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Interactive comment on "Observing carbon dioxide emissions over China's cities with the Orbiting Carbon Observatory-2" *by* Bo Zheng et al.

Anonymous Referee #1

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General comments.

The manuscript reports good progress in quantifying multiple megacity emissions of CO2 in China using a plume transport model and CO2 observations by OCO-2 satellite. The mean estimate of the emissions from selected megacity areas is comparable with inventory data. The manuscript is well written and can be recommended for publication after minor revisions, taking into the account the following comments:

Detailed comments.

Line 42 As for instrument noise (not retrieval noise) it may be better to use a number in the order of 0.3 - 0.6 ppm as in (Worden et al., 2017)

Line 49 Authors write "To our knowledge, no attempt has been made yet to infer an-

thropogenic emissions from actual satellite data over a large area or a long period to evaluate a large-scale CO2 budget." Suggest being more specific here and write as "actual OCO-2 data", otherwise, when speaking about satellites, there is a study by Janardanan et al., (2016) using several years of CO2 data for assessing emissions from large regions. Also adding somewhere reference to Kort et al., 2012 is useful from historical context.

Line 176 "The ceiling height of 500 m is comparable to the maximum height that smoke plumes from power plants and industrial plants typically reach." The assumption seems to be weak, as turbulent mixing is supposed to mix CO2 up to PBL top, exceeding 500 m in many occasions. The practical choice of using a mean wind vector below 500 m may be driven by other reasons.

Line 222 More informative reference to ODIAC is given by Oda et al., (2018)

Line 267 For CO2-M there is a recent mission paper by Janssens-Maenhout et al. (2020)

Line 210 Summertime uptake by green spaces in a city should not be used as an explanation here as vegetation uptake is also present in the background used as reference for estimating enhancements.

Line 235 There is an impression that there is a 200-300% disagreement between MEIC and other inventories in cities, and it is caused by misplacing industrial emissions. There are other factors apart from placing industrial emissions. ODIAC is using a simple disaggregation of emissions by using nightlights, which may lead to underestimation of road emissions, as found by Gateley and Hutyra (2017), so it is supposed to be missing some emissions in cites still it was found by Gateley and Hutyra (2017) to correlate well with the detailed inventory at 5 km resolution. EDGAR inventory is not supposed to suffer from misplacing industrial emissions to the same extent as ODIAC thus there should be another reason for disagreement. A reader would benefit from providing more details on scale and reason for discrepancies between the inventories

in the target areas.

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