Atmos. Meas. Tech. Discuss., 2, C1185–C1188, 2010
www.atmos-meas-tech-discuss.net/2/C1185/2010/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of tropospheric column densities of NO_2 from combined SCIAMACHY nadir/limb measurements" *by* S. Beirle et al.

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Received and published: 28 January 2010

We thank H. K. Roscoe for his positive feedback and constructive comments. Below we respond to the specific/technical comments point-by-point.

Specific comments:

1. In the SCIAMACHY data processing, are both room temperature and lowtemperature cross sections of NO2 fitted? The manuscript makes no mention of this.

Reply: We apologize for leaving out this information. In the DOAS fits (both for nadir

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and for limb), a single NO2 cross-section for 220K (nadir) / 223K (limb) is included, which is appropriate for the stratosphere. The resulting TSCDs presented in this manuscript are not yet corrected for temperature effects. A temperature correction thus has to be applied within the retrieval of TVCDs.
We clarify this aspect in the revised manuscript.

2. The analyses ignore variations in tropopause height. This will be serious for an operational scheme. Some sentences about how to implement this in the future would be useful.

Reply: From our analysis of the limb profiles, we found the impact of the choice of the TH (between 12 and 18 km) on LVCDs to be rather small (<5%; see 2.4.2 and discussion). For the range of LVCDs from 1 to 5e15 molec/cm2 (compare Fig. 1 in the supplements), the 5% correspond to absolute errors of 5 to 25e13 molec/cm2. For an absolute limb correction scheme, the fixed TH can thus lead to significant errors in the limb estimation, in particular for high latitudes. However, the choice of a fixed TH can not explain the different latitudinal dependencies of limb and nadir VCDs over the reference sector. I.e., up to now, the absolute error in limb and/or nadir VCD is overlaid by other (latitudinal dependent) errors which are not understood at the moment.

For the relative limb correction, however, the 5% error on longitudinal variations (up to 1e15 molec/cm2, see Fig. 4) corresponds to LLV errors up to 5e13 molec/cm2, which is clearly below typical values of ΔW_{RSM}, i.e. the standard deviaton of VCDs in the Reference sector (compare Fig. S2 in the supplements).

The discussion of the impact of the fixed TH on LVCDs and TSCDs is extended accordingly in the manuscript.

3. A lot of effort goes into improving the tropospheric product at 50degS, then later the manuscript asserts that there is so little NO2 there that the remaining discrepancies are not important because 50 degS could be ignored. This is contradictory, and in any case if the product ever became good enough to see the emission of NO2 from the Antarctic snowpack in summer it would add yet more value to SCIAMACHY data.

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Reply: We agree that our reasoning is somehow inconsistent in this aspect. We thus modify our conclusions on page 3008, line 5.
Improving the quality of the stratospheric estimation is of course desirable, also for 50°S. However, we have to note that all presented algorithms have problems for high Southern latitudes. But even with potential future improvements, NO2 emissions from Antarctic snowpack are probably too small to be detectable from satellite instruments.

Technical comments:

Throughout – the acronym soup of RMS, RLC, ALC, SES, LVCD is distressing. Some can be spelled out
Throughout – some acronyms are re-introduced, some several times

Reply: We are aware that the amount of acronyms makes the manuscript difficult to read initially. Nevertheless, we would like to keep all the acronyms, as in our view they improve readability, as soon as their meaning has been learned by the reader.
To help the reader in this process, we did
a) provide a list of acronyms in Table 1, and
b) define some acronyms more than once. This introduces indeed some redundancy, which we would like to keep as help for the reader.

p2984 l3 – insert "the" after "As"

Reply: Done.

p2986 l17 – replace "no" by "not"

Reply: Done.

p2991 l26 – by "some percents" do you mean "only a few percent" ?

Reply: Changed to "a few percent".

Eqtns 2, 4, 6, 7 – contain a colon before the equals sign

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Reply: The colon is meant to indicate a definition.

p2993 l26 – insert "a" before "function"

Reply: Done.

p2994 l2023 – there is a contradiction in sigma-longitude. Is it 10deg or 20deg?

Reply: Sigma-longitude is defined as 20°*cos(lat) (p. 2994 line 20), i.e. it is a function of latitude, resulting in 20° at the equator and in 10° at 60°N. By this definition, longitudinal variations of L at the equator are smoothed stronger than for high latitudes, to allow strong gradients at the polar vortex.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 2983, 2009.