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Atmospheric Measurement Techniques Discussions

Interactive comment on "Water vapour profiles from SCIAMACHY solar occultation measurements derived with an onion peeling approach" *by* S. Noël et al.

Anonymous Referee #1

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The paper describes a simple approach to retrieve water vapor profiles from SCIAMACHY limb occultation spectra. The approach uses onion-peeling and treats non-linearities in the radiative transfer by correction factors which are derived from radiative transfer simulations. In general, the paper is well written and the advantages and limitations of the approach are clearly worked out. It provides also some initial validation. However, a thorough description of errors is missing. I recommend publication after some mostly minor revisions.

General comments:
The drawback of the onion-peeling approach is the lack of retrieval characteristics

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(averaging kernels, error covariances) which this approach is not able to provide. Further, a specific shortcoming of onion-peeling is the strict error propagation from upper retrieval levels to lower ones. Although a stringent retrieval characterization as for optimal estimation or similar approaches seems not to be feasible, a thorough approach should be made to quantify better than previously done the random and systematic errors of the retrieved profiles.

Specific comments:

page 206, l 17-21: The arguments given here for application of the onion-peeling approach are not really convincing. E.g. (multiple) scattering is also not an issue for IR limb observations, nevertheless optimal estimation or similar approaches are widely used for IR retrievals. Further, the amount of data for the occultation observations of SCIAMACHY is limited, i.e. retrieval speed is not a similar severe limitation as for SCIAMACHY limb or nadir observations. A more thorough discussion of the pros and cons of onion-peeling versus optimal estimation for the SCIAMACHY solar occultation observations would be required here.

page 215, l 6-17: Does this mean that the various correction factors are not linearly independent of each other? Would another choice of correction factors then help to improve the approach?

page 216, l 5-7: Although I am not really familiar with the work of *Sofieva et al.*, I have some doubts that this is the right explanation for the oscillations in the profiles. I recommend to consult *von Clarmann et al., 1991* for a (another?) possible explanation.

page 217, l 18-20: I am a bit surprised that linear interpolation is accurate enough for the radiances. Have you tested the behavior of the radiance profiles at different spectral points?

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page 220/221 (Section "Validation") and Figs. 7/8: A log-linear plot covering 4 decades of the volume density over altitude is probably not the appropriate way to demonstrate good agreement between various data sets, given the very small variation of water vapor in the stratosphere in terms of vmr. The percentage differences shown in Fig 8c and 8d are far more appropriate.

page 221, l 14-15: I do not agree with this statement and do not believe that this is the explanation for the low correlation: the percentage variation of water vapor in the 15-20 km range is definitely not smaller than elsewhere, the contrary is true (compare Fig. 6).

page 222, l 14/15: This sentence refers to an estimated error of the retrievals, which in fact has not been provided. The sentence refers to Fig. 3b and related text, which is, however, certainly not the only error to be considered. The retrieval error as provided by error bars in Fig. 5c has not been explained. A short chapter which compiles all relevant random and systematic errors of the water vapor profiles should be provided.

Fig. 3: From what is shown in the figure and the text on page 215 I guess the figure caption should read: " ... (a) Saturation correction factors as function of the water vapor scaling factor for different tangent altitudes. ..."

References:

T.v. Clarmann, H. Fischer, H. Oelhaf, Instabilities in retrieval of atmospheric trace gas profiles caused by the use of atmospheric level models, *Appl. Opt.*, **Vol. 30**, No. 21, 2924-2925, 1991.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 203, 2010.