Reply to Referee #3

The authors present an updated version of the gridded emissions based on UNFCCC reports for the fugitive methane from fossil fuel sector. It is a very useful dataset as it enables analysis of the officially reported emissions for various purposes like: impact assessments and comparison with other approaches. The mansucript is well written and clearly illustrated. However, there is only one technical clarification to be resolved before it is published:

- **Thank you for your review and useful comments. We have revised the manuscript as needed based on your comments.**

Table S1 summarizes the country level emissions as estimated in GFEIv3 along with estimates from UNFCCC reports and IPCC T-1 approach. As per the methodology described, the GFEI uses UNFCCC emissions and redistributes it spatially and sectorally. As far as I understand, it does not alter the total reported UNFCCC emissions (or does it?)

1. If this is correct, then why the emissions mentioned in the UNFCCC columns do not match with GFEI estimates -
For e.g.:
Afghanistan: GFEI total = 0.0+0.1+0.1 = 0.2 Gg but UNFCCC total = 0.0+2.0 = 2.0
Australia: GFEI total = 10.9+274.5+1007.0 = 1292.4 Gg but UNFCCC total = 284.0+1007.0 = 1291.0
There are several other countries. Ideally, they should match exactly if no alteration has been made to UNFCCC reported values.

- **For GFEI v3 national emissions, the UNFCCC reported emissions are used directly when the reported year matches the year of GFEI v3 emissions (2020), and we adjust emissions if 2020 data is not reported. This is the case for Afghanistan. This statement is made in lines 124-130, and to improve clarity as pointed out by the referee, we have added a clear explanation of why emissions in GFEI may differ from UNFCCC in lines 130-134:**
    - **"This means that national emissions in GFEI will match UNFCCC reported emissions when the reported emissions are available for**

2020 (e.g., for Annex I countries, for non-Annex I countries that report 2020 emissions) whereas GFEI emissions in Table S1 may differ from UNFCCC reported emissions if scaling was needed to update the year to 2020, as described above and in Scarpelli et al. (2022a)."

- **For Australia, the slight difference is due to an issue with our country masking which we have now fixed, and the numbers now align – see comment below for more explanation.**

2. Even for countries with no UNFCCC data, it should match with T-1 approach as mentioned in Methodology. But this is not the case in the Table S1
For e.g.:
Iraq: GFEI total = 2547.0+29.3 + 0.0 = 2576.3 but IPCC T-1 total (for O/G) = 2715.9
Libya: GFEI total = 271.0 + 20.1 + 0.0 = 291.1 but IPCC T-1 total = 281.9

- **Thank you for pointing this out. This disagreement was due to the mask used to select grid cells belonging to each country. The emission estimates were slightly different due to some grid cells containing infrastructure belonging to 2 or more countries (e.g., along country borders or offshore). Previously we assigned each grid cell to one country to calculate country totals, but we have now updated the masks used to account for this multi-country contribution to grid cells. After making this masking update, the numbers are now in agreement. The correct country emissions are now used in GFEI v3, and we have updated the Figures and Table 1 and S1, as needed.**
- **We have also added more clarity in lines 138-143 and Table S1 (e.g., for Oman, Ghana, Pakistan, and Equatorial Guinea) on the countries where we use UNFCCC data from reports to make it clearer when we use UNFCCC versus IPCC Tier 1 estimates.**

3. Also, why T-1 estimates are present for O/G only and not for Coal sector.

- **The IPCC Tier 1 estimates are used to disaggregate UNFCCC reporting for oil-gas to subsectors, and we have adjusted the language in line 125 to make this clear. We do not do this for coal as GFEI does not include coal**

subsectors, and we use the mine-level data provided by Roy 2023 (Table S2) for non-reporting countries where UNFCCC data is not available. We have also made this clearer in the text in lines 121-123 and line 127-128.

- **"For coal, we have the Roy (2023) emissions by subsector, including surface mining, underground mining, and post-mining emissions (Roy, 2023), and therefore do not produce IPCC Tier 1 estimates for coal. In the US, we also have coal emissions for abandoned mines from Maasakkers et al. (2023)."**
- **"For coal, we use the EIA coal production data to update the year for the UNFCCC coal emissions as needed."**

Please clarify, if I am missing something as it is currently not aligning with the methodology.

- **Thank for pointing out these points of confusion in our explanation of the methodology. We have adjusted the language (as mentioned above) to improve clarity, and we are thankful for the reviewer for bringing our attention to the country masking issue which has now been fixed.**