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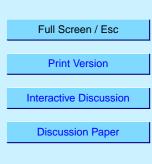
Interactive comment on "Intercontinental transport of nitrogen oxide pollution plumes" by M. Wenig et al.

M. Wenig et al.

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Addressing the questions about the treatment of lightning NO_x production: We used the LIS dataset in order to get information about the lightning activity in the analyzed area. The number of flashed has been multiplied by the production rate of 6.7 10^{25} molecules/flash for intracloud flashes and 6.7 10^{26} molecules/flash for cloud-to ground flashes given by Jourdain et al.. We assumed 5% cloud-to-ground flashes according to the very high flash rates and using the formula IC/CG=2.7 F^{1/2} given by Rutledge et al. Pickering et al., 1998 (see paper) states that tropical systems, particularly those over marine areas, tended to have a greater fraction of intracloud flashes. For the FLEXPART lightning simulation the NOx tracer particles had been released between 5 and 10 km height.

LIS is not observing the area permanently, so we scaled the resulting number of NOx molecules by a factor of 250, assuming the thunder storms to last 12 hours. This



resulted in 10% of the lightning induced NOx compared to the total amount of NOx from the FLEXPART simulation. The exact fraction of lightning NOx can be seen in Table 1. The high values in column 3 come from the fact that in early stage of the transport the industrial plume has not yet reached the ocean. Because of the referee's and A. Richter's comment, we increased the scaling factor (time scaling factor=500 corresponding to 2 overpasses per day with 90 seconds viewing time respectively, production rate 6.7 10²⁵*0.95+6.7 10²⁶*0.05 molecules/flash). The fraction of lighting induced NOx increased to approximately 25% (see Table2). The uncertainties are still very high, so the main conclusion of the paper is that the plume reaching Australia consists of both, industrial NO2 emitted in South Africa, and lightning NO2 produced over the Indian Ocean near South Africa. This can be confirmed by a comparison of the shapes of the plumes produced by lightning and industrial emissions, since there are areas, dominated by lightning NOx and areas dominated by industrial NOx, all seen by GOME, especially the areas not covered by clouds (see Fig.3).

Addressing the referee's question about the differences between our algorithm to estimate the tropospheric fraction of NO2 and other algorithms: We are using an algorithm to separate the stratospheric and tropospheric fraction of the total vertical NO2 column seen by GOME which is utilizing several assumptions about the spatial distribution and temporal variance of the Stratosphere and the Troposphere. In comparison to the reference sector method from Andreas Richter et al., our algorithm is using more information than one Orbit per day so that we can also resolve zonal variations, but we are using only one spectral window (430-450nm), whereas Andreas Richter et al. is additionally using the additional wavelength band 345 - 359 nm (see for example "Quantification of Tropospheric Measurements from Nadir Viewing UV/vis Instruments", TROPOSAT (EUROTRAC-2 subproject) Task Group 1, by Andreas Richter, Folkard Wittrock, Annette Ladstätter-Weißenmayer, John P. Burrows and Thomas Wagner). Martin et al. combines GOME measurements with model results, which we can not do, since we are using the comparison of the GOME measurements with model results to validate both. The first version of our algorithm is described in Leue et al. (2001) and the new

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version is described in detail in Wenig 2001. There, also comparisons with in-situ data is shown.

Table 1: FLEXPART lightning NOx in percentage of total FLEXPART NOx (industrial+lightning)

Date/whole area seen in fig3(paper)/ocean only

| 05/04/1998 | 0.00945 | 0.3939 |
|------------|----------|---------|
| 05/05/1998 | 1.60451 | 21.2381 |
| 05/06/1998 | 5.41546 | 65.9199 |
| 05/07/1998 | 10.35070 | 21.9508 |
| 05/08/1998 | 8.60432 | 10.9591 |
| 05/09/1998 | 8.60928 | 9.6072 |
| 05/10/1998 | 8.46404 | 8.8824 |
| 05/11/1998 | 9.99398 | 10.2958 |
| 05/12/1998 | 10.00680 | 10.2544 |
| 05/13/1998 | 9.35731 | 9.8777 |
| 05/14/1998 | 8.28894 | 10.5325 |

Table 2: FLEXPART lightning NOx in percentage of total FLEXPART NOx (industrial+lightning) with new scaling factor

Date/whole area seen in fig3(paper)/ocean only

| 05/04/1998 | 0.0274 | 1.13375 |
|------------|---------|---------|
| 05/05/1998 | 4.5154 | 43.8828 |
| 05/06/1998 | 14.2397 | 84.87 |
| 05/07/1998 | 25.0840 | 44.9219 |
| 05/08/1998 | 21.4464 | 26.3045 |
| 05/09/1998 | 21.4570 | 23.5602 |
| 05/10/1998 | 21.1452 | 22.0396 |
| 05/11/1998 | 24.3574 | 24.9725 |

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| 05/12/1998 | 24.3837 | 24.8885 |
|------------|---------|---------|
| 05/13/1998 | 23.0399 | 24.1187 |
| 05/14/1998 | 20.7673 | 25.451 |

Interactive comment on Atmos. Chem. Phys. Discuss., 2, 2151, 2002.

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