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Lightning-produced NO_2 observed by two ground-based UV-visible spectrometers at Vanscoy, Saskatchewan in August 2004

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Abstract. Ground-based measurements of ozone and NO_2 differential slant columns by the SAOZ (Système d'Analyse par Observations Zénithales) and UT-GBS (University of Toronto Ground-Based Spectrometer) instruments during the MANTRA 2004 field campaign are presented herein. During the afternoon of 28 August, a thunderstorm passed over the instruments, which were installed at Vanscoy, Saskatchewan (52° N, 107° W). Enhanced differential slant columns of ozone and NO_2 were observed by both instruments during the storm, with maximum values of two and 25 times the expected clear sky columns, respectively. The enhanced ozone differential slant columns are primarily due to the longer path traversed by the solar radiation caused by multiple scattering inside the thick cloud layer associated with the thunderstorm. The enhanced NO_2 columns are partly attributed to NO_x production by lightning. Two new methods are used to separate the NO_2 enhancements into contributions from the longer path length and production by lightning. Combining the observed excess NO_2 with lightning flash data from the Canadian Lightning Detection Network and Environment Canada Doppler radar measurements, the production of NO_2 molecules per lightning flash is determined. Using these two methods, the best estimate of the production rate is found to be $(7.88\pm2.52)\times10^{26}$ molecules NO_2/flash from the UT-GBS and $(6.81\pm2.17)\times10^{26}$ molecules NO_2/flash from SAOZ. These results are consistent with the range of previous estimates reported in the literature.

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