

## Satellite-based observations of rain-induced NO<sub>x</sub> emissions from soils around Lake Chad in the Sahel

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Rain-induced emission pulses of NO<sub>x</sub> ( $\equiv$  NO + NO<sub>2</sub>) from soils have been observed in many semi-arid regions over the world. They are induced by the first precipitation of the wet season and are mainly caused by the sudden re-activation of microbes in the soil releasing reactive nitrogen. In this study, a single intense event of pulsed NO<sub>x</sub> emissions from soils around Lake Chad is investigated. This is achieved by analysing daily tropospheric NO<sub>2</sub> vertical column densities (VCDs) as observed by the satellite-based OMI instrument together with other satellite and model data on precipitation, lightning, fire and wind. The study region of Lake Chad and its ecosystems are indispensable to life in the Sahel region. Climate variability and unsustainable water utilization, however, caused a drastic decrease in the lakes' surface area which, in turn, lead to extensive land cover changes converting former lake area to shrub land and fertile farm land.

The results indicate that the region of Lake Chad does not only show consistent enhancements in average NO<sub>2</sub> VCDs in the early months of the wet season compared to its surrounding desert but also exhibits particularly strong NO<sub>x</sub> emissions shortly after a single large-scale precipitation event in June 2007. NO<sub>2</sub> VCDs measured 14 hours after this precipitation event show strong enhancements ( $2.5 \cdot 10^{15}$  molecules cm<sup>-2</sup>) compared to the seasonal background VCDs and, moreover, represent the highest detected NO<sub>2</sub> VCDs of the entire year. Detailed analysis of potential contributors to the observed NO<sub>2</sub> VCDs strongly indicate that fire, lightning and retrieval artefacts cannot explain the NO<sub>2</sub> pulse. The estimated emission flux from the soil, calculated based on mass balance, amounts to about  $32.3 \text{ ng N m}^{-2} \text{ s}^{-1}$ , which corresponds to about 65 tonnes of nitrogen released to the atmosphere within one day.