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Area integrated emission of biogenic nitric oxide by Lagrangian dispersion modeling (LASAT): Milan oasis, Taklimakan desert (Xinjiang, PR China)

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Today's knowledge of soil biogenic NO emission rates from arid and hyper-arid land is based on a total of about 20 experimental studies. Nevertheless, biogenic NO emissions even from non-managed arid and hyper-arid soils are significant and may range between 1-10 ng m-2 s-1 (in terms of nitrogen, if conditions for soil NO production are favourable (optimum soil moisture, high soil temperatures). Irrigated and fertilized oases, ranging about 3000 km long around the great Central Asian Taklimakan desert form the backbone of the agricultural output (80% of the Chinese cotton production) of the Xinjiang Uygur Autonomous Region (NW-China). Recent and future development of farmland and intensification of agriculture will definitely impact the regional soil NO emission and consequently the budget of nitrogen oxides and ozone. Up to today, only a few studies have preliminarily addressed soil biogenic NO emissions from the Taklimakan desert.

In our contribution, we will focus on the quantification of the area integrated NO emission from the Milan oasis located on the most southern fringe of the Takalimkan desert (39.26°N, 88.91°E). At a first step, the 3D distribution of ambient NO concentration is calculated using a state-of-the-art commercially available dispersion model (LASAT 3.2, Lagrange Simulation of Aerosol-Transport). Performing the dispersion simulation, transport and turbulent diffusion are simulated for a group of representative "simulation particles" by means of a stochastic process (Lagrange simulation). Surface sources (individual cotton fields, Jujube orchards) are known: their geographical location as well as their areal extent, their stage of vegetation growth as well as irrigation and fertilization events and amounts, soil temperatures and soil water contents. This information is used to up-scale our results of field specific potential net NO emission, which has been parameterized in terms of soil temperature, soil water content, and soil nutrient content. Meteorological input for LASAT (wind speed and wind direction, atmospheric stability, roughness length, radiation intensity) is provided by the results of an automatic weather station network, consisting of six individual stations which have been distributed over the entire oasis.

Given the 3D distribution of ambient NO concentration, vertical cross-sections of NO concentrations up-wind and down-wind the Milan oasis will be constructed (perpendicular to the main wind direction). The height- and cross-wind integrated horizontal NO fluxes at the up-wind and down-wind end of the oasis is then calculated by double integration of the product of NO concentration and horizontal wind speed (from ground to height of mixing layer and along the cross-wind extension of the oasis). The difference between the down-wind and up-wind integrated horizontal NO fluxes is considered to be equal the area-integrated NO emission of the entire oasis, provided the horizontal NO Flux at the up-wind end of the oasis is known (most likely equal zero, since the oasis is isolated by the Taklimakan desert for more than 100-150 km).

Results of a three week period (June 2011) will be presented and will be discussed in comparison to up-scaled, field-specific in-situ measured NO fluxes (dynamic chamber and aerodynamic gradient techniques).