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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global impact of road traffic emissions on tropospheric ozone" *by* S. Matthes et al.

Anonymous Referee #2

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The paper " Global impact of road traffic emissions on tropospheric ozone" by S. Matthes, V. Grewe, R. Sausen, and G.-J. Roelofs uses a global 3-D coupled chemistry GCM to study the impact of emissions of NOx, CO, and NMVOCs from road traffic on tropospheric ozone. The study simulates the effect of emissions of NOx, CO and NMHCs on tropospheric ozone using the standard method of performing a set of model simulations, first a control run with all emissions and then perturbation runs removing the emissions from road traffic. The study adds to a surprisingly short list of previous studies of the impact of road traffic emissions on the chemical composition of the atmosphere (I only know of the study by Granier and Brasseur). The topic of the study agrees well with the scope of ACP and I thus recommend publication after some revi-

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sions as described below.

In this paper 1990 emissions are used. Road traffic is a sector with rapid growth in traffic volume, but also technological changes like catalysts and more aerodynamic vehicles. Although some of these factors may have counteracted each other, there has most likely been significant changes in regional distribution of the emissions, the NOx/CO and NOx/NMVOC ratios in the emissions. Reading only the abstract and the conclusions, one get the impression that it is the impact of current emissions from road traffic that has been simulated. The year of the emissions must be given in both the abstract and in the summary and conclusions section. Also, I believe that the summary and conclusions section should be extended with a paragraph on the difference between the 1990 emissions used in this study and more recent estimates (e.g. the EDGAR Fast Track, emissions for year 2000 http://www.rivm.nl/edgar/model/v32ft2000edgar/edgarv32ft-prec/), and how the changes might influence the current impact of road traffic emissions (without new model simulations).

Relative vs. absolute ozone changes. All the results for ozone are presented as relative changes (%), although impacts (RF or air quality) are related to absolute changes (eg. ppbv). The reader must be able to somehow extract the concentration changes. There should either be a new figure showing the ozone concentrations in ppbv in the control run (surface maps (Jan/Jul) and cross sections (Jan/Jul)) or figures 5, 6, and 9 should be redrawn in ppbv. I would recommend the first option.

Validation of the model. Section 3 compares the modeled NO2 distribution only with observations of the NO2 column from GOME. I agree that it is very important to validate the model's NOx distribution due to the non-linear ozone-NOx chemistry, however, I believe the NO2 column data from GOME is the most relevant dataset. This is due to, as mentioned by the authors: "On the other hand, the observations have a small sensitivity in the surface layer of the atmosphere due to physical reasons. Furthermore it is stated (block 10342, line 2) that: The year 1990 was chosen as reference year, since complete emission data and atmospheric observations were available." The GOME data are certainly not from 1990 and that is the only atmospheric observations that are used. As far as I can see, the model version used here is the same as the used by Roelofs and Lelieveld (JGR, 2000), in which there is a fair amount of model validation. I would recommend that you begin Section 3 with a paragraph summing up the findings in R&L, (in particular wrt. NOx, ozone and PAN) and then shorten the following discussion of the GOME comparison.

Plume effects A significant fraction of the emissions take place in urban areas with high background concentrations of precursors. The fact that the resolved scale in the model is about 400x300 km at mid latitudes means that there is likely to be an overestimate of the ozone production efficiency in the model (cf. Meijer et al. (GRL, 1997) on similar effects of aircraft plumes). This should be mentioned in the discussion.

Contribution to ozone during episodes, air quality issues. Air quality issues related to ozone is mentioned in the first sentence of the Introduction. Health standards and crop loss of ozone is generally related to ozone episodes where concentrations exceeds a certain threshold value. Thus a relevant question is how do the emissions from road traffic affect the ozone levels during these episodes. If some statistical information about this has been saved during the model simulations, I think it should be shown in the paper.

Role of PAN. There is some redundancy in the description of the role of NMHC and PAN for NOx transport and ozone production, as the discussion is started at several places in the manuscript, but not done properly until Section 4.2. I believe it would be better to simply refer to Section 4.2 when the role of PAN is touched upon earlier in the paper.

Block 10349, line 23: "In January, road traffic NMHC emissions contribute strongest to zonally averaged ozone in source latitudes with more than 4% relative contribution, by inhibiting ozone titration, and more than 2% in northern hemispheric extratropics, but

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outside the main source regions." I don't understand how adding NMHCs can inhibit ozone titration. Please explain.

Minor comments

Block 10343, line 15 Another factor complicating the comparison between the model and the GOME NO2 column is the difference between the year of emissions and the year of observations.

Block 10344, line 10 "because, first, in these regions respective tropospheric NO2-columns are very low and, second, the corresponding reference sector in the model system is influenced by tropospheric NO2 ". Please clarify, it is difficult to understand what the word respective refers to.

Block 10341, line 4 Evaluatex –> Evaluated

Block 10343, line 18 calcultes –> calculates

Meijer, E. W., P. F. J. van Velthoven, W. M. F. Wauben, J. P. Beck, G. J. M. Velders, The effects of the conversion of nitrogen oxides in aircraft exhaust plumes in global models, Geophys. Res. Lett., 24(23), 3013-3016, 10.1029/97GL53156, 1997

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 10339, 2005.