

Interactive comment on “Comparison and evaluation of modelled and GOME measurement derived tropospheric NO₂ columns over Western and Eastern Europe” by I. B. Konovalov et al.

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First of all, we would like to thank the reviewer for generally positive evaluation of our paper and helpful comments.

We agree that the paper could benefit from a broader discussion of comparison with NO₂ ground based measurements. Accordingly, we have introduced a special paragraph in the end of Section 3 (before the final paragraph) of the final version of the paper. As it was already argued in Section 3 (see p. 6512 of the reviewed version of the paper), the comparison with NO₂ ground based measurements is, in our opinion, indeed less suitable for evaluation of the model than comparison with ozone measure-

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ments, particularly because real NO₂ concentrations averaged over an 0.5x0.5 deg.² area may be very different from NO₂ concentration at points of the ground based measurements. In response to the reviewer's request to "make plausible that simulated column values of NO₂ are not really affected by the model's inability to simulate near-ground NO₂ levels", we have performed some additional analysis and found, in particular, that GOME NO₂ columns over EMEP sites correlate better with corresponding modeled than measured ground based NO₂ concentrations averaged over 3 summer months similar to GOME measurements. For example, the correlation coefficients for the data of 1997 are 0.73 and 0.62, respectively. In our opinion, this result shows that when spatially averaged characteristics of real NO₂ fields are of interest, the CHIMERE output is more credible than the "point" measurements of NO₂. On the other hand, it is hardly possible to say about "the model's inability to simulate near-ground NO₂ levels" anyway, because, although the results of comparison of day-to-day variations of simulated and measured near-ground NO₂ concentrations are indeed rather unsatisfactory, the spatial correlation between the same data averaged over 3 months is rather significant (e.g., R=0.82 in 1997) and comparable to that obtained in the case of comparison of CHIMERE NO₂ columns with GOME data.

The reviewer suggests that it could be "that the analysis is hampered by the fact that CHIMERE performs worse for chemical regimes as they appear to be present in Eastern Europe". In fact, it was a particular aim of our analysis to identify "differences in statistical characteristics and uncertainties of the GOME derived and simulated NO₂ columns between Western and Eastern Europe" (see, e.g., Introduction, p. 6508, last paragraph), and we could not conclude that CHIMERE "performs worse" in Eastern Europe than in Western Europe. On the contrary, our results allowed us "to make a tentative conclusion that the overall model performance with regard to simulations of ground ozone is similar both for Eastern and Western Europe" (see p. 6534, line 19). And, with regard to NO₂ columns, "we have found no evidences, that either the performance of CHIMERE or the quality of the NO₂ columns derived from GOME measurements is unambiguously worse for Eastern than for Western Europe" (p.6536, line 6).

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We believe that we have chosen appropriate ways to address the differences between Western and Eastern Europe, and the relevant issues have been discussed sufficiently deeply (see, e.g. p.6516, lines 5-18, p. 6525, lines 8-25, p. 6530, lines 12-27).

The last comment of the reviewer concerns our suggestions about some uncertainties in the emission data used in CHIMERE. Specifically, based on the large difference in the average (over the whole model domain) decrease of NO₂ from 1997 to 2001 in CHIMERE (11%) and in GOME data (0.1%), we made a careful suggestion that “the EMEP emission database may overestimate an actual reduction of the anthropogenic NO_x emissions”, although note further that “this supposition needs further careful analysis that is beyond the scope of this paper”. We agree with the reviewer’s remark that “if the model outcome can be made plausible, it strengthens the suggestion”. However, the question on errors in model responses to emission changes is extremely difficult and requires a special study anyway. Indeed, on the one hand, it hardly possible to assume that “the model responds in an inappropriate way to emission changes” as one can easily see in the plots that the model predicts larger NO₂ columns over urbanized areas, and much smaller ones over predominantly rural areas, as it should be in reality. But on the other hand, there may exist, in principle, model errors caused, for example, by inaccuracies in representation of vertical and/or horizontal transport. As the meteorological situation in 1997 differs from that in 2001 such inaccuracies may lead to different effects in different years. Besides, the data from GOME measurements may also represent inter-annual changes of the real NO₂ level insufficiently accurately (due to, e.g., ageing of the instrument and unaccounted changes in AMFs and aerosol loading). Nevertheless, taking into account that the relative difference in inter-annual changes of the average level of NO₂ in the troposphere given by model and GOME is very large, we think that our very careful suggestion is relevant and may become a starting point for future special studies. Similar arguments are relevant for our suggestion which concerns exceptionally large differences between GOME and CHIMERE NO₂ columns over Krakow and Moscow areas, except that instead of inter-annual differences in the factors that may lead to the differences between the data from GOME

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and CHIMERE, it would be necessary to consider the respective “inter-regional” differences. We have added an additional “restrictive” sentence in the final version of the paper.

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