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The Global Impact of Traffic Emissions on Ozone and OH

P. Hoor (1), J. Lelieveld (1), P. Jöckel (1), R.. Sausen (2), V. Grewe (2), P. van Velthoven (3), I.S.A Isaksen (4), O. Dessens (5), D. Hauglustaine (6), M. Prather (7), and the QUANTIFY-AC3 Team

(1) Max Planck Institute for Chemistry, Department of Atmospheric Chemistry, Mainz, Germany (hoor@mpch-mainz.mpg.de), (2) Institute for Atmospheric Physics, German Aerospace Center (DLR), Oberpfaffenhofen, Germany, (3) Royal Netherlands Meteorological Institute, KNMI, De Bilt, The Netherlands, (4) Dept. of Geosciences, University of Oslo, Norway, (5) Centre for Atmospheric Science, Dept. of Chemistry, Cambridge, United Kingdom, (6) Laboratoire des Sciences du Climat et de l'Environment (LSCE), CEN de Saclay, Gif-sur-Yvette, France, (7) Dept.of Earth System Science, University of California, Irvine, USA

To estimate the impact of emissions by road, aircraft and ship traffic on ozone of the present-day atmosphere seven different atmospheric chemistry models simulated the atmospheric composition of the year 2003. Based on newly developed global emission inventories for road, ship and aircraft emissions each model performed a series of five simulations: A base scenario using the full set of emissions, three sensitivity studies with each individual sector of transport reduced by 5% and one simulation with all traffic related emissions reduced by 5%. The approach minimizes non-linearities of the atmospheric chemical effects and the results are later scaled to 100%.
The mean maximum effect on ozone predicted by the models is 4.0 DU and maximizes over the northern subtropical Atlantic. The relative effect amounts to more than 15% for the zonal mean (5.5 ppbv) compared to unperturbed conditions.
In the region of maximum column ozone sensitivity maritime emissions contribute to more than 80% to the boundary layer during northern summer. Ship exhausts contribute to the total southern hemispheric traffic induced tropospheric ozone perturbation about 60%–80% throughout the year (1–1.5 ppbv).
Road emissions have the strongest impact on ozone over the continental boundary layer and the free troposphere. Their impact on the northern hemisphere upper troposphere competes with aircraft emissions over the continents due to vertical transport and convection. On a global basis NOx emissions from aircraft perturb ozone most efficiently. In the tropopause region between 30 and 60°N aircraft emissions account for 4 ppbv during July (3%) and 3ppbv (2%) during Januay, respectively.
In the lower troposphere chemistry responds most sensitively to ship emissions in the marine boundary layer over the Atlantic, where the effect on ozone can exceed 10% and on OH even 15% (5 105 moelcules/cm3) during summer (zonal mean). The global annual methane lifetime reduction caused by ship exhaust is estimated to be on the order of 3.5 - 4%, road by 1.5% and aircraft around 1%, respectively.