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Interactive comment on "Quantitative assessment of changes in surface particulate matter concentrations over China during the COVID-19 pandemic and their implications for Chinese economic activity" *by* Hyun Cheol Kim et al.

Anonymous Referee #3

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This study intends to investigate the timeline of economy recovery in China using the changes in emissions of aerosol precursors during the COVID-19 pandemic, 2020. Since the emissions highly depend on the human and economic activities, an accurate assessment on emissions in China may provide some proves for China economy in that period. Without the bottom-up emission inventory in 2020, this study estimates the emissions of NOx, SO2 and other 4 kinds of pollutants (Fig. S3) by combining the WRF/CMAQ simulations and observed concentrations of NOx, SO2 and aerosols. Inventory in 2016 is used and adjusted to 2020 after comparing the simulated and

observed pollutant concentrations. Then plenty of analyses are performed according to the estimated emissions. Overall, the paper is well structured and provides abundant results on the topic. However, there are several noticeable flaws in the manuscript. Hence, these analytic results would be questioned.

1. I do know why the authors named the paper as "Quantitative assessment of changes in surface particulate matter concentrations. . .", since the study mainly talks about the variations in emissions using model results and an emission-adjustment method. The comparison on surface particulate matter concentrations between the period and previous years has been showed by other studies or reports as the study mentioned. And we scarcely need a model assessment when we have the pollutant observations, considering the model results were adjusted by observations in the manuscript.

2. The study claimed that "Meteorological influences were reduced by combining surface data with output from a three-dimensional chemistry model to calculate estimated emissions" (Section 3.1). I do not understand why combining the pollutant observations with model simulation can reduce the meteorological effects. The concentration time series, no matter from observation or from model, would be varied with the simulated/realistic meteorology. And, the adjusted emissions computed using eq. (1) or (6) should change with varied pollutant observations following meteorology.

3. Again, I am afraid that the "less sensitive of emission to meteorological variations" (line 119 and Fig. 2) would be not related to the combination process but due to the smoothing process with 7-day running average. If there is no any smoothing process, I believe the estimated emission time series would variation more sharply than Figure 2 shown. Hence, the combination based on linear ratio of concentrations could not remove the meteorological influences on emission estimation.

4. Top-down emission adjustments is the kernel of this study (Section 3.2). Here ratio between observed and simulated pollutant concentrations in every grid cell and day are used as a base scaling coefficient (eq. (3)). Accurate emission estimation using the eq.

(3) strongly depends on the simulation quality in COVID-19 pandemic. However, the study only shows a daily time series validation during whole years (I guess the domain-averaged concentrations. The paper did not mention). It is not enough for this study. The authors should provide an estimation in every grid-cell (or sites) near LNY-period.

5. The study also introduces another coefficient β to furtherly adjust the ratio between observed and simulated pollutant concentrations. However, the major flow is that the study determines the β using two simulated concentration (adj1 and base in eq. (5)). Here the β in eq. (5) reflects the scaling relationship between simulation "adj1" and "base" but not the relationship between a simulation and an observation. In another word, the β in eq (5) should not be the one in eq. (3). Therefore, the introducing process of β in eq. (5) "as Equation (3) can be written (line 152)" are not reasonable.

6. The study used the pollutant observation in the COVID-19 pandemic to validate the emission adjustment method (line 169). But considering the emission adjustment process is determined by the pollutant observations in the same period and grid-cells and β almost equal to 1, it is not a meaningful validation for the method.

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