We thank the reviewers for their additional comments. We have amended the manuscript to address the specific technical comments raised and appreciate the reviewer's consideration of our revised manuscript.

Reviewer 1

The information that has been added to sections 2.1, 2.6, 3.4, and the added appendices A and B satisfactorily address the concerns I had with the first submission of this work. I believe this paper to be suitable for publication.

We thank the reviewer for their assessment and are pleased that the additions have satisfactorily addressed their concerns.

A couple very minor technical considerations:

Line 80: Slant column density is capitalized as a proper noun with no associated alphabetization. Is this intentional? I would not normally think slant column density is a proper noun.

The reviewer is correct. No capitalisation is needed here, and this has been corrected.

Figure 3: The y-axis limit of 120% appears to have been chosen to accommodate the legend. However, this introduces a bit of visual confusion, especially when combined with the bounding box. I would recommend using 100% as the y-axis limit and finding another way to accommodate the legend.

We appreciate this suggestion. We agree that keeping the axis limit at 100% is clearer and this has been updated in the figure.

Reviewer 2

I thank the authors for taking the time to address my comments.

My main concern remains if NIMCAM will be able to make sufficiently useful retrievals of total column methane given its design, especially with the newly added CO2 proxy using only one band. I'd prefer this retrieval be demonstrated with existing spectra, even for the simpler point source case, for example with spectra from MethaneAIR, but I trust that the proof of this performance will be in a future publication as mentioned in Appendix B.

Past this, I maintain some concerns from my original review:

1. The inversion results might decrease the errors on the fluxes (as it must) and improve the fit to true fluxes as given by the RMSE, but visually, the results are not compelling. If, for example, you had to write out how Figure 7(b)(g) was better than Figure 7(b)(c), what would that description be? This concern might be more related to the characteristics of the OSSE than the value of NIMCAM.
2. Equation 4 is not how uncertainty reduction is typically defined (the square root would typically not include the 1, e.g. equation 10 in https://doi.org/10.5194/acp-26-11893-2026).
3. The stated TROPOMI precision (~1 ppb) is still quite low, especially given the authors imply through their citations that they use the Bremen product, which includes a correction on the precision values to make them more realistic (see the WFMD product ATBD).

We thank the reviewer for their feedback.

1. We agree that the visual differences between the prior and posterior flux fields are less striking than the corresponding RMSE reductions might suggest. The posterior fluxes do exhibit an improvement in the magnitude of the bias with the truth, and this is the main driver of the improvement. However, some clear spatial discrepancies remain because the prior flux distribution differs significantly from the prescribed truth. Consequently, the inversion reduces the magnitude of the flux errors without fully recovering the true spatial pattern, highlighting the inherent limitations of atmospheric inverse modelling when observational information is finite and the prior contains structural errors.
2. We thank the reviewer for this observation. We acknowledge that the quantity defined in Eq. 4 differs from the conventional definition of uncertainty reduction used in many inversion studies. In this work, we define uncertainty reduction as the square root of the variance reduction. Our objective is not to report an absolute uncertainty-reduction metric that can be directly compared with other studies, but rather to provide a consistent measure for comparing the

relative performance of different observing-system configurations. Since the same definition is applied throughout the manuscript, the conclusions regarding the relative performance of the different configurations are unaffected.

Variance reduction is also a standard metric in many inversion studies (e.g. https://doi.org/10.5194/acp-9-2619-2009)

3. We agree that the TROPOMI precision values adopted here are likely optimistic, particularly when compared with the uncertainty characterisation provided in the WFMD Bremen product documentation. The observation uncertainties used in this study should be regarded as a lower bound on the expected retrieval uncertainty. The purpose of this experiment is to provide an assessment under idealised conditions and to compare observing-system configurations on a consistent basis. The manuscript states that the assumed observation errors describe a lower limit estimate.