**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "NO$_2$ Profile Retrieval using airborne multi axis UV-visible skylight absorption measurements over central Europe" *by* M. Bruns et al.

J. Kaiser (Referee)

j.kaiser@ecmwf.int

Received and published: 24 February 2006

GENERAL COMMENTS

The paper presents a new method for the retrieval of atmospheric trace gas profiles from air-borne multi-axis UV-visible spectrometry. The method combines the methodological principle developed by Bruns et al. 2004 with the one of Wang et al. 2005: The number different light paths through the atmosphere is increased by considering several viewing angles as well as several spectral regions. A sensitivity study convincingly demonstrates the improved NO2 profile retrieval capability of the new method.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU

The method is also applied to an AMAXDOAS measurement section over Switzerland and Italy. The presented NO2 profile retrieval results show that the method separates NO2 in the boundary layer from NO2 in the free troposphere. Individual contributions by highways and a city are clearly discernible. The paper proves with real data the value of instruments like AMAXDOAS for regional air quality monitoring and source attribution. These retrievals are seminal. The presented results are new and scientifically relevant and I recommend publication in ACP.

SPECIFIC COMMENTS

In my opinion, following two aspects need additional discussion by the authors. They both relate to the sensitivity study showing that the profile retrieval is best for the retrieval layers at 7 and 9 km, cf. Fig. 2: (1) The retrieval results are discussed for the boundary layer only. The discussion should be extended to the entire retrieved profiles.

(2) The retrieval results at 7 km altitude seem to consistently exhibit significantly negativ mixing ratio values, cf. Fig. 5 b-e. Since this is unphysical, the method seems to become unstable at the altitude at which it is expected to perform best, when confronted with real data. Is this really so? Why? Can it be improved?

Fig. 5 a should also be improved in the following ways:

(3) The colour bar should be extended to cover all retrieved values, i.e. clearly showing the negative ones.

(4) The smoothing hides both the vertical and horizontal resolutions of the results. Single-coloured blocks extending over the retrieval layers and the individual measurement periods might be easier for the reader to interpret correctly.

The following comments are recommendations for consideration by the authors:

(5) The lower bounds (3 and 2 km) of the vertical resolutions cited in the abstract and throughout the paper simply reflect the retrieval grid spacing. It is not clear to me that a finer retrieval grid spacing would not lead to an improved vertical resolution.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU

(6) p 500, l 10: I doubt that SCIATRAN or any other radiative transfer model are capable of modelling your spedific measursments with smaller errors than 2%, mostly because the model parameter "aerosol profile optical properties" is not known sufficiently. Another error arises from simplifications in the modelling of the surface reflectance.

(7) p 500, l 23-24: Motivate your choice for the correlaiont length.

(8) p 501, l 22 - 502, l 6: How realistic is each of your assumptions in general? How do they compare to the values encountered during the real measurements? Why do you choose this particular retrieval grid?

(9) p 505, l 26: Is "(0-2.5 km)" your assumption of the vertical extend of the boundary layer? If yes, you should motivate it because this choice has a huge effect on your derived vertical column, and consequently the comparision to SCIAMACHY. Anyway, you should show how you convert the retrieved profile, which has a relatively coarse resolution for this task, to a vertical column.

(10) p 506, l 3: A figure showing both footprints, by SCIAMACHY and AMAXDOAS, would be very helpful.

(11) p 504, l 27 - p 506, l 9: This paragraph may implicitely give the impression that AMAXDOAS is not capable of validating SCIAMACHY with an useful accuracy of, say, 50%. You may want to either discuss the SCIAMACHY validation more thoroughly or delete it or, of course, leave it unchanged.

(12) p 506, l 22-26: Since you have not shown that all other potential setups are inferior you cannot conclude that your setup is "ideal".

(13) p 507, l 10-11: I would consider the presented comparison between SCIAMACHY and your single AMAXDOAS vertical column to be reasonable, not "quite good". The underlying reason is that I get the impression that the two are fairly different quantities. So, I would only dare to draw conclusions on the scale of an order of magnitude.

TECHNICAL COMMENTS

EGU

Again, these are recommendations for consideration by the authors.

(14) I would recommend to start the abstract with a statment about your method and results.

(15) The abstract should state that you combine two previously established methods.

(16) p 494, l 21, 22, 24 and other pages: names of chemical species are written in lower case.

(17) p 495, l 1: are -> is

(18) p 495, l 1-2: delete "As can be seen below"

(19) p 495, l 14: different -> several (twice)

(20) p 495, l 23 and throughout the text: I find the semicolon ';' between two references difficult to interpret. However, this may be my personal problem with the ACP style.

(21) p 495, l 21-23: The sentence is difficult to understand. Please reformulate.

(22) p 496, l 3-9: Move paragraph further to the beginning of the section.

(23) p 22, l 22 - p 497, l 4: This is no AMAXDOAS instrument description. Delete or move to section 3.1.

(24) p 497, l 6-10: Not relevant. Delete.

(25) p 497, l 11: the -> a

(26) p 498, l 4: state explicitly that you obtain the slant columns with DOAS.

(27) p 498, l 9: Delta x and Delta y need to be defined.

(28) p 498, l 18 - p 499, l 12: Difficult to read. Try to formulate all more clearly.

(29) p 498, l 20 - 21: This definition of "weighting functions" is inconsistent with Equation 3. "intensity" of what? (of the radiation!)

EGU

(30) Equation 4: A motivation or derivation for this term would be helpful.

(31) p 500, l 16-17: Give the units of the cited elements of S_a.

(32) p 503, l 15: What do you mean by "the observed layer is getting thinner"? I do not understand this sentence.

(33) p 503, l 22: clever -> cleverly

(34) p 504, l 10: How many measurements were taken during this period?

(35) p 506, l 3: location do -> locations

(36) p 507, l 5: the flight -> the AMAXDOAS flight

(37) Table 1 and Fig 3 are not needed.

(38) Fig 1: Which channel is this?

(39) Fig 2: The left plot is a bit overcrowded. You may want to produce it in colour.

(40) Fig 6: How do you define the "footprint" of AMAXDOAS?

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 493, 2006.

Full Screen / Esc

Print Version

Interactive Discussion

Discussion Paper

EGU