Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-162-RC2, 2020
© Author(s) 2020. This work is distributed under
the Creative Commons Attribution 4.0 License.

Atmospheric Measurement Techniques Discussions

Interactive comment on "Quantifying CO_2 emissions of a city with the Copernicus Anthropogenic CO_2 Monitoring satellite mission" *by* Gerrit Kuhlmann et al.

Anonymous Referee #2

Received and published: 4 September 2020

The paper describes simulation studies of CO2 inversions from the future CO2M satellite mission. It is shown how the number of satellites, instrument errors and errors in the methodology contribute to the overall CO2 inversion errors. Different configurations are compared. The paper is well written, and figures and tables are clear. The paper is very important material for the CO2M mission.

General remarks The paper uses the mean bias (MB) and standard deviation (SD) as metrics. However, in several cases also the term "error" is used. It is unclear what is meant by "error". I propose to only use the chosen metrics (in this cases MB and SD) and avoiding other terms.

Printer-friendly version

Discussion paper

The SD is strongly influenced by outliers. Also, it assumes that errors are Gaussian distributed. I suggest that the authors also look into the use of other metrics, e.g. based on percentiles (for example 25% to 75% percentile range, or 16% to 50% and 50% to 18% if you want to compare to the SD). How would this change the presented results?

Code and data availability. "Column averaged dry air mole fractions of all simulated tracers are available both as 2D fields and as synthetic satellite products through ESA.". Given the importance of the study for the CO2M mission, all data should be made available online (by direct link) instead of upon request. Also, the authors should consider making the code available.

How are city emissions currently computed using ground based data and energy consumption data, and how do uncertainties therein compare with reported ones for CO2M?

Specific Comments

Section 2 The NOx chemistry is simplified to a large extent by using a constant lifetime and parametrized NO/NO2 ratio. How will these simplifications affect the end result?

Section 3.1 The matrix H provides the translation from the emission to the XCO2 field at any point in the domain. I believe that this is time dependent, i.e. information on atmospheric transport is contained in this matrix. Please include more information on the matrix H in this section.

"The plume may also contain emissions emitted earlier in the day, but this information is not available from the model". Why is this information not available?

Page 9, line 28 to 30 "To estimate the uncertainty . . . city plume". This procedure is not clear to me. Can you elaborate on the procedure to compute these effective winds?

Page 9: do you compute the fluxes for CO2 only, or also for NO2?

Caption Figure 3. What does the line represent? Please add this to the caption.

CC BY

Figures 4 c-e and 5 c-e. The legend overlaps the data points, which is rather annoying. Please resolve this.

Table 3: I assume that the Median plume size is measured in number of ground pixels? Please add to the table and/or caption.

Line 32, p21: “In contrast, SDs are reduced when the curve is fitted by constraining its width using the NO2 observations resulting in the lowest retrieval errors.” It is true that the SDs are the smallest, but not true for the MB. Therefore, I don’t think that the retrieval errors are the lowest. Also, how do the authors define “retrieval errors”?

Section 4.3.2: it is stated that the retrieval error is mostly related to the instrument noise. The SD therefore increases with increasing noise. However, also the MB increases significantly with the instrument noise, contributing significantly to the total MB. I have two questions about that: 1. Why would the MB increase with the noise? 2. Can the positive MB be explained?

P 27, line 25 “the requirement of an uncertainty of 7 Mt yr$-$1 for single overpasses was clearly met under the assumption of a perfect model“. This is true for the current setup, however certain important satellite retrieval errors were ignored. This shall be mentioned and discussed.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-162, 2020.

Printer-friendly version

Discussion paper

CC BY