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Atmospheric Measurement Techniques Discussions

Interactive comment on "SCIAMACHY stratospheric aerosol extinction profile retrieval" *by* G. Taha et al.

Anonymous Referee #1

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The article describes OMPS/LP retrieval algorithm and studies its performance and validity against synthetic and "semi-authentic" reflectance measurements. The retrieval algorithm is studied firstly by using synthetic radiance measurements corresponding to selected profiles of 450 limb scattering measurements of SCIAMACHY that also have co-located SAGE II occultation measurements. Secondly, of those 450 co-locations 120 SCIAMACHY radiance measurements are processed into OMPS-like measurements and then inverted using OMPS/LP and compared with SAGE II.

General Comments

In lack of actual satellite born measurements the validation of new instruments is typically based on simulators. The usability of this relies on the ability to generate actual

instrument characteristics and noise. Here, in addition to using a simulator, existing SCIAMACHY radiance measurements are convolved into OMPS type measurements.

The article does a fair job in describing the work done on validating OMPS/LP against various atmospheric conditions. However, the main motivation, retrieval of stratospheric aerosol extinction coefficient profile to better account for the aerosol effects in ozone profile retrieval process is left mostly untouched, with only one vague reference to it in the text.

Specific Comments

The algorithm is based on optimal estimation, which uses non-linear minimization to estimate the model parameters and their posterior uncertainties given the forward model and parameter prior specifications. The prior for OMPS/LP algorithm is described in page 5346, Sec 2.1, line 15 onwards. The sensitivity of the results to the selected prior is not discussed at all. Also, it seems that the term "a prior vector" is sometimes used as the initial value for iteration and sometimes as mean for the prior distribution. E.g. at page 5351 Sec. 4.2 line 4, and page 5349 Sec. 3, line 15 "a very small aerosol a priori" seems to refer to the initial value of optimization iteration. In general, details related to numerical methods should be distinguished from the statistical model used. Never the less, if the method is sensitive to the initialization, is should be a cause of great caution.

Is the same forward model used in simulating the measurements and in the retrieval algorithm? Is so, this "inverse crime" typically result much too optimistic uncertainty estimates as it underestimates the bias related to modelling error and other approximations in the modelling assumptions.

Text is missing discussion on how well the real characteristic of actual OMPS measurements can be reproduced from SCIAMACHY measurements by the reconstruction outlined in Section 4.1

I would be more at ease with the term "difference" than with "bias". In the synthetic data case we are retrieving known profiles and we know the truth. The bias of the estimation algorithm could then be estimated by repeating the same retrieval with repeated sampling of the noise term. In the text the mean difference is wrt. the selected scenarios and will contain other sources of uncertainties than the bias in the classical sense. In the SCIAMACHY radiance measurement case the SAGE II profiles are assumed be accurate, but then the temporal and spatial difference in co-occurrence will still cause large differences to the results that are not related to the bias in the strict sense (as noted by the authors, also).

The term "mean bias" is also troublesome (Fig. 13, for example). Bias is usually defined as mean difference of the estimator to the true value, so it already includes taking the mean. Unless the term refers to the bias wrt. the mean in contrast to the bias wrt. median, for example. I would prefer "mean difference", still.

The only place where the primary goal of the study (as stated in the Abstract) is assessed is at page 5355, Sec 4.5, line 13: "which could be attributed to an improved aerosol profile solution", where it is referring to Fig. 14. More elaboration on this matter would be in place.

More comments:

page 5345, Sec 2.2, line 21: aerosol size distribution is mentioned here but in the rest of the text very little is said about the possibility to infer about it.

page 5347 Sec 2.1 line 1: The last sentence tries to explain how the uncertainties are calculated and how noise is added to the simulated reflectances(?). Maybe you should be more specific to make this more clear.

page 5347 Sec 2.2 line 21 "maximum likelihood" -> "maximum a posteriori" if real priors are used in the optimal estimation.

page 5349 Sec. 3 line 27 "It is clear" please be more specific, "Because of ..., it is clear

..."

page 5356, Sec 5, line 4: isn't there a danger that fine-tuning an algorithm to give results that agree too well with some specific external data set would induce additional bias?

Technical Corrections

page 5345, Sec 1, line 13: sensors, ..., are

page 5345, Sec 1, line 18: next year -> 2012(?)

page 5345, Sec 1, line 22: data are

page 5347 Sec 2.1 line 4: this paragraph describes the OMPS/LP algorithm. Maybe some other phrasing would better reveal the sequential structure. Maybe replace "first, ... The following step, ... then ... Finally" with "first, ... secondly, ... third, ..." etc.

page 5352, Sec 4.3, line 26: SAGE II

page 5353, Sec 4.3, line 9: remove second comma (,)

page 5353, Sec 4.3, line 2: SAGE II

page 5353, Sec 4.3, line 13: profile shapes

page 5353, Sec 4.3, line 15: maybe move the last sentence a little earlier in the paragraph

page 5354, Sec 4.4, line 15: The last sentence is vague, it is either trivial or else in need of some quantification between "real" variation and "unreal" variation caused by retrieval algorithm.

page 5354, Sec 4.4, line 26: "should be suitable", again vague, why not just "is suitable"?

page 5354, Sec 4.4, line 28: The last sentence is too long and it is hard to get its

meaning.

page 5355, Sec 4.5, line 7: (Stratozone 2.0), remove the parentheses.

Figures

General: please check that in every plot the axes are labeled and the scales and tick mark labels are reasonable. See also the discussion on "mean bias" vs. "mean difference" above.

Fig. 6: Why not use 2*sigma lines for retrieval uncertainty as they are more easily interpreted as approximate 95% probability limits.

Fig. 8: y_init -> y_meas?

Fig. 9: labels, x axis ticks, only "A Priori" (=initial?) and last iteration are visible.

Fig. 14: 1-sigma to 2-sigma as in in Fig. 6?

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 5343, 2010.