Supplementary Information

Title: Spatio-seasonal concentrations, source apportionment and assessment of associated human health risks of $PM_{2.5}$-Bound polycyclic aromatic hydrocarbons in Delhi, India

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Table S1: Summary of chemical analytical parameters during quantification of PAHs

Chemical name of individual PAH	Chemical Abbreviation	No of Rings	Targeted Mass	Retention time	Blank Concentration (ng/ml)	IDL (ng/ml)	MDL (ng/m^3)	% Recovery
Naphthalene	Naph	2	128	8.21	0.94	0.62	0.01	87
Acenaphthylene	Acy	3	152	11.54	1.06	0.68	0.02	88
Acenaphthene	Ace	3	154	12.83	1.04	0.64	0.02	86
Fluorene	Flu	3	166	13.19	1.43	0.89	0.02	96
Phenanthrene	Phe	3	178	15.69	1.47	1.05	0.02	92
Anthracene	Ant	3	178	15.81	1.29	0.83	0.02	90
Fluoranthene	Flan	4	202	16.38	1.26	0.91	0.02	89
Pyrene	Pyr	4	202	20.15	1.17	0.59	0.01	93
Benzo[*a*]anthracene	BaA	4	228	25.09	1.93	1.38	0.03	101
Chrysene	Chr	4	228	25.27	1.75	0.93	0.02	102
Benzo[*b*]fluoranthene	BbF	5	252	31.34	1.48	0.82	0.02	101
Benzo[*k*]fluoranthene	BkF	5	252	31.52	1.23	0.71	0.01	108
Benzo[*a*]pyrene	BaP	5	252	33.35	1.14	0.65	0.01	109
Indeno[*1,2,3-cd*]pyrene	InP	6	276	40.91	1.69	0.91	0.02	107
Dibenzo[*ah*]anthracene	DahA	5	278	41.33	2.23	1.76	0.04	106
Benzo[*ghi*]perylene	BghiP	6	276	42.53	1.68	0.96	0.02	108

Table S2: Details of characteristic ratios used for qualitative assessment of sources of PAHs

S. No	characteristic ratio	Ratio	Sources
1.	LMW/HMW	< 1	Pyrolytic
		> 1	Petrogenic
2.	BaA/(BaA+Chr)	< 0.2	Petrogenic
		0.2 ≤ 0.35	Either Petrogenic or Combustion
		> 0.35	Combustion
3.	InP/BghiP	~ 0.4	Gasoline
		~ 1.0	Diesel
4.	BaP/BghiP	0.3-0.78	Traffic
		0.9-6.6	Coal

Table S3: Source profiles of emission sources of PAHs used for CMB8.2 model simulation

PAHs	Coal Combustion		Biomass burning		Vehicles			MSW burning	Others	
	Residential	Powerplant	Fuel wood	CRB (paddy)	Petrol	Diesel	CNG		LPG	Non-road diesel engine
Flu	0.064	0.168	0.036	0.189	0.002	0.103	0.232	0.066	0.058	0.172
Phe	0.001	0.061	0.001	0.493	0.022	0.039	0.143	0.433	0.002	0.505
Ant	0.001	0.039	0.001	0.085	0.006	0.061	0.012	0.079	0.001	0.062
Pyr	0.236	0.086	0.082	0.091	0.324	0.134	0.373	0.173	0.293	0.131
BaA	0.045	0.147	0.035	0.032	0.058	0.121	0.066	0.051	0.042	0.017
Chr	0.074	0.162	0.051	0.035	0.051	0.076	0.134	0.046	0.094	0.027
BbF	0.062	0.088	0.055	0.031	0.071	0.013	0.001	0.063	0.047	0.023
BkF	0.065	0.033	0.061	0.021	0.071	0.002	0.001	0.013	0.068	0.017
BaP	0.121	0.064	0.401	0.011	0.147	0.245	0.001	0.031	0.168	0.014
InP	0.089	0.062	0.091	0.005	0.149	0.203	0.001	0.021	0.056	0.014
DahA	0.137	0.024	0.101	0.002	0.003	0.002	0.001	0.001	0.098	0.002
BghiP	0.105	0.066	0.085	0.005	0.097	0.002	0.035	0.023	0.073	0.016

Table S4: Polycyclic aromatic hydrocarbons (PAHs) with their toxicity data

S. No	Compound	Chemical Abbreviation	IARC Classification	Toxic Equivalent Factor (TEF)
1.	Fluorene	Flu	3	0.001
2.	Phenanthrene	Phe	3	0.001
3.	Anthracene	Ant	3	0.01
4.	Pyrene	Pyr	3	0.001
5.	Benzo[a]anthracene	BaA	2B	0.1
6.	Chrysene	Chr	2B	0.01
7.	Benzo[b]fluoranthene	BbF	2B	0.1
8.	Benzo[k]fluoranthene	BkF	2B	0.1
9.	Benzo[a]pyrene	BaP	1	1.0
10.	Indeno[l,2,3-cd]pyrene	InP	2B	0.1
11.	Dibenzo[a,h]anthracene	DahA	2A	1.0
12.	Benzo[g,h,i]perylene	BghiP	3	0.01

IARC: International Agency for Research on Cancer

Table S5. Exposure parameters considered for cancer risk assessment

Parameter	Unit of expression	Values considered	Reference
IR_a	m^3/h	0.65	*USEPA (2011)*
IR_b	m^3/day	15.7	*USEPA (2011)*
ET	h/day	24	*Mateo et al. (2018)*
EF	days/year	365	*USEPA (2005)*
ED	years	54	*Jamhar et al. (2014)*
ADAF	NA	1	*USEPA (2005)*
BW	kg	70	*USEPA (2011)*
AT	days	25250	*USEPA (2005), Jamhar et al. (2014)*
IUR	ng/m^3	8.7×10^{-5}	*WHO (2005)*

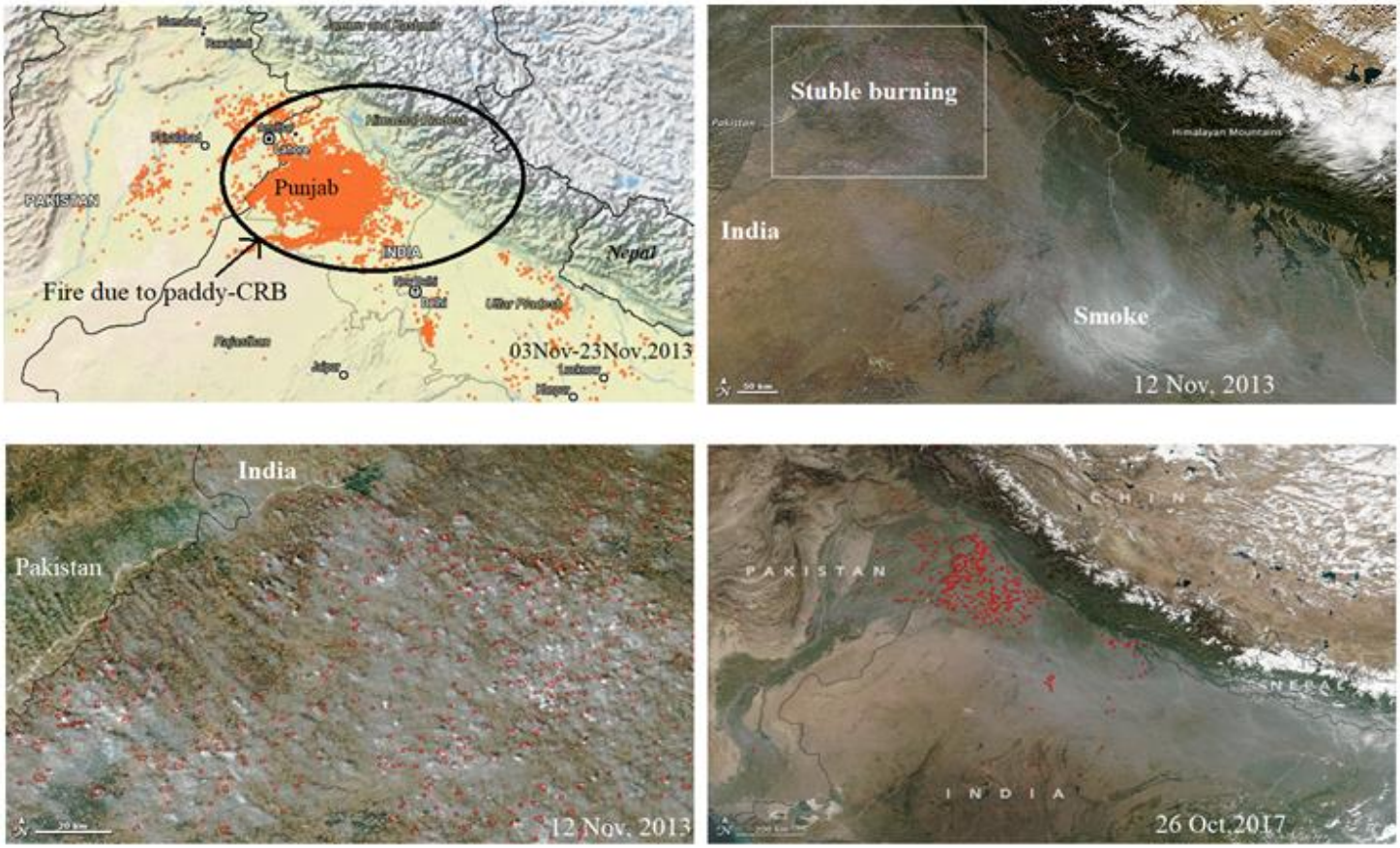

Fig. S1. Terra and Aqua MODIS satellite images showing biomass (crop-residue) burning hotspots in North India close to Delhi during winter (November 2013) and smoke formation in the IGP region. Downloaded from https://visibleearth.nasa.gov

References

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