Atmos. Chem. Phys. Discuss., 5, S3794–S3795, 2005
www.atmos-chem-phys.org/acpd/5/S3794/
European Geosciences Union

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimating the NO_x produced by lightning from GOME and NLDN data: a case study in the Gulf of Mexico" *by* S. Beirle et al.

Anonymous Referee #1

Received and published: 13 November 2005

Lightning remains the most uncertain source of NOx emissions. This clever and thorough manuscript combines observations from multiple datasets with regional modeling to provide perhaps the best evidence to date for detection of lightning NOx using the GOME satellite instrument. The authors also consider the various factors involved in quantifying lightning NOx emissions per flash and outline a method for determination of global lightning NOx emissions. The manuscript should be published in ACP. Below are comments and suggestions.

Sections 1-3 are very well written. Sections 4 and 5 are more difficult to follow. It would

be helpful to include a table that summarizes the factors involved in the calculation of NOx / flash. The table could also contain the uncertainties in each component. The calculation of the total uncertainty from the individual sources was unclear.

The calculation of the AMF in section 4.1 includes a convolution of box AMFs from Hild et al. with an expected vertical profile of lightning emissions from Pickering et al. This is a reasonable approach, however it appears to neglect vertical variation in the NO / NO2 ratio. The box AMFs were calculated for NO2 while the vertical profile of lightning emissions is for NOx. A suggestion to correct this issue is to multiply the profile of NOx emissions by the vertically resolved NO2 / NOx ratio (i.e. Bradshaw et al., GRL, 1999, 471-474) before convolution with the box AMFs.

The NO2/NOx ratio used in section 4.4 is based on measurements in the thunderstorm anvil. However as noted by the authors, GOME has some sensitivity to NO2 below the anvil due to multiple scattering. It would be more complete to use an "effective NO2/NOx ratio" that represents the observed ratio over the column. A possible approach would be to convolve a vertically resolved NO2/NOx ratio with the vertically resolved GOME sensitivity weighted by the profile of lightning NOx emissions.

A longitudinally invariant stratospheric AMF was effectively used in this analysis. Enhanced sensitivity to stratospheric NO2 above cloud top could contribute to a minor enhancement in the NO2 slant columns and introduce a small bias in the vertical columns. A potential approach to quantify the bias from this issue would be to compare NO2 slant columns at a similar latitude and month as found here over the remote ocean for two different cases: 1) no cloud and 2) a high cloud without lightning.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 11295, 2005.