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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Highly resolved global distribution of tropospheric NO_2 using GOME narrow swath mode data" *by* S. Beirle et al.

S. Beirle et al.

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We thank Rev#1 for his/her constructive remarks and answer his/her questions and remarks as follows:

Reviewer comment: Figure 4 and the associated discussion are anecdotal and not convincing as an explanation of the streaking in Figure 3b. The streaking persists over deserts such as the Sahara or central Australia where no large seasonal variation in NO2 would be expected. The streaking may arise from incomplete removal of instrumental artifacts. Figure 4 and the associated discussion should be cut (or better justified). The method to correct for streaking seems appropriate even if the streaking does not arise from seasonal variation in NOx emissions.

Reply: Indeed, the mean of the NSM in Fig. 3c is sensitive to single "outliers", especially for North-Western Africa, where the total number of NSM observations is only

about 5 (Fig. 2). So instrumental artefacts may also be a possible reason for stripelike-structures, and we list this possibility in our manuscript. As Rev. #1 stated, our method would also correct such artefacts. However, we find no indication for such effects, and could instead ascribe the stripes to the temporally inhomogeneous sampling: some spots are scanned predominantly in, e.g., summer, while others nearby are mainly for other times of the year. This leads to a systematic shift in the mean VCD. We illustrate this effect for the Congo region, where it is quite pronounced due to the strong yearly cycle of NOx emissions because of biomass burning. However, we checked this effect also for other regions, and found that seasonal cycles of the NO2 VCD are also present for most regions, e.g. the equatorial Atlantic Ocean (due to outflow from the Congo region), the Pacific (probably due to shortcomings in the stratospheric estimation), Central Australia (lightning, see Beirle et al., 2003b) and even the Sahara (possibly due to albedo variations). We clarified the corresponding discussion in the manuscript.

Reviewer comment: The linear relation between forward and backscan measurements may arise from snow cover if the cloud detection algorithm reports a snow covered scene as a cloudy scene. Snow cover would have the opposite effect of clouds in many cases. The correlation in Figure 9 is only applied to data in the continental northern hemisphere where snow confounds interpretation. Does the linear relationship exist in the tropics?

Reply: Snow cover may indeed interfere with the shielding effects of clouds. To exclude this interference, we now consider only observations for summer (Jun-Aug). The general result (of Fig. 9) is quite the same. The expected difference of NSM backscan and averaged NSM forescans is proportional to the tropospheric burden of NO2 and thus hard to check in the tropics. We therefore concentrate on polluted regions in our analysis. However, further investigation revealed that the findings of Fig. 9 are not as surprising as we thought in our ACPD manuscript, as we explain in item 5 of our general reply.

ACPD

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Reviewer comment: Is the seasonal correction used to produce Figure 3c also applied to the NSM backscan? Inconsistencies would affect interpretation of Figure 9.

Reply: For the data shown in Fig. 3c, we use the original NSM backscan for the seasonal correction by comparing it with the SSM annual mean (1996-2001). The data shown in Fig. 9, however, is the uncorrected data directly measured by GOME. We clarified this in our manuscript.

Reviewer comment: The discussion of the NOx lifetime should be related to previous calculations based on in situ measurements or model calculations. The mean wind speed (1 m/s) used in this calculation is low, even for a lower limit.

Reply: The point we want to make is that the low extent of the "hot spots" allows to give a conservative upper estimate of the mean lifetime of tropospheric NO2. The low value of 1m/s seems to be an appropriate lower limit for the mean wind speed, as can be seen from the NCEP/NCAR yearly mean climatology available at http://www.cdc.noaa.gov/HistData/ . We extended the paragraph on the lifetime and added information on model and measurement data.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 1665, 2004.