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Global impact of road traffic emissions on tropospheric ozone

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Abstract. Road traffic is one of the major anthropogenic emission sectors for NO_x, CO and NMHCs (non-methane hydrocarbons). We applied ECHAM4/CBM, a general circulation model coupled to a chemistry module, which includes higher hydrocarbons, to investigate the global impact of 1990 road traffic emissions on the atmosphere. Improving over previous global modelling studies, which concentrated on road traffic NO_x and CO emissions only, we assess the impact of NMHC emissions from road traffic. It is revealed that NMHC emissions from road traffic play a key role for the impact on ozone. They are responsible for (indirect) long-range transport of NO_x from road traffic via the formation of PAN, which is not found in a simulation without NMHC emissions from road traffic. Long-range transport of NMHC-induced PAN impacts on the ozone distribution in Northern Hemisphere regions far away from the sources, especially in arctic and remote maritime regions. In July total road traffic emissions (NO_x, CO and NMHCs) contribute to the zonally averaged ozone distribution by more than 12% near the surface in the Northern Hemisphere midlatitudes and arctic latitudes. In January road traffic emissions contribute near the surface in northern and southern extratropics more than 8%. Sensitivity studies for regional emission show that effective transport of road traffic emissions occurs mainly in the free troposphere. In tropical latitudes of America up to an altitude of 200 hPa, global road traffic emissions contribute about 8% to the ozone concentration. In arctic latitudes NMHC emissions from road transport are responsible for about 90% of PAN increase from road transport, leading to a contribution to ozone concentrations of up to 15%.

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