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Sensitivity of satellite observations for lightning NO_x

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Lightning provides a natural source of nitrogen oxides (NOx=NO+NO2), dominating the production in the tropical upper troposphere, with strong impact on ozone production. Recent estimates of lightning produced NOx (LNOx) are about 5 Tg [N] per year, but uncertainties are still high.

Satellite measurements of NO2 provide a new and independent approach to estimate LNOx. Despite the comparably small signal, and the still large uncertainties, LNOx has been identified clearly in satellite observations, showing (a) average enhancements over lightning active areas as well as (b) a direct signal at strong lightning events. Quantitative estimates result in numbers at the lower end of current literature values ($\sim$2 Tg [N] per year), with still high uncertainties. Open questions remain in particular for the observations of freshly produced LNOx that show generally low signals and an unexpected high variability in the NO2 columns.

Here we present a comprehensive analysis of observed NO2 columns over lightning active thunderstorms indicated by the World Wide Lightning Location Network WWLLN.

In addition, the sensitivity of satellite observations for fresh lightning NOx within cumulonimbus clouds is studied in detail involving cloud resolving models and the radiative transfer model McArtim.