Comment on amt-2022-48

Anonymous Referee #2

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Referee comment on "Complementing XCO$_2$ imagery with ground-based CO$_2$ and ^{14}CO$_2$ measurements to monitor CO$_2$ emissions from fossil fuels on a regional to local scale" by Elise Potier et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-48-RC2, 2022

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This paper quantifies the uncertainty reduction in fossil fuel emission estimates caused by different combinations of XCO2 satellite data, CO$_2$ surface observations and ^{14}CO$_2$ observations. The study uses 1 day model simulations that map the CO$_2$ emissions from different regions and emission categories on the expected signal in the measurement network.

The paper has a clear focus, and presents the results in a clear and concise way. However, the paper is somewhat limited in scope: only one day in 2015, biases are not addressed, and no actual observations are simulated. There are a number of issues (listed below) that need to be addressed before the paper can be published in its final form.

I furthermore attach an annotated pdf in which minor (and some major) issues are addressed.

Model errors

I find the treatment of model errors particularly simplified (line 312: *Here we assume that the uncertainty in the observation operator is dominated by that of the transport model and we ignore temporal and spatial auto-correlations in these uncertainties)*. Given the large role of errors in this paper, I would expect at least an analysis how the uncertainty reduction depends on the (sometimes) arbitrary choices of model error.

Satellite track

A CO2M track is used to investigate the sensitivity of XCO2 data to CO_2 emissions. However, the track is from 2014 (including the cloudiness etc.), which differs from the simulated year 2015. This might potentially introduce biases and the authors should at least argue why they focus on 2015 while the track is simulated for 2014.

Self-referencing

There is annoying self-referencing, while important work of other groups is not mentioned. For instance, the important paper by Basu et al. 2020 (PNAS) is missing, which is a severe oversight by the author team, and actually quite worrying. Instead, there is substantial self-referencing. I understand that this work builds on many existing activities in the group. However, it is a good tradition to give an overview of activities performed by other groups (e.g. in the introduction). Now, the introduction is used to already present a misplaced introduction of their own system (lines 60-65), which clearly belongs in the method section.

Please also note the supplement to this comment:
https://amt.copernicus.org/preprints/amt-2022-48/amt-2022-48-RC2-supplement.pdf