

Atmos. Meas. Tech. Discuss., referee comment RC2
<https://doi.org/10.5194/amt-2022-258-RC2>, 2022
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Comment on amt-2022-258

Anonymous Referee #1

Referee comment on "Advances in retrieving XCH₄ and XCO from Sentinel-5 Precursor: improvements in the scientific TROPOMI/WFMD algorithm" by Oliver Schneising et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2022-258-RC2>, 2022

This paper introduces updates to the TROPOMI Weighting Function Modified DOAS (WFMD) algorithm for xCH₄ and xCO retrievals. Main updates described include increasing the number of polynomial terms in fitting from 2 to 3, updating the digital elevation model (DEM), refining machine learning (random forest) models for cloud screening and xCH₄ bias correction, implementing a destriping scheme based on combined wavelet-Fourier filtering. The authors evaluated the updated TROPOMI retrievals using TCCON retrievals. Global trends in CH₄ and CO derived from TROPOMI retrievals were also compared with those from a surface monitoring network. Overall, the paper is well written and the topic should be of interests to readers of Atmos. Meas. Tech. Some of the updates, for example the destriping scheme, are quite interesting and can be potentially applied to other algorithms. I would recommend that the paper be accepted for publication after some revisions and clarifications.

Specific comments:

The paper made extensive comparisons between v1.5 and v1.8 of the TROPOMI/WFMD algorithm. The previous algorithm paper (Schneising et al., 2019) is focused on v1.2, and it appears that a detailed description of v1.5 has not yet been published. It would be helpful to add a table that summarizes the differences between the three versions (v1.2, v1.5, and v1.8).

Figure 1 and section 3.1: the increase of polynomials in fitting is an updated applied to all retrievals. Can the authors include some results for other areas?

Figure 3a: there appears to be a gradient along 60 N, especially over Siberia. Is there any

explanation for this?

Figure 4: perhaps it would be useful to compare the same version of the algorithm with the DEM model as the only difference.

Section 3.3.1/3.3.2, does the change in TROPOMI spatial resolution have any effects on the trained models for cloud screening and bias correction? Do the models need to be re-trained to account for the change in resolution (and also the cross-track index)?

Lines 191-193: how were the parameters a , b , and c determined?

Section 3.3.2, given that the cross-track index is an input to the trained model, would one expect the striping to be eliminated or reduced by the bias correction procedure?

Section 3.4 – is the destriping scheme run after the bias correction? Please clarify.

Line 296: it would be helpful to briefly introduce Coif16 to readers who are less familiar with the method.

Table 1: Why are the random error and especially systematic error for v1.2 different from the values given in Schneising et al. (2019)? Also it appears that the systematic error in this paper follows a different definition?