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Comment on acp-2022-205

Anonymous Referee #2

Referee comment on "Insights on estimating urban CO₂ emissions using eddy-covariance flux measurements" by Kyung-Eun Min et al., Atmos. Chem. Phys. Discuss.,
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"Insights on estimating urban CO₂ emissions using eddy-covariance flux measurements"

Kyung-Eun Min et.al,2022

General comments

This manuscript try to quantify CO₂ emission strengths of individual urban activities (vehicle, industry, heat generation et.al.) based on less than one year measurements with Eddy-Covariance (EC) method at Gwangju, Korea. The author estimated CO₂ emission factors (EFs) of Traffic/Industry/Heat from the EC measurement, while the plants influence on CO₂ exchange including photosynthesis and respiration can be estimated as the net balance of total emissions among all activities with observation (for the estimation of EF of vegetation). Based on their EFs estimations, they found that the annual CO₂ emissions of traffic and space heating were more than 2.5 times higher than those of the emission inventory for Gwangju in 2017-2018. However, this experiment setup and data are not reliable. The CO₂ flux measuring system was installed on the helideck of the Gwangju city hall, so the building's effect on the EC measurement could not be ignoring. The results are not robust. On the other side, there are lot of EC towers to measurement the Co₂ flux in city since the beginning of 21st century, and some sites have collected more than 10 years dataset. CO₂ emission factors (EFs) could not be used to other city as a universal parameter for the estimation of the annual co₂ flux in the city. By the way, the model to simulate the co₂ flux over city has been published (Jarvi, L., et al.(2019),JGR: Atmos.).This manuscript is not suitable to be accepted by ACP.

Specific comments

1) L123-134 "The CO₂ flux measuring system was installed on the helideck of the Gwangju city hall,.....Our EC system was installed outside of inertial sublayer ...and sufficiently lower than the planetary boundary layer.", is it correct? The measurement is

set in Gwangju city hall (90 m above the ground – building height: 85 m, helideck: 3 m and measuring system structure: 2 m), so it is not satisfied the guideline on the flux measurement in the city. The building's effect on the flow has large influence on the EC measurement.

2) L166-167 "footprint boundaries were defined to confine 70% of average total flux during the measurement period.", usually we use the footprint boundaries to cover 90% of average total flux ".

3) L172-174 " To assess the quantitative contributions of the individual sources, the wind directions were split into two sectors; (1) the Eastern Industrial Area (EIA, 45°-100°) and (2) the Southern Green Area (SGA, 100°-225°), based on whether or not the fetch includes the automobile production plant and urban vegetation .", it is too simple to assess the quantitative contributions with two sectors division, due to the complex flow field in this city. So the EFs estimation has too large uncertainty.

4) Gwangju city is located in a basin area, while there is a more than 1000m High Mountain in the east of the city. The local circulation due to the terrain should be occurred sometime during the season, and may be interaction with the urban heat island (UHI) in Gwangju city. So the co2 flux measurement may be also influence by the two circulation. This manuscript didn't consider any information on the topic. By the way, the wind rose (daytime or nighttime) during 2017-2018 could not be found in the text.

Jarvi, L., Havu, M., Ward, H. C., Bellucco, V., McFadden, J. P., Toivonen, T., Heikinheimo, V., Kolari, P., Riikonen, A., & Grimmond, C. S. B. (2019). Spatial Modeling of Local-Scale Biogenic and Anthropogenic Carbon Dioxide Emissions in Helsinki. *Journal of Geophysical Research : Atmospheres*, 1124(15), 8363-8384.