Author comments on the manuscript “Sentinel-5 SWIR Detector Persistence on Trace Gas Retrievals”, reviewer 1

We thank the referee for the thoughtful assessment of our work and for highlighting considerations regarding its scope and positioning. We appreciate the recognition of the technical quality and clarity of the manuscript. While the study is focused on Sentinel-5, it provides a systematic quantification of detector persistence effects and their impact on trace-gas retrievals, which we believe is of broader relevance to the remote sensing community. We have nevertheless carefully considered the referee’s suggestions and addressed the minor comments below to further improve the manuscript. Page, line, and figure numbers refer to the original manuscript unless stated otherwise.

General Comments:

1. **Lines 13-14, and elsewhere: The abstract and conclusions refer to CH4 errors as those from the full-physics retrieval and just mention “proxy” without reference to what it means, but a strength of Sentinel-5 is precisely that one can use the proxy method for CH4 (unlike TROPOMI). The proxy product will receive far more use than the full-physics product for CH4 and it should be presented as the default product for CH4.**

   Adjusted

   According to the Sentinel-5 CH_4 Algorithm Theoretical Basis Document (ATBD) from ESA [Landgraf et al. 2025], both the full-physics and proxy retrieval approaches are described and foreseen as part of the Level-2 CH_4 product, without one being formally defined as the default. In this context, we treat both approaches on an equal footing in our analysis and discussion. That said, we agree with the referee that the term “proxy” was not sufficiently clear. We have therefore revised the manuscript to improve the clarity of its description in Section 2.3, as well as the abstract and conclusions.

   We changed the sentence in P1, L8 from:
   “This study quantifies persistence-induced biases for CH_4, CO, and the CH_4/CO_2 proxy ratio using the operational RemoTeC CH_4 retrieval algorithm, an also examines persistence errors for a potential CO_2 product. “
   to:
   “This study quantifies persistence-induced biases for CH_4, CO, and a potential CO_2 product from full-physics retrievals, as well as for the CH_4/CO_2 proxy ratio, whose relative error is representative of proxy CH_4 retrievals, using the operational RemoTeC CH_4 retrieval algorithm.”

   Changed P1, L13 from:
   “ 0.71 % for the proxy “
   to:
   “ 0.71 % for the CH_4/CO_2 proxy ratio “

   Added P6, L175:
   “The persistence error affecting the proxy product originates from errors in the retrieved CH_4 and CO_2 columns entering Eq. (1). Since the proxy XCH_4 is directly proportional to the ratio $[CH_4]/[CO_2]$, the relative error in this ratio propagates one-to-one into the relative error of the proxy CH_4 product. Therefore, in the following, we quantify persistence effects for the proxy retrieval in terms of the relative error in the CH_4/CO_2 ratio.”

   Changed P7, L199:
   “and 1 pixel for the proxy ratio.”
   To:
   “and 1 pixel for the CH_4/CO_2 proxy ratio.”

   Changed P9, L271 (also included changes from Comment 2):
   “This study quantified the impact of detector persistence on Sentinel-5 CH_4, CO_2, CO, and CH_4/CO_2 proxy retrievals under realistic surface conditions. The persistence effect—caused by charge trapping and de-trapping charges in the SWIR detector— was simulated to assess its propagation into Level-2

trace-gas products. Persistence-induced biases are most pronounced over low-albedo, high-contrast scenes such as lakes, coastal zones, or other mixed water–land pixels. Although mean biases remain small, the maximum localized deviations—1.59 % for CH_4, 4 % for CO, 1.55 % for CO_2 and 0.71 % for the proxy—constitute substantial fractions of the CO and proxy uncertainty budget (20 %, 1 %) and exceed those for CH_4 and CO_2 (1 %, 0.5 %). These results highlight the need for effective mitigation in operational processing."

To:

"This study quantified the impact of detector persistence on Sentinel-5 CH_4, CO_2, and CO full-physics retrievals, as well as on proxy CH_4 retrievals based on the CH_4/CO_2 ratio, under realistic surface conditions. The persistence effect—caused by charge trapping and de-trapping in the SWIR detector—was simulated to assess its propagation into Level-2 trace-gas products. Persistence-induced biases are most pronounced in high-contrast scenes, such as lakes, coastal zones, and mixed land–water pixels. Overall, the biases remain small at scene level, with typical amplitudes below 0.12 % for CH_4, 0.10 % for CO_2, 0.34 % for CO, and 0.06 % for the CH_4/CO_2 proxy ratio. Larger deviations occur in spatially structured regions, where localized errors can reach up to 1.59 % for CH_4, 1.55 % for CO_2, 4 % for CO, and 0.71 % for the CH_4/CO_2 proxy ratio. While these effects represent a noticeable contribution to the error budget in such conditions—particularly for CO and, to a lesser extent, for the proxy—they do not dominate the overall error budget under typical observing conditions. Nevertheless, their spatial correlation with surface contrast may introduce patterns that could be misinterpreted as localized enhancements, highlighting the importance of targeted mitigation strategies such as filtering of affected high-contrast pixels in operational processing."

2. **Lines 13-14, and conclusions: Giving maximum errors in abstract/conclusions is misleading without the error statistics, which would show that the errors are in general considerably smaller than these maxima. In fact, what I get from this work is that the detector lag will not significantly affect my use of the proxy product for CH4 – I have other errors to worry about.**

   Adjusted

   We agree that quoting only maximum errors in the abstract and conclusions can overemphasize worst-case situations. We have therefore revised the text to better distinguish between typical errors and the larger deviations found in specific high-contrast scenes. In particular, we now emphasize that the scene-wide bias statistics are generally small, while the largest errors are concentrated in mixed and high-contrast pixels such as coastal and land–water interface regions. We have also moderated the wording regarding the impact on the proxy product to reflect that persistence is not the dominant error source under most conditions, although it remains relevant in high-contrast scenes, where persistence-induced errors are spatially structured and correlated with surface features, potentially introducing patterns that could be misinterpreted as localized CH_4 enhancements depending on the application.

   We changed in P1, L11:

   "Across these scenes, the induced biases remain small, with typical amplitudes below 0.12 % for CH_4, 0.10 % for CO_2, 0.34 % for CO, and 0.06 % for the CH_4/CO_2 proxy. However, localized outliers reaching up to 1.59 % for CH_4, 1.55 % for CO_2, 4.01 % for CO and 0.71 % for the proxy constitute a substantial fraction of the CO and the proxy performance targets, and exceed those defined for CH_4 and CO_2. Our findings suggest that targeted post-filtering, such as omitting coastal and land–water interface pixels, can effectively reduce the most significant outliers in the persistence bias, thus aligning the retrieval biases with the required mission performance. "

   To:

   "Across these scenes, persistence-induced biases are generally small, with typical amplitudes below 0.12 % for CH_4, 0.10 % for CO_2, 0.34 % for CO, and 0.06 % for the CH_4/CO_2 proxy. However, larger deviations occur in high-contrast scenes, particularly at coasts and land–water transitions, where localized errors can reach up to 1.59 % for CH_4, 1.55 % for CO_2, 4.01 % for CO, and 0.71 % for the proxy. These values represent a substantial fraction of the performance targets for CO and the proxy, and exceed those for CH_4 and CO_2. This indicates that, while persistence is not the dominant error source under most conditions, it can still produce non-negligible biases in spatially structured scenes, which may be misinterpreted as localized enhancements. Therefore, such effects should be mitigated, for example through targeted quality control or filtering of affected pixels."

   Changed in P9,L271:

This change affects the same paragraph as discussed above in Comment 1. To avoid repetition, we refer to the revised version provided in the previous response, which incorporates all changes.

3. **Figure 1 is not very helpful. It would be more helpful without unfamiliar abbreviations and with a more substantial caption that describes the overall OSSE strategy.**

   Adjusted

   We agree that the original version of Figure 1 was not sufficiently self-explanatory. The figure has been revised to improve clarity by replacing abbreviations (e.g. L1B and L2). We have also expanded the caption to better describe the overall OSSE strategy illustrated in the figure.

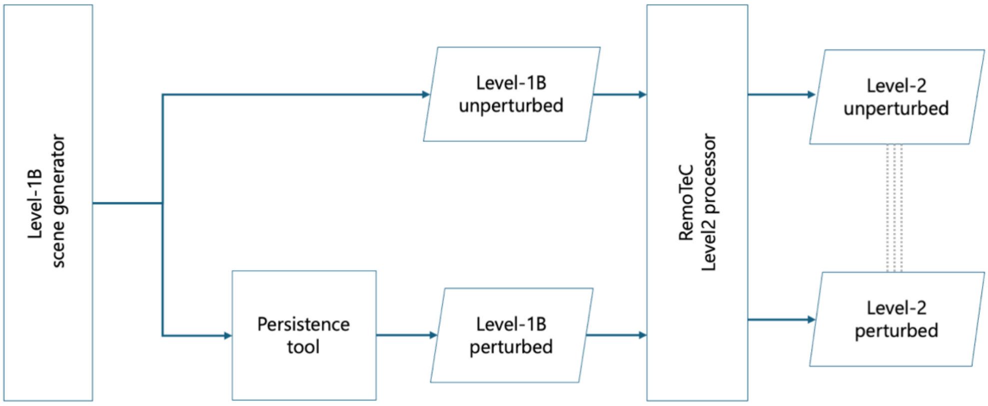

Figure 1. Schematic overview of the simulation framework used to assess the impact of persistence perturbations. Synthetic spectra are generated from a common reference scene and propagated through two processing branches: one including persistence perturbations and one without perturbations. The resulting Level-1B radiance spectra are processed independently through the retrieval chain to produce Level-2 products. The comparison between the perturbed and unperturbed Level-2 outputs enables quantification of the impact of persistence effects on the retrieved quantities.

4. **Line 120: I didn't understand reff = 4. Is it missing a unit? But um would be too large and nm too small?**

   Adjusted

   In the original manuscript, the parameter was incorrectly described as an effective radius. In our setup, the aerosol size distribution is prescribed as a power-law distribution following Butz et al. (2010), and the parameter value refers to the exponent of this distribution rather than to a particle radius. It is therefore dimensionless. We have revised the text accordingly to correct this description and avoid confusion.

   We have changed P.4, L.118 from:
   "The synthetic spectra include a mild aerosol load with an aerosol optical thickness of 0.1 at 760 nm, represented by a Gaussian vertical distribution centered near the surface (Butz et al., 2010), and assuming standard size distribution with reff = 4 (Butz et al., 2011) and optical properties taken from lookup tables (Dubovik et al., 2006)."
   To:
   "The synthetic spectra include a mild aerosol load with an aerosol optical thickness of 0.1 at 760 nm, represented by a Gaussian vertical distribution centered near the surface (Butz et al., 2010), with aerosol microphysical properties described by a power-law particle size distribution (α = 4; Butz et al., 2011) and optical properties taken from lookup tables (Dubovik et al., 2006)."

5. **Line 120: I didn't understand "Surface albedo spectral dependence is modeled as wavelength-independent." Does this mean that the albedo spectra are just scaled up or down depending on surface? That wouldn't make sense because the wavelength dependence of the albedo should vary with surface type.**

Adjusted

We agree that, in reality, the spectral dependence of surface albedo varies with surface type. In our study, however, the surface albedo is treated as a constant value within each spectral band, while varying between bands and from pixel to pixel. This simplification is applied consistently in both the forward simulations and the retrieval. This is motivated by the fact that the Sentinel-2 data used to construct the reference scenes provide albedo values integrated over broad spectral bands, rather than spectrally resolved reflectance. As a result, no wavelength-dependent albedo within each band can be derived in a consistent way. The albedo is therefore treated as spectrally constant within each band in the forward simulations, and the same assumption is adopted in the retrieval to ensure that any differences can be attributed solely to the persistence effect. We have revised the text to clarify this point.

We changed line in P.4, L120 from:
"Surface albedo spectral dependence is modeled as wavelength-independent."
To:
"Surface albedo is treated as constant within each spectral band (i.e. wavelength-independent), while varying between bands and from pixel to pixel, consistent with the band-averaged reflectance provided by Sentinel-2."

Added on P7, L185 the following line, where we have also addressed comment from referee 1:
"The same albedo parameterization as in the forward simulations is adopted in the retrieval. For trace gases and, where applicable, aerosols, the a priori is set equal to the true state used to generate the synthetic spectra, and no explicit a priori uncertainties are imposed. This configuration provides a consistent reference case, so that the dominant differences between perturbed and unperturbed retrievals can be attributed to the persistence effect."

6. **Line 199 and elsewhere. I don't understand why the detector lag would affect the CH4 proxy retrieval at all, since the albedo cancels between CO2 and CH4, except for some smearing which is maybe what the "one pixel" refers to? But that effect would be independent of change in albedo and it would not translate into a systematic bias.**

Adjusted

We agree that the proxy method reduces errors that are common to both CH_4 and CO_2 retrievals. However, the cancellation is not complete. In our case, detector persistence affects the measured radiances in a scene- and wavelength-dependent manner. Since CH_4 and CO_2 are retrieved from different spectral regions with different absorption features and radiance levels, the persistence-induced perturbations are not identical for the two gases. As a result, they do not fully cancel in the proxy ratio and can lead to residual biases. We have clarified this point in the manuscript.

We added on P7, L207 the following text:
"The non-zero bias in the proxy ratio further indicates that persistence-induced perturbations differ between the spectral regions used for CH_4 and CO_2 retrievals, and therefore do not fully cancel in the ratio."
And on P9, L276:
"The presence of residual biases in the proxy product indicates that persistence effects do not fully cancel between the CH_4 and CO_2 retrievals."

7. **Line 205: I don't understand the nits unit. Aren't the % errors reported for column mixing ratio?**

Adjusted

The unit "nits%" was a typographical error. The proxy bias is expressed as a relative error, consistent with the other quantities, and has been corrected to "%" in the revised manuscript.

8. **Line 260 and elsewhere: I think that the authors' recommendation to exclude fractional water scenes is too radical and would result in unnecessary loss of information for important locations such as coastal cities. The errors reported are not that large, and I certainly would not want to filter out proxy data on that basis.**

   We agree that a strict exclusion of fractional water scenes may not be desirable in all applications, particularly for regions of interest such as coastal areas. Our intention was not to propose a rigid filtering criterion, but rather to illustrate a possible mitigation strategy to reduce the largest persistence-induced biases. In practice, such filtering can be implemented through quality flags, allowing users to balance data coverage and accuracy depending on their specific application. We have revised the text to clarify that this approach is not prescriptive and that more refined filtering strategies can be developed.

   In this context, it is worth noting that filtering of mixed land–water pixels is already commonly applied in operational retrievals (e.g. via land-fraction-based quality flags in the CH4 TROPOMI product; SRON, 2025), albeit for different reasons.

   We changed on P10, L286:
   "This demonstrates that such masking can substantially limit persistence-induced artifacts in the operational retrievals, providing a practical short-term solution."
   To:
   "While such masking is effective in limiting the largest persistence-induced artifacts, it may also reduce data coverage in regions of interest such as coastal areas. In practice, this trade-off can be managed through quality indicators, allowing users to balance data coverage and accuracy depending on their application."

References

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Author comments on the manuscript “Sentinel-5 SWIR Detector Persistence on Trace Gas Retrievals”, reviewer 2

We thank the referee for the positive assessment of the manuscript and for the constructive comments. We appreciate the recognition of the overall clarity of the methods and results, and we address the points requiring further explanation in detail below. The original comments are reproduced in *bold*, followed by our replies. Page, line, and figure numbers refer to the original manuscript unless stated otherwise.

General Comments:

1. **The methodology section should make clear how instrument noise is handled. It seems that all simulations of spectra do not consider instrument noise, but this is not clearly written in the text. This may be valid because the persistence effect probably results in more systematic errors, but noise will affect the signal levels on the detector in different ways for high and low intensities, which may possibly influence the results. The same applies for e.g. dark signals, which are also not mentioned (and probably not considered). The consideration (or not) of noise and darks should be stated in the text and a possible impact on the results should be discussed.**

   Adjusted

   Instrument noise was not explicitly added to the simulated spectra used in this study, as the analysis was designed to isolate the systematic retrieval errors caused by detector persistence under otherwise controlled conditions. The retrieval nevertheless accounts for the expected instrument noise through signal-dependent noise estimates, which determine the relative weighting of the spectral measurements. Assuming that errors remain sufficiently small for linear error propagation to apply, persistence-induced biases can be treated separately from random noise contributions. In this framework, noise would primarily increase the variability of the retrieval results, while the systematic effects of persistence remain unchanged.

   We added on P4, L124 the following line:
   “Instrument noise is not explicitly added to the simulated spectra, as the aim is to isolate persistence-induced biases. This simplification neglects signal-dependent noise, which contributes a statistical component to the mission error budget. The magnitude of this component is specified in the mission requirements *(European Space Agency (ESA), 2020a)*.”

2. **The results presented in the paper are mainly based on the simulation of three different regions for a constant geometry. How representative are these regions (and geometry) for the global data provide by Sentinel-5? How many data would be affected, and how many would be filtered out on a global scale? This would give more insight on how relevant the effect and possible correction would be.**

   Partially adjusted

   The simulations presented in this study are not intended to provide globally representative statistics, but rather to assess the sensitivity of the retrievals to persistence effects under controlled conditions. The selected regions were designed to span a range of surface albedo values and contrasts, including extreme configurations where persistence effects are expected to be most pronounced, with large and heterogenous albedo transitions.
   A constant viewing and illumination geometry was assumed in order to isolate the effect of persistence and avoid introducing additional variability related to changing observation conditions. While geometry influences absolute radiance levels, the persistence effect primarily depends on relative changes in radiance across the scene, so the qualitative behavior described here is expected to be broadly representative.
   Because persistence-induced biases depend strongly on local scene characteristics (e.g. albedo contrast and spatial transitions), and since the simulated scenes are not sampled from a global distribution, it is

not possible to derive meaningful global statistics (e.g. fraction of affected data) from this setup. Providing such estimates based on a limited set of constructed scenarios could therefore be misleading.

Moreover, a purely global perspective does not fully capture the relevance of persistence-induced errors, as it overlooks their impact at the local scale. Persistence-induced biases occurring in regions with strong radiance gradients can directly affect the estimation of localized sources, even if they represent only a small fraction of the global data. The objective of this study is therefore not to quantify the global occurrence of persistence effects, but to investigate their magnitude and behavior under representative and extreme conditions. Instead, the results should be interpreted as indicative of potential local impacts, particularly in regions with strong radiance gradients such as coastal zones or inland water bodies.

We changed p8, L222 the line:
"We assess the spatial variability of the resulting persistence bias, its dependence on surface albedo, and the effect of simple filtering strategies on the overall bias statistics."
To:
"We assess the spatial variability of the resulting persistence bias for each scene, its dependence on surface albedo, and the effect of simple filtering strategies on the overall bias statistics. The selected regions are not intended to be globally representative, but rather to span a range of surface albedo conditions and contrasts; the results should therefore be interpreted as indicative of local effects rather than global statistics."

Specific Comments:

3. **p. 2, l. 58–59: 'MicroCarb and CO2M adopt more stringent accuracy requirements for XCO2 (of 0.4 ppm...)' Is there a reference for these accuracy requirement values?**

   Adjusted

   Changed in P2, L57:
   "For context, dedicated CO_2 missions such as MicroCarb and CO2M adopt more stringent accuracy requirements for XCO_2 (of 0.4 ppm, corresponding to approximately 0.1 %), which makes it particularly relevant to assess persistence effects on CO_2 the present analysis."
   To:
   "For context, dedicated CO_2 missions such as MicroCarb and CO2M adopt more stringent accuracy requirements for XCO_2, on the order of ~0.1 % or below (ESA, 2020b; ESA, 2024), highlighting the importance of assessing persistence effects on CO_2 in the present analysis."

4. **p. 4, l. 115: Please describe which spectroscopic data, especially which absorption cross sections, have been used. Are these the same as used in the operational retrievals?**

   Adjusted

   We have clarified the spectroscopic setup used in the simulations. Absorption cross-sections are computed line-by-line using spectroscopic parameters from the HITRAN database (Rothman et al., 2009), together with additional spectroscopic data from Tran et al. (2006) and Scheepmaker et al. (2013). This setup is consistent with the RemoTeC retrieval framework. As the Sentinel-5 retrieval algorithms are still under development, the final operational spectroscopic configuration has not yet been finalized.

   We changed on P4, L114 the following line:
   "The accurate modeling of absorption by molecules relies on spectroscopic databases, which provide the absorption cross-section of the target absorber CH4 as well as of the interfering gases CO, CO2, H2O and O2 (Tran et al., 2006; Rothman et al., 2009; Scheepmaker et al., 2013)."
   To:
   "Molecular absorption is modeled using spectroscopic parameters from the HITRAN database (Rothman et al., 2009), with additional spectroscopic data for methane and related species from Tran et al. (2006) and Scheepmaker et al. (2013). Line-by-line absorption cross-sections are computed for CH_4 and the interfering gases CO, CO_2, H_2O, and O_2, consistent with the spectroscopic setup used in the RemoTeC retrieval framework."

5. **p. 5, retrieval section: Which a-priori values have been used? Are they equal to the true values? What about assumed a-priori uncertainties? Is this in line with the operational processing? Please explain.**

   Clarified

   For trace gases and, where applicable, aerosols, the a priori is set equal to the true state used to generate the synthetic spectra, while surface albedo is retrieved with a scene-independent a priori. The same albedo parameterization as in the forward simulations is adopted in the retrieval. This setup is largely consistent with the operational processing in terms of the retrieval configuration, but differs in the choice of a priori state. In operational products, the a priori is derived from external information and is generally not equal to the true atmospheric state Here, setting the a priori equal to the true state is a deliberate simplification to minimize a priori-related errors and isolate the impact of persistence. This ensures that, in the absence of persistence, the retrieval is consistent with the true state, so that differences between perturbed and unperturbed retrievals can be attributed directly to persistence-induced effects. We have clarified this point in the manuscript.

   Added on P7, L185 the following line, where we have also addressed comment from referee 1:
   "The same albedo parameterization as in the forward simulations is adopted in the retrieval. For trace gases and, where applicable, aerosols, the a priori is set equal to the true state used to generate the synthetic spectra, and no explicit a priori uncertainties are imposed. This configuration provides a consistent reference case, so that the dominant differences between perturbed and unperturbed retrievals can be attributed to the persistence effect."

6. **p. 9, l 256: 'we applied an a posteriori land-fraction filter to remove pixels partially or fully over water.' Does this mean that Sentinel-5 will perform retrievals over water/ocean (maybe in glint mode)? If this is the case, a lot of data would possibly be filtered out, which is not considered in the numbers derived from the simulations. Please explain.**

   The applied land-fraction filter is intended as a simple a posteriori mitigation approach to identify and remove pixels most affected by strong albedo transitions, particularly at land–water interfaces. It is not intended to exclude all water or ocean observations. Retrievals over water, for example in sunglint geometry, are routinely performed (e.g. for TROPOMI methane retrievals; Lorente, 2022) and remain an important component of the observing strategy. The purpose of the filter in this study is to demonstrate that persistence-induced outliers can be reduced using a simple scene-based criterion. At the same time, we note that sunglint scenes may themselves be affected by persistence due to strong radiance contrasts, and therefore also require further investigation. In an operational context, filtering approaches would need to be optimized to balance data coverage and data quality, and refined to retain valid observations—including glint—while selectively removing the most problematic pixels. We have clarified this point in the manuscript.

   Added on P9, L269:
   "At the same time, observations over water (e.g. sunglint) remain important and may also be affected by persistence, requiring optimized filtering strategies to retain such data while removing the most problematic pixels."

7. **p. 21, Fig. 6: 'The dotted lines denote the contour plots...' These contour plots are not mentioned in the text. If these are relevant, they should be discussed; if not, they should be removed.**

   Adjusted

   The contour lines represent the density distribution of data points in the (albedo, ΔA) parameter space. We have now included a brief explanation and discussion of these contours in the text, highlighting that the largest persistence-induced biases occur in relatively sparsely populated regions.

We added on P8, L242 the line:
“The dotted contour lines indicate the density distribution of data points in the (*Albedo,* Δ*Albedo*) space, showing that the largest persistence-induced biases occur in relatively sparsely populated regions of the parameter space.”

Technical Corrections:

8. **p. 6, l. 165: What is meant with ‘numerical range’ - please explain or remove.**

   Adjusted

   This was a typographical issue arising from a LaTeX formatting error. The text has been corrected to explicitly state the NIR spectral range (745–773 nm).

   We changed the sentency to: “Additionally, the NIR band (745–773 nm) is used to constrain atmospheric scattering properties.”

9. **p. 7, l. 205: ‘nits%’ - should probably be ‘%’?**
   Adjusted

10. **p. 12, section B2: A reference to this section should be given in the main text.**
    Adjusted

    We have added a reference to Appendix B2 in the main text to guide the reader to the corresponding results for CO_2, CO, and the CH_4/CO_2 proxy ratio.

    We changed on P8, L224 the line:
    "Figure 5a present the relative persistence CH4 bias maps for each study region."
    to:
    "Figure 5a presents the relative persistence CH_4 bias maps for each study region; while the corresponding maps for CO_2, CO, and the CH_4/ CO_2 proxy ratio are shown in Appendix B2 (Fig. A2)."

    We added on P8, L245:
    "A similar relationship is observed for CO_2, CO, and the CH_4/ CO_2 proxy ratio (see Appendix B2, Fig. A4)."

    We added on P9, L260 (sentence introducing Fig. 5b):
    "The impact of this filtering is illustrated in Figure 5b and Table 1; the corresponding maps for CO_2, CO, and the CH_4/ CO_2 proxy ratio are shown in Appendix B2 (Fig. A3)."

11. **p. 21, Fig. 6: Caption: ‘panel (C)’ → ‘panel (B)’**

    Adjusted

12. **p. 23, Table 1: Please include also the number of data points before / after the filtering (or the percentage filtered out) for each scene.**

    Adjusted

    We have included the percentage of data points removed by the land–water filtering step for each scene in Table 1 (see last row). This allows a straightforward comparison across scenes while preserving the readability of the statistical results. The table caption has been updated accordingly to clarify this addition.

    Added the following sentence Caption in Table 1:
    “The last row reports the percentage of pixels removed by the land-water filter for each scene; values correspond to the full-physics retrievals, with differences for the proxy retrieval below 1 %.”

References:

European Space Agency (ESA), 2020a: Sentinel-5: ESA's Polar-orbiting Atmospheric Composition Mission in Support of Copernicus Services, Esa sp-1336, ESA Communications, Noordwijk, The Netherlands, https://www.esa.int/About_Us/ESA_Publications/SP-1336_Sentinel-5_ESA_s_Polar-orbiting_Atmospheric_Composition_Mission_in_Support_of_Copernicus_Services, 2020.

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Author comments on the manuscript "Sentinel-5 SWIR Detector Persistence on Trace Gas Retrievals", reviewer 3

We thank the referee for the positive assessment of our work and for the constructive comments provided, which have helped us improve the manuscript. Below, we provide point-by-point responses to the reviewer's comments. The original comments are reproduced in *bold*, followed by our replies. Page, line, and figure numbers refer to the original manuscript unless stated otherwise.

1. **P2 l58: Can you add a reference for the MicroCarb and CO2M requirements?**

   Adjusted

   We have added appropriate references for the MicroCarb and CO2M accuracy requirements in the revised manuscript.

2. **P3 l79: "where CNES model applies a temporal sampling of the incoming signal". This was unclear. Would it be more appropriate to call it a "temporal smoothing" and then also reference the appendix where it is described in more detail?**

   Adjusted

   We agree that the original wording was unclear. We have revised the text to better describe the role of the CNES model as simulating the temporal response of the detector, including persistence effects, and added a reference to Appendix A where the model is described in more detail.

   We changed on P2, L78 line:
   "The synthetic radiances approximate detector-level signals at each readout and served as input to the persistence-effect simulation, where CNES model (Section 2.2) applies a temporal sampling of the incoming signal."
   To:
   "The synthetic radiances approximate detector-level signals at each readout and served as input to the persistence-effect simulation, where the CNES model (Section 2.2) simulates the temporal response of the detector to the incoming signal, including persistence effects due to charge trapping and de-trapping (see Appendix A for details)."

3. **P4 l116: Was HITRAN08 used for all of the line parameters? Why? What profile was assumed?**

   We have clarified in the revised manuscript that the spectroscopic parameters are based on the HITRAN database (Rothman et al., 2009), supplemented by additional datasets for methane and related species, and that the atmospheric profiles used in the forward simulations are derived from an ECHAM model simulation.

   We changed P4, L114 from:
   "The accurate modeling of absorption by molecules relies on spectroscopic databases, which provide the absorption cross-section of the target absorber CH4 as well as of the interfering gases CO, CO2, H2O and O2 (Tran et al., 2006; Rothman et al., 2009; Scheepmaker et al., 2013). In order to construct the synthetic S5 radiance spectra, we used a standard model profile for the trace gases."
   To:
   "Molecular absorption is modeled using spectroscopic parameters from the HITRAN database (Rothman et al., 2009), with additional spectroscopic data for methane and related species from Tran et al. (2006) and Scheepmaker et al. (2013). Line-by-line absorption cross-sections are computed for CH_4 and the interfering gases CO, CO_2, H_2O, and O_2, consistent with the spectroscopic setup used in the RemoTeC retrieval framework. The atmospheric profiles for trace gases, temperature, and pressure are derived from an ECHAM model simulation, and are kept fixed across all simulations."

4. **P6 l165: I'm not sure what the '(numerical range)' indicates**

   Adjusted

   This was a typographical issue arising from a formatting error. The text has been corrected accordingly.

   Changed to: “Additionally, the NIR band (745–773 nm) is used to constrain atmospheric scattering properties.”

5. **P6 l175: 'extend' -> extent**

   Adjusted

6. **Fig7: font very small**

   Adjusted