

## ***Interactive comment on “Retrieval and validation of ozone columns derived from measurements of SCIAMACHY on Envisat” by H. J. Eskes et al.***

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General:

This paper reports on the SCIAMACHY total ozone retrieval with the KNMI TOSOMI algorithm and its validation by comparison with groundbased data and various GOME retrievals. The current and official total column data product that is provided by ESA is based upon an outdated algorithm that is equivalent to GOME (Gome Data Processor) Version 2.7, short GDP-2.7. That algorithm has been already superseded by GDP-V4 and any of the other new GOME total ozone algorithms available such as TOGOMI, on which TOSOMI is based, and WFDOAS are at about the same level as GDP V4 and have demonstrated that they produce GOME total ozone with high precision.

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This paper and also our paper on preliminary use of SCIAMACHY WFDOAS (Bracher et al., ACP, 2005, accepted) show that the new generation of algorithms are equally well applicable to SCIAMACHY and will make the SCIAMACHY data very compatible with the GOME and TOMS data record. This paper represents an important contribution and is particularly well suited for the special issue on SCIAMACHY. A particular nice element of the paper is the demonstration of how data assimilation techniques can be used as an additional diagnostics of satellite retrievals. Overall the paper is well written and it deserves publications. There are several issues as outlined below that needs to be addressed and, if solved, will further improve the paper.

Major points:

p. 4439, lines 5-26, cross-section issue. The authors discuss here the various ozone cross sections (Bass-Paur, GOME FM, SCIAMACHY FM) that are available. The major idea behind using the GOME FM and SCIAMACHY FM cross-sections, that are based upon spectroscopic measurements done with both satellite spectrometers on ground before launch, is that this will provide the best match in spectral resolution between radiance and the molecular cross-sections. The UV channels of GOME and SCIAMACHY are nearly identical, but it is known that the instrumental slit function for SCIAMACHY is slightly wider than for GOME. This can be easily verified by comparing GOME and SCIAMACHY solar irradiances with high spectrally resolved reference spectra and proper fitting of the instrumental slit function. The current TOSOMI algorithm uses the GOME cross-section like TOGOMI and it could therefore potentially explain the -1.5% bias of TOSOMI to the groundbased data (assuming a 0% bias of TOGOMI with respect to the ground). The replacement with SCIAMACHY FM cross-section that leads to a change in the bias on the order of +5% is certainly larger than expected from the differences in the spectral resolution between GOME and SCIAMACHY and remains an unresolved issue. This could be made a bit more clear in this paper. Similar change in the bias was also reported in our paper by Bracher et al. ACP, 2005, with the SCIAMACHY WFDOAS algorithm.

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p. 4443, lines 19-25. The authors discuss the positive bias under ozone hole conditions in the Antarctic. The bias reaches almost 6-8% (Fig. 8) which is larger than the expected bias for Dobsons (-4% from Bernhard et al., 2005) under ozone hole condition so that underestimation of Dobsons explains only about half of the observed TOSOMI bias. In addition, the strong positive bias with TOSOMI is also observed during Antarctic fall under high SZA condition before the onset of the ozone hole. Similar problems were also found with WFDOAS for GOME (Weber et al., ACP, 2005) and I also remember that TOGOMI had a similar high bias. Please comment on this.

p. 4444, lines 8-10 and Figure 10. From this figure it looks like that TOSOMI overestimates high altitude stations like Mona Loa, Boulder, and one Alpine station (the last is not very clear to recognise here). From the text and the algorithm description it is not clear, if the surface altitude is accounted for in the retrieval. Particularly, for SCIAMACHY that is an important issue due to the higher spatial resolution achieved compared to GOME. Please clarify.

p. 4445, lines 21-24. The authors mention that the jumps in the differences between TOSOMI and GFP-V4 is most likely due to the missing update in the solar spectrum after 23rd May 2003 in GDP-V4. At this point some more information on the use of the solar spectra for all algorithms should be given. What solar spectra are used for TOSOMI (ESM or ASM diffuser spectra)? How come that TOGOMI does not have the problem with the solar spectrum. Is the solar spectrum obtained from the so-called sun package rather than taking the mean spectrum from the GOME Level-1 data product? Please clarify.

p. 4450, lines 14-19. Differences between observations and assimilated forecast data depends on cloud-fraction. Do the direct comparison between observations and ground data reveal a bias as a function of the retrieved cloud fractions?

Minor Points:

p. 4431, line 18, The year for Coldewey-Egbers et al. is here 2004, although in the

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reference section the proper citation for 2005 is given. Weber et al. 2004 is now published in ACP 2005.

p. 4433, lines 10-14, improper alignments of items vi) and vii). Under item vii) it is mentioned that the DAK radiative transfer model contains polarisation. Please clarify if this is used in the total ozone retrieval or empirical AMF procedure (all other algorithms neglect polarisation) and if yes, how important is this?

p. 4433, line 24, What are "effective cross-sections"? Please explain.

p. 4436, line 23, "The empirical AMF approach reproduces the entire DOAS procedure". Suggest to rephrase as follows: "The empirical AMF approach is based upon a DOAS fitting of simulated radiances".

p. 4442, line 8, "Dobson, Brewer, or filter". Change "or" to "and".

p. 4444, line 16, change "it's data" to "its data".

p. 4444, line 19, GOME and SCIAMACHY can be compared after 2003, but not globally. Change sentence as follows: "As a result, GOME and SCIAMACHY can only be compared on a global scale during the first half of 2003".

p. 4445, line 11, "excluding the last period". Specify that period.

p. 4445, line 24, explain briefly Southern Atlantic Anomaly and indicate latitudes/longitudes that are affected.

p. 44450, item i) and ii) The general reader is normally not familiar with the definition of states for SCIAMACHY. This should be defined and explained here.

p. 4451, lines 17-19. "The root-mean-square differences between these ozone retrievals is of the order of only 1% over a 5-month period and binned daily on 1 deg latitude strips." change to "on the order of" and "when daily binned into 1 deg latitude bands".

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References: Change "Bernard" to "Bernhard". Bernhard et al. is now published in JGR. Weber et al. is also now published in ACP 2005.

Citation: A. Bracher, L.N. Lamsal, M. Weber, K. Bramstedt, M. Coldewey-Egbers, J. P. Burrows, Global satellite validation of SCIAMACHY O3 columns with GOME WFDOAS, Atmos. Chem. Phys. Discuss. 5, 795-813, 2005 (accepted for publication in ACP).

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 4429, 2005.

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