



Supplement of

Role of atmospheric aerosols in severe winter fog over the Indo-Gangetic Plain of India: a case study

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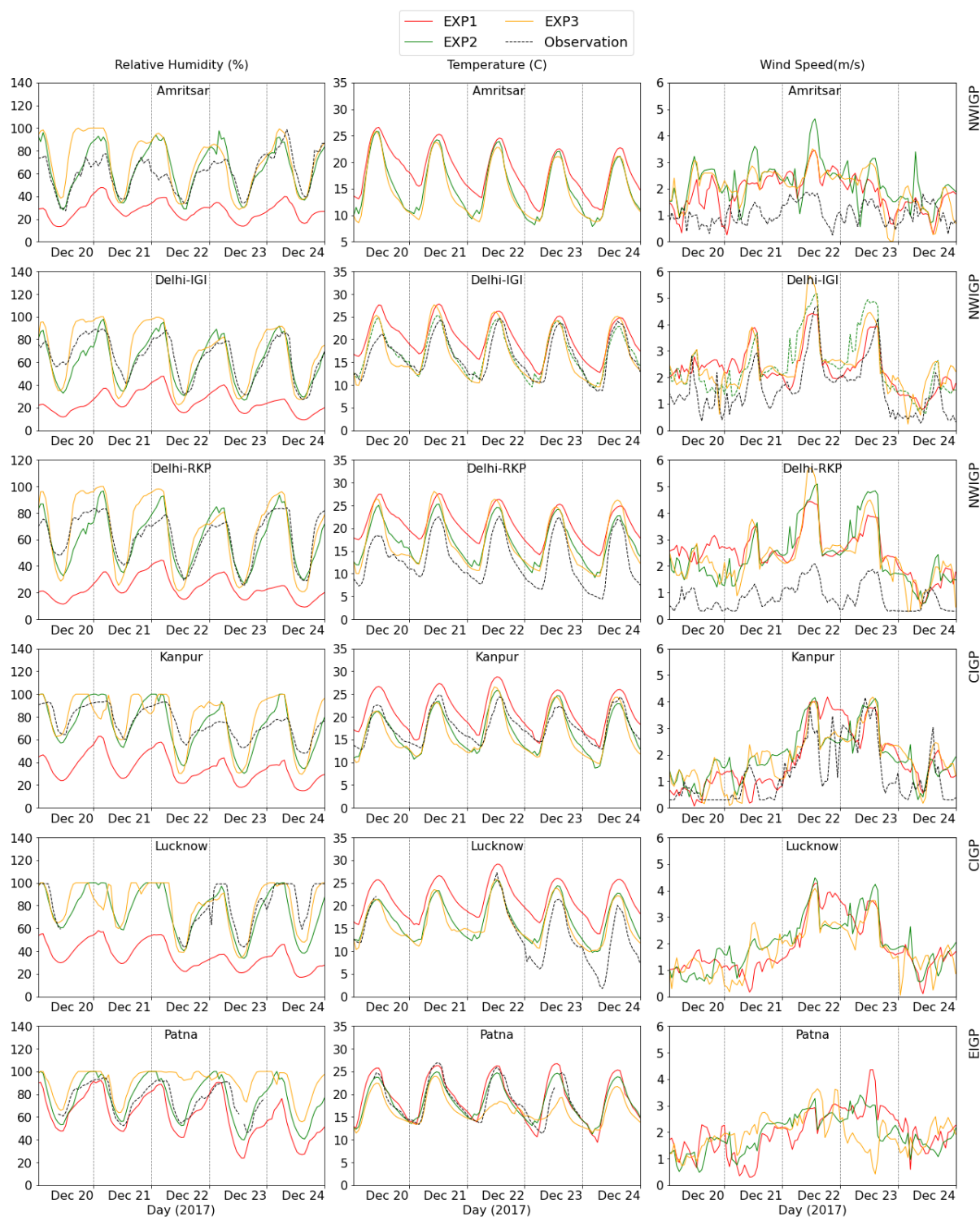


Figure S1 Time series of simulated and observed 2-m relative humidity, 2-m temperature, and 10-m wind speed at stations in six major cities. Observations are obtained from CPCB (Central Pollution Board of India) except at IGI-Delhi, which is from the WiFEX campaign. Due to gaps in CPCB data, only four stations report wind speeds for this time period. The period of study is 20th December 2017 to 24th December 2017.

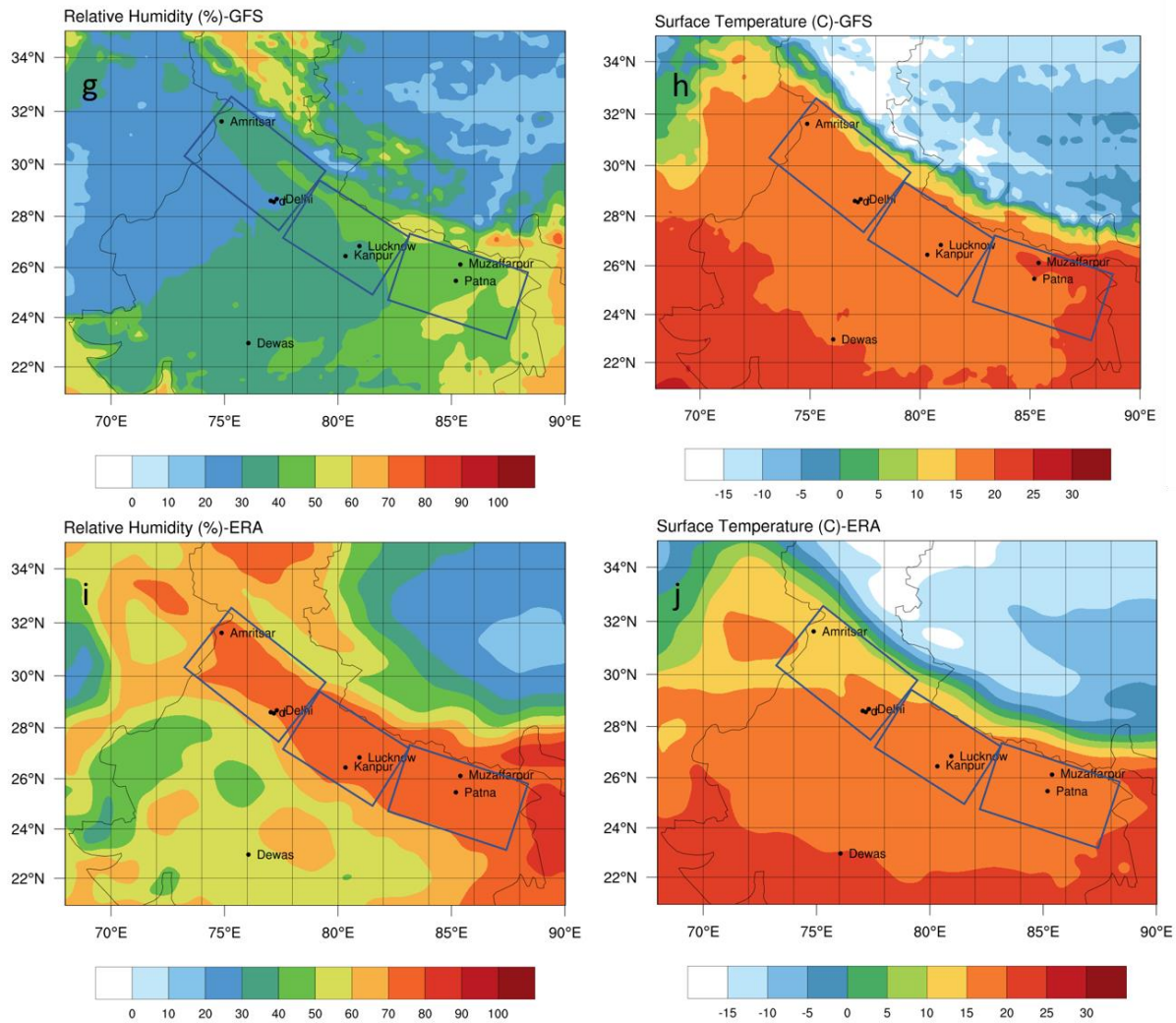
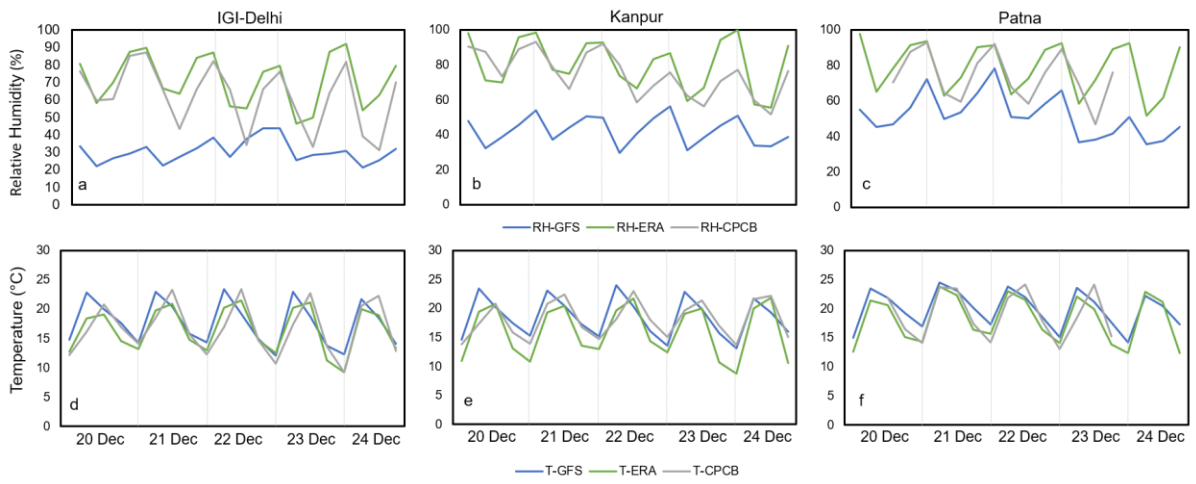


Figure S2 (i) Comparison of RH (a-c) and T (d-f) at the surface with measurements from CPCB (Central Pollution Control Board of India) for the stations IGI in Delhi (NWIGP), Kanpur (CIGP), and

Patna (EIGP) respectively. (ii) Maps of relative humidity and surface temperature from NCEP Final Analysis (GFS-FNL) datasets (g and h) and ERA-Interim Project (i and j).



Figure S3: (a) Meteorology monitoring station at Amritsar (b,c) Map showing area around the meteorology monitoring station at RKPuram, Delhi. Pictures obtained from ©Google Earth (<https://earth.google.com/>)

Table S1. Statistical analysis for WRF-Chem simulated and observed PM_{2.5} from eight CPCB stations.

Stations	No of data points	Mean_ PM _{2.5} CPCB	Stdev	Mean_ PM _{2.5} WRF Chem	Stdev	NMB%	RMSE	NRMSE	r	p
Amritsar	119	83.2	32.0	85.0	44.6	2.17	41.41	0.50	0.45	2.5E-07
Dwarka (Delhi)	119	209	76.0	108	116.	-48.49	137	0.65	0.61	2.7E-13
IHBAS (Delhi)	119	127.5	51.9	168.2	126.06	31.92	124	0.97	0.38	2.5E-05
RKP (Delhi)	119	239.43	95.7	142.6	130	-40.44	144	0.6	0.59	2.0E-12
Kanpur	119	232	141	109	74.8	-53.02	172	0.74	0.52	1.3E-09
Lucknow	73	169.04	83.26	86	55.45	-30.14	100	0.59	0.74	6.9E-14
Patna	82	211	78.0	141	98.3	-32.31	138	0.65	0.08	0.47
Muzaffarpur	111	227.4	83.64	138.5	78.7	-36.47	143	0.63	0.04	0.67

* $NMB(\%) = \frac{\sum(Modelled - Observation)}{\sum Observation} * 100\%$

* $NRMSE = RMSE / Mean_PM_{2.5_CPCB}$

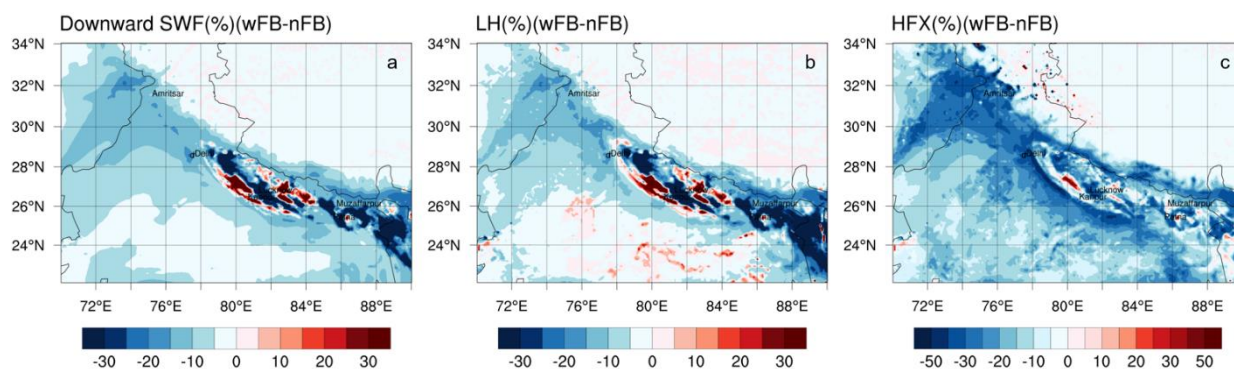


Figure S4 Effect of Aerosol Radiation Feedback on the (a) surface reaching shortwave flux (SWF), (b) latent heat flux (LH), and (c) sensible heat flux (HFX) for December 24, 2017 at local noon (13:30-15:30 IST).

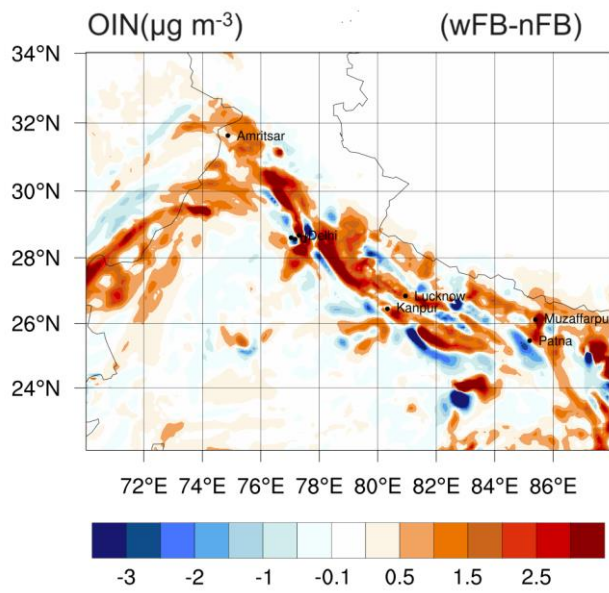


Figure S5 Effect of Aerosol Radiation Feedback on surface OIN (other inorganics) concentrations for December 24, 2017 at local noon (13:30-15:30 IST).

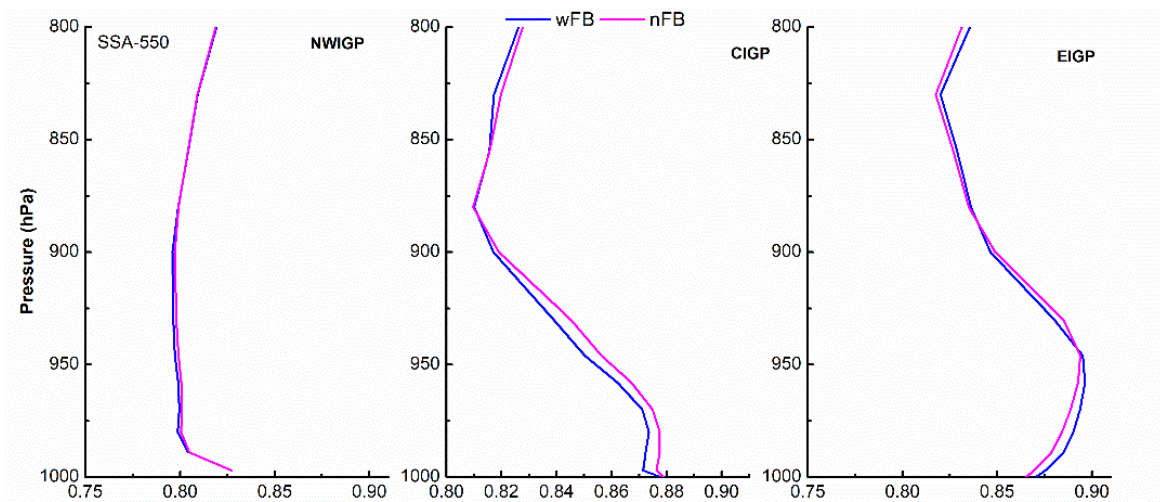


Figure S6 Single scattering albedo (SSA) profile at 550nm over NWIGP, CIGP, and EIGP with and without aerosol-radiation (AR) feedback averaged for December 23 and 24, 2017.

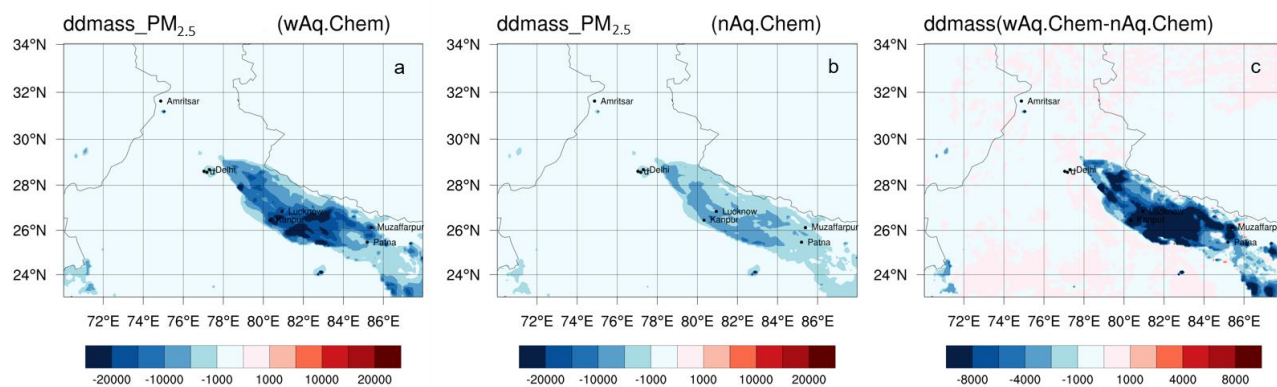


Figure S7 Dry deposition ($ddmass$) flux ($\mu\text{g m}^{-2}\text{h}^{-1}$) of $\text{PM}_{2.5}$ (a) with aqueous phase chemistry (b) without aqueous phase chemistry and (c) difference between with and without aqueous phase chemistry over IGP for 24 Dec 2017.

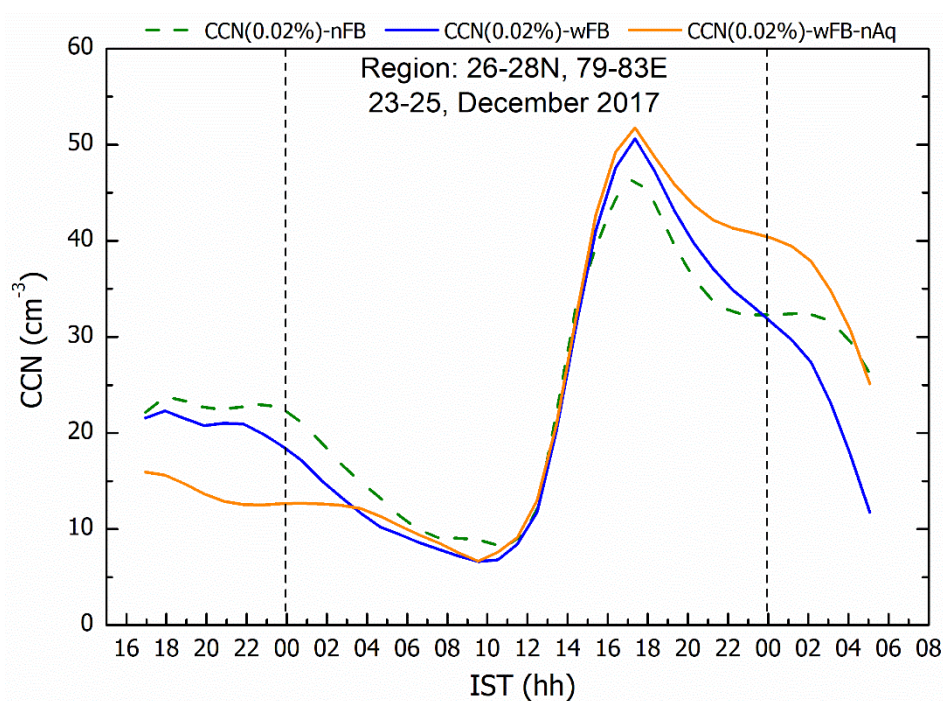


Figure S8 Hourly variation in WRF-Chem CCN at 0.02% supersaturation for the simulations with AR feedback, no AR Feedback, and no Aqueous phase chemistry. These are average CCN concentrations for CIGP (26°N - 28°N , 79°E - 83°E ; both foggy and non-foggy grid points) from December 23, 15:30 hrs to 25 December, 04:30 hrs.