Geophysical Research Abstracts
Vol. 12, EGU2010-5836, 2010
EGU General Assembly 2010

Direct observation of lightning-produced NO_x: A clouded view

Steffen Beirle and Thomas Wagner
MPI Chemie Mainz, Satellite remote sensing, Mainz, Germany (steffen.beirle@mpic.de)

Lightning is an important source of NO_x in the free troposphere, especially in the tropics, with high impact on ozone production. However, estimates of lightning NO_x (LNO_x) per flash are still quite uncertain. Here we discuss the potential of satellite observations of NO_2 to quantify freshly produced LNO_x, with a focus on strong lightning events.

Recent cloud-resolving model studies reveal that satellite measurements are sensitive for freshly produced LNO_x, even under cumulonimbus cloud conditions. Also, some case studies show clearly enhanced NO_2 column densities over active lightning systems.

We present a systematic analysis of NO_2 tropospheric slant column densities (TSCDs) from satellite measurements over active thunderstorms, as detected by the World-Wide Lightning Location Network (WWLLN), where WWLLN detection efficiency is estimated using the LIS flash climatology. Only very strong lightning events are considered, having flash densities (FDs) above 1 km^{-2} h^{-1} inside the satellite pixel within the last hour. The respective NO_2 TSCDs are expected to be higher than 7.5e15 molec/cm^2 (as long as outflow can be neglected), which should be clearly visible in the satellite measurements.

We find about 100 satellite measurements per year coinciding with high flash rates. For some of these events, a clear enhancement of NO_2 TSCD could be observed. However, the measured TSCDs are generally far below the expected values. In addition, in most of the cases, no significantly enhanced NO_2 TSCDs could be found, and the correlation of FD and TSCD is low.

Our study reveals fundamental inconsistencies of recent estimates of the LNO_x production per flash combined with the sensitivity of LNO_x from satellite. Further investigation has to reveal how far this can be related to the assumed LNO_x production per flash, radiative transfer issues, and/or NO_x chemistry in cumulonimbus clouds.