Comment on gmd-2021-438

Anonymous Referee #1

Referee comment on "Recovery of sparse urban greenhouse gas emissions" by Benjamin Zanger et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-438-RC1, 2022

The paper investigates whether GHG emissions from urban areas are sparse (in physical or wavelet space) and whether they could be estimated from concentration measurements via sparse recovery. The authors find that the Gini index is a measure of the sparse nature of the emissions (as found in bottom-up inventories) and sparse reconstruction can indeed reconstruction them. They prove this with synthetic data . They find that emissions that have to be reconstructed in wavelet space are not very robust to noise in the measurements. They provide the code and data used in this study, so reproducibility is possible.

The work is good and I would recommend that it be published provided that the issues I mention below are addressed. They are minor, except for the language used in the text. Sections 1, 2 and 6 are well-written. The technical sections 3, 4 and 5 have grammatical errors and have to examined carefully. I will provide some examples below.

- Line 57: What is a 3rd-level wavelet transform? If emissions on a N x N grid are subjected to Haar transform, one gets a transform hierarchy of log2(N) levels. In a 3rd-level transform, do you ignore all levels finer than 3 (which would give a very rough emission field) or do you only keep level 3?
- Line 390: "SR is good at localization and SR-in-wavelet-domain is not robust to noise". I see that empirically from the results, but can you explain why? Does it have anything to do with the 3rd-level transform? Or Haar wavelets, which are oscillatory? Or because you do not impose non-negativity on the estimated emissions?
- In Sec 4.2.2, 4.2.3 and 4.2.4, what are the wind coverage in the cities? Are the wind velocities the same or are the footprints stretched to cover the cities which are of different sizes?
- Fig 7 and Fig. D1: The x-axis has bins called "0 - 0.4%" ; the label on the x-axis is "Highest emission in inventory". What does it mean? Do you rank-order the gridded emissions, and bin them in unequal bins? How were the bin cutoffs decided? Should that be cast in terms of percentiles of the gridded emissions? Or is it the percentiles of teir ranks? Some explanation of what this axis is, in the text or captions, would be

helpful
- The English in Sec 3, 4 and 5 needs to be improved.
  - The is a lot of use of the emissions being "good compressible" or "well compressible". I think one could simply use "compressible"
  - Also, in the text and tables, one sees emissions "not good compressible" or "not well compressible" . What about non-compressible?
  - The is also use of the terms "amount of measurements" and "less measurements". Measurements in this paper are counts. What about using "number of measurements" and "fewer measurements"?
  - Line 332: The authors talk about estimating the measurement counts needed to achieve "descent results". That is rather casual. What about "acceptable results"? Also, what would constitute an "acceptable result"? Please clarify
  - Fig 7: The caption mentions "how many percents ...." This is hard to decipher. What about explaining the figure in the text where there is no shortage of space?

On the whole, a rather nice and innovative paper.