

1. This paper addresses a relevant scientific question within the scope of AMT. The question is the sensitivity of retrieved ozone profiles to incorrect cloud information (input to forward RT model during inversion).
2. This is novel work for ozone profiles, although Sioris et al. (JGR, 2003) have studied the sensitivity of retrieved NO<sub>2</sub> profiles to various clouds and this work should probably be recognized (one sentence).
3. Substantial conclusions are reached on the sensitivity of retrieved O<sub>3</sub> profiles to clouds, especially with respect to the dependence on solar zenith angle and cloud optical thickness (COT). Although, the discussion of the SZA dependence is not very insightful, nor is the discussion on the COT dependence for small COT.
4. The assumptions and methods are clearly outlined but some of the assumptions are not valid (see below).
5. The results are sufficient to support the interpretations and conclusions.
6. The description of experiments and calculations are sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results).
7. The authors do not give proper credit to related work (see above) but they do clearly indicate their own new/original contribution.
8. The title clearly reflects the contents of the paper.
9. The abstract provides a concise and complete summary.
10. The overall presentation is well structured and clear.
11. The language is fluent and precise.
12. Mathematical formulae, symbols, abbreviations, and units are correctly defined and used. However, the symbol 'l' used as a line-of-sight coordinate strongly resembles 'I' used for intensity. This may cause confusion and may be resolved by the use of a font which improves the distinction between these letters.
13. Page 387 of the paper should be eliminated. The derivative with respect to ozone number density is not relevant. Also, additional effort is encouraged to reduce the length of this paper. The paper is too theoretical, at times distracting from the main message.
14. The reference to Roebeling *et al.* is unnecessary. Also, there is a reference to previous work by one of the co-authors (Rozanov and Kokhanovsky, 2008) when earlier work by others could have been cited instead. This comes across as egocentric. Also, the comparison with nadir geometry is admittedly not apples-to-apples (since the triplet is not used) and thus is not very relevant.

### Macroscopic comments

In the conclusions section, it would be nice if the authors suggested how this study will impact their retrieval algorithm, i.e. will any of the lessons learned be applied? Perhaps this is beyond the scope of this paper.

The paper focuses on the sensitivity to clouds below the FOV. Perhaps, a sentence could be written (providing a reference) about what is done to determine whether clouds are in the FOV in analyzing real SCIAMACHY data. High clouds clearly are observed by SCIAMACHY in the tropics and as shown in this paper, the effect is larger than the effect of extremely thick clouds below the field of view.

Also, there is not much insight as to why the sensitivity to clouds below the FOV increases with decreasing altitude. Some discussion of this is presented in Sioris et al. (JGR, 2003) and Sioris's PhD thesis. In spite of the 49 equations and 30 pages, this paper is lacking in terms of discussion, and explanation with words of how the relevant radiative transfer processes produce the observed sensitivities. For the discussion of why the Chappuis triplet and the radiance have a direct relationship, it appears to be based on an assumption that is not valid.

The use of the term "radiation" in several instances in the appendix is not appropriate. The appropriate term for this quantity should have units that match the units on the right-hand side of the equations (e.g. A7, A13). Conventional notation is recommended.

### Microscopic science comments

P380L2- "...affecting trace gas retrievals." -> e.g. "and thus affect trace gas retrievals".

P381L2- Instantaneous cloud coverage is not 60%. Please provide a peer-reviewed reference for this. The Pruppacher and Jaenicke (1995) reference states that, over land, the coverage is 52.4%. Using Cloudsat observations, Mace *et al.* (*Geophys. Res. Lett.*, 2007) found 50.6% and this value is an overestimate because of the finite size of the Cloudsat footprint (1.4 x 2.5 km) and no ability to resolve sub-pixel cloud fraction.

P381L17- The reason provided for why limb scattering radiative transfer is complex is not correct. This source of complexity (*i.e.* multiple scattering) is true for other geometries. What makes the radiative transfer complex in limb geometry is that plane-parallel assumptions are no longer valid.

P386L19- It is interesting that the authors find 307 and 310 nm substantially affected by multiple scattering and surface reflection. It is good to see this discussed.

P390 The following is not likely to be valid: "Assuming the relative error of the ozone profile retrieval to be independent of altitude..."

P396L20-22 The authors make a good point regarding the importance of removing information going into the retrieval from tangent heights for which clouds are in the field of view.

P396L26-28 The authors do a good job of studying a wide range of COT values and closely examining the sign of the sensitivity.

P403L6-25 This explanation is very weak. Ideally, there would be an explanation why the sensitivity decreases as SZA increases above 80 degrees and a second explanation why the sensitivity increases for increasing SZA at small SZA.

P407L17-18 I entered some reasonable values for the quantities in Eq. A2 and Eq. A5 and find 7% differences for  $I_N$ . Perhaps higher order terms of series need to be considered (?)

P414L2-5 the assumption is not valid for ozone in the Chappuis band e.g. at mid-latitude tropopause tangent heights.

#### Technical

P381L17 “It...”-> “This geometry...”

P382L19-20- “The sensitivity ... of ozone profiles retrieved...” -> “Ozone profiles are retrieved ...”

P383-P384 “In the framework of this approach...”-> “With this approach...”

P384L6 “...for a proper...” -> “...for the proper...”

P384L17-18 “...is commonly retrieved exploiting...Chappuis ozone absorption bands.” -> “is commonly retrieved by exploiting ...Chappuis absorption bands.”

P384L24 “...Huggins bands of ozone was...”-> “...Huggins bands was...”

P385L17 “...shorter...” -> “...smaller...”

P389L25 What is “this” ?

P393L2-3 Remove sentence. It already appears in a more suitable place at the bottom of the page.

P394L19 “...errors...”-> “...error...”

P408L20 “...radiation filed...” -> “...radiation field...”

P410L14 "...Eq. (A8) results for the single scattering source function in..." -> "...Eq. (A8) for the single scattering source function becomes..."

P417L12 "...Experiment..." -> "...experiment..."

P426Fig1 – symbols used in legend should match symbols used in plot (*i.e.* 5-point star vs. 8-point star)

P431Fig6- the subscripts "c" and "f" in the righthand plot should be explained in the caption.