Sensitivity of satellite observations for lightning NO\textsubscript{x}

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Lightning provides a natural source of nitrogen oxides (NO\textsubscript{x}=NO+NO\textsubscript{2}), dominating the production in the tropical upper troposphere, with strong impact on ozone production. Recent estimates of lightning produced NO\textsubscript{x} (LNO\textsubscript{x}) are about 5 Tg [N] per year, but uncertainties are still high.

Satellite measurements of NO\textsubscript{2} provide a new and independent approach to estimate LNO\textsubscript{x}. Despite the comparably small signal, and the still large uncertainties, LNO\textsubscript{x} 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 LNO\textsubscript{x} that show generally low signals and an unexpected high variability in the NO\textsubscript{2} columns.

Here we present a comprehensive analysis of observed NO\textsubscript{2} columns over lightning active thunderstorms indicated by the World Wide Lightning Location Network WWLLN.

In addition, the sensitivity of satellite observations for fresh lightning NO\textsubscript{x} within cumulonimbus clouds is studied in detail involving cloud resolving models and the radiative transfer model McArtim.