

Dear Reviewer,

Thank you for the careful and comprehensive review of the manuscript. The main changes performed on the manuscript have been:

- The inversion of the color ramp in Figure 8 and 10.

- Summary rewording.

In addition to those changes, a number of corrections and clarifications have been made throughout the text regarding other minor concerns. Please, find below point-by-point responses (in blue) to your comments and suggestions.

Kind regards,

Javier Roger, on behalf of the authors

Response to comments – Reviewer: Marvin Knapp

Major Comments:

None

Minor Comments:

Line 139: “Different original values, characterized by diverse deviations, could have also led to overestimated dXCH₄ values. Therefore, deviations from the model will probably introduce biases in the retrieved values.” – As I understand it, I wouldn’t call this a bias. The calculated enhancements just include the noise of the underlying data, as is to be expected. In the case of a two-channel retrieval, this noise is high, but it reduces with increasing information content from more channels (up to a point, as you illustrate in Figure 4). I suggest rephrasing to something like “Natural enhancements scatter around their true value since the measurements are subject to noise, thus an overestimation would have been equally likely.”

Corrected.

L156: “... which leads to a background noise reduction but also an underestimation of enhanced pixels.” – You’ve shown that with your plot, no need to use “could”.

Corrected.

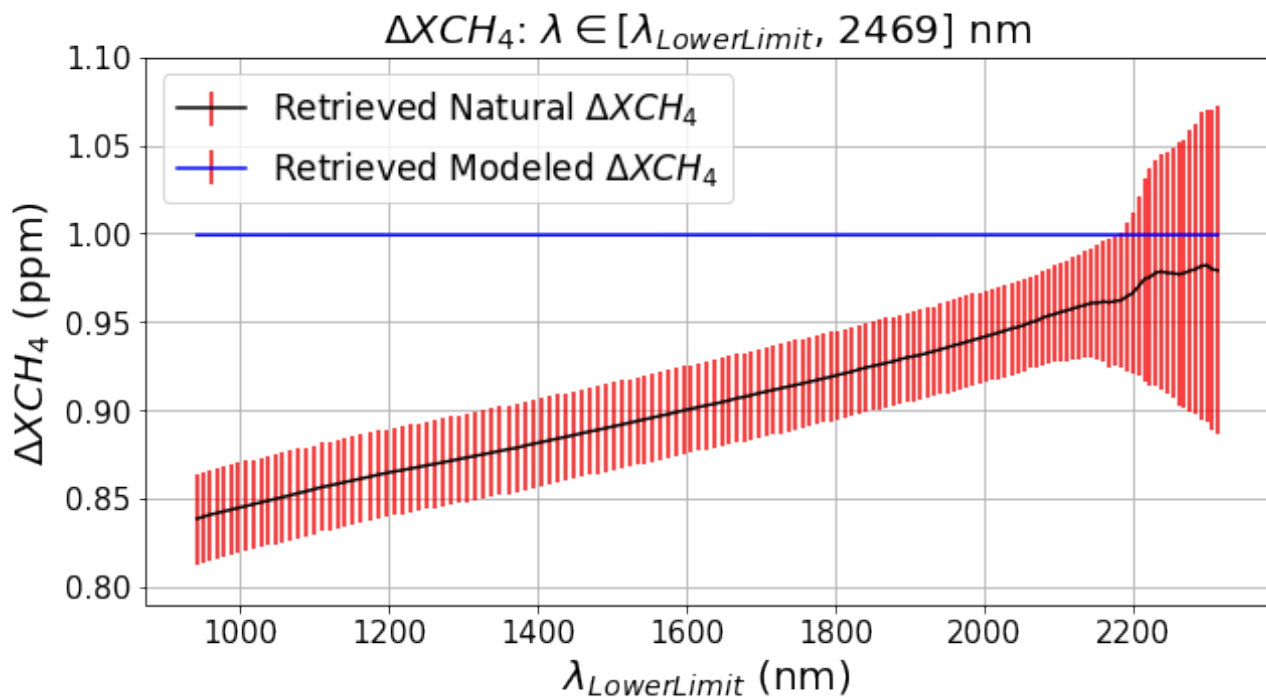
L159: I think you should state here clearly that artifact reduction is a major selling point of the retrieval. You should refer that it is a result of your investigation - something along the lines of “New retrieval artifacts may appear when including the 1700 nm absorption window, but overall, the increased spectral interval mitigates false detections efficiently, as is shown in section 3.”

Corrected.

L165: Since the 0-radiance pixels between 1800-1950 nm do not cause an increase in variability, I am not convinced that your explanation is correct. Does the retrieval noise shrink again when you

exclude the water bands? In any case, it is reasonable to exclude these intervals, they may cause trouble, and do not add value to the retrieval. But it seems to me more like the non-zero values below 1400 nm cause the rise in uncertainty, which is somehow interesting. If you have strong evidence that it is the water bands (like the decrease of noise after exclusion), state it explicitly. If not, just note that you are removing the water bands for the abovementioned reasons and that the noise increase is due to the addition of the bright channels below 1400 nm.

Radiance pixel values around 1900 nm did not reach 0-values, but values around 1400 nm did. However, if I exclude those bands with 0-values from the ~1400 nm bands, the retrieval noise shrinks again. Here we show the left panel of Figure 4 when excluding those bands.



Therefore, the presence of 0-values is probably the reason of the sudden increase in retrieval noise. We clarify this in the text.

L176: Since the SWIR range from 1000-2500 nm shows a higher noise, why didn't you choose the interval from 1500-2500 nm for the COMBO-MF? I guess the even broader interval might be more capable of reducing artifacts, even though it has a larger variability. If you chose it because of that, you should state it here to avoid confusion.

Regarding the previous comment, if we remove the bands around 1400 nm, we find that there is no increase of variability. However, as the reviewer commented, the main reason has been the greater capability to exclude retrieval artifacts. We clarify this in the text.

Caption Figure 8: Add the subscript CH₄ to the Q in the caption. Also, you should mention in the caption that the constant enhancement of CO₂ and H₂O is only added to the plume pixels.

Corrected.

Figure 8+10: You might consider flipping the colorbar of the red-to-blue differences, it is more common to denote positive values with red and negative with blue.

Corrected.

L353: “Therefore, an appropriate use of Combo-MF should take into account the surface composition beneath potential methane emissions.” – This is hard to accomplish in reality, right? In any case, you can be more optimistic here. It is also possible that the COMBO-MF removes the influence of the air pollutants, which seem to significantly increase noise in the 2300-MF.

We write a sentence to be more optimistic regarding the application of Combo-MF. Regarding the influence of the air pollutants, we are not sure that the higher background noise in 2300-MF is due to the presence of air pollutants. Therefore, we do not mention it.

Figure 11: I think you should state here one time clearly that all shown plumes pass your plume masking procedure, and a-d are taken out as examples.

Corrected.

L380: I suggest adding a sentence which gives a broad overview, like “We investigated the retrieval performance in real observations of spectral imagers on satellites and airplanes, both using real and simulated plumes, and found a significant increase in the plume identification capability.” The investigation of the retrieval using a broad spectrum of scenes and instruments was done thoroughly and detailed in this study, and should be highlighted in the beginning of the summary.

Added.

L390: You don't mention that you recommend the Mix-MF for emission quantification. You should mention it in the summary, and it fits when you point out the caveats of the COMBO-MF.

Mix-MF was applied using preliminary masks coming from the simulated plumes, so we have not assessed its performance in realistic conditions. Mix-MF was only used to evaluate the clutter removal (already stated in the summary: ‘is less affected by background noise for small flux rate values’) with the use of this preliminary mask. Therefore, we are not able to conclude if there is an improved performance in real cases. Then, we do not mention it in the text.

Technical corrections:

L156: make*s* the

Corrected.

L203: “Moreover, in Figure 5 we can see ...” is wordy and somehow colloquial. I suggest rephrasing to the more concise form of “Figure 5 shows ...”

Corrected.

L330: “that can be more appreciated” → “that is more pronounced”

Corrected.

L351: “appreciate” → “identify”

Corrected.

L368: “We can observe” → “We observe”

Corrected.

L379ff: Excessive use of the passive tense, consider rewording using an active form of “We investigated the influence ...” or similar in at least part of the sentences.

Corrected.