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Atmospheric Measurement Techniques Discussions

Interactive comment on "

A new optimal estimation retrieval scheme for carbon monoxide using IASI spectral radiances – Part 1: Sensitivity analysis, error budget and simulations" *by* S. M. Illingworth et al.

Anonymous Referee #1

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The paper describes the performances of a retrieval system for CO using IASI spectral data. The paper is well structured and well written. It covers globally what is expected form a paper describing a retrieval scheme, although some aspects are missing. I suggest the paper being published provided some changes/improvements are applied.

General remarks:

- The title is a bit misleading as the scheme is not really brand new built from scratch. It is, as explained in the text, adapted form the Oxford RFM and GENLN2. I would suggest to simply entitle it something like: "ULIRS, an Optimal...".

- My second concern is the fact that the paper is divided in two parts. The second one being announced in the conclusion as "an inter-comparison with MOPPIT". I'm not sure the second part would be suitable for AMT. As such I believe that this paper is self-consistent and does not need a "Part I" label.

Specific comments:

- Figure 1 as well as figure 9 are probably useless to the good comprehension of this paper and are more relevant to a IASI description. I suggest discarding them.

- Section 3.1.1: authors claim that they are using a high resolution solar spectrum in order to account for the reflected solar flux in the TOA radiance. It would be instructive to provide a characterization of the impact of using such a high resolution spectrum instead of a simple black-body radiance.

- Section 3.1.3: Is the problem so non-linear that is deserves a Levenberg-Marquardt treatment?

- Section 3.2.1:

* A word should be added about what continua were included to the forward model.

* What is the impact of the temperature profile retrievals on the final product, and how does the retrieved temperature profile compare with the ECMWF ones?

* It is also not clear if layers average values or levels local values are actually fitted.

- Section 3.3.2: Is a time interpolation applied on the ECMWF data? Please clarify.

- Section 3.5.1: As it is, to my knowledge, the first paper presenting this for IASI, I

suggest that authors should give a detailed characterization of the impact of using a non-diagonal S_y matrix. And compare it to a pure diagonal one.

- Section 4.1: The "RFM resolution" is very confusing. Does this mean the sampling used to compute the "unapodized" spectra or what? Applying the IASI ILS to an already finite resolved spectrum is not the proper way.

- Last paragraph of section 4.1, the error at the edges of the spectrum are well known "spoiling" artifacts described in all good textbooks on FFT (see e.g. Numerical Recipes). It is maybe useless to insist on that point here.

- Section 4.2.2: Cautions should be taken in the error comparison between algorithms. The actual error reduction, as well as DOFS, depend on the prior covariance used. Strictly speaking only retrieval made with the same a priori are directly comparable. However the variability you use seems comparable to what is presented in George et al. (Atmos. Chem. Phys., 9, 8317–8330, 2009).

- Section 4.3: I appreciate the sensitivity tests made on emissivity and surface elevation errors.

- As IASI is throwing 1.3x10ˆ6 spectra a day, it would be interesting to provide a speed performance information.

Technical comments:

- Figure 6: I recommend presenting the covariance as a vertical profile of the square root of the diagonal and as a contour plot of the correlations. This usually enlightens better the correlation between altitudes. Also, as it is a matrix, try to have the picture presented as a square instead of a rectangle. On the caption split "TheCO" in "The CO"

- Figures 7 and 8, could you add the dashed lines that show the limits of the fitting interval.

- Figure 19: Why not using a 0-10 ppbv horizontal axis?

- Reference Ceccherini et al. in ACPD 9 is now published as ACP,10,3131-3139,2010.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3747, 2010.