

Response to comments from Editor (Dr. Jamie Shutler)

Black: Reviewer's comments; Blue: Author's answers; Green: Changes in the manuscript

Dear Editor,

We thank you for handling the manuscript and providing careful guidance to us.

We accept your comments and have included the suggested changes in the manuscript. Following is the point-by-point response and account of changes made in the manuscript.

Editor's comments:

I read your paper with interest as it is excellent to see satellite column integrated gas observations being used within a biogeoscience study. I have had significant issues in identifying reviewers for your manuscript, having invited 21 reviewers, 4 of which accepted, but then only 1 reviewer submitted a report. Hence I am now submitting this editor comment so that we can allow this review process to proceed. I realise that I have previously reviewed your paper prior to its publication within the discussion forum and that you revised your work addressing my earlier comments. So my comments below focus mainly on the major points raised by the single reviewer.

Its clear from the reviewer's comment that your manuscript has suffered from some unfortunate timing in relation to your analysis and then the subsequent release of an updated Sentinel 5P methane dataset. The production of this revised Sentinel 5P methane dataset was triggered by an error (regional bias) that was identified within these data (as presented most recently within Lorente et al., 2022, but also studied within the three other references identified by the reviewer). And it appears that this bias likely forms part of the signal identified within your analysis and manuscript. And you have (not surprisingly) attributed the signal to a change in the natural system, whereas it seems highly likely that at least a part of the signal you identify is due to the error within the Sentinel 5P methane data dataset. The updates and changes in this underlying Sentinel 5P dataset are likely to significantly impact your results and therefore the conclusions from your work are also likely to change.

In light of this, its clear that you should at least repeat your analysis using the updated datasets (i.e. those provided by the reviewer) and then revise your manuscript following the results of this new analysis. I therefore conclude that major revisions are required.

You can re-submit your analysis that use the most recent datasets, revise your conclusions and you may have to revise your paper title. If you choose to perform these major revisions you will need to make sure that you fully account for the new revised Sentinel 5P data along with the associated data uncertainties and make sure that you show how these uncertainties likely impact your results. This will help to illustrate how robust your findings are to the underlying uncertainties of the Sentinel 5P dataset. This issue of unfortunate timing highlights the need to

include the data version numbers and sources for all data (so authors can trace which datasets were used) so please make sure you include this information within your revised work.

Author's comments:

We are very thankful for your comments, suggestions, and consideration of our manuscript. We had used all available S-5p methane operational data at that time in the initial version of the paper. This consisted of data versions 01.02.02 up to 01.03.02 for both reprocessed and offline data (see product readme file for details on the processor version and changes - <https://sentinels.copernicus.eu/documents/247904/3541451/Sentinel-5P-Methane-Product-Readme-File.pdf/d7214038-25a9-416f-8deb-d5d6c766f92e?t=1678985481272>). The current versions (02.04.00 and 02.05.00) have undergone significant improvements in methane product quality based on changes in the spectroscopy, bias-correction method, surface reflectance spectral dependence using a higher order polynomial fit and so on. These changes were described in the scientific version of the SRON product (Lorente et al. 2022) and the latest version of the ATBD. Based on the validation results using TCCON data as reference the residual systematic and random uncertainty of the latest S-5p methane data are well within the mission requirement. However, as also pointed by the reviewer 1, these stations are sparse and there remains holes in critical regions of the world. Further extension of the ground-based network would help to better evaluate and constrain the biases of the satellite products in the future. We have used the new available operational S-5p data for all 4 years (2019-22) to show the robustness of our methodology. We have updated the title and the conclusions of the paper according to our new findings.

We have attached the modified version of the manuscript for your evaluation (in track changes mode so that changes become apparent).

We hope that the changes made are to the satisfaction of the reviewers. Thank you in advance for considering the manuscript, and please, contact us if you have any questions or need any further information.

Yours Sincerely,

Saheba Bhatnagar and Mahesh Kumar Sha (on behalf of all authors)