Atmos. Chem. Phys. Discuss., 3, S1597–S1599, 2003
www.atmos-chem-phys.org/acpd/3/S1597/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Weekly cycle of NO_2 by GOME measurements: A signature of anthropogenic sources" *by* S. Beirle et al.

S. Beirle et al.

Received and published: 25 September 2003

We want to kindly thank the reviewers for their thorough reviewing, their helping comments and for giving many impulses for our study. In our answer, we are dealing with the major topics within these general remarks and refer to the specific aspects in individual replies.

1. One major issue of the reviewers comments was the error analysis. We extended the discussion of statistical as well as systematic errors and clarified some too briefly mentioned aspects of our analysis.

The retrieval of tropospheric NO2 from satellite data is affected by many factors, especially the estimation of the stratospheric column, cloud cover, aerosol load, ground albedo and the NO2 profile. In this study we applied a quite simple stratospheric estimation and air mass factor correction to account for these factors. However, we focus

Full Screen / Esc
Print Version
Interactive Discussion
Discussion Paper

on the difference of Sunday and workday levels of tropospheric NO2. We assumed that none of the factors above has a day-of-week dependency and also checked this assumption for the cloud cover. Any regional bias in the air mass factor (due to a different profile shape) is multiplicative, thus not affecting the results of fig. 3.

Fig. 3 holds information about the statistical error: For every considered location and every day of the week we calculated the mean (of all data 1996-2001) and its statistical error. By normalizing we retrieved relative errors. The error bar of every subplot is the maximum of all these single relative errors. Since the scale of the plots is logarithmic, the length of this relative error bar is independent from the (normalized) NO2 VCD.

Additive offsets from lightning and also other sources (biomass burning, soil emissions) reduce the observable weekend effect. To account for this quantitatively, more information is necessary. For the locations under consideration, however, industrial emissions and transport are the dominating source.

The most important systematic error in this study is the interference of sources, since this error has a weekly cycle due to the 35 days periodicity of the ERS2 track. While relatively isolated sources (e.g. Milan) seem to be quite unaffected especially Essen (representing the industrialized Ruhr area) is influenced by this effect.

2. Second, we were asked to bring forward our analysis of the seasonal dependence. We added a figure, similar to figure 2, to illustrate the weekly cycle for winter and summer separately. Therefore we concentrated on Europe and the USA. For China and the middle east no new insights were gained. Obviously, the reduction of the amount of data enhances statistical errors in the seasonal study. The plots indicate a longer lifetime of NO2 in winter. Also the distribution of NO2 differs from summer to winter, its features are discussed in the revised paper.

3. A third focus of the interactive comments was the lifetime estimation. We are aware that the lifetime of NO2 in the boundary layer is highly variable in space and time. Still we think it is useful to estimate a mean lifetime for a given location. Knowledge of the

ACPD

3, S1597–S1599, 2003

mean lifetime of NO2 is needed to relate observed NO2 VCDs to emission budgets. In the revised paper, we added a discussion of NO2 removal processes and the variability of NO2 lifetime. To account for the strong seasonal dependence we performed our estimation for summer and winter data separately (see 2.). We retrieve a mean NO2 lifetime for Germany of approx. 6 hours in summer and about >18 hours in winter.

For our rough estimation, we neglected transport and argued, that the emitted NOx stays inside the chosen rectangle. This approach neglects outflow (mainly towards Poland) and inflow (mainly from Belgium and the Netherlands). Especially the inflow affects our study, since the incoming burden of NOx is subject to a weekly cycle itself. To account for this effect, we performed a second analysis, considering a larger rectangle that includes the large pollution plume over Belgium/Netherlands. The choice of this larger area leads to a higher Sunday minimum (i.e. a reduced weekend effect), but the shape of the winter/summer cycle and therefore the lifetime estimation is nearly unaffected.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 3451, 2003.