

***Interactive comment on “Retrieval of nitrogen dioxide stratospheric profiles from ground-based zenith-sky UV-visible observations: validation of the technique through correlative comparisons” by F. Hendrick et al.***

**Anonymous Referee #3**

Received and published: 14 July 2004

This manuscript presents a well written discussion of vertical profile retrieval for ground-based UV/vis absorption spectroscopic measurements. Especially the theoretical part of this study is very well presented and concisely written. The authors do also a very good job in conveying how much can be gained from applying this technique to UV/vis observations and at the same time make sure that e.g. the information content is described properly, i.e. by saying that there are only 2 independent pieces of information available in the measurements discussed.

The presentation of the comparison between the retrieved profiles and balloon and satellite data also reads very interesting. However, as it stands now, this part of the

paper is somewhat confusing. E.g. in the abstract, the authors say: “In order to validate the technique, the retrieved NO<sub>2</sub> vertical profiles and columns have been compared to correlative balloon and satellite observations.” But then they continue to rather use their own profiles as a basis to discuss the shortcomings of the satellite profiles and to a lesser extend of the balloon observations. In my opinion, this part of the paper is not correctly handled and might need some careful thought: you can’t really at the same time claim that you use a data set to validate the results of your new technique AND use your results as the basis to criticise the same data set.

This probably becomes clearest in their conclusion, where the authors say: “Retrieved NO<sub>2</sub> stratospheric profiles ... have been validated through comparisons with ... balloon and satellite observations.” But then continue on to say: ... the satellite instruments systematically overestimate the GB UV-visible data below 25–27 km ... Although I certainly don’t disagree at all with their discussion and findings, it would be good if the authors could clarify the issue a bit better (actual validation versus discussion of the comparison between the different data sets). I don’t think that this is a major issue but would be good if the authors could give it some more thought.

#### **Minor technical comments:**

Abstract: Be consistent with your locations: e.g. also use (69 N, 16 E) for Andoya or add another digit for Harestua’s lat/lon.

Page 2870, line 1: should be (the concentration of NO<sub>2</sub> and BrO ...)

Page 2871, line 15: ... Langley plots ...

Page 2871 etc.: The authors refer in the text to sections which are not there anymore, e.g. Sect. 3.2 in line 25, page 2872. This was correct in the original draft but when the authors renumbered the sections, several references to these sections were not changed in the text. This needs to be checked through and corrected. E.g. also now there is a subsection 3.1 under section 3 but no further subsections (3.2, etc.) – is

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subsection 3.1 then really necessary?

Page 2873, line 8: Shouldn't that read: . . . statistical error of the NO<sub>2</sub> DOAS fitting . . . ?

Page 2873, line 19: Again, there is no Sect. 4.2

Page 2874, line 6: In reality, . . . (delete 'the')

Page 2876, line 9: there is also no Sect. 5.4

Page 2879 "Our retrieval algorithm has been validated through comparison of . . ." This sounds like there has been a validation effort in the past but since there is no reference provided, I assume the authors actually mean something along the lines: "Our retrieval algorithm is validated here (i.e. in this paper) through . . ."

Page 2880, line 13: delete 'it'; . . . as can be seen in . . .

Page 2882, line 3: should read: . . . consists of two . . .

Page 2883, line 16: Examples of profile comparisons . . .

Page 2883, line 23: Sect. 5.4 should probably be Sect. 11

Page 2887, line 5: comma missing? . . . and forward model errors, profiles . . .

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Interactive comment on Atmos. Chem. Phys. Discuss., 4, 2867, 2004.

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