

Atmos. Meas. Tech. Discuss., referee comment RC2  
<https://doi.org/10.5194/amt-2021-190-RC2>, 2021  
© Author(s) 2021. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## Comment on amt-2021-190

Bavo Langerock (Referee)

---

Referee comment on "Intercomparison of CO measurements from TROPOMI, ACE-FTS, and a high-Arctic ground-based Fourier transform spectrometer" by Tyler Wizenberg et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-190-RC2>, 2021

---

The paper provides an interesting and valuable addition to the already published validation papers on the S5P CO product.

Comments/questions:

p3, l63: the destriped columns are now available (since processor >02)

§2.1: suggest to mention the definition of the tropomi grid

p4, l110: "relatively insensitive" ... a bit a confusing phrasing to me, I would say a column avk of 1 means all layers contribute equally?

p4, l120: as mentioned in the product readme file (PRF) §2 the processors before 010202 contained flaws (eg wrongly flagged sunglint pixels). Actually from <https://s5pexp.copernicus.eu> by combining RPRO and OFFL you can skip any processor below 010202 (see latest report on <https://mpc-vdaf.tropomi.eu/> or the PRF on <https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-5p/products-algorithms>)

§2.2, 2.3: suggest to add uncertainty estimates (similar to §2.1)

p6, l164-165: suggest to use [www.ndacc.org](http://www.ndacc.org) and add [cams27.aeronomie.be](http://cams27.aeronomie.be) to specify what is meant with the CAMS rapid delivery service

§2: general comment: add more information on measurement characteristics: plots of a typical  $\text{avk}$ , typical uncertainties, typical dofs, ... this is important to understand some of the arguments further down

p7, l205: can you give some information on the typical number of tropomi pixels in a collocation (to know how the threshold of 50 relates to the typical number)?

p8, l215: can you explain what you mean with pixel-to-pixel biases (vs pixel-to-pixel variability)?

p8, eq 1: depending on the VMR profile  $x$  being with respect to dry or wet air, this equation will alter. Can you add this specification for  $x$  and add a reference to the definition of the column averaged  $g$ ? The equation is derived from the hydrostatic balance equation and should be (for  $x$  being a vmr profile wrt dryair)

\[

$$\Sigma^{N_{i=1}} \frac{\Delta p_i (1-q_i) x_i}{M_{\text{da}}} g(h_i, \lambda)$$

\]

(so no column averaged  $g$  but the altitude dependent  $g$  and using a specific humidity profile  $q$ ). Did you approximate  $q \sim 0$ , can you motivate this? Why using the column averaged  $g$  instead of  $g$  from WGS84 eg?

p9, eq 2: same question:  $x$  being with respect to dryair will alter the equation and an approximation is used?

p9, l237: can you explain why the reference profile is used and not the "retrieved profile" (=scaled reference profile)?

p10, l269: I assume the true profile in eq 4 is the (unknown) true profile, while in eq 3 it is the ACE-FTS profile? If so, I would suggest to use another label for ACE-FTS in eq 3 (and where applicable).

p10, l285: ". In the following section describes..." -> "The following..."

p12, l328: sensitivity depends on the AVK units: did you use the AVK acting on vmr profiles (as reported in the GEOMS NDACC files) or the converted AVK acting on vmr profiles relative to the prior. The latter should be used for the sensitivity (SFIT4 uses relative units).

p14, fig2: the figure labels (a,b...) do not correspond to the labels in the legend. The figure (f) has a different scale on the x-axis ( $1e17$ ) compared to the y-axis ( $1e18$ ).

p18, l423: the sign of the null-space also depends on the sign of  $(I-A)$ ? I would need a bit more information to understand the statement..

p21, fig8: suggestion to use the same scales on the x axis for both subfigures: this will allow to see the effect of the smoothing more clearly

p22, l479: "mean total column DOFS" -> "mean total DOFS"

p25, l 512: 'latitudinal dependence ... present in both the unsmoothed and smoothed cases': can you relate this latitudinal dependence to the reported uncertainties? Is it significant?

Thank you for your replies.