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Atmospheric Measurement Techniques Discussions

Interactive comment on "The potential of satellite spectro-imagery for monitoring CO_2 emissions from large cities" *by* Grégoire Broquet et al.

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Please find a clearer presentation of the answers in the supplementary document.

Reviewer:

General comment. The study is devoted to evaluation of using satellite observations for monitoring whole city anthropogenic CO2 emissions, focusing also on dependence of the emission estimation errors on different spatial resolution of satellite spectrometers, based on specifications of CarbonSat and Sentinel-5. After doing the OSSE with regional inverse modeling system based on 2 km resolution transport model, authors arrive at conclusion that high resolution (<4km) XCO2 imaging is preferable for this application. As the focus of the study is to evaluate different configurations of satellite

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observations, the topic fits to the subject area of AMT. The manuscript is well written, and doesn't require substantial editorial corrections. The paper can be accepted after addressing comments, requiring minor revision.

Authors:

We thank the reviewer for this general evaluation of our paper and for his useful comments. Please find between these comments ("Reviewer") our answers and indications of how we improved the manuscript in line with them ("Authors").

Reviewer:

Detailed comments. One real source of CO2 flux errors authors did not elaborate on is covariance between aerosol load and anthropogenic CO2. Aerosol load over large cities is leading to systematic biases in CO2 retrievals, the effect is being quantified in some studies (e.g. Jung et al., 2016).

Authors:

This is now mentioned in section 5.

Reviewer:

Page 3, Lines 10-15 It would be worth adding a mention of recent results by Hakkarainen et al., (2016) and Nassar et al., (2017) obtained with OCO-2, and by Janardanan et al., (2016) with GOSAT. These studies are dealing with actual, not synthetic, data at relevant footprint resolution, therefore are providing hints on actual errors and biases in model and observations.

Authors:

These three publications are cited in the revised version of the manuscript.

Reviewer:

Page 9, Line 1 It is written as: "Consequently, there is no term associated with these

emissions in the equations used in this study and they are ignored in the analysis of the results." To avoid confusing reader, it is better to give more detail on whether the anthropogenic fluxes outside of Paris are ignored completely or those are included in forward simulation, but not optimized.

Authors:

We do not really have to consider a "forward simulation" in this study since we only solve for equations 4, 7, 11 and 12 but not for equation 5. We just had to consider it as a matter of illustration when producing Figures 1 and similar ones in the supplementary material, where these emissions outside the Paris area are ignored. This point is now clarified in section 2.5.1.

Reviewer:

Page 9, Line 28 Not everyone would agree with "This meteorological forcing does not account for urban land surface influences but we may neglect them for the OSSEs considered here". Breon et al., 2015 gave better excuse.

Authors:

Breon et al., 2015 considered ground based stations within and at the edge of the Paris urban area. This is very different from considering satellite observations, which focus on a whole plume whose length is more than 100 km downwind of the urban area. The other critical difference is that Breon et al. 2015 dealt with real data and thus needed to catch actual patterns of the transport rather than just to produce "realistic" simulations. The situation is the opposite for this paper. We have extended this piece of text to clarify it.

Reviewer:

Page 32, Lines 3-5 Lack of available spatial detail is mentioned as common problem for many cities. There are two comments. One: This is said without going into detail of Airparif comparison to other high-resolution inventories like one used by Lauvaux

et al., (2016), or produced by Tsagatakis et al., (2017). Second: for OSSE study, not having actual traffic count does not seem to be a major problem, synthetic traffic count should work.

Authors:

The sentence was misleading and has been improved. We did not aim at comparing Airparif to inventories for other cities. We meant that, to our knowledge: 1) Airparif provides a state-of-the-art quantitative description of the emissions from the Paris urban area at high spatial (1 km) and temporal (hourly) resolution 2) the current existing inventories with temporal variations (including the Airparif inventory) describe relatively homogeneous and cycling temporal variations of the emissions even when they have been derived from precise data at a high spatial and temporal resolution. The UK-NAEI inventory presented by Tsagatakis et al., (2017) has no temporal variation. The temporal variations in the Hestia inventory used by Lauvaux et al. (2016) are based on average diurnal and weekly cycles. The point was not really about the need for precise (actual) data on e.g. traffic count, but about using realistic hourly variations of the emissions for each 2 km grid cell of the transport model rather than homogeneous and cycling temporal variations in the inventory (either from real or synthetic data) to avoid having a too “diffuse” representation of the emissions.

Reviewer:

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Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2017-80/amt-2017-80-AC2-supplement.pdf

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