



Estimation of NO_x emissions from the Megacity of Lahore, Pakistan using car MAX-DOAS observations and comparison with OMI satellite data

Maria Razi (1), Reza Shaiganfar (1), Muhammad Fahim Khokhar (2), Steffen Dörner (1), Noor Ahmad (3), Sebastian Donner (1), Steffen Beirle (1), and Thomas Wagner (1)

(1) Max Planck Institute for Chemistry, Mainz, Germany (maria.razi@mpic.de), (2) Institute of Environmental Sciences and Engineering, NUST, Islamabad, Pakistan, (3) Environmental Protection Agency Punjab, Lahore, Pakistan

Lahore is a metropolitan city of Pakistan with about more than 10 million inhabitants and thus a strong emission source of atmospheric pollutants. The quantification of these emission sources is usually accomplished by so-called bottom-up inventories, based on the summation of the emissions of individual emission sources for all relevant emission categories. Such inventories are subject to large errors because of uncertainties in the emission estimates for individual sources as well as their numbers and characteristics. Here we present results of a top-down emission inventory for Lahore based on car multi-axis differential optical absorption spectroscopy (car-MAX-DOAS) observations. We performed such measurements around the city on Lahore on six days in December 2015. From the measured spectra we derive the vertically integrated concentration of NO₂ along the driving route (the so called tropospheric vertical column density, VCD).

By combining these observations with wind data we estimate the total NO₂ emissions from the city of Lahore. Since from the measured spectra only NO₂ (but not NO) can be retrieved, we convert the NO₂ emissions to total NO_x (NO₂ plus NO) emissions. We also apply corrections for the decay of NO_x on the way between the emission source and the location of the measurements. We compare the derived NO_x emissions to existing emission inventories. We also compare the spatial distributions of the tropospheric NO₂ VCDs observed by car MAX-DOAS with collocated results from satellite observations of the Ozone Monitoring Instrument (OMI).