down emissions estimates and the bottom-up inventories over Russia and other Eastern European Countries. The satellite-derived trends are compared directly with surface observations of NOx, while model results (constrained with the new emissions estimates) for ozone are compared with surface ozone measurements.

General Comments:

In general, this paper is well organized, excellently written and provides new insight on the rate of change of nitrogen oxide emissions in Europe. The later is strong indication for the effectiveness of emission reduction policy on the decadal scale. Further, the authors provide a logical approach toward estimating the uncertainty in their results and the conclusions derived from them. I strongly recommend publication of this article in ACP, following attention to a few specific comments.

Specific Comments:

1. NOx ground based measurements [Section 2.2 Page 2019, line 13]: It is well known that many ground based NO2 detectors have a strong positive artifact as a result of conversion of species other than NO2 (e.g., HNO3, PAN) to NO. Information on the type of NOx detectors used here and how the artifacts were treated in the analysis should be included. [See Dunlea et al. ACP 7, 2691-2704, 2007 for more information]

2. Location of Anthropogenic Regions [Section 2.5 Page 2022, line 9]: How were the anthropogenic regions used in this analysis selected? [e.g., using some threshold NO2 column, by location, or by a flagged NOx tracer in the model?

3. Relationship between NO2 vs. NOx emissions [Section 3.1 Page 2024, line 5]: It would be helpful to the reader to elaborate on point 5 as this is both an important and confusing point. The NOx lifetime is directly dependent on the magnitude of NOx through its feedback on OH. Additionally, VOC and CO emissions are likely to co-vary with changes in NOx, also effecting the NOx lifetime. The later of these two is mentioned at other points in the paper, however I think it would be helpful to the reader to have this outlined here.

4. Time varying NOx sources [Section 3.4]: The uncertainty analysis is both complete and well organized. I had one addition comment or potential source of error. How does the daily variation in emissions affect the results? Specifically, NOx emissions

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from mobile platforms are not evenly distributed throughout day and night and often have a morning and evening maximum. Presumably the model emissions that you are comparing to are 24hr averages? Does the fact that the satellite is sampling between 10-11AM during the summer make the satellite results more sensitive to changes in the morning automobile rush hour than the model that is averaging over 24hrs?

5. Figure Legends: Please add symbols [e.g., +] to the legends in Figures 4 and 5.

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