

*Supporting information for*

# Importance of meteorology and chemistry in determining air pollutant levels during COVID-19 lockdown in Indian cities

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Table S1: Summary of comparison between background levels and measured PM<sub>2.5</sub> and NO<sub>x</sub> for each site.

<b>SITE</b>	<b>POLLUTANT</b>	<b>SLOPE</b>	<b>R<sup>2</sup></b>
<b>R K PURAM, DELHI</b>	NO <sub>x</sub>	0.22	0.37
	PM <sub>2.5</sub>	0.76	0.74
<b>ITO, DELHI</b>	NO <sub>x</sub>	0.05	0.01
	PM <sub>2.5</sub>	0.15	0.02
<b>SANATHANAGAR, HYDERABAD</b>	NO <sub>x</sub>	0.3	0.31
	<b>ZOO PARK, HYDERABAD</b>	PM <sub>2.5</sub>	0.27

Table S2: Partial dependencies (%) of covariates used for PM<sub>2.5</sub> models at Delhi and Hyderabad. Trend is the meteorologically averaged trend that accounts for variation in meteorological covariates (i.e. RH, WS, WD, air temp, and dew point) and weekday and hour are the time-based covariates. NA indicates

<b>Site</b>	<b>Background NO<sub>x</sub></b>	<b>Trend</b>	<b>RH</b>	<b>Temperature</b>	<b>Dew point</b>	<b>Wind speed</b>	<b>Wind direction</b>	<b>Weekday</b>	<b>Hour</b>
<b>RK Puram, Delhi</b>	59.3	19.6	1.3	NA	1.8	1.5	0.7	3.1	12.6
<b>ITO, Delhi</b>	33.3	38.8	5.6	3.1	1.4	0.4	0.9	4.9	11.6
<b>Sanathnagar, Hyderabad</b>	54.8	15.9	2.7	6.5	6.2	1.8	NA	5.7	6.4

variables that were not included in the BRT model.

Table S3. Partial dependencies (%) of various used for NO<sub>x</sub> models at Delhi and Hyderabad. Trend is the meteorologically averaged trend that accounts for variation in meteorological covariates (i.e. RH, WS,

<b>Site</b>	<b>Background PM<sub>2.5</sub></b>	<b>RH</b>	<b>Temperature</b>	<b>Dew point</b>	<b>Wind direction</b>	<b>Trend</b>	<b>Wind Speed</b>	<b>Weekday</b>	<b>Hour</b>
<b>RK Puram, Delhi</b>	79.9	1	1	0.9	0.5	9.6	NA	2.4	4.8
<b>ITO, Delhi</b>	85.6	NA	1.7	0.9	0.6	6.9	NA	2.9	1.5
<b>Zoo Park, Hyderabad</b>	79	0.7	0.8	3.6	2.2	11.5	NA	1	1.3

WD, air temp, and dew point) and weekday and hour are the time-based covariates. NA indicates variables that were not included in the BRT model.

Table S4: Mean levels of PM<sub>2.5</sub> and NO<sub>x</sub> during the phase-I lockdown period (24 March – 24 April 2020) and corresponding dates for 2017-19 (L3Y). Variability shown is one standard deviation.

		<b>PM<sub>2.5</sub> (µg m<sup>-3</sup>)</b>		<b>NO<sub>x</sub> (ppbv)</b>	
		<i>2020</i>	<i>L3Y</i>	<i>2020</i>	<i>L3Y</i>
<b>Delhi</b>	<i>RK Puram</i>	40.0 ± 23.4	92.9 ± 52.2	16.1 ± 11.6	64.3 ± 42.8
	<i>ITO</i>	74.0 ± 46.3	86.8 ± 54.0	58.3 ± 79.7	79.7 ± 84.9
<b>Hyderabad</b>	<i>ZOO Park</i>	47.9 ± 12.6	56.6 ± 23.1	20.0 ± 6.4	36.0 ± 19.2
	<i>Santhanagar</i>	37.6 ± 14.5	52.5 ± 23.1	12.7 ± 9.3	28.4 ± 30.5

Table S5: Mean meteorological conditions during the phase-I lockdown period (24 March – 24 April 2020) and corresponding dates for 2017-19 (L3Y) at Safdarjung airport, Delhi. Variability shown is one standard deviation.

	<b>Wind speed (m s<sup>-1</sup>)</b>	<b>Temp (°C)</b>	<b>RH (%)</b>	<b>Atmos. Pressure (mb)</b>
<b>2020</b>	2.1 ± 1.4	27.3 ± 9.0	67.8 ± 20.3	1008 ± 8
<b>L3Y</b>	1.9 ± 1.7	28.0 ± 8.3	63.2 ± 22.4	1007 ± 8

Table S6: Mean meteorological conditions during the phase-I lockdown period (24 March – 24 April 2020) and corresponding dates for 2017-19 (L3Y) at Begumpet airport, Hyderabad. Variability shown is one standard deviation.

	<b>Wind speed (m s<sup>-1</sup>)</b>	<b>Temp (°C)</b>	<b>RH (%)</b>	<b>Atmos. Pressure (mb)</b>
<b>2020</b>	2.1 ± 1.2	28.4 ± 5.0	62.1 ± 19.7	1008 ± 5
<b>L3Y</b>	1.9 ± 1.6	28.1 ± 5.3	62.1 ± 22.3	1008 ± 5

Table S7: Correlation statistics on the predictive ability on the final BRT model performance compared to measured PM<sub>2.5</sub> levels at each site for the randomly extracted 25% of the 4 year training dataset. n refers to the number of data points in the training dataset and varies due to data availability while COE the Coefficient of Efficiency.

<b>PM<sub>2.5</sub></b>	<b>Site</b>	<b>n</b>	<b>RMSE</b>	<b>r<sup>2</sup></b>	<b>Mean of Bias</b>	<b>COE</b>
<b>Delhi</b>	RK Puram	7,760	34.37	0.93	0.09	0.64
	ITO	8,640	35.71	0.92	-0.08	0.67
<b>Hyderabad</b>	ZOO Park	9,588	10.74	0.91	0.03	0.66

Table S8: Correlation statistics on the predictive ability on the final BRT model performance compared to measured NO<sub>x</sub> levels at each site for the randomly extracted 25% of the 4 year training dataset. n refers to the number of data points in the training dataset and varies due to data availability while COE the Coefficient of Efficiency.

<b>NO<sub>x</sub></b>	<b>Site</b>	<b>n</b>	<b>RMSE</b>	<b>r<sup>2</sup></b>	<b>Mean of bias</b>	<b>COE</b>
<b>Delhi</b>	RK Puram	8,716	32.73	0.89	-0.14	0.60
	ITO	8,440	30.36	0.86	0.02	0.54
<b>Hyderabad</b>	Santhanagar	9,782	15.98	0.73	0.02	0.43

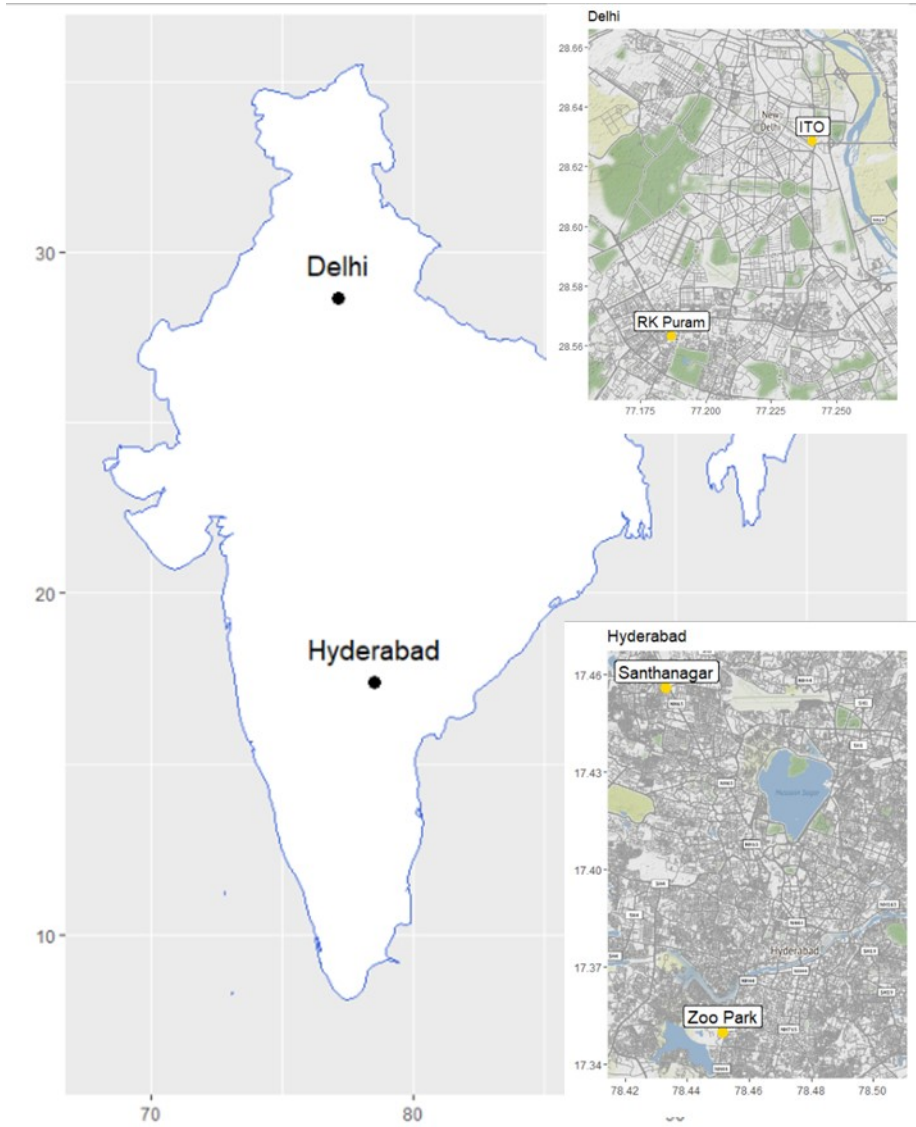


Figure S1: Map of the sampling sites in Delhi and Hyderabad. Street map data © OpenStreetMap contributors.

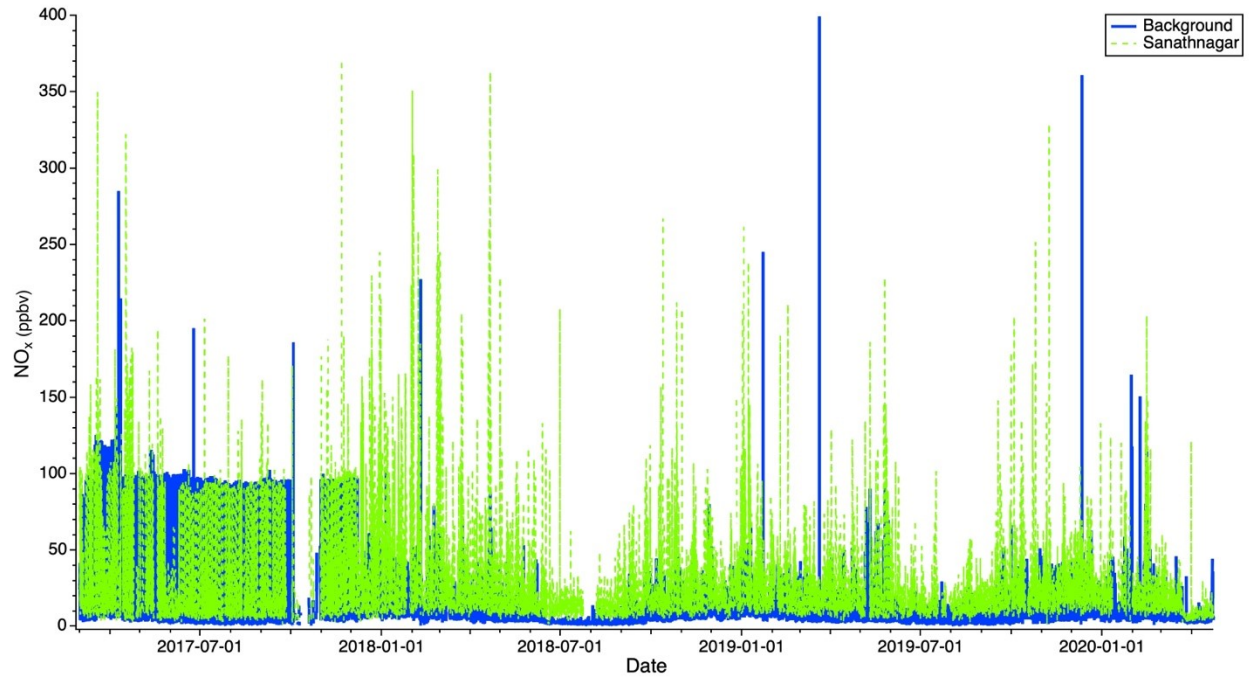


Figure S2. Timeseries of concentration of NO<sub>x</sub> at Sanathnagar (green dashed line) and background NO<sub>x</sub> from ICRISAT Patancheru, Hyderabad between 2017-2020 (green dashed line).

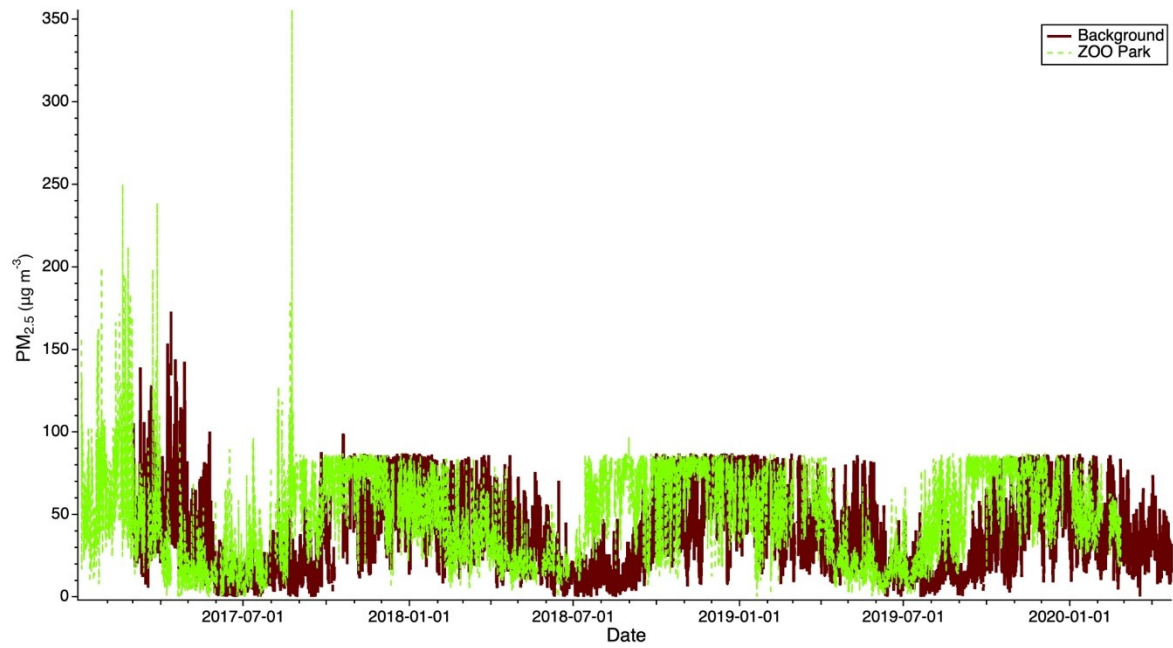


Figure S3. Timeseries of concentration of PM<sub>2.5</sub> at ZOO park (green dashed line) and background PM<sub>2.5</sub> gathered from ICRISAT Patancheru, Hyderabad between 2017-2020 (green dashed line).

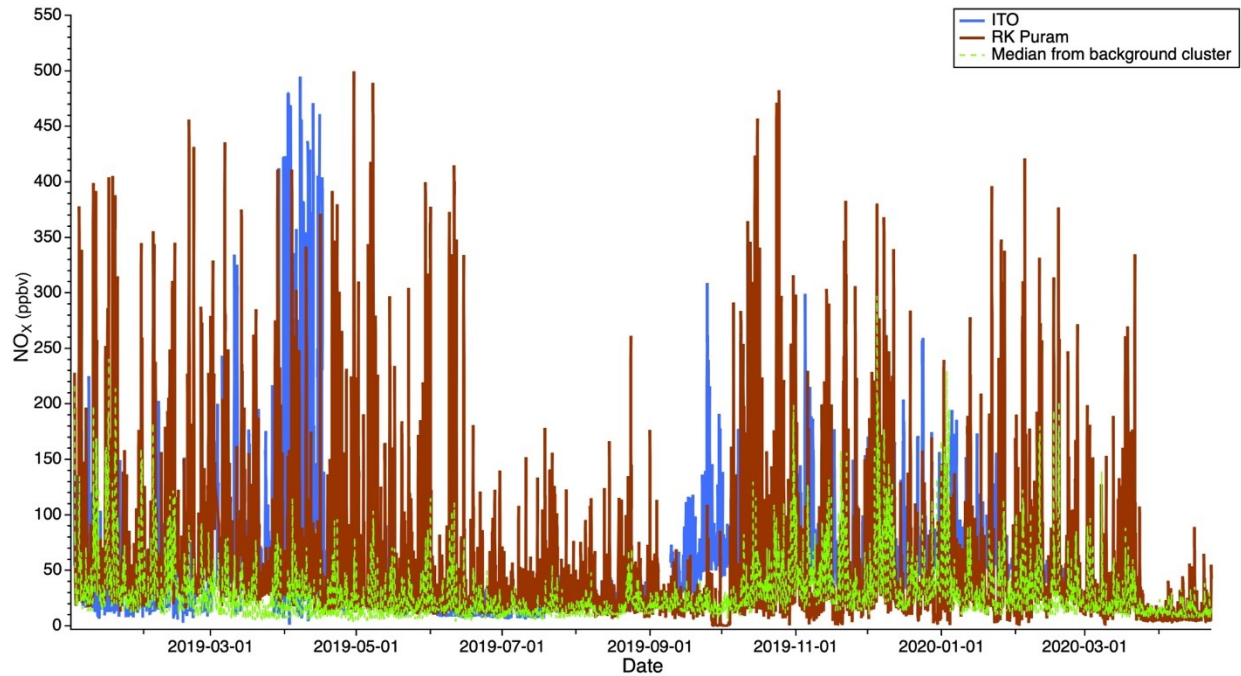


Figure S4. Timeseries of concentration of NO<sub>x</sub> at ITO (blue line), RK Puram (brown line), and median NO<sub>x</sub> gathered from four background sites in Delhi between 2019-2020 (green dashed line).

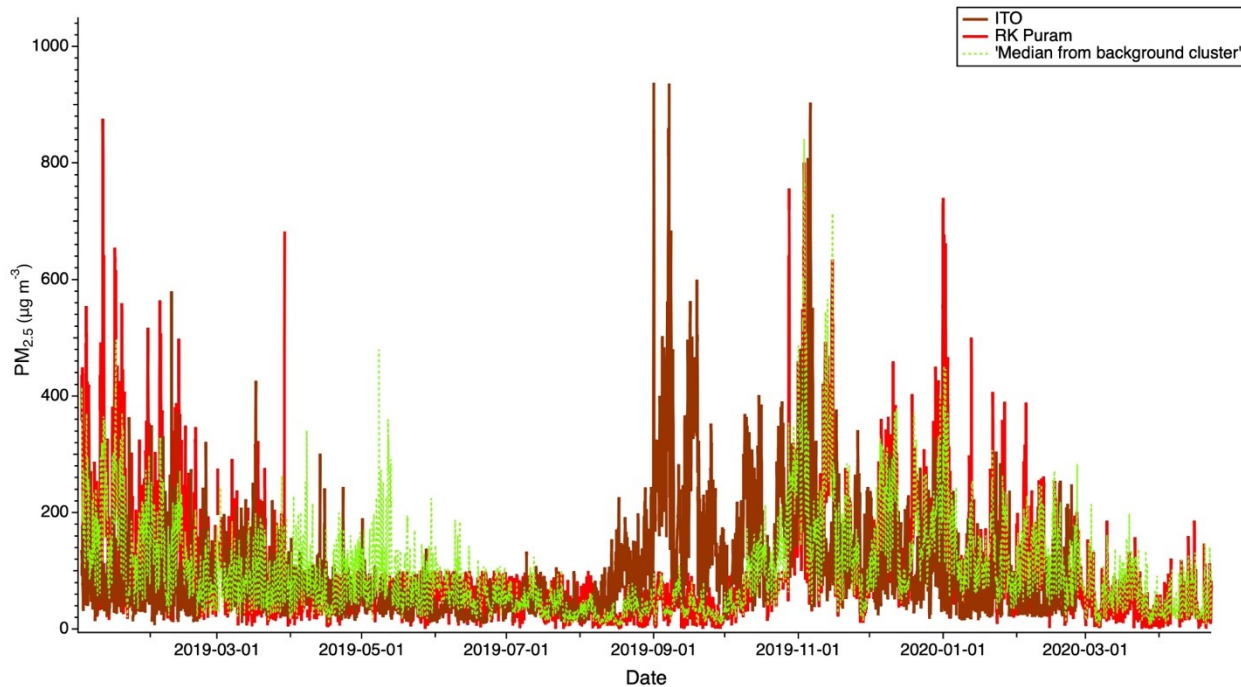


Figure S5. Timeseries of concentration of PM<sub>2.5</sub> at ITO (brown line), RK Puram (red line), and median PM<sub>2.5</sub> gathered from four background sites in Delhi between 2019-2020 (green dashed line).



## ITO, Delhi

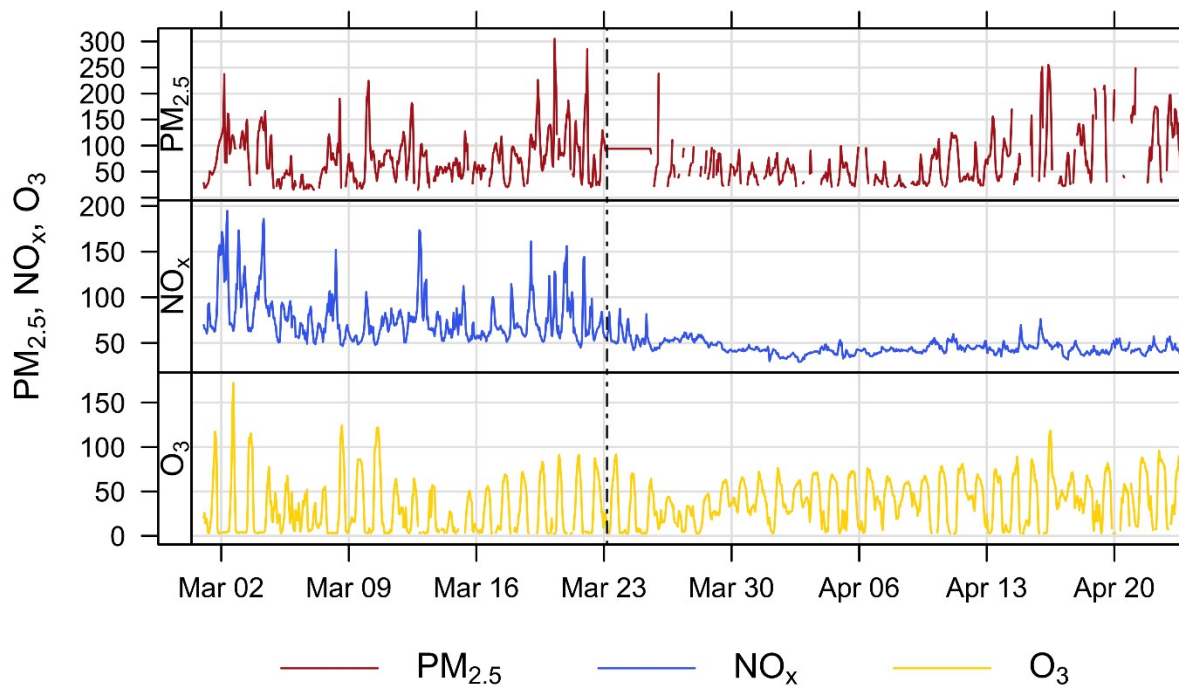


Figure S6: A time series of PM<sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ ), NO<sub>x</sub> (ppbv) and O<sub>3</sub> ( $\mu\text{g}/\text{m}^3$ ) levels pre-lockdown and during phase-I lockdown at ITO, Delhi. The marker placed on 23 March denotes the start of phase-I lockdown.

## Santhanagar, Hyderabad

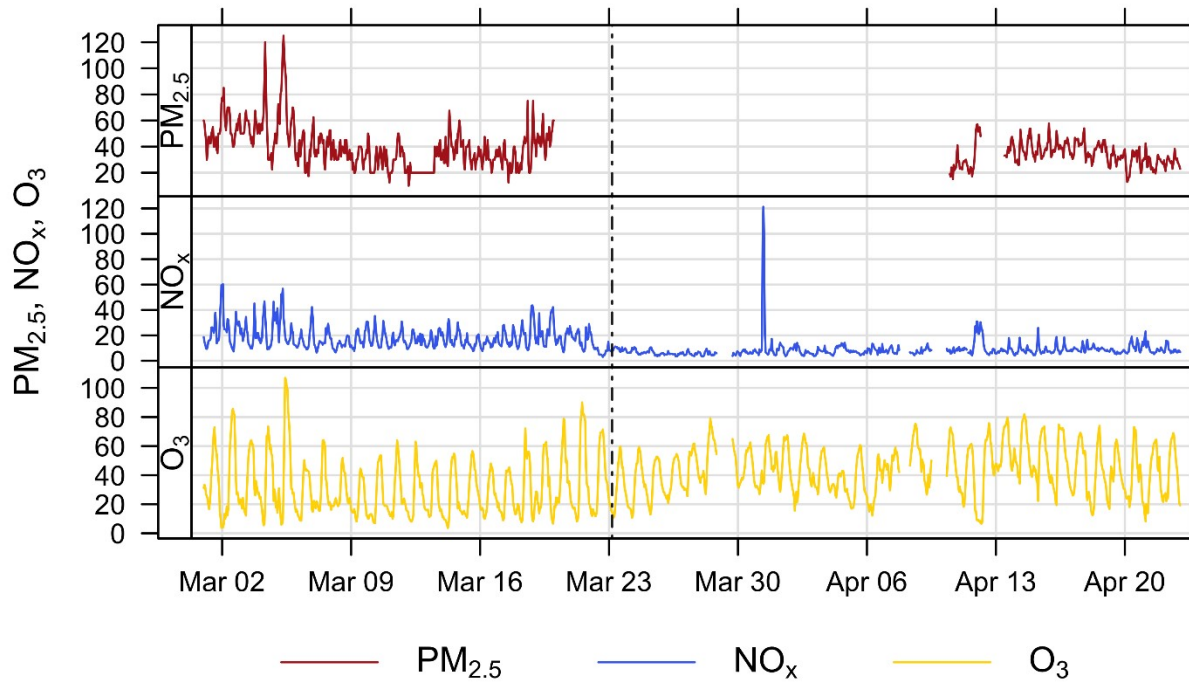
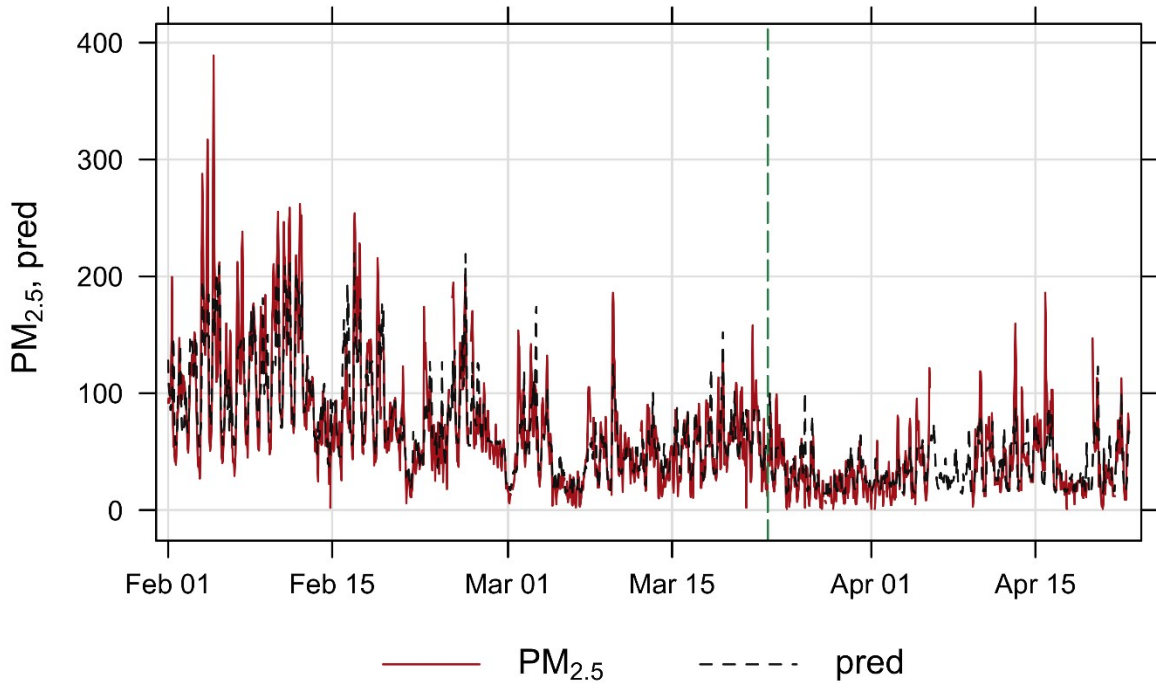
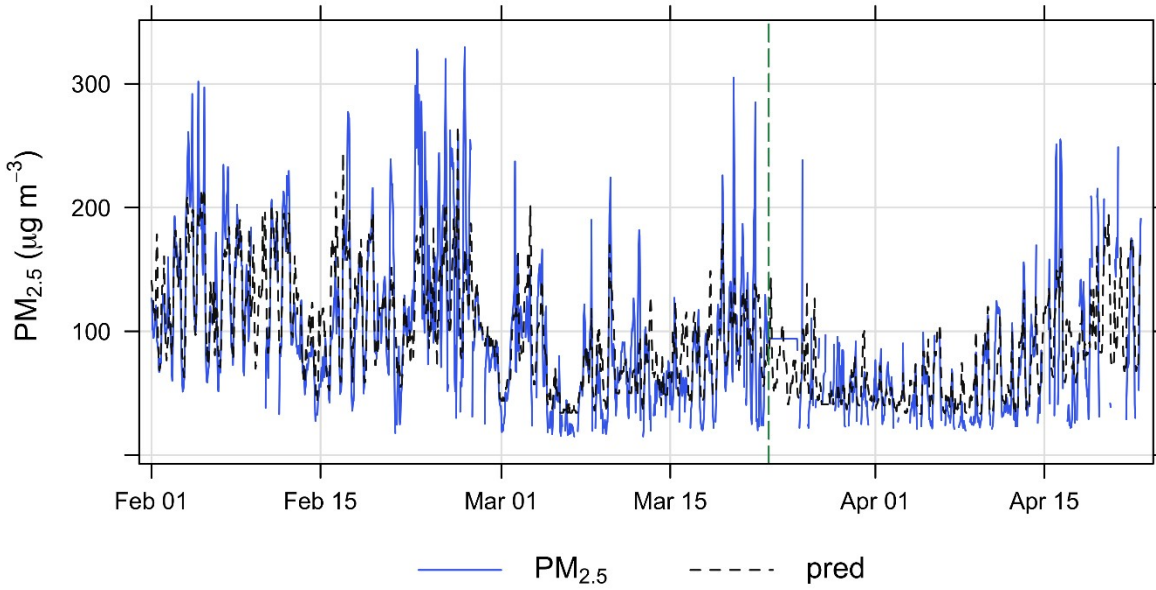


Figure S7: A time series of PM<sub>2.5</sub> (µg/m<sup>3</sup>), NO<sub>x</sub> (ppbv) and O<sub>3</sub> (µg/m<sup>3</sup>) levels pre-lockdown and during phase-I lockdown at Santhanagar, Hyderabad. The marker placed on 23 March denotes the start of phase-I lockdown.

### RK Puram, Delhi



### ITO, Delhi



### ZOO Park, Hyderabad

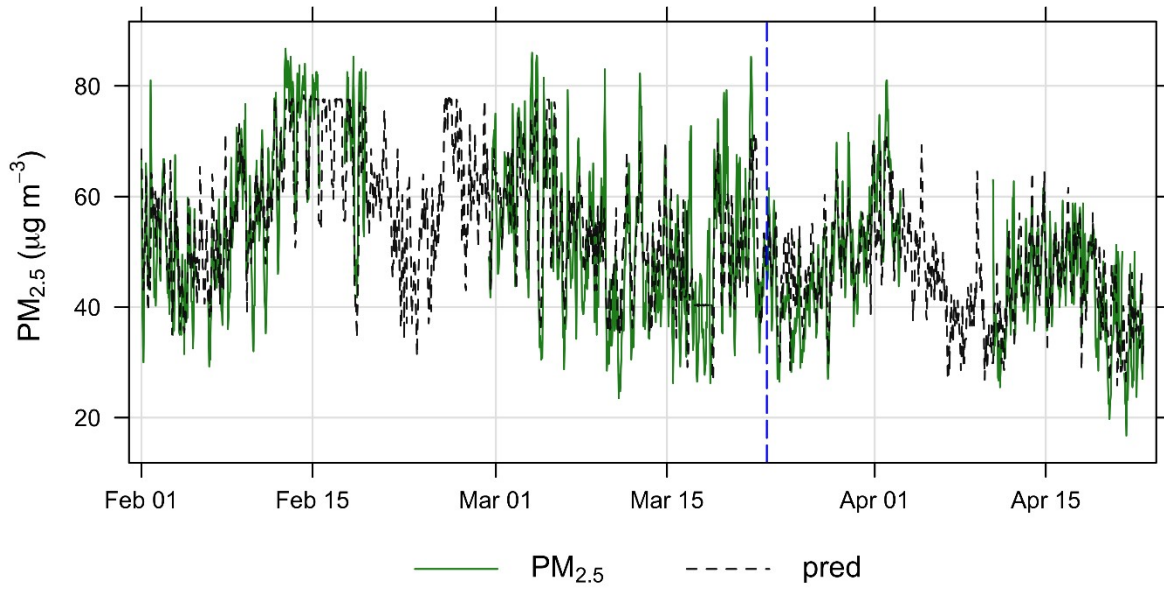
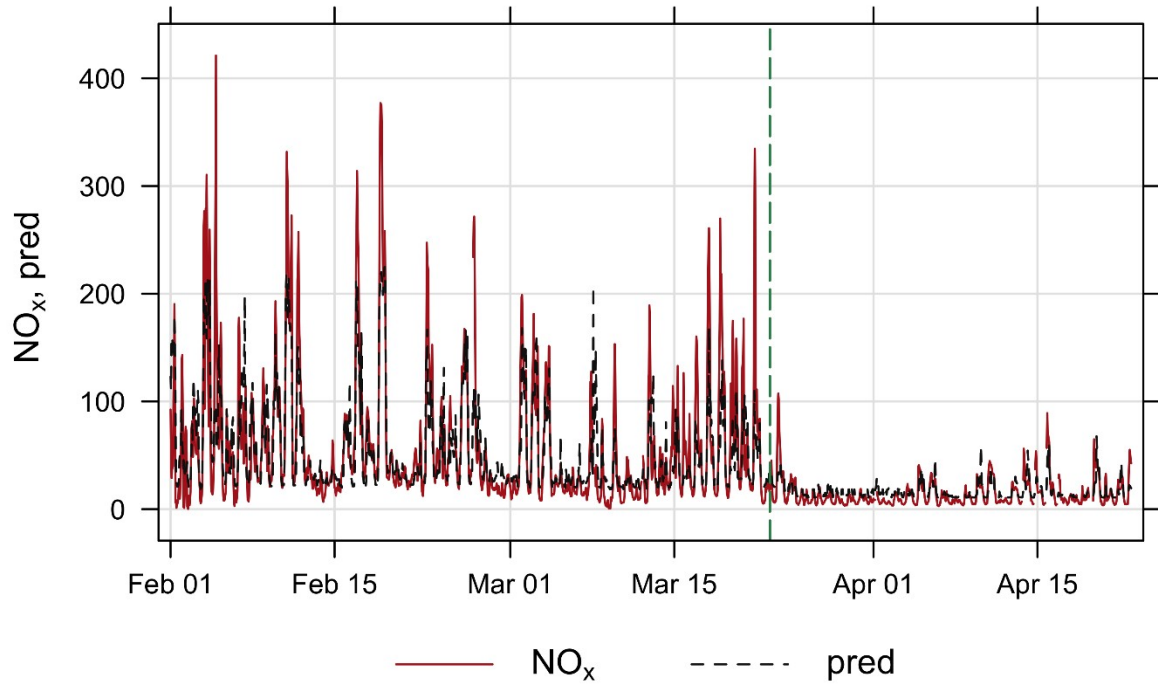
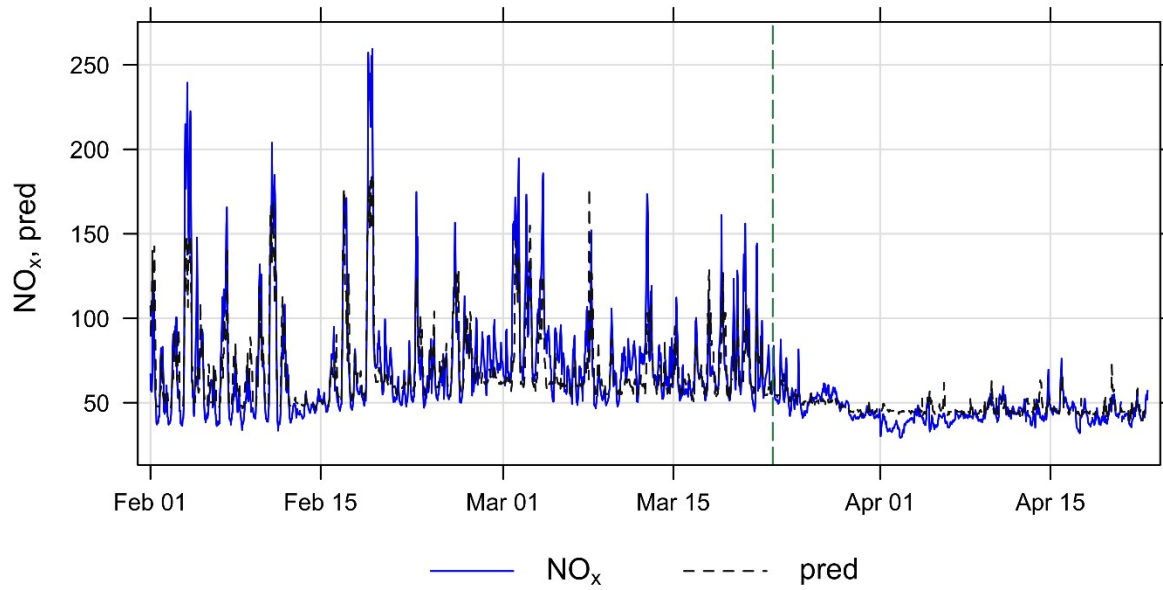


Figure S8: Time series of measured and predicted PM<sub>2.5</sub> mass concentrations pre-lockdown and during phase-I lockdown at RK Puram (Delhi), ITO (Delhi) and Zoo Park (Hyderabad).

### RK Puram, Delhi



### ITO, Delhi



## Sanathnagar, Hyderabad

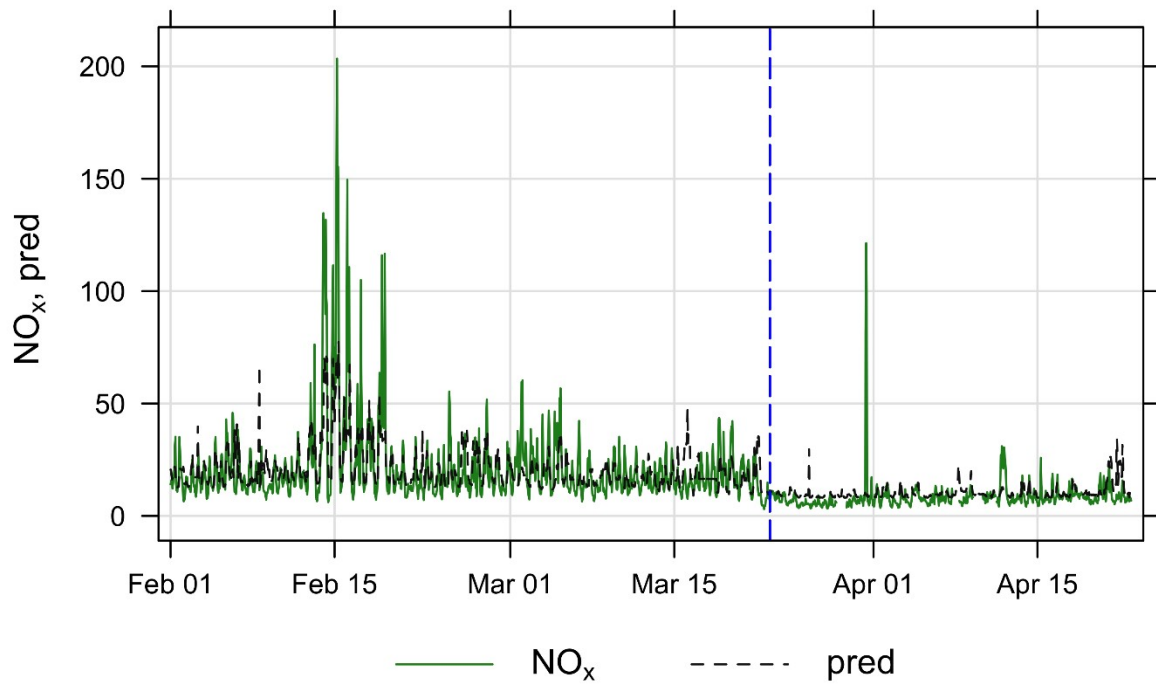
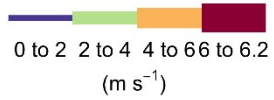
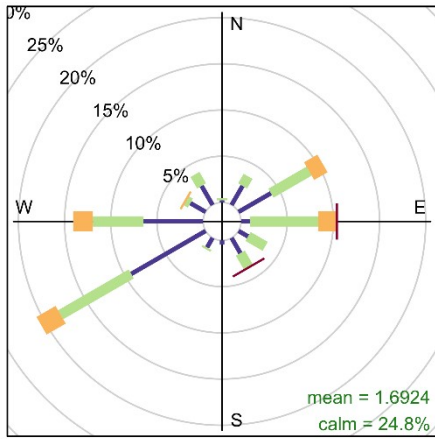
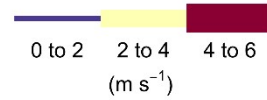
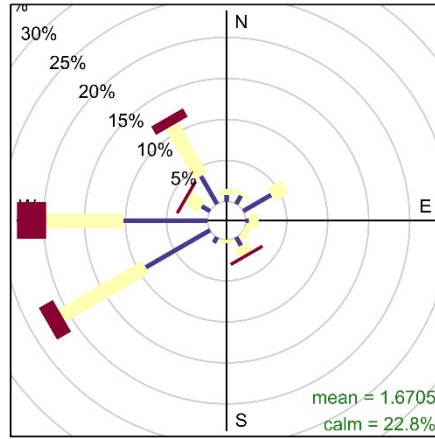


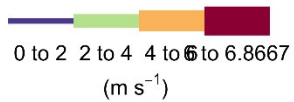
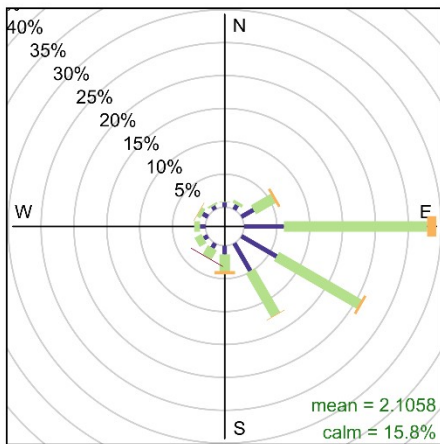
Figure S9: Time series of measured and predicted NO<sub>x</sub> mixing ratios pre-lockdown and during phase-I lockdown at RK Puram (Delhi), ITO (Delhi) and Santhanagar (Hyderabad).



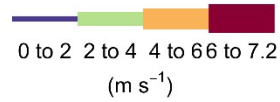
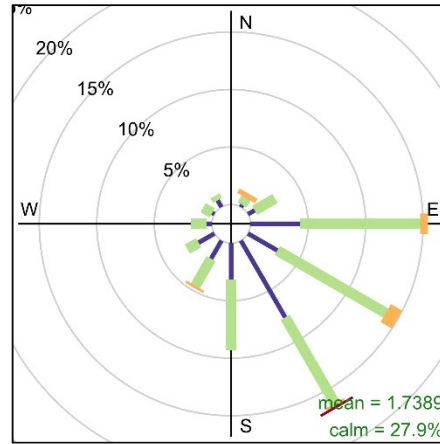
Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)

Figure S10: Wind rose plot for pre-lockdown (left) and during phase-I lockdown period (right) at Safdarjung airport (Delhi – top) and Begumpet airport (Hyderabad – bottom) (Feb-Apr 2020).

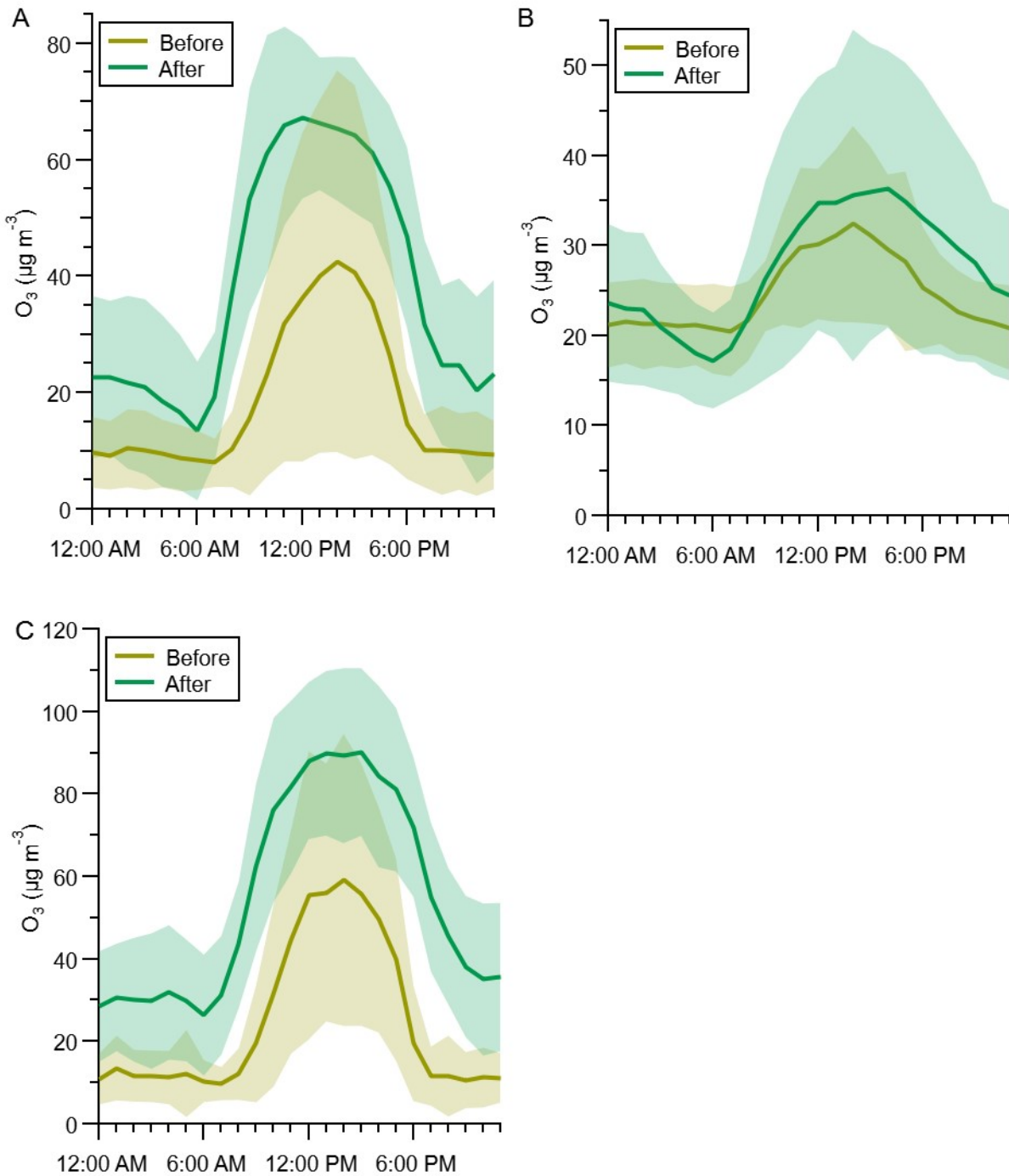


Fig S11: Comparison of diurnally-averaged O<sub>3</sub> pre-lockdown and during phase-I lockdown at: (A) Zoo Park (Hyderabad), (B) ITO (Delhi), and (C) RK Puram (Delhi) sites.



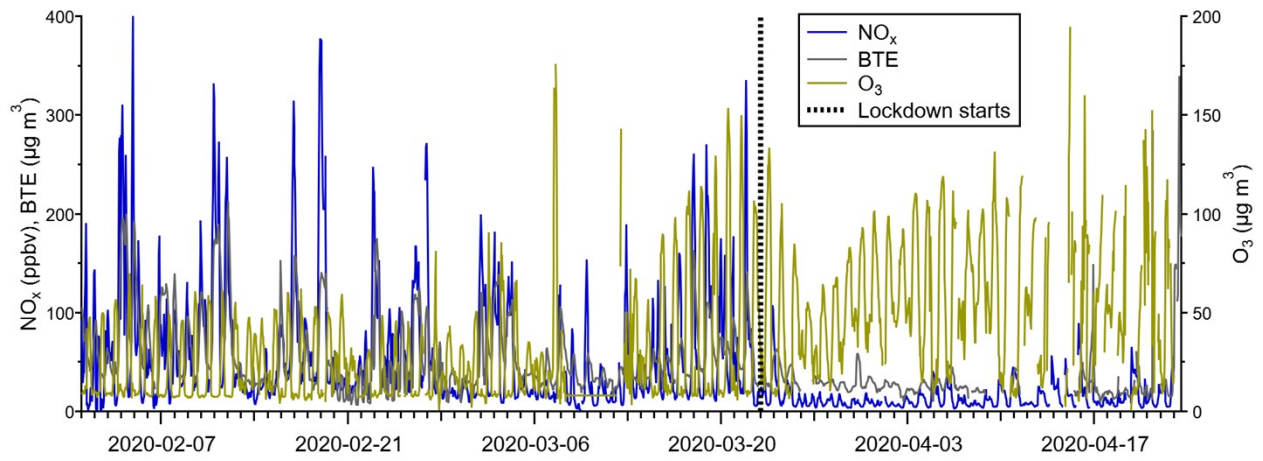


Fig S12: Time series of O<sub>3</sub>, NO<sub>x</sub>, and the sum of benzene, toluene, and ethylbenzene (BTE) from RK Puram. The vertical line indicates the start of the lockdown.

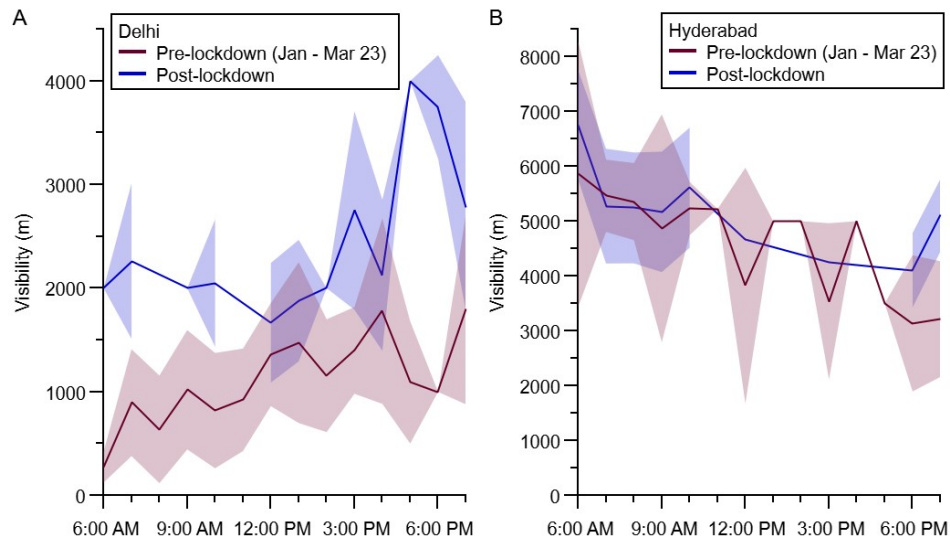


Fig S13: Comparison of visibility measurements before and after the lockdown at: (A) Safdarjung Airport, Delhi, and (B) Begumpet Airport, Hyderabad.

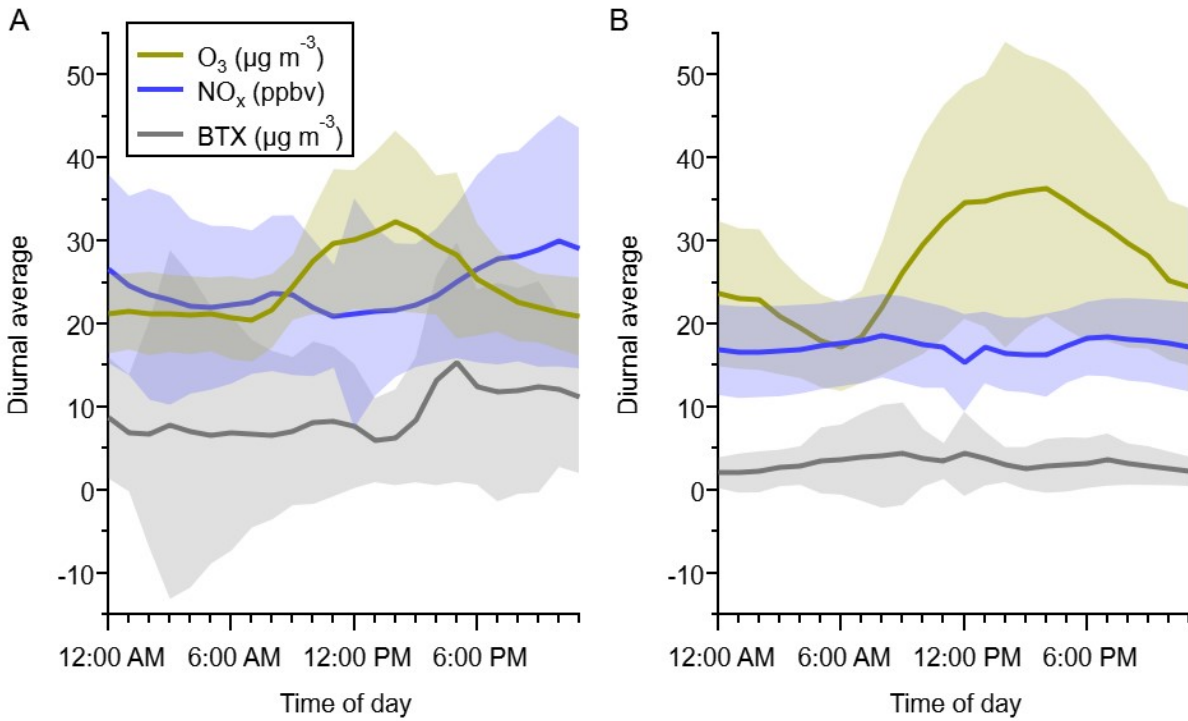


Fig S14: Diurnal averages of O<sub>3</sub>, NO<sub>x</sub>, and the sum of benzene, toluene, and xylene (BTX) in Zoo Park in the (A) 51 days preceding lockdown and (B) 17 days following start of phase-I lockdown. Shaded areas represent the standard deviation of the measurements.