

Interactive comment on “Retrieval interval mapping, a tool to optimize the spectral retrieval range in differential optical absorption spectroscopy” by L. Vogel et al.

Anonymous Referee #2

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Review of Vogel et al. ‘Retrieval interval mapping, a tool to optimize the spectral retrieval range in DOAS’

The paper describes a visualization tool for sensitivities in DOAS retrievals on the wavelength region that is evaluated. On the basis of synthetic spectra the authors evaluate BrO fit scenarios that are meant to resemble conditions of passive solar stray light DOAS conditions characteristic of zenith sky DOAS measurements of stratospheric BrO, and BrO measurements in volcanic plumes. The paper is well suited for publication in Atmospheric Measurement Techniques eventually, and interesting, though there

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are some major concerns that should be addressed prior to publication.

Major comments:

1) The paper discusses two passive DOAS applications, and mentions – for good reason as the reviewer agrees – about the need to consider ‘insufficient corrections for the Ring effect’ (abstract) and ‘the wavelength dependency of the Ring effect’ (p4198, l26), and ‘dependency of the retrieved values on … the Ring-effect’ (p4201, l15) in sensitivity studies to determine an optimal DOAS fit window. It comes as a surprise that given this extensive introduction, the authors then decide to neglect ‘most importantly the Ring-effect’ (p4203, l5) without further justification. No further treatment of the Ring effect is done. However, out of the blue the ‘insufficient correction for the Ring-effect’ appears again (p4218, l27) in what is supposedly the discussion of results section (Section 5.2 ‘Sensitivity to interfering absorbers’). Given the above, it appears somewhat ironical that one of the final statements (p4220, l24) concludes that ‘realistic simulations of… the Ring-effect’ is needed ‘in order to advise for a specific retrieval wavelength range’. Without treatment of the Ring-effect, the practical use from this paper ‘poses [more than?] certain limits’ on the ‘application… to measured spectra’ (p4203, l11). A ‘prime focus… to present the new method’ (p4203, l12) seems to be in contrast to the ambition to ‘demonstrate [a technique] … for stratospheric BrO measurements and for BrO measurements in volcanic plumes’ (abstract). Since the author’s choice is to discuss passive DOAS applications, an explicit treatment of the Ring-effect should be included in the revised version of this manuscript.

2) There is virtually no discussion about the criteria of choice to optimize a DOAS fit window. The only statement to the matter seems to be found in the conclusion section (p4222, l6-10). This does not seem to justify the word ‘optimization’ in the title. A better substitute might be ‘visualization’?

3) A significant risk consists in the lack of attention to the variability between the subset of wavelength ranges based on traditional criteria, as those have been applied in the

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DOAS community for decades. Further, Table 1 seems incomplete. The combination of significance criteria for a 2-band and a 3-band evaluation of BrO by a logical 'AND', as done in Coburn et al., warrants mentioning on p4199, and the study by Prados Ramon et al. is missing, for example. More importantly, the systematic application of the 'visualization tool' creates the (wrong?) impression that DOAS measurements are unreliable. The reviewer sees considerable risk that this might propagate to give DOAS a bad fame for no good reason. In reality, the application of the tool to the first scenario confirms conclusions that had been reached by authors that did not use the tool previously (Aliwell et al., 2002). For the second scenario in a volcanic plume, the visualization tool does not lead the authors to draw any conclusion. While the reviewer appreciates the benefit to 'documenting sensitivities in the fit', what is the benefit over traditional methods? At the very least, the amplitude in the variability of results from sensitivity tests should be discussed in context of the variability for the subset of fit scenarios that reflect 'choices made in the past' (reflected in Table 1, for example). The results from such a comparison might be worth mentioning in the abstract, and could be expanded on in the conclusion section.

4) Finally, the paper reads rather repetitive, is long, and in parts contradictory. For example, the definition of active and passive DOAS is found in the abstract, and again on p4198, l1, and again in l9 of the same page. Also, is the ambition of the paper a qualitative (p4196, l21) or a quantitative discussion (p4199, l5; and again p4200, l4) - which is correct? A quantitative discussion would be more useful. Finally, various combinations of sensitivities that affect the retrievals are given in different combinations and in different locations. Without ambition of completeness, a selection of locations are (1) p4196, l15, (2) p4198, l27, (3) p4200 l18, (4) p4201, l8, (5) p4221, l5, (6) p4221, l15, (7) p4221, l27. Only a subset of the mentioned parameters is actually being probed (see also point #1). Also, of the four parameters mentioned on p4221, l15, only the first three seem to be discussed, while the fourth is mentioned but not further discussed? A semi-quantitative justification of why some parameters were chosen, while others were neglected should be included. Text should be synergized, and shortened to focus on

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results.

Minor comments:

- Abstract, lines 1-18: this reads like an introduction. Indeed much of this text is being repeated several times in the manuscript. Consider removing here. The abstract fully captures the essence of the paper if it was to start on line 19.
- Abstract, line 16: the reviewer agrees the Ring effect should be an important consideration. It is mentioned here, but not further discussed in the paper. Since passive DOAS applications are discussed, this seems to be a major limitation of the paper. There is arguably little practical use for this paper without a thorough discussion of the Ring effect.
- What are the criteria 'to determine the optical evaluation wavelength range'? They seem to be the essence of any ambition for 'optimization', yet are not spelled out in the abstract?
- What is the difference between 'interference' and 'cross correlation'? Unless there is a reason to make this distinction, it would make for an easier read to pick on terminology and stick with it throughout the manuscript.
- P4209, l10: How is the correction factor defined?
- P4220, l15: Is the l0 correction crucial or not? Are the authors saying that l0 correction is insufficiently well possible?