Responses to reviewer 2

Dear Editor and Reviewer,

We thank you for your letter and for the reviewer's constructive comments concerning our manuscript. Those comments are all very valuable and helpful for revising and improving our paper. We have studied your comments carefully and have made corrections accordingly, which we hope to have addressed your concerns. Revised parts are marked in track change mode in the paper. The main corrections in the paper and the responses to the reviewer's comments are as follows.

Anonymous Referee #2

This is a potentially very interesting paper but the current version is poorly organized and inadequately explained. It needs serious reorganization to tell a direct and clear story.

Response: Thank you for your good suggestions, and we reorganized the results from national scale (total estimates in Section 4.1 and spatial distribution in Section 4.2), to provincial scale estimates and correlations, and finally to the finer grid level.

Most of the graphics are quite adequate but need a bit more explanation. Figures4a, 4b, etc need a lot more explanation.

Response: We added more descriptions and explanations in lines 297–300 for Figures 6a, 6b, 6d, 6g.

The problems start early. This is a comparison of 9 datasets but sentence number 3 seems to accept values from one dataset (Le Quere et al.) – but this dataset does not appear to be part of the comparison.

Response: Thank you for this question. Le Quere et al. dataset is named GCP/CDIAC in this comparison because their works in Global Carbon Project (GCP) used CDIAC data set for most years and used BP data to extrapolate the most recent two years.

Sentence number 3 is a general background introduction due to its relatively large impact.

Table 1 lists the properties of the datasets to be compared, but there are only 7 in the table.

Response: Thank you for this question. We agree with you to complete Table 1 and added the other two datasets (GCP/CDIAC and NCCC) in Table 1. The original intention was to only include the gridded data that have been further analyzed for spatial characteristics in the latter part.

Sentence number 2 of paragraph 2 jumps abruptly and without explanation from Chinese emissions estimates to global gridded emissions datasets.

Response: Thank you, and we reorganized the introduction as total emissions estimate and spatial disaggregation. And we used transitional words to make the conjunction smoother.

Line 58 introduces the CDIAC dataset, which also turns out to be not part of the comparison.

Response: Thank you for this question. CDIAC is used by GCP and ODIAC, thus in total estimates they were identical for most of years, except for the recent two years that were extrapolated by BP data. And we added descriptions in lines 57-58, 136-137.

In line 100 datasets from EIA, IEA, and BP are introduced, but also apparently not used in the comparison. There is no consistent story line on what is being compared and why, on the fact that comparison will be made at the national, provincial, and grid bases.

Response: These three data sets do not include cement production emissions, and to make the data sets as comparable as possible, we did not include them in the main text. Moreover, we showed them in the supplement (Figure S1) and pointed out this caveat.

Table 1, text line 110, and Figure 2 all seem to say that CHRED exists only for 2007, but it appears elsewhere, for example Figure 4, with data for 2012?

Response: Thank you for the careful review, revised. This is our overlook during data update. CHRED for year 2012 was just available in recent months through

cooperation with data developer. The original comparison for CHRED was in 2007 and scaled to 2012 (Originally described in Figure 3 captions, and deleted after data update).

Interesting but ad hoc statements appear throughout the text. Line 102 says that one of the purposes of the study was to identify "spatiotemporal differences" but there is no further mention of temporal differences.

Response: Thank you for this question. We described the temporal differences in Section 4.1 (Figure 1) in lines around 168, 175, and 192.

CARMA enters the discussion in line 109, without definition or citation.

Response: Thank you. We added definition and citation in lines 304-310.

EF enters the discussion in line 88 but if it is defined it is lost in a sea of acronyms.

Response: Thank you, revised.

Biomass burning appears in line 118 but there is no mention, until the closing discussion, on how it is used.

Response: Thank you your question. Actually, only PKU included natural biomass burning from wild fire (Table S1, Emissions sectors), yet this only contributed a very small share close to 0, therefore it does not affect the estimates.

I did not find enough discussion of Figure 1 to make it useful.

Response: Thank you for this remind. We added in lines 146-149 and 334-336. Figure 1 is the summary of methodology for both total estimates and spatial disaggregation, i.e., activity data and EF determine the total emission estimates, and then affect the spatial distributions through disaggregation proxies of point, line and area sources.

IF FCPSC was defined I missed it.

Response: Sorry for the inconvenience. It first appeared in Table 1, and defined at the footnotes. We added it in the main text and also the acronym list.

Line 139 says "both are 21%". But does not say % of what. This problem appears elsewhere in the text as well.

Response: Sorry for the misleading. The range of the 9 estimates increased simultaneously from 0.7 to 2.1 Gt CO_2, both of the ranges are 21% of the corresponding years' total emissions, indicating the relative differences remained the

same level.

Also checked the others and revised in lines 111, 169 and 193.

In line 299, “same” as what?

Response: Thank you. Revised in line 393. The geolocation errors in China are relatively large, and only 45% of power plants were located in the same 0.1×0.1 °grid in CARMA v2.0 **as the real power plants locations that were identified by eyeballing in google maps (Fig. S1 in Wang t al, (2013))**.

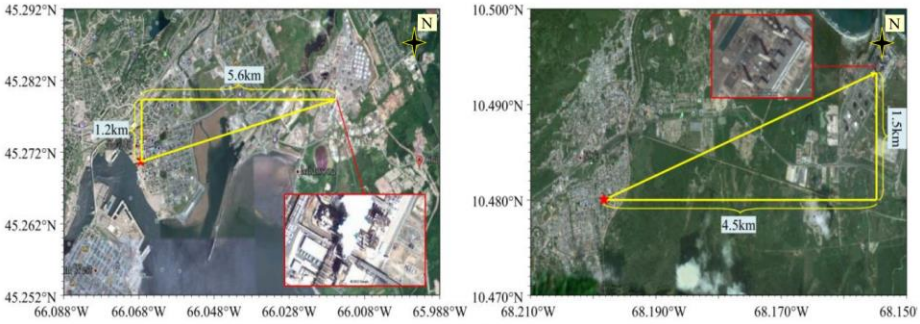

Fig. S1. Position offsets of randomly selected power stations recorded in the CARMA v2.0. The geographic positions of randomly selected 350 power stations (100 stations in China and 250 stations outside of China and U.S.A.) in the CARMA v2.0 list are checked against the presence of facility locations from visual inspection of Google imagery. The red circles are the true locations identified from Google Earth imagery, which are linked by blue lines to the CARMA v2.0 recorded locations. To do so, all stations in CARMA v2.0 were divided into 10 categories of equal sample sizes based on their annual fuel consumptions. For a stratified sampling, 50 stations (20 in China and 30 in other countries except the U.S.A.) were randomly selected from each category. The exact locations of the power stations were checked on Google Earth by searching the names of the stations and inspecting Google Earth images of power plants (chimneys and cooling towers). Roughly, 3 out of 4 stations selected were found in the Google Earth images, and 1 out of 4 stations could not be identified. As a result, 350 power stations with their locations (100 in China and 250 in other countries except the U.S.A.) were found after 476 stations were searched. The size of each circle is proportional to the emission from each power station. Two satellite images with typical views of power stations found on Google Earth are shown (the reported power stations by CARMA v2.0 are shown as red pentagrams).

Text around lines 145 to 155 is so poorly organized that it is hard to follow.

Response: Thank you. We reorganized and improved it by deleting trivial results and adding more explanations. Indeed, it is very challenging to explain all the differences among datasets, yet we provided the two main contributing factors: i.e., differences in EF for coal and systematic biases among national and provincial activity data.

Page 10 is rambling and disconnected. On line 225 do I understand that total emissions from large point sources are approximately the same even though one data set has 2320 points and the other 945? How does this fit in with the 720, 1706, and 2320 in line 303?

Response: Yes. Liu et al., (2015) reported that MEIC's power plant emissions are 2.5 Pg CO_2 from 2320 power plants, while CARMA also estimated it 2.5 Pg CO_2 from 945 plants (See below Fig. 13 from Liu et al., (2015)).

As suggested in lines 308-309, The CARMA dataset does not provide accurate geolocations (latitude and longitude) (Byers et al., 2019) for the Chinese power plants and almost all inventories have corrected the original data and thus have different power plant numbers (Janssens-Maenhout et al., 2019;Liu et al., 2015;Liu et al., 2013;Wang et al., 2013). Moreover, EDGAR used CARMA3.0 while ODIAC and PKU used CARMA2.0, new version included more power plants.

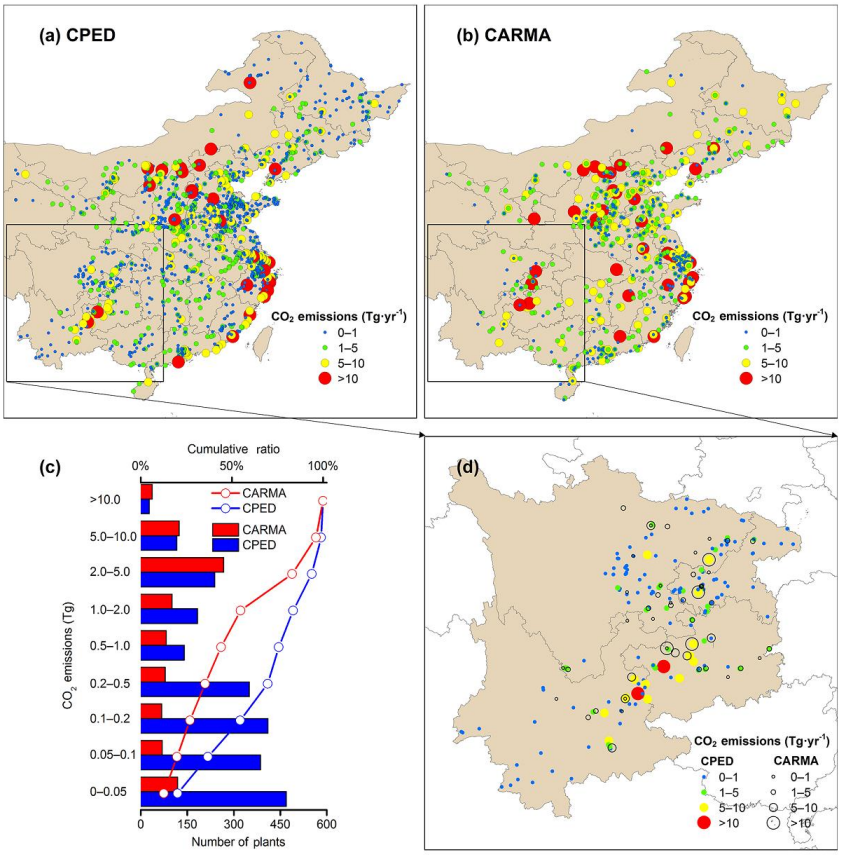

Figure 13. (a) Spatial distribution of CO_2 emissions in CPED in 2009. **(b)** Spatial distribution of CO_2 emissions in CARMA in 2009. **(c)** Comparisons of CO_2 emissions between CARMA and CPED by plant numbers in 2009. The plants are sorted according to ascending CO_2 emissions along the *y* axis. The red and blue lines denote the plant number cumulative ratio for CARMA and CPED, respectively. **(d)** Comparisons of the spatial distribution of CO_2 emissions in southwest China between CARMA and CPED in 2009.

I could list many additional problems of organization and flow of the text. There is much here that appears to be interesting. The paper needs a major re-organization and significant increase in explanations of what was done and why and what we learn from it.

Response: Thank you. We re-organized the Introductions, Results and added more contents in discussions. We separated total emissions and spatial disaggregation through rewriting the 2nd and 3rd paragraphs. We arranged the introduction from a general background of China's fossil fuel CO_2 emissions, and then to the total estimates and spatial proxies, followed by the local inventories developed within China using more detailed provincial activity data and local optimized emission factors. Finally we pointed out the importance of this study: Why Chinese are possible more uncertain and why it is important.

References:

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