**Comment on the paper “Satellite quantification of methane emissions from South American countries: A high-resolution inversion of TROPOMI and GOSAT observations” by Hancock et. al.**

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The paper by Hanock et. al. presents results from a top-down inversion model of methane emissions by economy sector for every country in South America. The authors use as input satellite products from TROPOMI and GOSAT, and the EDGARv7 inventory (with WetCHARTs and LPJ-Merra2 for wetlands) to spatially distribute emissions from livestock, waste, and rice production. As main findings, the authors highlight discrepancies with national anthropogenic emission inventories reported by many South American countries to the UNFCCC and propose recalculated values. In this regard, we have a series of comments that we think should be addressed:

**Major comments:**

1. The paper deals with matters that are very specific to individual countries and economy sectors in South America. However, the authors did not look for the insight and knowledge of South American scientists to contrast their results, enhance the discussion, and find explanations to their findings that reflect the reality of each country. We believe studies of this nature require local knowledge and collaboration, beyond the mere citation of some papers, to improve the credibility of the results and to correct potential biases. This critical aspect is missing in this paper. Including local expertise is crucial to identifying country-specific factors influencing emissions that can be easily overlooked by external researchers. As a good scientific practice, it is important that scientists in the Northern Hemisphere acknowledge the fact that every country in South America has experts who can be consulted and invited to contribute as co-authors to ensure studies about this region, especially those that deal with sensitive topics such as GHG emissions, are not done using a one-sided perspective.

2. The paper implies that the results from the satellite inversion are correct, and the bottom-up inventories are not. Particularly, this is evident from the use of the terms “correct or corrections” throughout the paper when referring to national inventories and reports. Thus, the authors of the paper assume that there is no error on satellite retrievals, but the error is in the UNFCCC reports. These are major statements that need to be demonstrated. One possible way is to compare the inversion results with another approach to estimate CH4 emissions or to consult specific information on how national inventories were produced to point out to specific issues.

3. The authors' approach to assessing the emissions that countries report to the UNFCCC does not coincide with the approach that the countries use in their reporting. This situation produced a very significant bias in the results presented in this work. To explain how biases come about, we will focus on the authors' assessment of livestock emissions, whose CH4 emissions are a key category for almost all countries in the region. Just as an example, we will focus on emissions from Argentina:

- The authors seem to imply that countries’ reporting to the UNFCCC is not very transparent. However, the original reports are in Spanish, contain great level of detail and are publicly available. For example, Argentina in its reports (<https://unfccc.int/sites/default/files/resource/argentina-bur5.pdf>) uses 238 pages (from 536 to 774) to thoroughly explain the emissions of this category. The country applies a level 2 approach and presents the enormous variability of the type of livestock considered, as well as some different modal systems (for winter and summer) that take place in the country.

- Despite the significant level of detail in the information provided by the country, the authors only use the total emissions reported for this category.

- All the complexity of the sector is simplified by taking average variables published by FAO, which is well known not to represent the sector in Argentina (and in many of the countries presented in the manuscript).

- With the FAO information, authors estimate emission factors, which they call “from UNFCCC”, when they actually differ substantially from what the country reports to the UNFCCC.

In the conclusions the authors state: “We compare the UNFCCC reports of anthropogenic emissions from individual countries to our best sector-resolved posterior estimates”. However, authors do not compare the UNFCCC reports from individual countries but compare their own estimates with those obtained in their calculations from satellite information.

4. The paper lacks context in the sense that methane emissions in South America, even with the proposed recalculation, are not compared against emissions of the main global emitters. In particular, the authors emphasize differences found between totals reported by countries and calculated using the satellite inversion method by sectors. To provide a fair and comprehensive context, the authors should compare South American emissions, both reported and recalculated as well as the difference, against those from major emitting countries worldwide. Such comparison should include the uncertainties in the satellite products (see the following comment). Without this comparison, the results can be misleading and fail to convey the true significance of the findings.

5. Validation of satellite retrievals against in situ measurements is crucial to ensure data reliability. However, there are no systematic validations of satellite products in South America. TROPOMI and GOSAT methane products (as well as other satellite products) heavily rely on validations mostly in the Northern Hemisphere. Consequently, there should be a quantification of the uncertainty in the results due to this regional validation gap.

**Specific comments:**

* The manuscript states that the global retrieval success rate for GOSAT is 23.5%. It would be beneficial to include the retrieval success rate specifically for South America, including differences between tropical and subtropical areas.
* Line 97 states that “We also subtract 9.2 ppb from all GOSAT observations following Balasus et al. (2023) to remove the global mean bias versus TCCON”. Is this valid for South America? There are probably large variations between the Northern and Southern Hemispheres. Some regions or periods might be overcorrected or undercorrected, potentially affecting the spatial and temporal accuracy of the emission estimates. Since the TCCON network lacks measurements in South America, it would be important to perform cross-validations with other independent measurements (e.g., aircraft data, in situ measurements) to verify the applied correction. Additionally, conducting sensitivity analyses to assess how the inversion results vary with different correction values would help understand the impact of this assumption.
* Figure 2: This figure seems to be based on global inventories merged with data from different countries. It would be appropriate to compare with national/regional inventories. Examples for Argentina are provided below, but an exhaustive review should be done by authors for all countries in South America.

https://isprs-annals.copernicus.org/articles/IV-3-W2-2020/107/2020/

https://www.sciencedirect.com/science/article/pii/S1352231019308866

* Figure 3: Posterior emission map (b) follows the shape and intensity of the prior emission map (a). This highlights the importance of using the best emission estimate as an a-priori starting point.
* Lines 75 to 77: “Livestock emissions are underestimated in all four of these countries. Argentina and Venezuela also underestimate their oil/gas emissions.” Why? Any explanation?
* Figure 6: Why are wetland emissions not shown here? It is evident that the largest discrepancies between UNFCCC and Posterior are Livestock and Oil/Gas, followed by Waste, but no discussion about them is given.
* The paper mentions that “There are few observations over the mountainous Andes, affecting much of Chile and Peru, , so that the inversion for those countries relies significantly on glint observations offshore and on observations of transported methane.”. How does this impact the uncertainties for these countries? We suggest expanding on this point to discuss the implications for the accuracy and reliability of the inversion results in these regions.