Supplement of

Modeling the impact of COVID-19 on air quality in southern California: implications for future control policies

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Regarding the emission reductions of power plants during the lockdown, we checked the change of CO$_2$, NO$_x$, and SO$_2$ emissions from power plants measured by the Continuous Emission Monitoring System (CEMS). The time series of SO$_2$ and CO$_2$ emissions in southern California during the pre-lockdown and lockdown periods are shown in Fig. S3 (NO$_x$ emissions are not available during this period). We can see that the CEMS-based SO$_2$ emissions have a strong day-to-day variation, making it difficult to achieve an accurate estimate of the COVID-19 related emission changes. The average SO$_2$ emission decreases by 39\% between the pre-lockdown and lockdown periods defined in this study, larger than the reduction rate estimated based on electricity demand (7\%). However, it is noted that the above CEMS-based reduction rate is also subject to large uncertainty due to the strong fluctuation of emission rates.

We then examined the potential impact of this difference on our results. As reported in the CARB emission inventory (CARB, 2021), the emissions of VOC, CO, NO$_x$, and PM$_{10}$ from power plants account for less than 1\% of the total emissions, and the emissions of SO$_2$, NH$_3$, and PM$_{2.5}$ all account for less than 3\%. For this reason, the different emission reduction rates estimated based on the CEMS and electricity demand will translate into less than 1\% difference in the total emissions of any pollutant (from 0.05\% to 1\%), which is expected to have a limited effect on the simulation results of mean air pollutant concentrations in southern California.

References
Figure S1. The population density in the area this study focuses on.

Figure S2. Air pollutant emissions in southern California with (red) and without (blue) the COVID-19 lockdown.
Figure S3. The power plant emissions of SO$_2$ and CO$_2$ in southern California measured by the CEMS before and during the COVID-19 lockdown.

Figure S4. Scattergrams of the simulated and observed monthly average PM$_{2.5}$ and MDA8 O$_3$ concentrations in southern California. (a-c) are for PM$_{2.5}$ and (d-f) are for MDA8 O$_3$. (a, d) are for the pre-lockdown period (February 18 to March 18) under the Base scenario (PreBase); (b, e) are for the lockdown period (March 19 to April 23) under the Base scenario (PostBase); (c, f) are for the lockdown period under the Lockdown scenario (PostLockdown).
Figure S5. Mean concentrations of simulated air pollutant concentrations in southern California: (a) PM$_{2.5}$ components; (b) MDA8 O$_3$; (c) NO$_2$; (d) SO$_2$. Pre$_{\text{Base}}$, Post$_{\text{Base}}$, and Post$_{\text{Lockdown}}$ have the same meanings as in Fig. 3.