

Dear Dr Janssen,

Thank you for your thorough efforts on this paper to date, for this response we have kept your comments in black, and our changes in blue. We have also re-read the paper again to try and remove any stray errors.

Dear authors,

I am happy to announce that all referees recommend your article for publication. Unfortunately, the current version does still contain too many glitches and phrases that are difficult to understand. I therefore ask you to correct the following list of remarks and suggestions. Please highlight any changes with respect to the current version. Since there might be oversights from my part, I also would like to ask you to carefully reread your corrected manuscript for further errors. Once you have updated the manuscript, the article can proceed to the next stages.

With kind regards

Christof JANSSEN

L 17 : suggesting that further

'That' added.

L 20 : verb missing : 'indicates different' instead of 'indicating differing'

Changed to 'indicates different'.

L 24 : Delete phrase With the aim of

Deleted.

L 25 : ‰ or % ?

This should be 100‰, changed to this.

L 27 : What does TEXT mean ?

Apologies, thought this was a section dealt with by the copy/edit team. The copyright statement has been removed.

L 79 : similar studies in the past

Changed.

L 81 : replace 'seasons. We' by 'seasons we'

Changed to 'seasons, we'.

L 84 : write 'unlikely to be affected at the'

Changed to 'unlikely to be affected to the'.

L 87 : replace '(see Eq. 1)' by 'which is defined as' and move Move eq 1 directly behind

Done.

L 94 : Replace 'This is a quantity that has been used' by 'd13C has been used'

Changed.

L 94 : Do you mean global studies ? If not, than I would prefer to remove this word here.

Globally has been removed.

L 127 : specify 'variations' as 'variations (standard deviations)'

Changed.

T 2 : For clarity, please replace  $\pm\sigma$  with  $\pm 1 \text{ sigma}$

Changed.

T 2 : Check unities. They are missing on the sigma values. The best is to add '/ ppmv', etc. in the table header

Changed.

L 149 : remove 'attempt to'

Removed.

L 156 : Phrase starting with 'Combined' is incomplete. Join phrases ending and starting in this line

Replaced 'Combined' with 'These are adjusted with'

L 168 : remove 'below' as Tables can float.

Removed.

L 172 : Correct grammar. A verb is missing in subordinate phrase starting with 'where'

This sentence has been replaced with the following "TCCON methane products are the result of a standardised process, where the final reported values are calculated from a weighted average of three retrieved values from windows 2, 3 and 4 as described in Table 3".

L 177 : The database included with the updated GGG2020 software, referred to in this study as GGG2020, which includes numerous updates to the GGG2014 spectroscopic parameters. -> The database included with the updated GGG2020 software which includes numerous updates to the GGG2014 spectroscopic parameters and is referred to as GGG2020 in this study.

Changed as suggested.

L 180 : 2020 is the current release, write HITRAN2016 release instead of current release HITRAN2016

The reference to the current release has been removed.

L 182 : lines shapes -> line shapes

Corrected.

L 189 : differentiate with them -> differentiate between them

Corrected.

L 191 : Some work has been performed previously comparing spectroscopic databases  
-> Some work on comparing spectroscopic databases has been performed previously  
Changed.

L 202 : parameters, the remaining -> parameters. The remaining  
Changed as suggested.

L 205 : speed dependent -> speed dependance  
Corrected,

L 206 : Please indicate the spectral bands used by Mendonca et al. The utility of using these parameters likely depends on a particular band.

Add the following clarification "(albeit in the 5880-6145 cm<sup>-1</sup> spectral region)"

L 210 : We note the -> We note that the  
Corrected.

L 217 : Make sure the equation terminates with a semicolon, not with a full stop.  
Changed.

L 218 : Remove full stop.  
Changed.

L 221 : Please spell out w.r.t.  
All instances of w.r.t. have been spelled out.

L 229 : impact -> impacts  
Changed.

L 233 : parameters 1) -> parameters: 1)  
Changed.

L 236 : all trace gas fitting is unclear (fitting of all trace gases ?). Please rephrase

Changed to “The GFIT retrieval algorithm is a scaling retrieval algorithm”, to simplify.

L 240 : Please refer to line strengths or line intensities and not cross sections

Changed to ‘line strengths’.

L 250 : use 'on these bias and precision values'.

Changed.

L 251 : instead does not seem to make any sense here. You could use 'still' here

We removed the ‘instead’ it is unnecessary.

L 252 : Remove Fundamentally

Removed.

L 254 : Insert full stop after '2018, 2019)' and use capital I in in-situ

Changed.

L 258 : Please explain 0.02 ppb.

Added the following at the end of the relevant sentence “calculated using Eq. 1 (Malina et al., 2018).

L 278 : is more complex region -> covers a more complex region.

Changed.

L 296 : Start new phase before 'this is likely'

Changed to “results. This is likely because”.

Figure 2 caption. Remove blue colour.

Removed.

L 303 : write out w.r.t.

As the similar comment above.

L 305 : Firstly without a secondly is considered bad style.

Firstly has been removed.

Please replace further in line 307.

Removed.

L 314 & 315 : remove all commas

Removed.

L 323 : Write Fig. 8

Done.

L 323 : Phrase unclear. Do you mean : We also find that the Xair value indicates the retrieval quality with only ... ?

Sentence changed to the following structure "We also find the retrieved XAir values indicate good quality retrievals, with only a small number falling outside the acceptable range."

L 325 : see comments on L323 & 303

Changed.

L 326 : Norm Abs Mean has been abbreviated and defined differently in Eq 4. Please use consistent notations (NAmean)

Changed to NAM, as suggested by the comment below.

L 327 : This has been said before. It is sufficient to write '... reference retrievals. Thus we assume any ...'

Removed extraneous text.

L 330 : Use consistent notation Norm Abs Mean. I propose to use NAM throughout, but correct Eq 4 as well.

NAM is now used through the whole paper.

L 371 : write 'knowledge of spectroscopic parameters in window 1 is not as good as in other windows'

Changed.

L 375 : replace '2017), however these' by '(2017). However, these'

Changed.

L 377 : Replace 'The implication being' by 'This implies'

Changed.

L 389 : 'We therefore fit' should start a new phrase.

Changed the sentence to "To account for non-linearity, we fit the normalised residual DMF values with a second order model, to expose any potential non-linearity. "

L 407 : 'and 12. Where' -> 'and 12 where'

Changed.

L 411 : 'to be the presence' -> 'to indicate the presence'

Changed.

L 411 : 'First considering' -> 'We first consider'

Changed.

L 414 : relationship in singular

Changed.

L 415 : add missing 'of'

Added.

L 423 : w.r.t.

As above comment.

L 425 : shows -> show

Changed.

L 427 : much larger than for/in any other case.

Changed.

L 427 : write 'especially in the Ny-Alesund retrievals'

Changed.

L 431 : Fig.

Changed.

L 434 : The sentence starting with 'with' is gramatically incomplete.

Sentence changed to "The windows and spectroscopic databases all show similar results, with no clear 'winner' or 'loser'".

L 439 : remove variation

Removed.

L 444 : Rephrase, eg Given that both Tsukuba and darwin have large variations ...., it is interesting that ...

Sentence changed to "Given both Tsukuba and Darwin both have large variations in background water vapour, this is an interesting result".

L 457 : suggests -> suggest



Changed.

L 481 : biases, the -> biases. The

Changed.

L 482 : results, however -> results. However,

Changed.

L 483 : The other sites, -> The other sites

Changed.

L 486 & 487 : Three consecutive uses of 'clear'. Please improve

Sentence changed to "In general, there is no obvious case of one window or database showing increased sensitivity over and above any of the others (although Ascension Island is typically less sensitive).".

L 492 : We note when -> We note that when

Changed.

L 493 : indicating these results -> indicating that these results

Changed.

L 494 : Start new phrase after combinations.

Done.

L 497 : write out w.r.t.

As comments above.

L 500 : the expected result. -> expected.

Changed.

L 502 : Eq 1), -> Eq 1)

Changed.

L 505 : write out wrt

As comments above.

L 507 : Tables 4 and 5 indicate

Changed.

L 508 : Better write 'GGG yields a mean uncertainty of 13CH<sub>4</sub> retrievals between ...'

Changed.

L 510 : by ~x200 -> by about 200 times

Changed.

L 513 : delete retrievals

Removed.

L 513 : at remote -> of remote

Changed.

L 515 : , considering -> and considering

Changed.

L 516 : The phrase is confusing. Please restructure

Phrase changed to "these combinations yield surprisingly consistent results across all sites and windows"

L 519 : (at least 2x any other -> (at least twice than for any other

Changed.

L 537 : Reconsider the phrase starting with 'Overall' as it is not clear.

Sentence changed to "Overall the results in Tables 4 and 5 suggest GEISA2020 has the most consistent 13CH<sub>4</sub> retrievals across all windows and sites, and relatively low bias levels."

L 539 : , however, Window -> . Window 4, however,

Changed.

L 542 : Remove 'in this paper' (we are not at the conclusion of the paper yet) and terminate the phrase after biases.

Removed, and changed.

L 543 : however it -> However it

Changed.

L 544 & 545 : you probably meant to write 'due to simultaneous variation of a number of ...', Delete simultaneously

Deleted.

L 594 : delete in each case. This seems redundant.

Agreed, removed.

L 610 : analysed is misspelled

Corrected.

L 610 : Terminate phrase after databases.

Changed.

L 603 : too many commas

Changed.

L 607 : write out w.r.t.

As comments above.

L 610 : suggesting that TCCON ....

Changed.

L 611 : bias to -> bias with respect to

Changed.

L 614 : suggest the GEISA -> suggests that the GEISA

Changed.

L 620 : show – shows

Changed.

L 620 : write out w.r.t

As comments above

L 623 : remove comma

Removed.

L 624 : Replace coma by full stop.

Replaced with semi-colon, which seemed more appropriate.

L 627 : Please rephrase. What do you want to say here ? What is a unique formation ?

Changed sentence to "Suggesting that the weightings normally used to generate TCCON methane products should depend on TCCON site and season."