SUPPLEMENTARY MATERIAL

Chemical characteristics and trends of Indian Summer Monsoon Rainfall: A Review

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Table S1: Summary of ionic species (μeq/l) in precipitation in the Northwest region

Location	Sampling Year	N	Latitude	Longitude	pH [mean±SD (min-max)]	Na^+	Mg^{2+}	Ca^{2+}	K^+	NH_4^+	Cl^-	NO_3^-	SO_4^{2-}	Reference
Northwest Region														
Delhi	1978	23	28.7041° N	77.1025° E	7.5 ± 0.3 (7.0-8.4)	170 ± 99	145 ± 209	133 ± 142	57 ± 71		136 ± 131		902 ± 576	Subramanian and Saxena, 1980
Delhi	2009-2011	1	28°37′ N	77°12′ E	5.8	14 ± 15	51 ± 75	108 ± 149	3.0 ± 11	32 ± 35	23 ± 27	30 ± 32	65 ± 58	Tiwari et al., 2016
Ahmedabad, Gujarat	2000	17	23.0°N	72.6°E	6.7 ± 0.4 (6.1-7.4)	67 ± 53	25 ± 18	131 ± 110	7.5 ± 7.1	88 ± 73	99 ± 78	25 ± 17	77 ± 57	Rastogi and Sarin, 2005
Ahmedabad, Gujarat	2001	48	23.0°N	72.6°E	6.8 ± 0.6 (5.2-8.2)	109 ± 176	32 ± 45	162 ± 189	5.8 ± 6.6	38 ± 27	125 ± 203	23 ± 20	73 ± 75	Rastogi and Sarin, 2005
Ahmedabad, Gujarat	2002	26	23.0°N	72.6°E	6.8 ± 0.5 (5.6-7.9)	179 ± 214	48 ± 52	296 ± 322	11 ± 14	52 ± 39	217 ± 261	37 ± 28	102 ± 89	Rastogi and Sarin, 2005
Ahmedabad, Gujarat	2008-2011	16	23°02.18' N	72°32.65' E	5.2 ± 0.3 (4.6-5.7)	25 ± 20	14 ± 10	63 ± 48	2.7 ± 1.6	39 ± 27	30 ± 25	20 ± 13	57 ± 32	Chatterjee and Singh, 2012
Kurukshetra, Haryana	2009-2011	1	29°96' N	76°83' E	5.6	19 ± 18	74 ± 101	120 ± 164	2.8 ± 6.0	29 ± 48	31 ± 31	30 ± 41	60 ± 71	Tiwari et al., 2016
Regional Average					6.7 ± 0.8	116 ± 159	54 ± 106	170 ± 211	16 ± 37	48 ± 44	129 ± 189	26 ± 22	222 ± 402	

Table S2: Summary of ionic species (μeq/l) in precipitation in the Hilly region

Location	Sampling Year	N	Latitude	Longitude	pH [mean±SD (min-max)]	Na^+	Mg^{2+}	Ca^{2+}	K^+	NH_4^+	Cl^-	NO_3^-	SO_4^{2-}	Reference
Hilly Region														
Kothi, Kullu, Himalaya	Jun-Oct, 2006-2007	1	32°31' N	77°20' E	5.7 ± 0.6 (5.2-6.4)	21 ± 12	10 ± 4.0	30 ± 8.0	5.0 ± 3.0	13 ± 5.0	26 ± 13	17 ± 5.0	25 ± 9.0	Tiwari et al., 2012
Manali, Western Himalaya	Jun-Sep, 2009-2011	1	32°24' N	77°16' E	5.7	15 ± 7.9	48 ± 70	102 ± 106	11 ± 10	8.4 ± 12	23 ± 12	30 ± 24	39 ± 38	Tiwari et al., 2016
Nainital, Central Himalayas	Jun-Sep, 2012	1	29.4° N	79.5° E	5.6 ± 0.3 (4.9-6.5)	50 ± 52	43 ± 34	124 ± 24	39 ± 12	40 ± 15	67 ± 13	12 ± 20	19 ± 22	Bisht et al., 2017
Roorkee, Uttarakhand	Jun-Sep, 2001-2002	1	29°51' N	77°63' E	7.0 ± 0.1 (6.9-7.2)	39 ± 18	23 ± 3.5	145 ± 11	15 ± 9.4		59 ± 22	33 ± 13	23 ± 6.3	Jawad Al Obaidy and Joshi, 2006
Regional Average					6.0 ± 0.7	31 ± 16	31 ± 18	100 ± 50	18 ± 15	21 ± 17	44 ± 23	23 ± 10	26 ± 8.9	

Table S3: Summary of ionic species (µeq/l) in precipitation in the Central northeast region

Location	Sampling Year	N	Latitude	Longitude	pH [mean±SD (min-max)]	Na^+	Mg^{2+}	Ca^{2+}	K^+	NH_4^+	Cl^-	NO_3^-	SO_4^{2-}	Reference
Central Northeast Region														
Dayalbagh, Agra	Jun-Sep, 1988	1	27°10' N	78°05' E	7.1	22	7.9	121	12	38	25	5.7	47	Kumar et al., 2002
Dayalbagh, Agra	Jun-Sep, 1991	1	27°10' N	78°05' E	6.9	48	24	137	5.1	42	21	15	24	Kumar et al., 2002
Dayalbagh, Agra	Jun-Sep, 1992	1	27°10' N	78°05' E	6.8	15	27	48	3.7		32	9.5	17	Kumar et al., 2002
Dayalbagh, Agra	Jun-Sep, 1994	1	27°10' N	78°05' E	6.7	24	23	66	4.3	23	33	20	18	Kumar et al., 2002
Dayalbagh, Agra	Jun-Sep, 1995	1	27°10' N	78°05' E	7.0	22	65	66	15	48	19	15	25	Kumar et al., 2002
Dayalbagh, Agra	Jun-Sep, 1996	1	27°10' N	78°05' E	7.1	18	49	56	4.6	115	29	28	30	Kumar et al., 2002
RRL, Bhubaneswar (Bl sample)	Mid-Jun to Mid-Oct, 1995-1997	1	20°16' N	85°50' E	6.3	29	11	37	3.4	18	31	12	27	Das et al., 2005
SBG, Bhubaneswar (Bl sample)	Jun-Oct, 1997-98	1	20°15' N	85°52' E	5.5	11	4.9	15	2.2	15	11	9.9	18	Das et al., 2005
Lucknow, UP, Monsoon	Mid-Jun to Sept, 1999-2001	1	26°30' to 27°30' N	80°34' to 81°12' E	6.5 ± 0.30	8.5 ± 5.2	4.4 ± 2.5	15 ± 5.8	2.4 ± 1.8	3.6 ± 2.9	9.9 ± 5.7	7.6 ± 4.1	14 ± 4.9	Khare et al., 2004
Ballia, Eastern Uttar Pradesh	Jul-Sep, 2001	1	25°44' N	84°11' E	6.3 ± 0.16	6.5 ± 7.7	5.2 ± 3.4	41 ± 29	3.6 ± 2.9	58 ± 28	8.9 ± 10	15 ± 13	33 ± 24	Tiwari et al., 2006
Dhanbad, Jharkhand	Jul-Oct, 2003	1	24°37' to 24°02' N	86°07' to 86°50' E	5.3 ± 0.59	16 ± 19	11 ± 15	38 ± 52	14 ± 32	30 ± 29	23 ± 25	7.4 ± 0.48	53 ± 40	Singh et al., 2007
Dhanbad, Jharkhand	Jul-Oct, 2004	1	24°37' to 24°02' N	86°07' to 86°50' E	5.6 ± 0.84	28 ± 31	20 ± 18	100 ± 117	14 ± 16.4	62 ± 11	34 ± 31	13 ± 17	77 ± 54	Singh et al., 2007
Dhanbad, Jharkhand	Jul-Oct, 2005	1	24°37' to 24°02' N	86°07' to 86°50' E	5.1 ± 0.70	19 ± 24	24 ± 34	102 ± 119	27 ± 53	46 ± 57	36 ± 46	17 ± 22	87 ± 107	Singh et al., 2007
BHU, Varanasi, Uttar Pradesh	Jun-Sep, 2009	1	25.2677° N	82.9913° E	5.9	25	13	63	5.9	12	28	21	33	Bisht et al., 2015
MAL, Varanasi, Uttar Pradesh	Jun-Sep, 2009	1	25.3255° N	82.9952° E	5.9	17	26	99	7.1	12	24	31	40	Bisht et al., 2015
Varanasi, Uttar Pradesh	Jun-Sep, 2009-2011	1	25°22' N	83°00' E	6.3 -7.9	13 ± 9.8	11 ± 13	52 ± 55	5.1 ± 8.2	14 ± 24	21 ± 13	22 ± 24	38 ± 41	Tiwari et al., 2016
Gorakhpur, Uttar Pradesh	Jun-Sep, 2009-2011	1	26°45' N	83°24' E	5.4	28 ± 13	102 ± 70	199 ± 159	5.7 ± 10	48 ± 34	47 ± 21	45 ± 29	79 ± 49	Tiwari et al., 2016
Kanpur, Uttar Pradesh	Jun-Sep, 2009-2011	1	26°28' N	80°20' E	5.8	17 ± 21	11 ± 26	67 ± 146	2.5 ± 5.9	32 ± 29	28 ± 32	25 ± 56	44 ± 84	Tiwari et al., 2016
Meerut, Uttar Pradesh	Jun-Sep, 2009-2011	1	28°59' N	77°42' E	5.7	15 ± 11	52 ± 50	93 ± 94	4.5 ± 16	28 ± 40	26 ± 18	28 ± 24	55 ± 38	Tiwari et al., 2016

Ballia, Eastern Uttar Pradesh	Jun-Sep, 2009-2011	1	25°44' N	84°11' E	6.0	20 ± 14	14 ± 16	109 ± 83	14 ± 16	31 ± 39	34 ± 21	28 ± 20	42 ± 27	Tiwari et al., 2016
Bokaro, Jharkhand	Jun-Sep, 2012	45	23° 45' N to 23°50' N	85° 30' E to 86°03' E	6.1	84 ± 32	119 ± 45	125 ± 73	16 ± 8.4	100 ± 55	100 ± 62	73 ± 38	133 ± 56	Mahato et al., 2016
Regional average					6.1 ± 0.53	64 ± 40	92 ± 60	116 ± 71	13 ± 8.6	81 ± 57	71 ± 60	56 ± 41	105 ± 65	

Table S4: Summary of ionic species (µeq/l) in precipitation in the Northeast region

Location	Sampling Year	N	Latitude	Longitude	pH [mean±SD (min-max)]	Na^+	Mg^{2+}	Ca^{2+}	K^+	NH_4^+	Cl^-	NO_3^-	SO_4^{2-}	Reference
Northeast Region														
Kolkata, West Bengal	Jun–Sep, 2013-2014	1	22.33° N	88.20° E	6.1 ± 1.4 (4.4-6.9)	54	17	117	14	37	40	25	88	Roy et al., 2016
Falta, West Bengal	Jun–Sep, 2013-2014	1	22.18° N	88.06° E	5.3 ± 1.1 (4.3-6.6)	57	12	7.1	3.1	18	56	11	40	Roy et al., 2016
Darjeeling, West Bengal	Jun–Sep, 2013-2014	1	27°01′ N	88°15′ E	5.0 ± 0.80 (4.2-6.1)	19	1.1	1.7	0.40	7.6	20	5.1	9.2	Roy et al., 2016
Kolkata, West Bengal	Jul-Oct, 2019	13	22°29′57.53" N	88°22′18.66" E	6.8 ± 0.74 (5.4-8.0)	60 ± 26	16 ± 10	61 ± 71			69 ± 34	202 ± 182	65 ± 61	Majumdar et al., 2020a
Jorhat, Assam	Mar 2005- Feb 2006	1	26.46° N	96.16° E	5.5 (4.1-7.1)	10 ± 10	9.8 ± 11	42 ± 49	6.3 ± 9.0	40 ± 76	7.7 ± 9.3	39 ± 62	53 ± 60	Kulshrestha et al., 2014
Guwahati, Assam	Jun 2016-Jun 2017	1	26°11′14″ N	91°41′30″ E	5.2	7.0 ± 10	6.0 ± 4.0	27 ± 21	8.0 ± 26		42 ± 21	60 ± 31	65 ± 32	Garaga et al., 2020
Regional Average					6.4 ± 0.92	52 ± 29	14 ± 9.8	55 ± 67	6.4 ± 5.3	26 ± 16	58 ± 35	151 ± 178	61 ± 55	

Table S5: Summary of ionic species (µeq/l) in precipitation in the Peninsular region

Location	Sampling Year	N	Latitude	Longitude	pH [mean±SD (min-max)]	Na^+	Mg^{2+}	Ca^{2+}	K^+	NH_4^+	Cl^-	NO_3^-	SO_4^{2-}	Reference
Peninsular Region														
Silent Valley, Kerala	Jun-Sep, 1989	1	11°8' N	76° 26' E	6.2	41	14	46	3.0	2.0	37	11	21	Prakasa Rao et al., 1995
Silent Valley, Kerala	Jun-Sep, 1990	1	11°8' N	76° 26' E	5.0	51	14	44	4.0	3.0	48	30	19	Prakasa Rao et al., 1995
Bangalore	Jun-Sep, 2005-2006	1	12°58' N	77° 35' E	5.0	32	9.3	92	10	33	37	41	80	Prasad et al., 2008
Bangalore	Jun-Sep, 2006-2007	1	12°58' N	77° 35' E	4.9	35	12	101	13	39	36	46	83	Prasad et al., 2008
Mangalore	Jul-Sep, 2009	10	12.9141° N	74.8560° E		46 ± 20	15 ± 8.3	38 ± 34	5.5 ± 4.2		48 ± 25	2.0 ± 1.4	17 ± 12	Gurumurthy et al., 2012
Regional average					5.3 ± 0.59	44 ± 18	14 ± 7.4	47 ± 37	6.0 ± 4.4	20 ± 19	45 ± 22	11 ± 16	27 ± 25	

Table S6: Summary of ionic species (µeq/l) in precipitation in the West central region

Location	Sampling Year	N	Latitude	Longitude	pH [mean±SD (min-max)]	Na^+	Mg^{2+}	Ca^{2+}	K^+	NH_4^+	Cl^-	NO_3^-	SO_4^{2-}	Reference
West Central Region														
Pune	Jul-Sep, 1988	25	18° 32' N	73° 51' E	6.4 ± 0.38	4.2 ± 3.6	4.1 ± 2.9	41 ± 35				7.7 ± 4.4	25 ± 17	Naik et al., 1994
Pune	Jun-Sep, 1992	1	18° 32' N	73° 51' E	6.0	15	5.0	16	1.0	11	20	8.0	12	Pillai et al., 2001
Pune	Jun-Sep, 1993	1	18° 32' N	73° 51' E	6.6	21	12	52	2.0	12	25	11	18	Pillai et al., 2001
Pune	Jun-Sep, 1994	1	18° 32' N	73° 51' E	6.6	33	14	66	1.0	11	32	10	24	Pillai et al., 2001
Pune	Jun-Sep, 1995	1	18° 32' N	73° 51' E	6.6	33	16	65	1.0	10	33	12	26	Pillai et al., 2001
Pune	Jun-Sep, 1996	1	18° 32' N	73° 51' E	5.9	28	17	57	2.0	11	19	13	28	Pillai et al., 2001
Pune	Jun-Sep, 1998	1	18° 32' N	73° 51' E	5.7	13	5.0	58	1.0	6.0	26	14	32	Pillai et al., 2001
Hyderabad	May-Oct, 1999-2001	28	17.57° N	78.5° E	6.4 ± 0.4 (5.5-7.2)	27 ± 23	14 ± 23	76 ± 86	17 ± 22	25 ± 22	62 ± 98	30 ± 69	23 ± 17	Kulshrestha et al., 2003
Kalyan, Mumbai	Jun-Sep, 1994-1995	1	18° 38' N	72° 52' E	5.3 (4.0-7.5)	147	64	130	6.0	14	134	66	110	Naik et al., 2002
Colaba, Mumbai	Jun-Sep, 1994-1995	1	18° 52' N	72° 47' E	6.4 (5.5-7.5)	179	59	155	6.0	12	171	34	52	Naik et al., 2002
Alibag, Mumbai	Jun-Sep, 1994-1995	1	19° 15' N	73° 07' E	6.7 (6.0-8.0)	220	48	133	5.0	8.0	236	9.0	36	Naik et al., 2002
Trombay, Mumbai	Jun-Sep, 2006	1	19°2' N	75° 53' E	5.7 (4.8-6.4)	221	129	331	9.9	51	275	17	174	Prathibha et al., 2010
Nagpur, Maharashtra	Jun-Aug, 2006	1	21°11′32″ N	79°06′13″ E	6.3 ± 0.30 (6.0-7.3)	12 ± 2.2	3.3 ± 1.2	29 ± 5.9	2.3 ± 1.0	7.0 ± 2.2	13 ± 2.6	10 ± 1.7	21 ± 5.4	Salve et al., 2008
Comba, Madgaon, South Goa	Jun-Sep, 2008	1	15°16′49″ N	73°57′37″ E	6.3 ± 0.28 (5.4-6.9)	87 ± 13	15 ± 2.5	43 ± 7.9	4.8 ± 0.67	13 ± 2.2	110 ± 19	12 ± 1.2	23 ± 4.0	Gobre et al., 2010
Regional average					6.3 ± 0.42	29 ± 47	13 ± 20	66 ± 74	13 ± 19	21 ± 20	70 ± 97	16 ± 42	28 ± 27	