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Interactive comment on "Inverse modelling of the spatial distribution of NO_x emissions on a continental scale using satellite data" *by* I. B. Konovalov et al.

Anonymous Referee #2

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General Comments This is an interesting manuscript that develops and presents an algorithm for inverse modelling of NOx emissions. The work is current. GOME and SCIAMACHY NO2 columns and the CHIMERE chemical transport model are used in the inversion. The approach is generally sound and thorough. However several remaining issues need to be addressed as described below.

Specific Comments Introduction The word "partially" should be added before "accounts" in the statement that the inversion accounts for transport. The model top is 500 hPa so transport in the free troposphere is not included. The model and GOME

are not sampled on the same day which introduces systematic biases in attempts to account for transport. Section 3.3.3 states that a value of M is 2, implying that transport is neglected beyond 1 degree around the central grid cell.

Section 2.1 Does this version of CHIMERE account for NOx emissions from aircraft and lightning? The parameterization for lightning should be discussed if included in CHIMERE. Otherwise, the expected errors from these omissions should be discussed.

The model top of 500 hPa is concerning. The expect errors associated with the omission of the middle and upper troposphere should be discussed. These errors should be included in the inversion.

Why is the model sampled on days in which the *model* has low cloud cover? Does the model cloud cover agree with the cloud cover determined from GOME? It would be better to sample the model during days of low cloud cover determined from GOME. Otherwise substantial sampling biases would be expected.

Section 2.2 It is concerning that the air mass factor calculation uses NO2 vertical distributions from MOZART rather than from CHIMERE. Why? How does the NO2 vertical distribution from MOZART compare with that from CHIMERE? The current approach is likely to bias the comparison between CHIMERE and GOME NO2 columns.

What is the expected accuracy of the GOME measurement of NO2? This information should be provided.

Equation 2 is unclear. What is the basis for using the numbers 3, 6, and 9?

Section 2.4 Ground-based monitoring networks of NO2 are often contaminated by other reactive nitrogen species. Is this an issue here?

Section 4.1 What are the standard deviations in Table 1? Do they refer to temporal variation or spatial variation?

The discussion of errors is a confusing part of the manuscript and should be clarified.

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Exactly how are the a priori errors determined? Are the GOME errors dependent upon the estimated uncertainty in the retrieval? What is the uncertainty in simulation of NO2 columns with CHIMERE for a known set of NOx emissions?

Conclusions “The improved emissions enabled strong reduction of the discrepancy between measured and modeled NO2 columns Ĕ” It should be clarified here that this reduction is only a test of the method and not an actual improvement of the model simulation. The same reduction in discrepancy would occur if the satellite data contained a systematic bias.

Figures 1, 7, and 8. The presentation of a logarithm of emissions is unusual. It would be clearer to provide actual emission rates.

Figure 1. Are emissions from lightning and aircraft included here?

Figure 11. Which ratios are statistically significant?

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12641, 2005.