Dear Reviewer,

Thank you for your review of our paper. In order to respond we have kept your original comments in the black text below, our responses are in blue, and our proposed changes to the paper are in underlined blue text.

The manuscript presented a study on retrievals of 13CH4 from TROPOMI and Sentinel 5/UVNS. It is well written and very informative. I suggest it be accepted from publication after minor revision.

Major comments:

1. Although reference papers are provided, I think it is helpful for the reader if the authors can provide a clearer description of the remoTeC algorithm, for example, the components of the state vector etc.

We have now included additional details about the RemoTeC algorithm, including the state vector, and the cost function that is minimized. Please see the updated section 2.2.

2. More explanations about why the average kernel for 13CH4 is different from 12CH4 are also welcome.

We have included the following statement in section 3.2. Which we believe answers the question as to the difference between the averaging kernels.

The $^{12}CH_4$ cAK exhibits the typical behaviour of CH_4 cAKs (e.g. Hu et al. (2016), which is expected since $^{12}CH_4$ makes up 98% of atmospheric CH_4. However the $^{13}CH_4$ cAK exhibits behavior closer to that of CO (Landgraf et al. 2016). Given that $^{13}CH_4$ makes up ~1.1% of atmospheric CH_4, the retrieval column loses sensitivity in the lower atmosphere, where H_2O dominates. Borsdorff et al. (2014) show that in the case where sensitivity is low in the troposphere, the cAK values are enhanced at other altitudes. This is apparent in the cAKs of $^{13}CH_4$ in Fig. 2, where cAK values larger than those of $^{12}CH_4$ are observed.

Minor comments:

1. Line 21, Page 1: 'The disagreement ...' The bottom-up approaches have large uncertainty as well.

We agree, we have modified the sentence to read as follows:

This disagreement is likely due to currently limited observations, incorrect atmospheric transport assumptions, uncertainties associated with bottom up inventories and uncertainties in modelling CH_4 chemical losses.

2. Line 22, Page1: 'or incorrect transport ...', There also are large uncertainties in modelling CH4 chemical losses.

Agreed, we have modified this sentence to include this statement. Please see the modification to point 1 above.

3. Line 15, Page 3: 'Parker et al.,...', Works by Frankenberg et al., 2005 and 2011 should also be cited.

Thank you, we have inserted these references.

4. Line 10, Page 5: A comparison of 13CH4 and 12CH4 absorptions at different atmosphere levels can be useful for the reader to understand the different sensitivity of the TROMOPI instrument to their abundance.

A discussion of the variation of Jacobians w.r.t. 13CH4 and 12CH4 is given in Malina et al. 2018. We have pointed to this work by inserting the following into the Jacobian bullet point in section 2.5.

In this study we investigate how the total column Jacobians vary between the isotopologues, however Malina et al. (2018} give examples of how the Jacobians vary on a profile basis.

5. Line 28, Page 6: '...and that is potential...', The whole sentence is not clear.

We have re-written the paragraph containing this, based on your comment, and based on the short comment of Professor Roeckmann as follows:

Malina et al. (2018) identify a target total uncertainty for d13C of 10‰ as a more realistic and potentially achievable value (based on simulations with GOSAT-2). Recently Fisher et al. (2017) show that a distinct regional d13C signature can be measured, in their particular case for boreal forest regions. Therefore, as opposed to tracking d13C changes, we may be able to identify the source type of regional methane sources on a global scale, thus adding additional information to the top down methane budget.

6. Fig 1: no unit shown for Jacobian. Also, no right-hand scale for 12CH4.

Jacobian units have been added to Figures 1 and 7. The caption for Figure 1 was incorrectly labeled, there should be no 'right-hand scale or left-hand scale' in the caption, we have therefore removed these. Please note that Reviewer 1 found that the coordinates and date given in the caption do not match those shown in the legend of the middle panel. The caption has been updated to reflect this.

7. Line 5, '...errors in Figure 4..'. Some explanation about the spots with high uncertainty (>1.5 ppb) will be helpful

The retrievals with high errors are characterized by low SNR retrievals. We have inserted the following sentence into the document at the end of this paragraph associated with Figure 4.

An investigation showed that these retrievals are all captured under low SNR conditions, largely driven by SZA and albedo, thus leading to high uncertainty.

Please note that in addition to the changes indicated above in response to your comments, we have also made changes to additional editorials we spotted. In addition, in response to Thomas Roeckmann's criticism, we have included a short section on the effects of scattering on the retrievals of $^{13}CH_4$. This now forms section 6 of the paper. Additional necessary details on the scattering elements of RemoTeC have been included in the RemoTeC section.

Please note that we spotted errors in Sections 3.5 and 4.5 of our original submission. The results shown in Tables 3, 4 and Figures 5, 6 and 11 were generated without the DFS > 1 filter that were included for the maps plots present in the rest of our submission. We have reprocessed this data, and have updated

the relevant figures and tables, including the filtering criteria. We have updated the relevant portions of the text that reference the original results.