

deep blue) in March-May 2020 and 2019.



**Figure S2.** The comparison of MODIS AOD (on AQUA) and AERONET AOD observations over Europe for three different algorithms (combined, dark target and deep blue) in in March-May 2020 and 2019.



**Figure S3.** Comparison of simulated tropospheric NO2 columns using the prior emission (prior) and top-down constrained emissions (post) with TROPOMI observations in **2019**. Note that TROPOMI columns are corrected for the bias and shape factors.



Figure S4. Same as Figure S3 but for 2020.



**Figure S5.** Comparison of simulated total HCHO columns using the prior emission (prior) and top-down constrained emissions (post) with TROPOMI observations in **2019**. Note that TROPOMI columns are corrected for the bias and shape factors.



Figure S6. Same as Figure S5 but for 2020.

## Tables:

Table S1. Statistics of surface temperature, relative humidity, and U/V-component wind from Mar	rch
through May in 2020.	

Variables	Unit <sup>a</sup>	Corr <sup>b</sup>	$\mu_m \pm \sigma_m^{\ c}$	$\mu_o \pm \sigma_o{}^{ m d}$	MB <sup>e</sup>	MAE <sup>f</sup>	RMSE <sup>g</sup>
Temperature	°C	0.932	8.655 <u>+</u> 8.514	9.531 <u>+</u> 7.977	-0.876	2.281	3.200
Relative Humidity	%	0.687	70.06 <u>+</u> 23.61	66.930 <u>+</u> 21.665	3.125	12.151	18.266
U wind	ms <sup>-1</sup>	0.806	0.541 <u>+</u> 3.331	0.549 <u>+</u> 3.580	-0.008	1.561	2.165
V wind	$ms^{-1}$	0.798	-0.153 <u>+</u> 3.285	-0.139 <u>+</u> 3.515	-0.014	1.573	2.172

**Table S2**. Statistics of surface temperature, relative humidity, and U/V-component wind from March through May in 2019.

Variables	Unit <sup>a</sup>	Corr <sup>b</sup>	$\mu_m \pm \sigma_m^{\ c}$	$\mu_o \pm \sigma_o{}^{ m d}$	MB <sup>e</sup>	MAE <sup>f</sup>	RMSE <sup>g</sup>
Temperature	°C	0.934	8.177 <u>+</u> 8.317	9.392 <u>+</u> 7.830	-1.216	2.356	3.214
Relative Humidity	%	0.728	75.18 <u>±</u> 21.82	69.02 <u>+</u> 21.368	6.159	12.86	17.075
U wind	ms <sup>-1</sup>	0.806	0.448 <u>+</u> 3.059	0.498 <u>+</u> 3.642	-0.050	1.551	2.162
V wind	ms <sup>-1</sup>	0.781	-0.078 <u>+</u> 2.928	-0.077 <u>+</u> 3.415	-0.001	1.550	2.150

<sup>a</sup>Units except for Correlation.

<sup>c</sup>Mean and  $1\sigma$  standard deviation of Model variables ( $Y_m$ )

<sup>d</sup>Mean and  $1\sigma$  standard deviation of observed variables ( $Y_o$ )

<sup>e</sup>Mean Bias  $(\mu_m - \mu_o)$ 

<sup>f</sup>Mean Absolute Error. MAE =  $\frac{1}{n} \sum |Y_m - Y_o|$ 

<sup>g</sup>Root Mean Square Error. RMSE =  $\frac{1}{n}\sqrt{\sum(Y_m - Y_o)^2}$ 

• Number of samplings : 5575860 for Temp, 5497687 for RH, 5073788 for wind.