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MAX-DOAS observations of tropospheric NO2 and H2O column densities from hyper-arid areas in Central-Asia

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We present the results of Auto Multi-AXis Differential Optical Absorption Spectroscopy (MAX DOAS) observation of tropospheric NO2 and H2O carried out in the hyper-arid Milan-Oasis (NW-China) from 13 to 28 July 2010. We selected Milan-Oasis (39.25°N, 88.92°E) in Taklamakan desert (part of the great Central Asian desert). There locates one of the farms of Xinjiang Production and Construction Crop, and the energy supply is provided by a nearby hydropower plant. By choosing Milan-oasis, we largely eliminate the influence on NO2 concentrations by fossil fuel combustion, so that we can focus on other factors such as land managements and local meteorological condition.

The MAX-DOAS instrument observes scattered sun light under various elevation angles (in our experiment: -3°, -2°, -1°, 0°, 1°, 2°, 4°, 6°, 8°, 10°, 15°, 20°, 45°, and 90° were chosen). The measurements of NO2 and H2O were performed in fixed locations in areas of 3 different land use types: agricultural fields (AF, cotton fields and jujube fields), transition zone (TZ, NE-upwind and SW-downwind) and the desert (DE). The measured spectrums are analyzed using DOAS fit algorithm, which yields the differential slant column density (dSCD). To convert the SCDs into vertical column densities (VCDs) air mass factors (AMFs) were applied. For our analysis, we chose the measurements of 15° and 20° and a geometrical approximation of AMF to calculate VCDs.

The average NO2 VCDs were: in AF10.23, in TZ-NE 9.07 in TZ-SW 8.89, and in DE 6.56 (in 1014molec/cm2); average H2O SCDs were in AF 1.10, in TZ-NE 0.80, in TZ-SW 1.21, and in DE 0.93(in 103molec/cm2). The average wind speed during the campaign was 2.36 with a maximum of 6.92 and a minimum of 0 (km/h). NO2 VCDs over agricultural fields are higher than those over transition zones and desert; and H2O SCDs are higher over agriculture fields and downwind transition zone than over the desert and upwind transition zone. From the comparisons we found that: (1) Agricultural land managements like irrigation and fertilization may increase tropospheric NO2 and H2O concentrations; (2) wind from northeast (desert area) was dry and the water vapor generated over the agricultural fields was transported by the wind to the downwind transition zone.

This is the first application of MAX-DOAS observation in hyper-arid area. Further study will be supported by comprehensive data measured during the planned large-scale field campaign in Milan-Oasis in summer 2011, during which we will continue the stationary MAX-DOAS observations and will also apply mobile measurements which can provide horizontal information.