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Four years of ground-based MAX-DOAS observations of aerosols, NO_2, SO_2 and HCHO in Wuxi, China

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Understanding the temporal variation and spatial distribution of the abundances of nitrogen dioxide (NO_2), sulphur dioxide (SO_2), formaldehyde (HCHO) and aerosols is necessary to study their role in tropospheric chemistry and to estimate their importance among anthropogenic emissions. To accomplish this, we operated a Multi AXis - Differential Optical Absorption Spectroscopy (MAX-DOAS) instrument from May 2011 to Nov 2014 in Wuxi, China. A new inversion algorithm PriAM (profile inversion algorithm of aerosol extinction and trace gas concentration) developed at AIOFM in cooperation with MPIC based on the optimal estimation algorithm is applied to obtain tropospheric profiles of trace gases and aerosols from the long-term observations. The performance of the inversion algorithm is evaluated by comparisons with other independent techniques for a period longer than one year. The cloud effect on the retrieved column densities, surface concentrations and profiles of the trace gases and aerosols is evaluated using of a cloud classification scheme based on the MAX-DOAS measurements themselves. From this study recommendations for the quality of the MAX-DOAS results for different cloud scenarios are given. Further, the MAX-DOAS results are used to characterize the seasonal, diurnal, and weekly variations of NO_2, SO_2, HCHO and aerosols. Systematic weekly variations are found for all the species, indicating a significant contribution of anthropogenic emissions to the observed abundances. The good correlations between the trace gases and aerosols, especially for HCHO, indicate a significant contribution of secondary aerosols from the precursors to the total aerosol load. We use the wind dependence of the pollutants to identify the dominating sources. High values are observed when the wind comes from the direction of industrial areas.