

Reviewer #1.

We want to thank the reviewer for his insightful and constructive comments. They helped us to improve the manuscript significantly not only for the specialized readers but also for the general community. We believe that with these comments the manuscript is quite stronger in reporting our findings.

The authors present new emission factors for Methane and NO_x emissions from natural gas cooking stoves in Chile and Colombia. These results can be directly used in emission inventories in Latin America and possibly elsewhere. As such this is a good and useful measurement report which should be published after some minor corrections and addressing one major shortcoming which would increase the use of the results.

We thank this positive general comment by the RC 1. And we agree about the quality and usefulness of this report.

one main shortcoming:

The article misses an integrated emission factor for 24 hrs from a home with a gas cookstove. From the survey it should be possible to indicate the time and amount gas combustion while cooking. This leads to a cooking-related emission factor per day. During the remainder of the time there is the constant leakage. Combined this should lead to an emission factor (cooking+leakage) for each home with a gas stove per 24 hours and standard deviation. This will be necessary to calculate annual total emissions by country and will increase the use of the results published.

We thank the reviewer for pointing this out. We now make it explicit in the manuscript that we lack detailed activity data (i.e., hours of use per day per burner and number of burners) which would be necessary to build a reliable integrated 24-hour emission factor. The questionnaire filled by participants only asked “how many times per day do you use the stove?”, so this information was not precise enough to quantify overall use. However, in the revised manuscript we used monthly consumption data from the natural gas bill to estimate daily use.

To address this, we have inferred natural gas consumption from the houses sampled in Bogotá, and combining it to our measurements, we estimated hours of stove use per day. We have now included these calculations in the manuscript.

We, however, caution the reader about the limitations on our activity data and urge the construction of detailed activity datasets.

General comments:

- The emission factors should be mentioned in the abstract.

We agree with the reviewer and now they are explicitly written in the abstract as follows “Our real-world measurements provide rare data on household cookstove emissions and inform emission factors used in GHG inventories. The mean (median) methane emission rate during combustion was 410.2 (63.9) mg/h in Bogotá and 331.2 (30.7) mg/h in Santiago, respectively. The equivalent energy-based methane emission factors derived from the data for residential stoves in Bogotá averaged 80.8 (median=16.2) and Santiago 41.2 (median=3.66) kgCH₄/TJ are many times higher than the Tier 1 IPCC emission factors currently used in national inventories.”

- The authors do mention that the sampled residences were select to “represent a wide variety of socio-economic status and locations etc.” + the questionnaire, but since the sample size is so small, it would be nice to have a bit more information about how it is representative (socioeconomically, type of homes, types of stoves etc.)

We expanded this section as requested including all the information gathered in the questionnaire.

Action: Now the text says:

“The sampled residences were selected to represent a variety of socio-economic status and locations within the city. The selected participants were asked to report information on stove characteristics through a short questionnaire. In the case of Colombia, natural gas use for cooking is widespread across socioeconomic sectors in urban areas, as its price has been competitive relative to electricity use. Therefore, house selection for sampling was carried out ensuring wide geographic coverage within the city and spanning houses in all socioeconomic status. As a result of this, the houses selected for sampling in Bogotá covered 11 out of the 16 administrative units in the city and spanned the totality of the six socioeconomic status classifications used by the Colombian Statistical Department. In the case of Santiago de Chile natural gas is consumed across all socioeconomic groups, but its penetration and relative importance are greater among higher- and middle-income households, particularly in urban areas with access to distribution networks (CDT, 2019; FNE, 2020) thus the sampling covered the user socioeconomic profile reflected in the 10 out of 40 administrative units in the city of Santiago. The gas stoves sampled averaged 7-years old in Santiago and 10-years in Bogotá as registered in the

self-reporting questionnaire. In some cases, the owner reported not knowing the age of the stove.”

- The authors mention outliers that skew the data. I know it’s not always possible to explain why outliers are there, but perhaps an indication as to what it could be: is it a sampling issue, or related to the stove itself, or unclear.

Based on the data and field notes we considered that the outliers are valid measurements. We had initially decided to exclude them just because they are so far outside the range of this already skewed distribution (approximately lognormal) that we considered that maybe these two points were overrepresented in our sample compared with the actual population of stoves. However, based on the comments by both reviewers, we have decided to keep them in our calculations, and we have expanded the discussion in the manuscript regarding the potential of those outliers to inflate the mean emission rate. We excluded one of the outliers from Santiago since there were issues with the CO₂ measurement in that particular sample.

- Line 31 and 52, statements suggest using natural gas is not a good choice for cooking due to CH₄ and NO_x pollution. While minimizing these emission is important, it is necessary to stress that cooking on solid fuels is, with regard to human health, far worse. See for example WHO, 2024. <https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health#:~:text=Around%202.1%20billion%20people%20worldwide,fuels%20and%20technologies%20in%20homes> This does not reduce the need for good emission factors for cooking on natural gas. But it should also not give the impression that people might as well keep cooking on wood, as gas cooking leads to CH₄ emission.

This point is well taken. We rewrote these statements to ensure our manuscript does not give the wrong idea of encouraging the use of dirtier fuels or negating the indoor air quality improvements of using NG instead of solid fuels.

Detailed / technical comments

- Line 75 replace methane by total GHG; otherwise the sentence does not make sense.

We changed the phrase as suggested by the RC1

Action: Now the text says: “Due to its strong global warming potential, even small leaks can contribute disproportionately to the total GHG emissions from buildings.”

- Check on using the hyphen consistently: Steady-state or steady steady state

We apologize for this inconsistency through the text.

Action: In the whole manuscript we used steady-state

- There is some repetition in the introduction – e.g. the third paragraph (line 77 etc) and paragraph (line 87 etc.) can be integrated and shortened. (Is the fourth paragraph necessary? It seems the intro reads as well without)

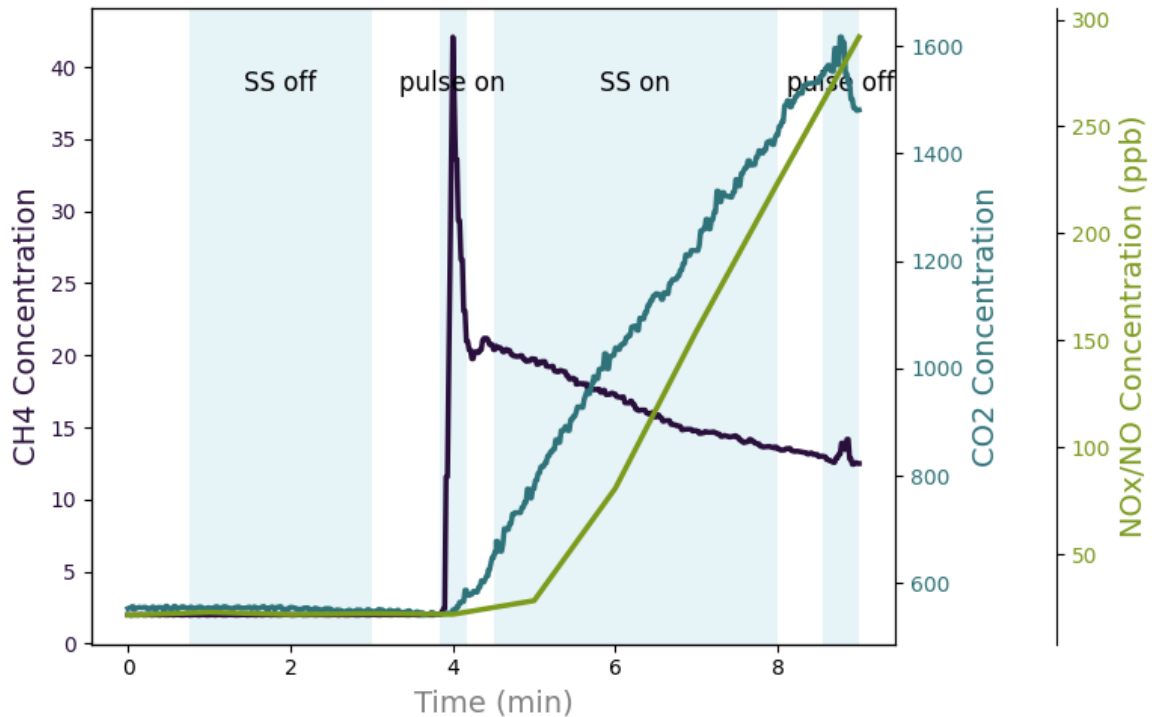
We took this recommendation from the reviewer. We completely reorganized and revised the introduction, including also the paragraph merging as suggested by the reviewer. Please see the revised manuscript with the reorganized introduction.

The specific paragraph under question now reads: “Natural gas appliances emit methane through incomplete combustion as well as through small but continuous methane leaks, even when the appliance is off (Lebel et al., 2022). Household cookstoves, although small in the quantity of gas burned when compared to gas furnaces, are important components play a crucial role in domestic energy use and contribute to GHG emissions. In developing countries, household fuel consumption represents a significant share of total energy use, yet the emission factors associated with small-scale fuel combustion are often poorly quantified compared to larger-scale sources (Levine, 1996). While some studies have reported emission factors for specific countries and fuel sources (e.g., Smith et al., 1993. Lebel et al. 2022), these datasets remain limited due to the overall scarcity of studies and the corresponding lack of geographic diversity, creating uncertainties in global emission inventories. Furthermore, fugitive methane emissions from residential appliances are often overlooked in the development of national emission inventories, and the reliance on generalized or non-local emission factors can lead to inaccurate estimation of emissions, affecting inventory accuracy. It also limits assimilation of research outcomes on the topic, as it is not an imported research initiative, but one that reflects local realities. These uncertainties hinder the accuracy of climate models and the development of effective mitigation and adaptation strategies. As research has shown in other natural gas applications, underestimating leakage of methane emissions can lead to significant misrepresentations of its full contribution to warming (e.g., Alvarez et al., 2012; Comer et al., 2024)”

- Fig 1 increase the size of the text on all axes; change the Spanish into English (Top of figure)

We improved the figure as suggested and corrected the Spanish in the top of figure

Action: New figure



- Both Discussion and Conclusion section are labeled 4.(Conclusions should be 5.)

We corrected this in the newer version of the manuscript; we apologize for this mistake.

- Last paragraph of 4. Discussion belongs in conclusions and can be integrated in the first conclusions paragraph.

We incorporated this in the newer version; we are thankful for this comment that increased the reading of the manuscript

Action:

We expanded the discussion section, and reorganized the conclusions as suggested by the reviewer.

- In the zenodo file please explain the abbreviation EC as in (EC_co2 (mg/min) EC_co (mg/min) EC_nox (mg/min) EC_ch4 (mg/min))

Done.

EC was meant as “Corrected Emission Rate”. Corrected here means in the sense of including the gas that is lost outside of the chamber. This is made clearer now in the manuscript and in the Zenodo files since we included a Readme.txt with the description of the data. We updated the Zenodo into a third version with in the following link <https://doi.org/10.5281/zenodo.19545481>