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# Temporal and spatial distribution of tropospheric $NO_2$ over arid areas of Central Asia by OMI Satellite observations: Evidence for a strong contribution of soil biogenic nitric oxide

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We present results observations of tropospheric $NO_2$ carried out by Ozone Monitoring Instrument (OMI) over the Central Asian arid areas from 2005 to 2011. We selected 8 oases (Ruoqiang, Milan, Waxxari, Qiemo, Minfeng, Shache, Awati and Kuche) in Taklimakan desert (part of the great Central Asian deserts). For these, spatial distributions, seasonal variations, and trends of tropospheric $NO_2$ Vertical Column Densities (VCDs) retrieved are discussed.

In the Taklimakan desert, oases are the centers of all human activities and the economy of the selected oases are dominated by oasis agriculture. Irrigation and fertilization favor the microbial production of nitric oxide in soils, which after emission is converted to $NO_2$ by ozone. Consequently, tropospheric $NO_2$-VCDs are a good proxy for biogenic NO emissions from soils. For contrast, we examined also the $NO_2$-VCDs in the area of the growing megacity Urumqi (43.85°N, 87.62°E), which is known as an anthropogenic highly polluted city in the Central Asian deserts.

For 2005-2011, all selected oases are hot spots of NO/$NO_2$ in the Taklimakan desert. Higher $NO_2$-VCDs were observed during growing seasons over all 8 oases. $NO_2$-VCDs observed in summer generally increased from 2005 to 2011. $NO_2$-VCDs over Urumqi were generally at least 1 order of magnitude higher than those over the oases. In contrast to the oases, wintertime $NO_2$-VCDs over Urumqi are higher than in summer.

We evaluated governmental statistical agricultural data of the 8 oasis, and compared the trends with corresponding summertime $NO_2$-VCDs. Inter-annual trends of $NO_2$-VCDs over the oases show similar patterns to those of N-fertilizer application and sown (and irrigated) areas.

Highest $NO_2$-VCDs observed in summer for agriculturally dominated oases are a strong indication that soil biogenic NO emission is the main contributor to the tropospheric $NO_2$ over all 8 oases, while in Urumqi fossil fuel combustion, particularly during winter, is the main source for NO/$NO_2$. With regard to recent/future agriculture development in the Taklimakan oases (80% of the current Chinese cotton production originates from there), biogenic NO emission from soils will provide an increasing contribution to tropospheric $NO_2$ over Central Asia.