

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

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Received and published: 17 April 2008

We would like to thank the Reviewer for the positive evaluation of our paper and thoughtful remarks. Our point-to-point responses to the specific comments are given below.

1. We were aware of recent findings concerning possible artifacts in NO₂ measurements performed by chemiluminescence analyzers. We did not discuss this point in the paper partly because we believe that these artifacts cannot change the conclusions of our study, and also because we do not have sufficient information which would allow us to accurately quantify the impact of these artifacts on the trends in NO_x concentrations reported in the paper. However, taking into account the Reviewer's concern, we

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provide brief discussion of this point in the revised version of the paper. Specifically, the following text is introduced in Section 4.2:

"Note that chemiluminescence analyzers which are employed in the UK automatic network may overestimate the actual concentration of NO₂ because of interference of non-NO_x reactive nitrogen (NO_z) species. For example, Dunlea et al. (2007) found that, during the MCMA-2003 field campaign in Mexico City (April 2003), the interference of NO_z species resulted in average NO₂ concentrations measured by the chemiluminescence monitors up to 22% greater than that from co-located spectroscopic measurements. Steinbacher et al. (2007) found that, on the average, only 70-83% of NO₂ measured at a non-elevated rural site could be attributed to real NO₂. We have no specific information about possible artifacts in the considered NO_x measurement in Great Britain, but it seems probable that they should be much smaller than those mentioned above. Indeed, the majority of the selected NO_x monitors (19 out of 21) are located in urban areas, and, therefore, the ratio of concentrations of secondary pollutants containing nitrogen (such as HNO₃ and alkyl nitrates) to those of primary NO_x pollutants at the selected AURN sites should be significantly smaller than at the rural sites considered by Steinbacher et al. Similarly, the climate in Mexico City is warmer and actinic fluxes larger than in Great Britain, and thus it is more favorable to oxidation processes. A bias which these artifacts may cause in the measured negative trend in NO_x concentrations in UK is likely positive, because concentrations of OH and O₃, which are responsible for the oxidation of NO_x species, are likely to increase in urban sites as NO_x emissions decrease. The magnitude of this bias is quite difficult to assess; most probably, it is less than 10 percent of the measured trend. Such bias cannot change any conclusions of this study."

2. The "anthropogenic" regions used in this analysis are selected in a quite simple way. We compared tropospheric NO₂ columns calculated by the model with and without anthropogenic emissions and selected only those grid cells where the ratio of the NO₂ column amount in this two runs was larger than 2. The corresponding explanatory

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sentence in section 2.5 is modified.

3. We agree with the Reviewer's suggestion to elaborate more on the point 5. In the revised version, we try to explain the basic assumptions regarding the relationships between NO_x emissions and NO₂ columns more clearly.

4. We agree that diurnal variations of emission sources is yet one more factor that can be responsible for a part of the differences between the NO_x emission trends derived from satellite measurements and calculated using the EMEP data. In the revised version, this potential factor is mentioned in the end of Section 3.4 (nearby a similar remark concerning the seasonal variations in emissions). Intuitively, it seems clear that these factors cannot explain neither the facts of major differences between our estimates and the EMEP data, which are mentioned in the Conclusions, nor the good agreement between them, which is found in many other regions. However, quantification of the impact of these factors is an extremely difficult task which is addressed to future studies.

5. The symbols are introduced in the figure legends as it has been requested by the Reviewer.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 2013, 2008.

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