Title: Monitoring and quantifying CO2 emissions of isolated power plants from space
MS No.: egusphere-2022-1490

Below we reply to the reviewer comments point by point. The reviewer comments are shown in *italic*, and corresponding modifications and citations of the manuscript are quoted.

Referee #1

(1) *Lin et al. "Monitoring and quantifying CO2 emissions of isolated power plants from space" builds off previous work on quantifying power plant emissions using OCO-2 and OCO-3 observations together with models. It is good to see this effort toward development of a more systematic and automated method that leverages what has been demonstrated by others in past case studies. Furthermore, the comparison between the Gaussian plume method (GPM) and Integrated Mass Enhancement (IME) method is a useful investigation that highlights the importance of the satellite coverage and resolution and the different nature of CO2 and CH4 plumes since the conclusion differs from that based on high spatial resolution CH4 observations in the literature. Overall, this is a useful study that helps to bring the field a step closer to the implementation of an operational system for CO2 anthropogenic emission monitoring as planned for CO2M. Following some minor revisions related to the specific points below, I would recommend its publication.*

Response: We thank Referee #1 for the encouraging comments. All comments and suggestions have been considered carefully and addressed below.

Specific Points

(2) *Line 43-44: These are not really the primary references regarding the difficulty to achieve accurate and detailed consumption data*

Response: We have changed it in the revised manuscript, as follows:
"especially for developing countries (Olivier et al., 2017; International Energy Agency, 2019; European Commission, 2019; Gilfillan and Marland, 2021)".

(3) *Line 63: Reuter et al. (2019) derived emission estimates for power plants, urban areas and wild fires*

Response: We have changed it in the revised manuscript, as follows:
"Reuter *et al.* (2019) used a few co-located regional enhancements of XCO2 and NO2 observed by OCO-2 and TROPOMI respectively to derive emission estimates for power plants, urban areas and wild fires".

(4) *Line 66: Nassar et al. (2022) https://www.frontiersin.org/articles/10.3389/frsen.2022.1028240/full is a key OCO-3 example worth mentioning*

Response: We add the reference of Nassar et al. (2022) in the revised manuscript, as follows:
"Nassar *et al.* (2017, 2021, 2022) extended the approach and applied it in backward mode in order to quantify CO_2 emissions from individual power plants using OCO-2 and OCO-3 XCO_2 data".

(5) *Line 71: Schwandner et al. 2017 is not the best choice of reference. Although the paper mentions power plants, it really focuses on XCO2 enhancements in an urban area (later understood to be topography related biases), while the only emission estimate is of volcanic emissions from one cloudy overpass*

Response: We have removed it in the revised manuscript.

(6) *Line 74: "manually-selected" is perhaps a better descriptor than "hand-picked" (slang)*

Response: We have corrected it as "manually-selected" in the revised manuscript,

(7) *Line 79: Intermittency of U.S. sources has previously been studied by Hill and Nassar (2019) https://doi.org/10.3390/rs11131608 and Velazco et al. (2011) www.atmos-meas-tech.net/4/2809/2011/, so these two past studies should be cited.*

Response: We have added the reference of Velazco et al. (2011) and Hill and Nassar (2019) in the revised manuscript, as follows:

"Velazco *et al.* (2011) quantified errors of power plant annual emission estimates by a hypothetical CarbonSat constellation. Hill and Nassar (2019) assessed pixel size and revisit rate requirements for monitoring power plant CO2 emissions from space".

(8) *Line 97: "≤ 1.29 x 2.25 km2" (It is worth noting that this is the maximum footprint size, since it is usually smaller due to solar angle and viewing geometry)*

Response: We have corrected it in the revised manuscript.

(9) *Line 97: "~52" degrees is recommended since the value can be exceeded by a few tenths of a degree in some cases*

Response: We have corrected it in the revised manuscript.

(10) *Line 111: daily global coverage before loss of data due to clouds*

Response: The tropospheric NO2 data of TROPOMI has daily global coverage, where each observation is having a quality factor. Depending on the application a (cloud) filtering can be applied to the original data. Therefore, we would like to keep this phrasing. In line 114 the filtering for clouds is mentioned.

(11) *Line 119: This EPA link has annual power plant emission data, but is it the correct link for the hourly data too?*

Response: We have updated the link in the revised manuscript, as follows: "https://www.epa.gov/airmarkets/power-sector-emissions-data".

(12) *Line 257: Nassar et al. 2021 used the assumed height of the chimney plus an assumed 250 m for typical plume rise above the stack height*

Response: Thanks. We have changed it in the revised manuscript, as follows:

"Previous studies used various choices of wind information to approximately account for the plume spreading, such as the wind speed at the assumed average height of the chimney (250m, Nassar et al., 2017; Chevallier et al., 2022), or the assumed height of the chimney plus an assumed 250 m for typical plume rise above the stack height (Nassar et al., 2021), or at …".

(13) *Line 295: For clarify, it would be helpful to specify that the x-axis is labelled with YYMMDD.*

Response: Thanks. We have updated Figure 3 in the revised manuscript.

(14) *Line 374: Should revise language about GeoCarb as it has recently been cancelled by NASA.*

Line 375: CO2M is a Copernicus mission with ESA and EUMETSAT involvement

Response: We have corrected it in the revised manuscript based on the comments of Reviewer 1 and Reviewer 2, as follows:

"such as the planned European Carbon Dioxide Monitoring Mission (CO2M) and the Japanese Global Observing Satellite for Greenhouse gases and Water cycle (GOSAT-GW)".