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Evaluation of tropospheric SO_2 retrieved from MAX-DOAS measurements in Xianghe, China

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Ground-based Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measurements of sulfur dioxide (SO_2) have been performed at the Xianghe station (39.77°N, 117.0°E) located at ∼50 km South-East of Beijing from March 2010 to February 2013. Tropospheric SO_2 vertical profiles and corresponding vertical column densities (VCDs), retrieved by applying the Optimal Estimation Method to the MAX-DOAS observations, have been used to study the seasonal and diurnal cycles of SO_2, in combination to correlative measurements from in situ instruments, as well as meteorological data. A marked seasonality is observed in both SO_2 VCD and surface concentration, with a maximum in winter (February) and a minimum in summer (July). This can be explained by the larger emissions in winter due to the domestic heating and more favorable meteorological conditions for the accumulation of SO_2 close to the ground during this period. Wind speed and direction are also found to be two key parameters in controlling the level of the SO_2-related pollution at Xianghe. In the case of east or southwest wind, the SO_2 concentration rises with the increase of the wind speed, since heavy polluting industries are located to the east and southwest of the station. In contrast, when wind comes from other directions, the stronger the wind, the less SO_2 is observed. Regarding the diurnal cycle, the SO_2 amount is larger in the early morning and late evening and lower at noon, in line with the diurnal variation of pollutant emissions and atmospheric stability. The observed diurnal cycles of MAX-DOAS SO_2 surface concentration are also in very good agreement (correlation coefficient close to 0.9) with those from collocated in-situ data, demonstrating the reliability and robustness of our retrieval.