We would like to thank the reviewer for their valuable comments and include responses below. The response to each comment is included below with the changes to the text highlighted in yellow. Line numbers have been included where appropriate.

## Reviewer #2

**The authors present a detailed top-down quantification of methane emissions from Brazil. They use GOSAT satellite observations to estimate sectoral and regional emissions at a monthly temporal resolution. The analyses are performed in a thorough manner and include multiple sensitivities tests. The inversion estimates larger emissions from Brazil during 2014-2018 than during 2011-2013, which could have contributed to the accelerated global methane growth rate from 2014. The robustness of emission estimates derived here gives confidence in the capability of satellite observations—-which suffer from coverage issues over the tropics due to clouds—-to provide good emission quantifications from tropical regions. This study provides a demonstration of how the rapidly expanding satellite observation dataset can be used to constrain country emissions, which can aid in emission reporting and monitoring. The manuscript is well written, with clearly presented results, and it is suitable for publication after some minor issues are addressed.**

**Minor comments:**

1) **Line 124**: **A uniform distribution ranging from 0.2 to 200 nmol mol-1 is used to define the model-measurement PDF. Does this mean that the inversion does not allow the model mixing ratios to be lower than measurements? Why not use a PDF centred around zero?**

We apologize for a poorly phrased sentence. To clarify, the model-measurement uncertainty is represented with a Gaussian PDF centred on zero with a standard deviation that is governed by a hyper-parameter with a range of values allowed from 0.2-200 nmol $mol^{-1}$.

*The text has now been updated as follows:*
Line [124-126] The model-measurement uncertainty was governed by a Gaussian distribution centred on zero and with a standard deviation that was a hyper-parameter in the inversion. The standard deviation hyper-parameter was described by a uniform distribution with a range of 0.2 to 200 nmol $mol^{-1}$.

2) **Line 126**: **Are there PDFs of the two offsets? I assume that they would be needed for the inversion to decide the relative weights of the emission vs offset adjustments. Or are the offsets evaluated before the emissions in a separate step? Please clarify.**

The offsets are both represented in the inversion with Normal PDFs. The text describing this has been expanded to include these details (with associated parameters).

*The text has now been updated as follows:*
Line [128-133] In addition, an offset parameter was included to account for any differences between the satellite and the calibrated ground-based measurements and their representation by models. A normal PDF was defined for both of these types of offsets, centered on zero, and where the standard deviation of PDFs were governed by hyper-parameters. The standard deviations of the boundary condition offsets were allowed to vary up to up to 100 nmol $mol^{-1}$ and up to 50.0 nmol $mol^{-1}$ for the offset between surface and satellite data.

3) **Line 190**: **Impact of model-CO2 on the proxy-XCH4 dataset is crucial for regions like Brazil as they can have strong CO2 emission interannual variabilities, which would impact proxy-**

**XCH4. The CO2 models assimilating only surface observations might not capture such variabilities well due to lack of surface observation in the region. One way to address this would be to compare the full-physics XCH4 data with the proxy data for differences in interannual variabilities.**

We agree that our sensitivity analysis would not fully capture all of the uncertainties in the $CO_2$ field, but this test does reveal where models could show significant differences (particularly because they are not anchored to many observations in the region). To re-do the inversion using the full-physics product would be out of scope of this paper, as that dataset would have to be carefully assessed as well (the full-physics product for example, could be affected by clouds and aerosols). We have instead added a note about the limitations of these tests.

*The text has now been updated as follows:*
Line [196-198] We re-ran the inversion for each of the ten datasets for the full 2010-2018 time period, which allowed us to investigate random errors in $XCO_2$. However, additional uncertainties could nevertheless remain due to sparse $CO_2$ observations in the region.

4) **Line 216 to 220**: **The September 2010 biomass burning emissions difference of be-tween GFED and the inversion is not a good example of "Our analysis shows that individual years exhibit features that are not present in the bottom-up estimates." As both estimates show 2010 has the highest biomass burning emissions and emission peaks in September.**

We have clarified the statement here that, though the September 2010 feature is reflected in the GFED prior, our estimated emissions are still significantly higher than GFED.

*The text has now been updated as follows:*
Line [221] Our analysis shows that individual years show some differences from the bottom-up estimates.

5) **Line 205**: **The authors write "The inversion results show that the Biomass burning emis-sion rose by 1±0.4 Tg/yr between 2011-2013 to 2014-2018". Can this be checked in the GFED data of more recent years?**

The latest GFED product shows an increase between these two periods of 0.4 Tg/yr. It should be noted that the product produced from 2017+ is not the final product (classed as a *beta product*) and thus there is uncertainty around this exact figure. The presence of a rise of this magnitude seems largely consistent with the result presented in the paper. However, for consistency as we did not use the beta product in our prior, we have not added this discussion to the text.

Technical Corrections:

- **Line 11**: **The sentence is difficult to understand. Writing it as an inline list will make it easier to read.**

*The text has now been updated as follows:*
[Lines 12-13] We show that satellite data is beneficial for constraining national-scale $CH_4$ emissions, and, through a series of sensitivity studies and validation experiments using data not assimilated in the inversion, we demonstrate that (a) calibrated ground-based data are important to include alongside satellite data in a regional inversion, and that (b) inversions must account for any offsets between the two data streams and their representations by models.

- **Line 220: remove the double "is"**

Updated.

- **Line 345: "modelling but" => "modelling, but"**

Updated.