

Pernini et al. presents the novel open-path laser system “GreenLITE™” with multiple reflectors and transceivers deployed in a tailings pond and an open-pit mine experiments. This system has a much wider spatial coverage that might provide valuable information to estimate the fugitive GHG emissions in addition to other measurement techniques. This is a clearly written manuscript with methods and results arranged in a logical order, which made it easy to follow. Overall, this work is appropriately placed in AMT. The content of the paper, which covers GHG measurements and its application to quantify the fugitive CH<sub>4</sub> emissions together with an inverse dispersion model, is relevant to the journal and its readers. Much of the analyses and conclusions are sound. I recommend publication after the following comments are addressed.

#### **General comments:**

The results of this paper would be much stronger if it places the emission estimates together with better uncertainty quantification. The authors have already touched on this issue in section 5.3:

First, Table 4 shows that the impact of surface meteorology and measurement precision is significant and not negligible. However, the last sentence in the first paragraph of section 5.3 only pointed out these errors without further analysis and discussion. For example, what are the potential reasons for the day-to-day & the day-night differences? what are the impacts of these uncertainties on the total emission estimates?

Second, the authors have discussed different sources of uncertainties and some potential improvements. However, it remains unclear to me which one might have a major impact than the others. It would be interesting to see somewhere that explores the impact rankings of these sources of uncertainties. For example, if using a different dispersion model looked at the same thing, would the authors get a similar magnitude of the emission estimates?

The authors do not necessarily need a major modification given that the limitations of the approach are discussed in the end, but I just wanted to caution about overconfidence in retrieved emissions. Therefore, it would be better to add proper uncertainty estimates together with the absolute emissions both in the abstract (P1 Line19) and the main text (P11 Line 8 and P23 Line16).

General note on figures and tables:

Much effort should be put to avoid the redundancy of the figures and tables. For example, Figure 1 and Figure 3 could be combined; Figure 7 and 8 could go to supplement; Table1 and Figure11, Table 2 and Figure 14 are redundant.

#### **Specific comments:**

P8 Line 15: It would be interesting to add the measured concentrations for each chord either in Figure 10 or a supplement figure. This might to some extent be helpful in 1) verifying whether the definition of the background field is appropriate; 2) providing information on the spatial variations of the concentration and emissions; 3) understanding what the contribution from each individual chord to the total amount is.

P9 Line 6: The P23 Line4 describes well the arbitrary definition of the size of these “white rectangles” as well as its limitation, but I don’t think I would have understood here, especially for the choice of the width, until reading section 5.3. Maybe a few sentences in terms of this model setup should come earlier.

P11 Line 8: Add an uncertainty for the period Jul-Oct 2019. The superscript “6” is not an exponential notation here, it might be good to move it to the end of the sentence to avoid misunderstanding.

P11 Line 10: Given the seasonal variability of the emissions, it would be good to explain how to scale these emission rates over the sampling period to annual fluxes.

Figure 6: What are the reasons that may explain the negative values? How are these negative values accounted for in the emission estimates?

Figure 9: The caption and the main text are “two-day moving average”, the legends for the blue dots are inconsistent: “1 Day Boxcar” in Figure 9, while “2 Day Boxcar” in Figure 6 and Figure 13.

Figure 12: Eliminate the day in the x-label.

P18 Line 4: The method and justification for discarding these known emissions sources need to be given. By using the lowest concentration within the mine domain, how did the authors exclude the impact of these nearby sources?

P22 Line 4: It might be insufficient to use the Chowdury 2015 study as a reference to quantify the uncertainty in the dispersion model. As already noted by the authors, there are many differences in terms of the model setup.

Font sizes in some figures could be larger, e.g., Figure 10.

Units should be checked in many places throughout the article to improve clarity and comparability, e.g., t/day in abstract, metric tons/day in P11 Line 8, metric ton/day in Table 4, t/yr in Table 1, t/month in Figure 14.