Statistics metrics used in analysis

$$ME = \frac{1}{n}\sum_{i=1}^{n}|P_i - O_i| \quad (1)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(P_i - O_i)^2}{n}} \quad (2)$$

$$NMB = \frac{\sum_{i=1}^{n}(P_i - O_i)}{\sum_{i=1}^{n} O_i} \quad (3)$$

$$NME = \frac{\sum_{i=1}^{n}|P_i - O_i|}{\sum_{i=1}^{n} O_i} \quad (4)$$

$$R = \frac{\sum_{i=1}^{n}\left((P_i - \bar{P}) * (O_i - \bar{O})\right)}{\sqrt{\sum_{i=1}^{n}(P_i - \bar{P})^2 * \sum_{i=1}^{n}(O_i - \bar{O})^2}} \quad (5)$$

$$CRMSE = \sqrt{\frac{\sum_{i=1}^{n}\left((P_i - \bar{P}) - (O_i - \bar{O})\right)^2}{n}} \quad (6)$$

Where P_i is the i-th prediction value, O_i is the i-th observed value, $\bar{P}$ is the mean predicted value, $\bar{O}$ is the mean observed value, and n is total number of paired sample.

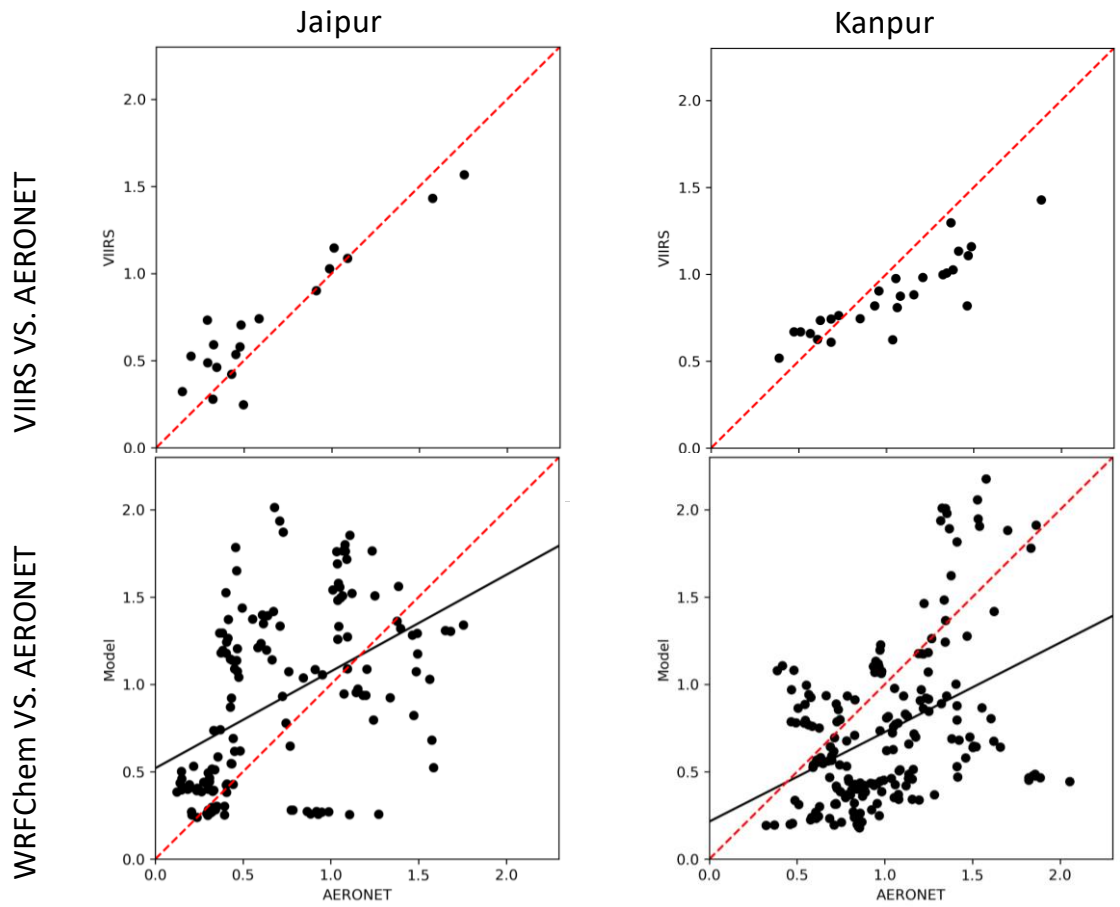

Figure S1 AOD550 scatter plot for VIIRS vs. AERONET (top row) and WRF-Chem vs AERONET (bottom row) for Jaipur (left column) and Kanpur (right column). Dashed lines shows 1-1 line

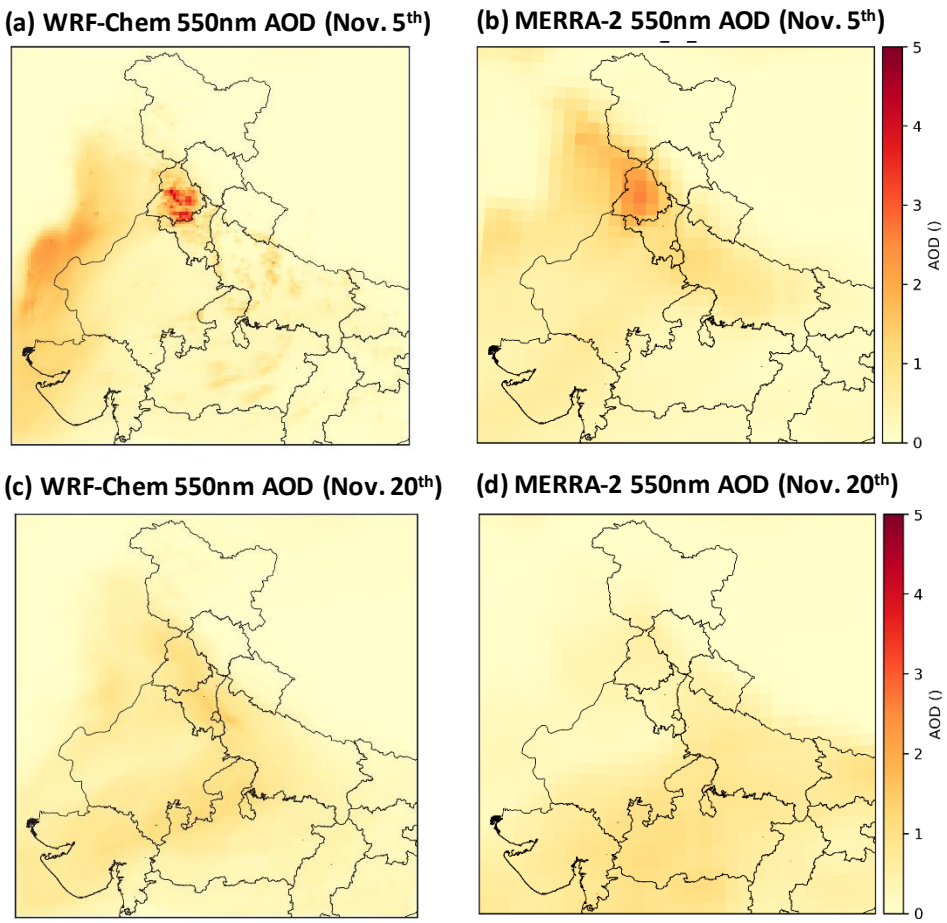

Figure S2 Modeled (left column) and MERRA-2 (right column) AOD maps at 550 nm for Nov 5th (panels: a, b) and Nov 20th (panels: c, d) daytime hours. Color bar is modified (compared to the plots in manuscript) to better represent low AOD values.

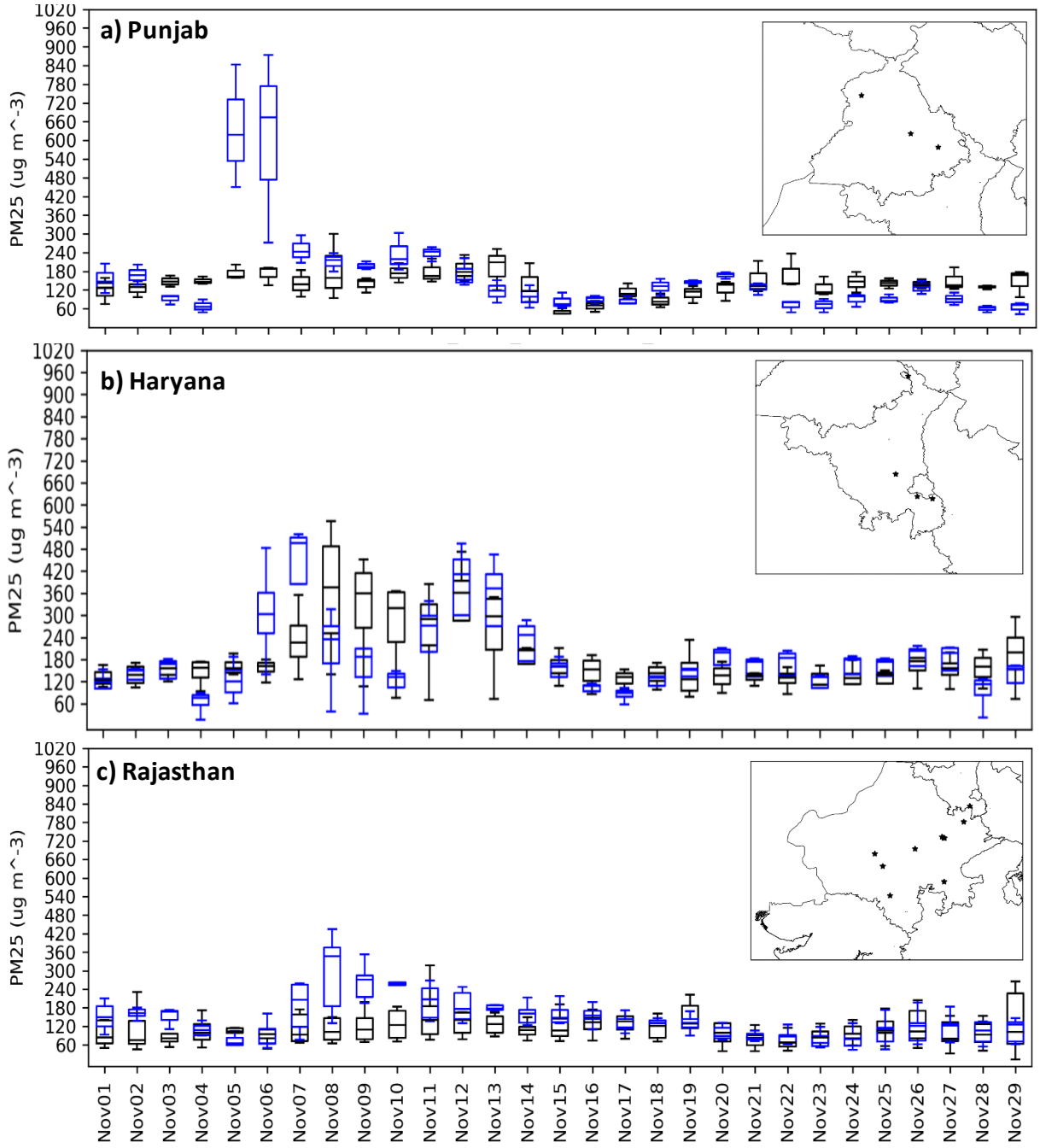

Figure S3 Box and Whisker plots of observed (black) and modeled (base scenario) daily $PM_{2.5}$ concentration averaged over all CPCB stations in: a) Punjab (3 stations), b) Haryana (4 stations), c) Rajasthan (10 stations). The inset maps show the location of stations in each province.

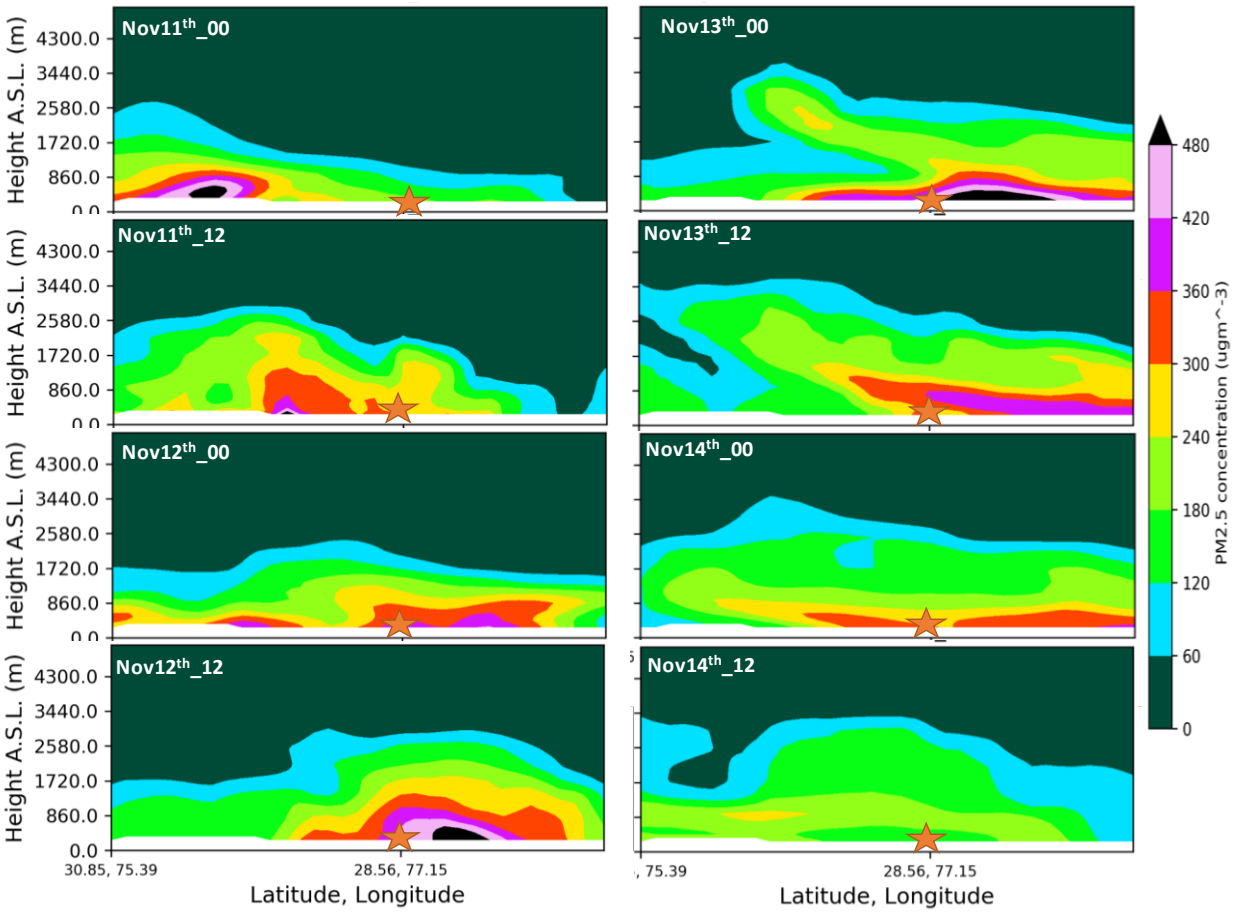

Figure S4 Vertical cross section of $PM_{2.5}$ concentration through the path shown in Fig. 1 for the days between Nov. 11th and Nov. 14th. For each day, two snapshots are shown at 00UTC (5:30AM local time) and 12UTC (5:30PM local time). The orange star shows the location of Delhi through the path.

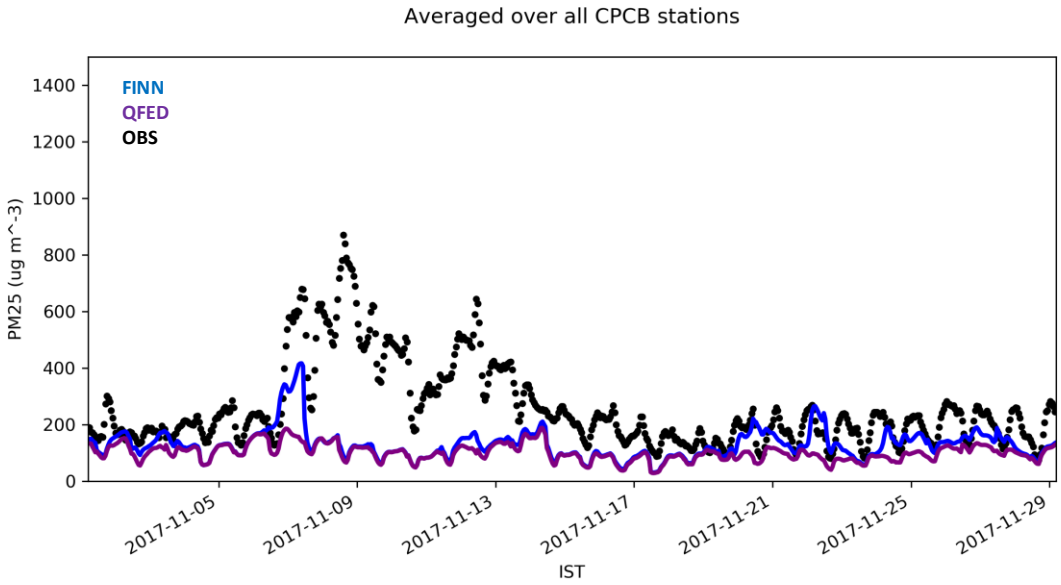

Figure S5 $PM_{2.5}$ time series using FINN (blue) and QFED (purple) biomass burning emission inventories averaged over all CPCB stations

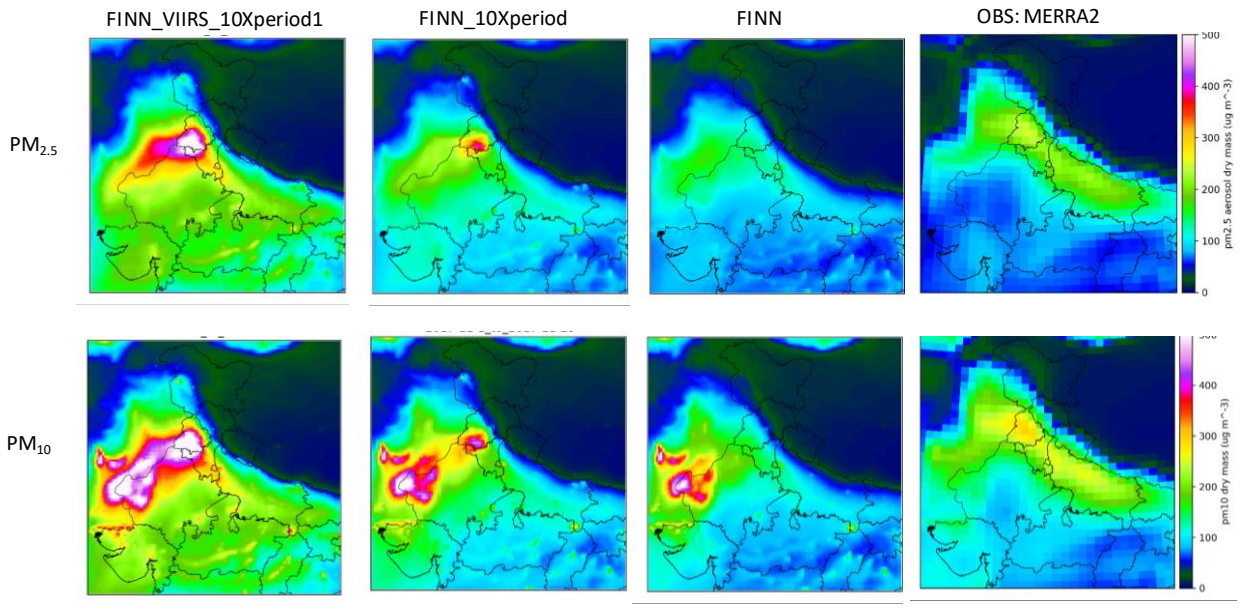

Figure S6 maps of $PM_{2.5}$ (top row) and PM_{10} (bottom row) concentration averaged in November 2017 (all hours) using different experiments on FINN biomass burning emission inventory

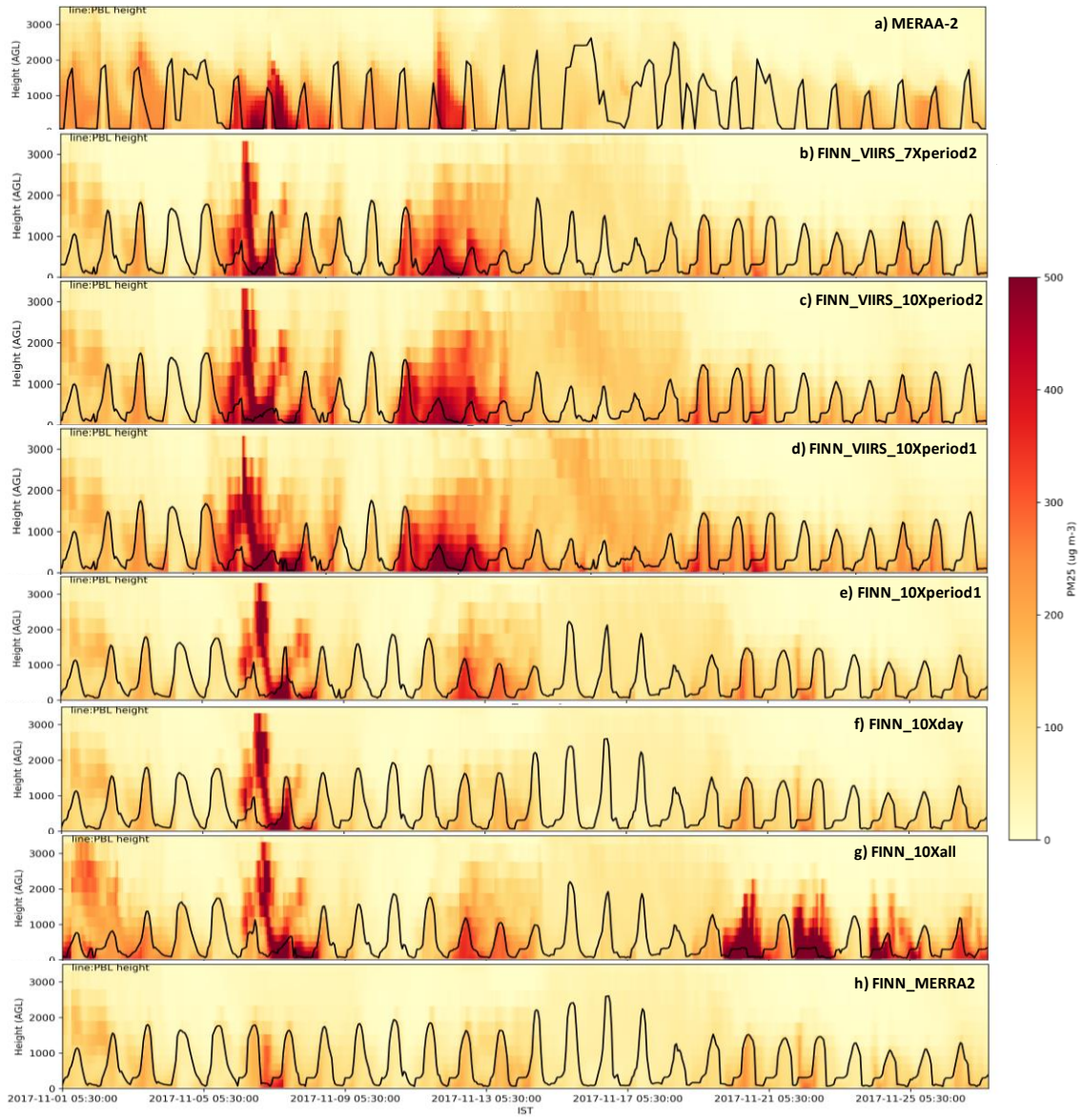

Figure S7 vertical cross section model $PM_{2.5}$ sensitivity to different experiments on FINN emission inventory at US Embassy coordinates

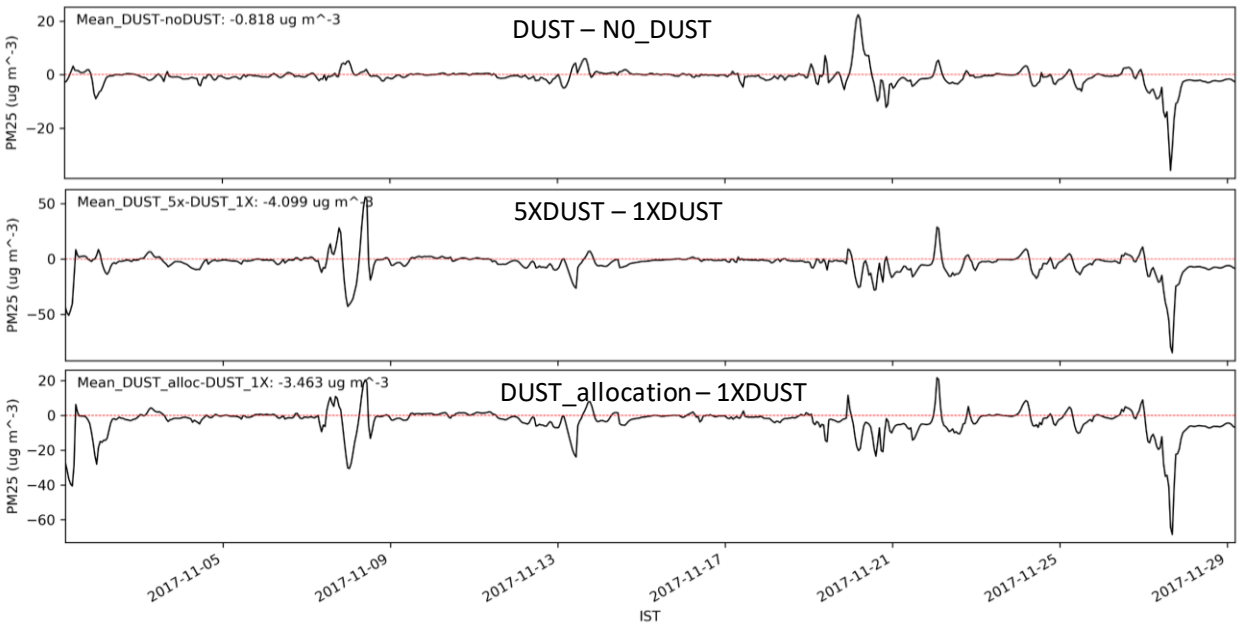

Figure S8 $PM_{2.5}$ concentrations' difference time series due to modifications in dust-scheme at the location of the US Embassy

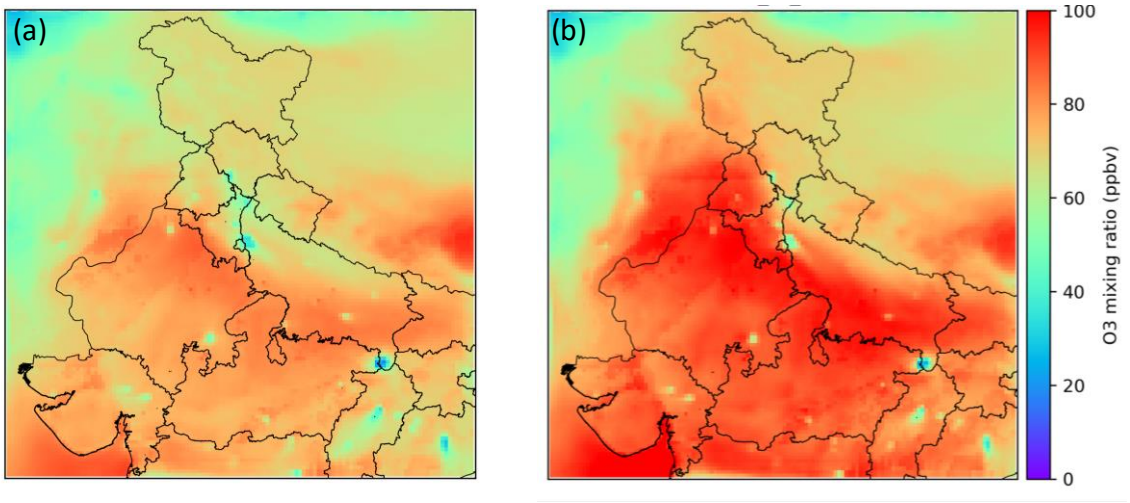

Figure S9 Daytime (8AM-6PM) ozone concentrations averaged during November 2017 for: a) a scenario without fire emission scaling (FINN_MERRA2) and b) base scenario with 7times higher fire emissions. Panel b is copied from the manuscript (Fig. 15) for easier comparison.

Table S1 coordinates of CPCB ground measurement stations in Delhi used for statistical performance of experiments

Station	Latitude	Longitude
Alipur	28.8153	77.1530
Anand Vihar	28.6468	77.3160
Aya Nagar	28.4707	77.1099
Burari Crossing	28.7256	77.2011
CRRI Mathura Road	28.5512	77.2736
DTU	28.7500	77.1113
East Arjun Nagar	28.6556	77.2859
IGI Airport (T3)	28.5628	77.1180
IHBAS, Dilshad Garden	28.6812	77.3025
ITO	28.6317	77.2494
Lodhi Road	28.5918	77.2273
Mandir Marg	28.6364	77.2011
NSIT Dwarka	28.6091	77.0325
North Campus, DU	28.6574	77.1585
Punjabi Bagh	28.6740	77.1310
Pusa	28.6396	77.1463
R K Puram	28.5633	77.1869
Shadipur	28.6515	77.1473
Sirifort	28.5504	77.2159

Table S2 Statistics of all experiments for all days in November 2017 compared with data from CPCB stations: STD: Standard Deviation, R: Pearson Correlation Coefficient, RMSE: Root Mean Squared Error, NMB: Normalized Mean Bias, NME; Normalized Mean Error, MB: Mean Bias, ME: Mean Error

ITEM	Hourly Mean	Hourly STD	24-hours R	24-hours RMSE	24-hours NMB	24-hours NME	24-hours MB	24-hours ME
CPCB Obs. data	255.47	146.62	—	—	—	—	—	—
FINN_VIIRS_7Xperiod2	213.86	113.87	0.48	118.47	-16.6	27.63	-42.38	70.54
FINN_VIIRS_10Xperiod2	254.15	149.44	0.51	112.52	-1.06	29.56	-2.72	75.46
FINN_VIIRS_10Xperiod1	276.2	136.42	0.54	104.11	7.27	29.51	18.56	75.34
FINN_10Xperiod1	174.33	95.92	0.44	136.21	-32.06	35.62	-81.86	90.94
FINN_10Xday	151.73	85.99	0.39	155.43	-40.61	42.13	-103.68	107.54
FINN_10Xall	295.48	279.81	0	279.68	15.57	66.47	37.21	169.69
NO_DUST	294.84	279.96	0	279.8	14.31	66.42	36.54	169.57
DUST_5X	298.85	280.76	-0.01	281.62	15.95	66.81	40.71	170.55
DUST_allocation	298.25	280.39	0	281.03	15.71	66.79	40.1	170.5
FINN_MERRA2	141.94	55.93	0.33	167.88	-44.32	45.82	-113.14	116.98
FINN_MOZART	130.39	53.23	0.3	176.91	-48.73	49.19	-124.4	125.58
FINN_CAMS	128.45	53.6	0.31	178.2	-49.59	49.96	-126.59	127.54
FINN_CAMCHEM	127.03	51.93	0.27	180.72	-50.24	50.49	-128.25	128.9
QFED_CAMCHEM	101.15	29.25	0.41	196.33	-60.11	60.11	-153.44	153.44

Table S3 Same as Table S2 except after excluding extreme days of Nov. 7th, 8th, 9th, 10th.

Scenario	Hourly Mean	Hourly Standard Deviation	24-hours R	24-hours RMSE	24-hours NMB	24-hours NME	24-hours MB	24-hours ME
CPCB Obs data	215.26	97.58						
FINN_VIIRS_7Xperiod2	209.91	104.94	0.7	55.11	-2.44	18.96	-5	38.94
FINN_VIIRS_10Xperiod2	241.75	123.19	0.66	88.56	13.98	25.56	28.71	52.5
FINN_VIIRS_10Xperiod1	264.67	109.84	0.65	76.87	20.93	25.63	42.99	52.64
FINN_10Xperiod1	166.16	64.42	0.57	81.43	-24.3	28.73	-49.92	59.01
FINN_10Xday	143.82	58.12	0.42	101.02	-32.74	34.62	-67.25	71.12
FINN_10Xall	301.38	287.4	-0.03	261.96	31.22	68.94	64.12	141.62
NO_DUST	300.63	287.54	-0.02	262.09	30.89	68.89	63.45	141.51
DUST_5X	305.6	288.48	-0.03	263.76	33.05	69.26	67.88	142.25
DUST_allocation	304.7	288.02	-0.03	263.29	32.59	69.29	67.13	142.32
FINN_MERRA2	141.58	51.65	0.42	107.42	-35.26	37.13	-72.43	76.27
FINN_MOZART	130.44	49.2	0.4	116.37	-40.21	40.78	-82.58	83.76
FINN_CAMS	128.27	49.17	0.4	117.8	-41.18	41.64	-84.59	85.53
FINN_CAMCHEM	129.56	48.87	0.38	117.98	-40.85	41.21	-83.91	84.64
QFED_CAMCHEM	100.23	29.29	0.5	146.14	-55	55	-112.98	112.98