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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Time-resolved emission reductions for atmospheric chemistry modelling in Europe during the COVID-19 lockdowns" *by* Marc Guevara et al.

Anonymous Referee #2

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The authors estimated the daily reductions in air pollutant emissions due to COVID-19 in Europe and evaluated the time-resolved emissions data through air quality model simulations of NO2. Activity indicators including electricity demand, heating degree day, and Google mobility reports are used in this study to represent the relative changes in emissions from different source sectors. The comparisons between simulated and observed NO2 concentrations suggest the improvement of modeling results driven by the daily emission reduction factors based on the activity indicators. This paper provides important results on the effect of COVID-19 on anthropogenic emissions and air quality, which is a hot topic at present not only in Europe but also in the other continents. Overall, I think this paper deserves publication in ACP but I still have concerns

about the uncertainties in the method and results. I suggest that the authors carefully clarify the uncertainties in the method and add a specific section in the main text to discuss the uncertainties in detail.

Major comments:

1. Energy industry. The electricity demand is estimated to have increased during COVID-19 over the Northern European countries such as Denmark, Norway, and Sweden. Why did this happen? Are these weird results relevant to the errors in the ML models designed to account for the influence of temperature fluctuations on electricity demand? Are there any temperature anomalies over North Europe during the COVID period? The authors did not explain the potential errors in the method but just assumed a null reduction of the electricity demand in Denmark, Finland, and Norway (Lines 178 to 180 in Page 6), which is not acceptable in my opinion.

2. Manufacturing industry. This study attributed 25% of the total electricity demand reduction to the reduction in manufacturing industry activity, which is rather arbitrary. What is the uncertainty involved in using such a uniform factor for the industry sector in different European countries? The authors said that the manufacturing industry sector has maintained certain activities during the COVID-19 pandemic (Line 215 in Page 7), which is not consistent with what I saw in Fig. 4a. The production of cement, iron, steel, and glass all declined significantly during April 2020 in Spain.

3. Road transport. The authors acknowledged that the emission reduction factors for the traffic sector may be overestimated because the activity levels of heavy-duty vehicles on interurban roads did not decline as much as those light-duty vehicles on urban roads. This could be the largest source of uncertainty in this study because the transport sector is the major source of NOx emissions and the heavy-duty vehicles account for a large part of transport emissions. I suggest that the authors provide more discussions on this uncertainty and try to reduce it if possible.

4. Modeling results. This study evaluated modeled NO2 concentrations with obser-

vations (Fig. 12) during the pre-lockdown and lockdown periods, respectively, which is very helpful to understand the uncertainties in the estimates of daily emissions. I suggest the authors add another figure that compares the observed and simulated NO2 decline from pre-lockdown to lockdown periods, which gives the audience more information on the accuracy of the estimated emission reduction factors.

5. Conclusions. The conclusion section is not organized well. Some paragraphs repeated the text from the method section, such as lines 509 to 517 in Page 16. Besides, the discussions on the uncertainties are not the conclusions of this study and should be written in a specific new section. Please remove the unnecessary text in the conclusions, add a new section of 'Uncertainties', and provide a condensed conclusion section.

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