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MAX-DOAS measurements of tropospheric vertical profiles of NO_2, SO_2, HCHO, HONO and aerosols in the western North China Plain

Yang Wang (1), Steffen Dörner (1), Thomas Wagner (1), Yuying Wang (2), Hao He (2), Xinrong Ren (3), Zhanqing Li (2,3), Donghui Li (4), Hua Xu (4), Zhengqiang Li (4), Jiwei Xu (5), Dong Liu (5), Zhenzhu Wang (5), Isabelle De Smedt (6), and Nicolas Theys (6)

(1) Max-Planck institute for Chemistry, satellite group, Mainz, Germany (y.wang@mpic.de), (2) College of Global Change and Earth System Sciences, Beijing Normal University, Beijing, China, (3) Department of Atmospheric and Oceanic Science and ESSIC, University of Maryland, College Park, Maryland, USA, (4) Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, (5) Key Laboratory of Atmospheric Composition and Optical Radiation, Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Hefei, China, (6) Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium

Xingtai is one of the most polluted cities in China and is located on the western edge of the large industrial zone of the North China plain. The Taihang Mountains in the west of Xingtai block transport of polluted air mass towards western China and cause accumulation of pollutants along the mountains. Severely polluted air harms health of about seven million inhabitants in Xingtai. Air pollution also influences the amount and properties of condensation nuclei for the formation of convective clouds, and thus potentially initiates heavy rainfall. In order to study the interaction of pollutants and clouds, the Atmosphere-Aerosol-Boundary Layer-Cloud (A2BC) Interaction Joint Experiment was held around Xingtai in the period from May to June 2016. Various instruments measuring gaseous pollutants, aerosols, clouds, precipitation, and radiance are operated at a monitoring station (37.18° N, 114.36° E) in the suburban area of Xintai city and aboard two aircrafts which flew up and down in spirals between 0.2 km and 4 km over the station. We operated a Multi Axis (MAX-) Differential Optical Absorption Spectroscopy (DOAS) instrument at the station in order to derive tropospheric vertical profiles of NO_2, SO_2, HCHO, HONO and aerosols during daytime with a time resolution of about 10 minutes. The results are verified by comparisons with other ground-based and aircraft measurements. The MAX-DOAS results are applied to characterize the vertical profiles, the diurnal cycles, and wind dependence of the pollutants. Emission sources and transport effect of pollutants are investigated based on systematic analysis and case studies. Some days with high HONO concentrations (up to 1ppb near the ground) around noon are found which is probably related to a significant emission flux from the soil after fertilization.