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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Direct observation of two dimensional trace gas distribution with an airborne Imaging DOAS instrument" *by* K.-P. Heue et al.

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General comments:
"Direct observations of two dimensional trace gas distribution with an airborne Imaging DOAS instrument" by K.-P. Heue et al. is an excellent manuscript describing design and performance of a new airborne imaging DOAS instrument (iDOAS), showing iDOAS measurements of NO2 columns over South Africa. The paper fits perfectly into the scope of ACP, reads well, and the quality of the figures is excellent.

Besides a few minor modifications (see specific comments and technical corrections), I suggest those two changes in the paper:

1) Use vertical columns all through the paper
2) Compare to OMI instead of (or in addition to) SCHIAMACHY

Ad 1)
The figures in the manuscript sometimes show vertical NO2 columns (figures 1 and 12), sometimes iDOAS slant columns (figures 8 and 9), and sometimes iDOAS slant columns together with SCIAMACHY tropospheric slant columns (figures 10, 11, and 14). Since the authors have already done the work to determine the AMF for the iDOAS data (section 2.3, last paragraph), and the satellite data are also available as vertical columns, I don‘t see the point of not converting everything to vertical columns. Then the paper is more consistent and the reader does not have to think about possible differences in the data caused by different AMF from iDOAS and the satellite.

Ad 2)
In section 3.4 the authors list the main problems in comparing iDOAS data with SCHIAMACHY retrievals: the large satellite footprint and the early overpass time more then 2 hours before the flights started. Those two issues could be hugely improved using OMI data instead. OMI overpass time on the 6th of October 2006 is 11:36UT, right at the end of the flight, and OMI‘s pixels size is significantly smaller than SCHIAMACHY‘s. I think from an iDOAS versus OMI comparison, the usefulness of iDOAS for satellite validation could be tested much better than it is done in the manuscript so far.

Specific comments:
- Section 2.1, first paragraph: “..field of view (5-60deg)..“. What does the range 5 to 60deg mean? Isn‘t the field of view 28deg?
Fig. 5: I would add “3“ in the caption “the total distance between the 3 light sources was 9.9m“; maybe even labeling the light sources in the figure.
- Section 2.2, 1st paragraph: isn‘t 8 pixels more like 0.9deg?
- Section 2.2, 2nd and 3rd paragraphs: it says the “typical resolution“ along track ranges from 90-200m and the “typical integration time“ is 1 second or less. I recommend a bit more details for this part: How was the integration time determined? How do

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(mathematically) the integration time and the flight altitude translate into the along track range?
- Section 2.3, last paragraph: I am a bit puzzled, that the AMF is 2.2 for all conditions. Did e.g. the SZA hardly change during the flights? I suggest a bit more explanation in that part.
- Fig. 8: I suggest either using the same color code for both figures or mentioning in the caption the different color coding scales.
- Section 2.3, 3rd paragraph: "..(tVCD) is often a more accurate quantity .." I do not think the word "accurate" is appropriate in this case. I suggest removing this part and simply combining the two sentences: "The tropospheric vertical column density (tVCD) gives the integrated ..independent of the light path".
- Section 3.1, first paragraph: in "Here only the nadir direction.." Does "here" refer to figures 8 and 14? Does it mean that the thickness of the lines corresponds to the total swath, but the color is just determined by the nadir pixel?
- Section 3.3, last paragraph: "The exact direction .. cannot be determined." To what level can it be determined?
- Section 4, 5th paragraph: Maybe the authors could add a few more sentences about the capabilities of the system for measurements other than NO2 slant columns. Can vertical profiles be measured using varying flight altitudes? What about other trace gases like HCHO? On page 5 it says that CCD lines are co-added to improve the S/N. How many lines would have to be co-added to get sufficient S/N for HCHO retrievals?

Technical corrections:
- Section 1 and fig. 1: in the body text the location is spelled "Highveld", in the figure caption it is spelled "Heighveld".
- Section 1, last sentence: add a dot at the end.
- Section 2, first paragraph: replace "interesting object" by "object of interest".
- Section 2, 2nd paragraph: I suggest removing the last sentence "They can be colour coded ..". This is obvious.
- Section 2.1, 5th paragraph: The sentence "As the entrance slit is .. altitude above the

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ground.“ I think this sentence reads better like: “As the entrance slit is .. total field of view is 28deg and therefore the total swath width at the ground equals half the flight altitude.“
- Section 2.2, 3rd paragraph: AMSL is not defined.
Fig. 12, caption: replace “line“ by “lines“.
- Section 4, 1st paragraph: replace “noe“ by “one“.
- Section 4, 2nd paragraph: replace “distant“ by “distance“

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 11879, 2008.