

Interactive comment on “Improvement of the retrieval algorithm for GOSAT SWIR XCO₂ and XCH₄ and their validation using TCCON data” by Y. Yoshida et al.

Anonymous Referee #2

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The study by Yoshida et al. collects and evaluates various development steps for the GOSAT XCO₂ and XCH₄ retrieval algorithm operated at the National Institute for Environmental Studies (NIES), Japan. Since the early version of the algorithm, the authors themselves and others have identified key aspects that enhance accuracy of the greenhouse gas concentrations retrieved from GOSAT. The paper under review demonstrates that these key aspects have been successfully built into the most recent version of the NIES algorithm and that performance of the algorithm is competitive with what has been reported by others [Wunch et al., 2011; Parker et al., 2011; Butz et al., 2011; Oshchepkov et al., 2012]. Thus, the study is of interest to the data user as well as the algorithm development community.

The paper is well written, the employed methods are robust, and – in most cases – due reference is given to the work of others.

Therefore, I recommend publication in AMT after considering some minor comments below:

- Title, abstract: I recommend that the title and/or abstract identifies the algorithm under investigation as the “NIES algorithm” or the “official GOSAT processor” (or similar) in order to distinguish the presented effort from other GOSAT retrieval algorithms.

- p.952,l.22: of an aerosol optical depth -> of aerosol optical depth

- p.953,l.23: from 30 + km altitude -> from above 30 km altitude

- p.954,l.7: due to the very strong absorption of O2 A-band -> due to overwhelmingly strong telluric O2 absorption in the A-band range

- p.954,l.8: depending on the airmass -> depending on airmass

- section 2.2, figure 3,4,5: Is it correct that the logarithm of the aerosol optical thickness profile is retrieved? If so, this needs to be stated explicitly in section 2.2. Retrieving the logarithm of AOD makes the forward model significantly more non-linear which could result in slow convergence or the retrieval sticking to the prior values. In the view of the latter aspect, it would be helpful to show a figure comparing prior and posterior AOD (eg. by replacing the upper panels of figure 4 with the prior minus posterior difference).

- p.954,l.17: AOD are therefore -> AOD is therefore

- p.954,l.24: “However, we had planned to use ...” It is not clear to me what was “planned” and what was actually “done”. Please rephrase.

- p.955,l.10: instead of AOD -> instead of integrated AOD

- p.955,l.10: “Possible reasons for the overestimation ...” I suggest removing this sentence, since it is redundant to the rationale before.

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- p.956,l.6: tendency with CO₂ -> tendency as CO₂
- p.956,l.28: The non-linear response creates an offset -> The non-linear response of the detector recording the interferogram creates a radiance offset in the spectral domaine
- p.957,l.6: no-aerosols -> no aerosols
- p.958,l.1: The paper should comment on the fact that other groups find different scaling factors for the O₂ cross section: 1.030 [Butz et al., 2011], 1.025 [Crisp et al., 2012], surface pressure scaling of 1.004 [Cogan et al., 2012]
- section 3.1: Could you quantify the typical change in slant airmass when correcting the pointing offset?
- p.959,l.7: are updated according to the update -> are taken from the most recent version
- p.959,l.25: “the chi-squared cost function” Do you refer to term 1 in equation (1) ?
- p.969,l.5: To my knowledge, an empirical noise criterion has been developed by the ACOS team. This should be acknowledged here.
- p.962,l.11: “Furthermore, possible signs . . .” I suggest removing this sentence since it is speculative.
- P.963,l.24 “and those over ocean at present; above comparisons are made for land data using Gain-H”. This sentence reads awkward. Consider rephrasing.
- Table 2, table 1 in supplement: Please add the standard deviation of biases A which is much more interesting than the mean bias.
- Fig.10: The vertical bars in -> The error bars in
- Fig.15, upper panels: Looking at the dependence of retrieval error (difference between GOSAT and TCCON) on the difference between retrieved and a priori surface

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pressure, I would think that using the a priori surface pressure for calculating mixing ratios would improve accuracy substantially.

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