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Atmospheric Chemistry and Physics Discussions

Interactive comment on "COVID-19 lockdowns highlight a risk of increasing ozone pollution in European urban areas" *by* Stuart K. Grange et al.

Anonymous Referee #1

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This paper analyzed the effect of the European COVID-19 lockdowns on NO2, O3, and Ox concentrations by comparing the observation and business as usual (BAU) derived from machine learning at 246 stations. The lockdown effect was determined by the Bayesian change point models. This analyze gave an 34% reduction of NO2 concentration and 30% increase of O3 leading to little change in Ox. Therefore, the change in NO2 and O3 is mainly a repartitioning of Ox. This paper presents a timely and important analysis of evaluating the lockdown impact on air quality in Europe. The paper is well written and structured. I suggest the authors to consider the following comments, which may help to improve the paper.

General Comments:

1. The description of methods are not detailed enough. Although most of the methods

are used and described in previous studies, more detail information, for example about how the calculation of BAU, is useful for the reader to understand the data processing. There are some references provided to show how to perform the data analysis but are written in a specific programming language. The fundamental description in the paper would be helpful in case some of the readers are not using this tool.

2. The input and output of random forest model is hourly data. This is different from Grange et al. (2018), where daily averaged data was used. Why is the change? If hourly data is used, I am not sure how well the model captures the lockdown effect if the variability is mainly contributed by diurnal variation. Also, it would be very helpful to show the performance of the BAU calculation in a time series plot in their absolute concentration, perhaps in the supplement. The current comparison is only show in Fig A1 with some averaged R^2 is not enough. At least the performance for different countries should be show individually unless the model performances are the same. The calculation of Ox BAU is not clear. Is it calculated from the Ox observation like NO2 and O3, or the sum of NO2_BAU and O3_BAU?

3. The argument of ozone pollution need for evidence to support. As discussed in section 3.5, the increase in O3 is mainly a repartitioning of Ox during the lockdown. The Ox/O3/NO2 concentrations were missing so I cannot tell from the paper itself if all Ox are in the form of O3, will O3 exceed the limit? This is a rough estimation assuming only repartitioning play a role. As mentioned in the paper, the ozone formation is nonlinear with VOC and NOx and Europe is likely in the VOC-limited regime. Reduction in NOx do not lead to higher O3 formation. If the reduction in NOx is stronger than lockdown in the future, ozone production could move to NOx-limited regime, which ozone pollution less important.

Technical comments:

Line 109: The model prediction is corrected by -3.7ug for NO2. How much you result sensitive to this correction.

Line 112: The underprediction of NO2 is attributed to mild temperature and windy conditions. Isn't this indicating the model is not able to predict the condition in 2020?

Line 210âĂŤ213: The projection of NO2 reduction and O3 increase in the future is assuming a linear trend, which seems to me a bit too simple. Especially calculating the year to reach the lockdown impact bothers me.

Line 229âĂŤ230: This sentence is not clear.

Line 233: maybe you want to refer your argument to table 1.

Line 274: I think better to state the access of both NO and NO2 data.

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