

Interactive comment on “Tropospheric NO₂ vertical column densities over Beijing: results of the first three-years of ground-based MAX-DOAS measurements (2008–2011) and satellite validation” by J. Z. Ma et al.

Reply to Anonymous Referee #1

Referee comments

This paper reports on the measurements of tropospheric columns of NO₂ over Beijing during a period of three years using MAXDOAS instrumentation and on the validation of such measurements and satellite data. Satellite data used for validation are data from SCIAMACHY and three different sets of data from OMI. My opinion is that it is well suited for publication in ACPD and particularly in the special issue “Atmospheric impacts of Eastern Asia megacities” after taking into account some comments. I find the English should be improved; the text is very descriptive and difficult to understand in some parts.

Author Responses

We thank the anonymous referee for his/her constructive comments on the manuscript and have revised the manuscript accordingly. We also tried to improve the English of our manuscript. The ACP editorial office will be requested to provide help refining the English language further, and certainly we would like to cover the charges of such service.

Referee comments

Section 2.2 Spectral retrieval. Dark current. A more detailed explanation about the removal of dark current is necessary as dark current depends not only on Temperature but on exposure time.

Author Responses

As pointed out by the referee, dark current depends not only on temperature but also exposure time. Since dark current signal exponentially decreases with decreasing detector temperature, the cooling system in Mini MAX-DOAS can keep the detector at a low and stable detector and thus reduce the dark current signal. To digitally correct for remaining dark backgrounds, a dark current spectrum is determined by taking one scan with a long integration time (typically several 10's for the Min MAX-DOAS systems). As suggested by the referee, we have added such sentence “*We used 10000 msec and 1 scan for dark current measurements and 3 msec and 1000 scans for electronic offset measurements*” to the revised version of the manuscript (page 6, line 1-2).

Referee comments

Page 6 L21. Figure 2. I miss error fit and NO₂ SCD for both cases.

Author Responses

In Figure 2 we show the spectral residual (difference between measured spectra and fit result) and, as suggested by the referee, we have provided NO₂ SCD values in the figure caption of the revised manuscript (page 33, line 6-8).

Referee comments

Page 7 L20 Figure 3. Why are those particular days selected? Indicate what days are cloudless or cloudy would be useful in the following discussion.

Author Responses

We have indicated what days are cloudless or cloudy in the updated version of Figure 3 and the text (page 8, line 6-7). These cases were selected randomly, but they could demonstrate the effects of different weather conditions (cloudy or clear) and pollution (heavy or less) conditions on the retrieved NO₂ results, as already discussed in the manuscript (page 7, line 24 to page 8, line 14).

Referee comments

Section 2.4. Satellite data I find this section too descriptive with no new information included, it is OK to describe the sets of data that have been used in this work but from page 10 L10 to page 11 L3 I find this information unnecessary. The same from page 11 L11 to L21.

Author Responses

With regards to satellite data description, we have removed the sentences that are not so informative for comparisons with ground measurements. On the other hand, we would like to still keep some brief descriptions about footprint and crossing time of SCIAMACHY (page 10, line 25 to page 11, line 7) and OMI (page 11, line 15-24) in Section 2.4, which would be very useful for the following comparisons with the MAX-DOAS results.

Referee comments

Section 3.5 Cloud Effects The use of C320/C434 index would be very interesting if it would be used to predict what days are cloudy, but in this section I don't see the point to introduce this concept without any conclusion. Please clarify the objective of this part or remove it.

Author Responses

Our data have shown that the effect of clouds on the colour ratio of C320 to C434 is clearly visible, and the tropospheric NO₂ VCD is correlated with the reciprocal of the C320/C434 ratio, as described in the manuscript (page 17, line 15-18). This indicates that it is possible to use the C320/C434 ratio measured by MAX-DOAS itself as a threshold parameter to separate clear and cloudy conditions. We have added the conclusion about cloud effect in Section 4 of the revised manuscript.