

Interactive comment on “Methane vertical profiles over the Indian subcontinent derived from the GOSAT/TANSO-FTS thermal infrared sensor” by Dmitry A. Belikov et al.

Anonymous Referee #2

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General Comments:

This manuscript presents the vertical distribution of CH₄ from GOSAT retrievals over India within the context of elucidating: a) issues related to GOSAT sensitivities and ‘a priori’ profiles, b) processes influencing the spatiotemporal distribution (emissions, transport), and c) variability across the region. All these aspects are relevant to atmospheric CH₄ investigations especially that there are only few retrievals (and less in-situ datasets) available. These three aspects are also described in the paper within a fairly reasonable depth. However, I have two major concerns, which require attention from the authors. That is,

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1) The relevance of this study to the scope of AMT is unclear. Unless the paper is refocused on issues with GOSAT retrievals esp the choice of a priori and/or highlighting the sensitivities of GOSAT and the proper use and interpretation of these retrievals. The paper already presented several figures and discussion to these points but more emphasis could be made to bring it closer to the scope of AMT.

2) Lacks comparison (verification) with available independent measurements. While it is understandable that there are only few measurements available, model-based comparisons are not sufficient. Some efforts to compare with other measurements (aircraft or ground based or other retrievals from different instrument) would strengthen the paper's findings.

Specific Comments: 1) Title is a bit misleading as the paper does not discuss this in depth.

2) Abstract states that the objective is to understand retrieval sensitivity, but the results are more towards comparison of CH₄ variations across with models including emissions, without any independent measurements to compare with.

3) Line 16: Stating "22 vertical levels . . . provide critical information" is misleading. Might be better to state its DOFS and vertical sensitivities.

4) Line 18: 'excepting' ?

5) Line 95-100. It would be great to describe the retrieval algorithm including a priori error covariance assumptions (if this is an optimal estimation). A short description as well of NEIS relative to MIROC (esp emissions used in NEIS).

6) Line 105-110. This is a very useful discussion of GOSAT retrievals. Why are these other retrievals not used for comparison over India in this study?

7) Section 3.2. This is also a very useful section. If DOFS is 1, why do we have profile information?

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- 8) Line 213. 'resampled' ?
- 9) Line 221. It may be interesting to show differences in AK over land and ocean.
- 10) Figure 4 & 5. These figures are informative.
- 11) Figure 9, Line 284-287. What about the retrieval errors (from the a posteriori estimates)? Please elaborate 'we found that differences between a priori and retrieved CH₄ profiles are larger than its retrieval error...'.
'a priori' is consistent across the manuscript (including italics and non-italics).
- 12) Line 311-312. This sentence is unclear. Please restate.
- 13) Line 316-317. Is this a study where different a priori profiles (and I assumed the error covariance is the same) are used in the retrievals. Please make sure the use of 'a priori' is consistent across the manuscript (including italics and non-italics).
- 14) Line 320-324. This is a useful discussion and should be highlighted more.
- 15) Figure 11. More discussion on this (relative to a priori) would strengthen this paper.
- 16) Section 3.5. This looks like more of a comparison with ACTM and elucidating differences. It may be better if this can be made a separate section with slightly different heading.
- 17) Line 375. 'ACTM WH is superior to ACTM CAO'. It's unclear from the bar graphs.
- 18) Line 399. What is the basis for 10-15 Tg yr overestimation (How was this number derived?)
- 19) Conclusions. While comparison with models is informative, it remains to be proven if the differences between GOSAT and modeled profiles reflect 'real' differences — unless independent measurements (and/or retrieval experiments) are made.

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