

Atmos. Meas. Tech. Discuss., referee comment RC2
<https://doi.org/10.5194/amt-2022-255-RC2>, 2023
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Comment on amt-2022-255

Anonymous Referee #2

Referee comment on "Accounting for surface reflectance spectral features in TROPOMI methane retrievals" by Alba Lorente et al., Atmos. Meas. Tech. Discuss.,
<https://doi.org/10.5194/amt-2022-255-RC2>, 2023

General comments:

This manuscript documents the improved surface reflectance model that has been implemented in the SRON methane (CH₄) retrievals from the TROPOMI instrument. These changes are based on increasing from a second-order polynomial to a third-order polynomial within the surface reflectance model. The second-order scheme led to artefacts with anomalously high XCH₄ values over certain surfaces. The paper describes the changes, analyses the differences between the old scheme and the new one, and validates the new retrieval values against independent observations. The authors successfully demonstrate that the new version removes the artefacts in a number of diverse locations.

The results in the paper are clear and convincing, whilst the writing is generally succinct and coherent. The new developments to the retrievals are important, given the potential of TROPOMI CH₄ retrievals to provide comprehensive and long-running observation of global CH₄. As mentioned in the text, the artefacts that were present in the previous version of the data may have already led to misjudged conclusions in other research.

Taking this all into account, I am happy recommend publication in AMT subject to some minor changes, detailed below.

Specific comments:

Figures 1 & 3: Perhaps an inset in each row, showing the location of the zoom area in a global or at least regional context would be helpful here.

Figure 3: make it clearer that the difference plots show the 2nd-order scheme minus the 3rd order scheme. I think that the phrase "difference between XCH4 retrieved with second and third order polynomial" is not quite clear enough.

Line 147 and elsewhere in that paragraph: I wasn't quite sure that the numbers in the text matched that in Table 1. For example, the text states that the average bias for the corrected XCH4 is -0.2% whereas the Table states that it is -0.3%. Then on line 149, the bias is stated as +0.3%. Otherwise, if I have misunderstood, please clarify the text.

Line 148: I was initially confused about the use of the word 'uncorrected' here as I assumed that it was referring to use of the second-order polynomial. The caption text above Table 1 does make the meaning clear but it would helpful if this information was included in the main text here too.

Line 167: Could you briefly state the second-order values here to aid the reader? "Similar magnitude" is a bit vague.

General throughout text: You state that the third-order polynomial scheme significantly improves results over the regions that previously had artefacts due to errors in the surface reflectance, but no improvements away from these regions. You state that a second order-polynomial is optimal elsewhere, in fact. Does this mean that the third-order scheme leads to reduced performance elsewhere and the second-order scheme should be used there – i.e. a mix of schemes is necessary? Or just that the third-order scheme is used globally but does not produce improvements in most regions? The text discussing this needs to be clearer.

Technical corrections:

Line 19: have been -> has been

Line 22: was launch -> was launched

Line 33: type -> types

Line 38: asses -> assess

Line 133: even the -> even though the

Line 166: remove 'as well'