

## ***Interactive comment on “The potential of satellite spectro-imagery for monitoring CO<sub>2</sub> emissions from large cities” by Grégoire Broquet et al.***

### **Anonymous Referee #4**

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#### General comment.

The study is devoted to evaluation of using satellite observations for monitoring whole city anthropogenic CO<sub>2</sub> 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) XCO<sub>2</sub> imaging is preferable for this application. As the focus of the study is to evaluate different configurations of satellite 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.

C1

#### Detailed comments.

One real source of CO<sub>2</sub> flux errors authors did not elaborate on is covariance between aerosol load and anthropogenic CO<sub>2</sub>. Aerosol load over large cities is leading to systematic biases in CO<sub>2</sub> retrievals, the effect is being quantified in some studies (e.g. Jung et al., 2016).

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 Janardan 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.

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.

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.

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 Tsigataki 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.

#### References

Hakkarainen, J., Jalongo, I., and Tamminen, J.: Direct space-based observations of

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anthropogenic CO<sub>2</sub> emission areas from OCO-2, *Geophysical Research Letters*, 43, 11400-11406, 10.1002/2016GL070885, 2016.

Janardanan, R., Maksyutov, S., Oda, T., Saito, M., Kaiser, J., Ganshin, A., Stohl, A., Matsunaga, T., Yoshida, Y., and Yokota, T.: Comparing GOSAT observations of localized CO<sub>2</sub> enhancements by large emitters with inventory-based estimates, *Geophysical Research Letters*, 43, 3486-3493, 10.1002/2016GL067843, 2016

Jung, Y., Kim, J., Kim, W., Boesch, H., Lee, H., Cho, C., and Goo, T.: Impact of Aerosol Property on the Accuracy of a CO<sub>2</sub> Retrieval Algorithm from Satellite Remote Sensing, *Remote Sensing*, 8, 10.3390/rs8040322, 2016.

Lauvaux, T., Miles, N., Deng, A., Richardson, S., Cambaliza, M., Davis, K., Gaudet, B., Gurney, K., Huang, J., O'Keefe, D., Song, Y., Karion, A., Oda, T., Patarasuk, R., Razlivanov, I., Sarmiento, D., Shepson, P., Sweeney, C., Turnbull, J., and Wu, K.: High-resolution atmospheric inversion of urban CO<sub>2</sub> emissions during the dormant season of the Indianapolis Flux Experiment (INFLUX), *Journal of Geophysical Research-Atmospheres*, 121, 5213-5236, 10.1002/2015JD024473, 2016.

Nassar, R., Hill, T., McLinden, C., Wunch, D., Jones, D., and Crisp, D.: Quantifying CO<sub>2</sub> Emissions From Individual Power Plants From Space, *Geophysical Research Letters*, 44, 10045-10053, 10.1002/2017GL074702, 2017.

Tsagatakis, I., Brace, S., Passant, N., Pearson, B., Kiff, B., Richardson, J., and Ruddy, M.: UK Emission Mapping Methodology - A report of the National Atmospheric Emission Inventory 2015, Ricardo Energy & Environment, London, 1-63, 2017.

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Interactive comment on *Atmos. Meas. Tech. Discuss.*, doi:10.5194/amt-2017-80, 2017.