

[Home](#)[Online Library ACP](#)[Recent Final Revised Papers](#)[Volumes and Issues](#)[Special Issues](#)[Library Search](#)[Title and Author Search](#)[Online Library ACPD](#)[Alerts & RSS Feeds](#)[General Information](#)[Submission](#)[Review](#)[Production](#)[Subscription](#)[Comment on a Paper](#)

Impact
Factor
4.865

ISI
indexed

[Volumes and Issues](#) [Contents of Issue 3](#)

Atmos. Chem. Phys., 9, 1077-1094, 2009

www.atmos-chem-phys.net/9/1077/2009/

© Author(s) 2009. This work is distributed under the Creative Commons Attribution 3.0 License.

Sensitivity of satellite observations for freshly produced lightning NO_x

S. Beirle¹, M. Salzmänn², M. G. Lawrence¹, and T. Wagner¹¹Max-Planck-Institut für Chemie, (Otto Hahn Institute), Mainz, Germany²Atmospheric and Oceanic Sciences Program, Princeton University, Princeton, NJ, USA

Abstract. In this study, we analyse the sensitivity of nadir viewing satellite observations in the visible range to freshly produced lightning NO_x. This is a particular challenge due to the complex and highly variable conditions of meteorology, (photo-) chemistry, and radiative transfer in and around cumulonimbus clouds. For the first time, such a study is performed accounting for photo-chemistry, dynamics, and radiative transfer in a consistent way: A one week episode in the TOGA COARE/CEPEX region (Pacific) in December 1992 is simulated with a 3-D cloud resolving chemistry model. The simulated hydrometeor mixing ratios are fed into a Monte Carlo radiative transfer model to calculate box-Air Mass Factors (box-AMFs) for NO₂. From these box-AMFs, together with model NO_x profiles, slant columns of NO₂ (S^{NO₂}), i.e. synthetic satellite measurements, are calculated and set in relation to the actual model NO_x vertical column (V^{NO_x}), yielding the "sensitivity" S^{NO₂}/V^{NO_x}.

From this study, we find a mean sensitivity of 0.46. NO_x below the cloud bottom is mostly present as NO₂, but shielded from the satellites' view, whereas NO_x at the cloud top or above is shifted to NO due to high photolysis and low temperature, and hence not detectable from space. However, a significant fraction of the lightning produced NO_x in the middle part of the cloud is present as NO₂ and has a good visibility from space. Due to the resulting total sensitivity being quite high, nadir viewing satellites provide a valuable additional platform to quantify NO_x production by lightning; strong lightning events over "clean" regions should be clearly detectable in satellite observations. Since the observed enhancement of NO₂ column densities over mesoscale convective systems are lower than expected for current estimates of NO_x production per flash, satellite measurements can in particular constrain the upper bound of lightning NO_x production estimates.

[Final Revised Paper](#) (PDF, 3997 KB) [Discussion Paper](#) (ACPD)

Citation: Beirle, S., Salzmänn, M., Lawrence, M. G., and Wagner, T.: Sensitivity of satellite observations for freshly produced lightning NO_x, Atmos. Chem. Phys., 9, 1077-1094, 2009. [Bibtex](#) [EndNote](#) [Reference Manager](#)

[Search ACP](#)Library Search [»](#)Author Search [»](#)[News](#)

- [Sister Journals AMT & GMD](#)
- [Financial Support for Authors](#)
- [Journal Impact Factor](#)
- [Public Relations & Background Information](#)

[Recent Papers](#)

01 | ACPD, 12 Mar 2009:
A new insight on tropospheric methane in the Tropics – first year from IASI hyperspectral infrared observations

02 | ACP, 12 Mar 2009:
HOCl chemistry in the Antarctic Stratospheric Vortex 2002, as observed with the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS)

03 | ACP, 12 Mar 2009:
Comparison of tropospheric gas-phase chemistry schemes for use within global models

