



Air quality monitoring network in Hong Kong

Presented by: Eric HO
Air Science Group
Environmental Protection Department, HKSAR

HKEPD's Air Quality Monitoring Network

- HKEPD operates a network of fifteen (15) Air Quality Monitoring Stations. 12 stations for monitoring general (ambient) air quality and 3 stations for roadside air quality.
- Another new general station will be established by 2015
- Eight major air pollutants measured (NO₂, CO, O₃, SO₂, PM₁₀, PM_{2.5}, TSP and Lead)

Locations of Existing HKEPD's Air Quality Monitoring Stations (AQMS)



Main Objectives

- understand air pollution problems in order to develop cost-effective policies and solutions;
- assess the extent of compliance or otherwise with the standards and targets;
- assist the assessment of public's exposure to air pollution; and
- provide the public with information on current and forecasted air quality

A typical general AQMS



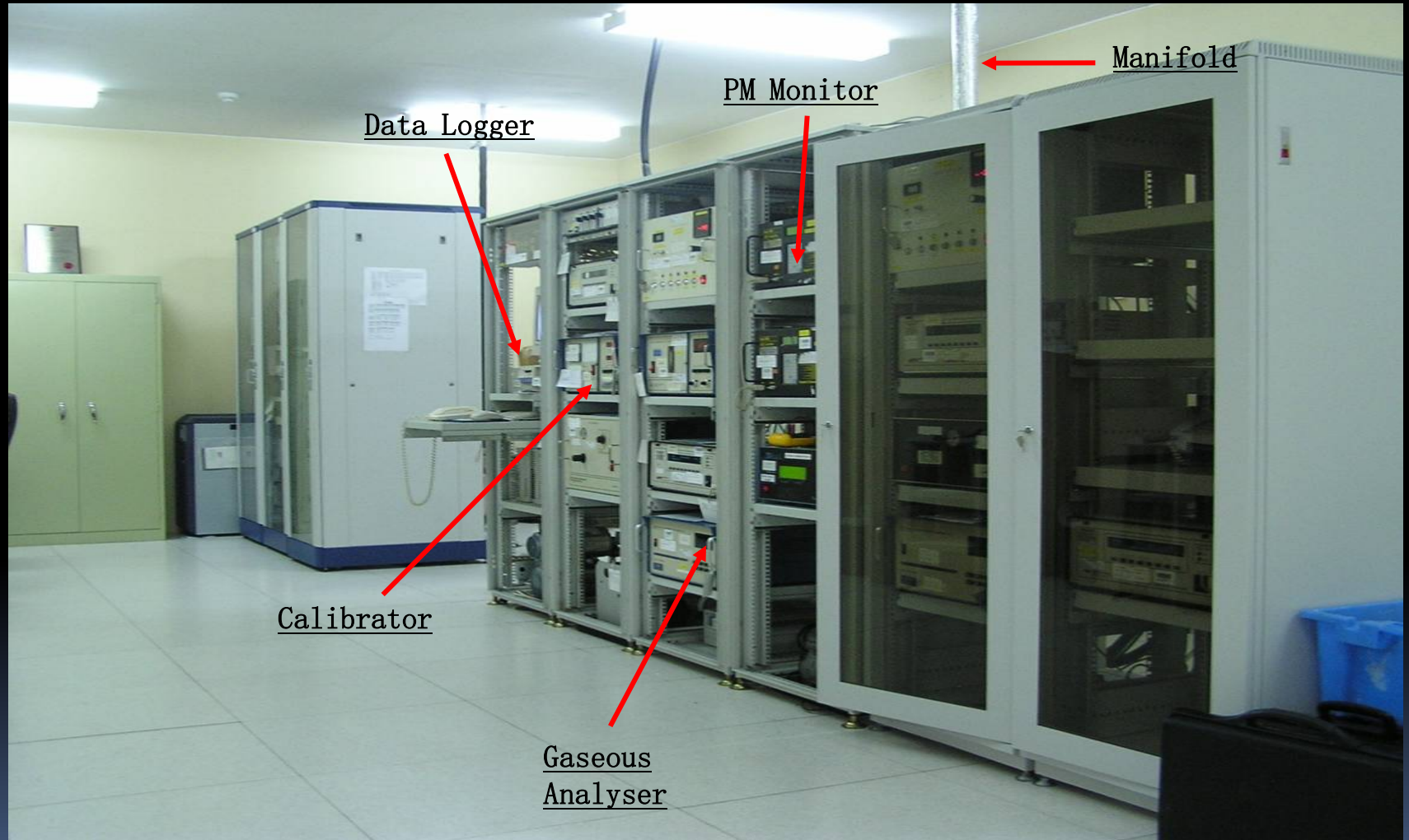
Sampling inlet

Located on the
roof of low rise
building

High volume samplers



Setup inside a typical general AQMS



New general AQMS at Tuen Mun



Roadside Air Quality Monitoring Station (Central)

- Microscale Monitoring station
- To assess the impact of vehicular emissions to sensitive users including pedestrians in Central district as well as to determine the roadside air quality in areas of similar conditions





GIORGIO ARMANI

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Background General AQMS (Tap Mun)

- To serve as the background station for tracking impact of regional air pollution
- One of the 3 Hong Kong stations in the PRD Regional Air Quality Monitoring Network



Air Science Laboratory

Maintenance & Development

-  Equipment maintenance
-  Testing and calibration
-  Handling of filter samples



Quality Control & Quality Assurance

-  To perform quality audits
-  To ensure data are highly accurate and precise



Data Processing & Management

-  Handling of data collected
-  Releasing of information to the public

FORECAST of Health Risk			
29-08-2014	Today P.M.	Tomorrow A.M.	
General Stations	Low to Moderate	Low	
Roadside Stations	Low to Moderate	Low to Moderate	
 低 LOW  中 MODERATE  高 HIGH  甚高 VERY HIGH  嚴重 SERIOUS			
1 2 3 4 5 6 7 8 9 10 10+			
Air Quality Health Index			
11:00 29-08-2014		AQHI	Health Risk
Central/Western		2 	Low
Eastern		2 	Low
Kwun Tong		2 	Low
Sham Shui Po		2 	Low

Other measurements and studies

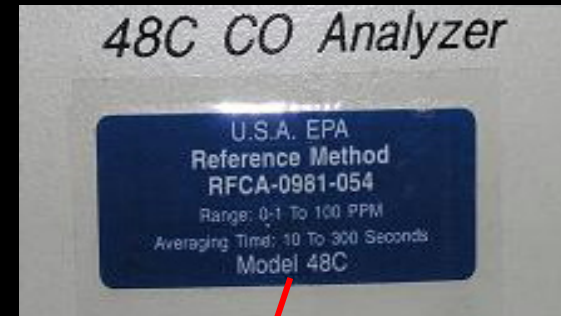
- Toxic Air Pollutants including persistent organic pollutants (POPs) are measured at two general stations
- Acid Rain Samplers in three general stations
- **Saturation Monitoring Studies:** To conduct territory-wide intensive PM_{2.5} and nitrogen dioxide (NO₂) measurement studies covering both ambient and roadside in the coming two years for characterising spatial distribution of air pollution and adequacy of the monitoring network.

Acid Rain System



Equipment Selection and Measurement Method

- All equipment used are designated by USEPA
- USEPA reference or equivalent methods are used for monitoring



Equipment used in measuring air pollutant concentration

<u>Pollutants</u>	<u>Measurement Principle</u>	<u>Commercial Instrument</u>
SO ₂	UV fluorescence	TECO Model 43A, 43I, API 100E
NO/NO ₂ /NO _x	Chemiluminescence	API 200A, Thermo 42I
O ₃	UV absorption	API 400/400A, Thermo 49I
CO	Non-dispersive infra red absorption with gas filter correlation	TECO Model 48C API 300
TSP	Gravimetric	General Metals 2310
PM ₁₀ & PM _{2.5}	Gravimetric Oscillating microbalance	Graseby Anderson PM ₁₀ , Partisol 2025 R&P TEOM series 1400-AB, 1405DF
SO ₂ , NO ₂ , O ₃	Differential Optical Absorption Spectroscopy	Opsis AR 500 System

Standards of Air Quality Monitoring Network

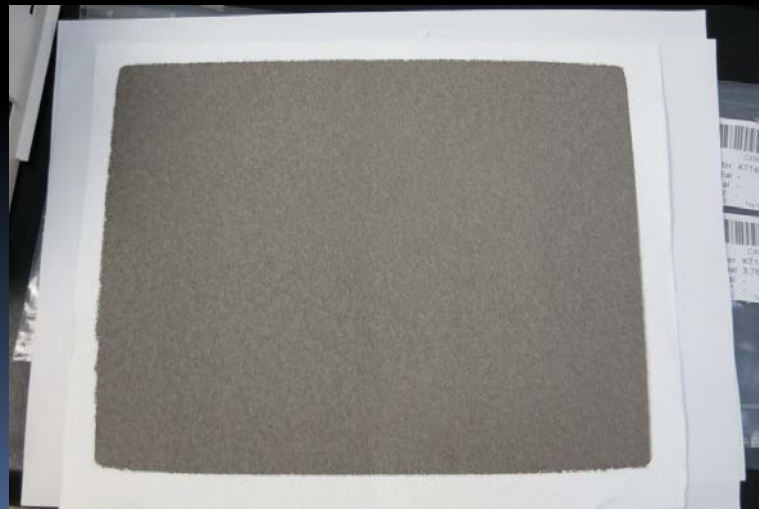
- ISO17025 accreditation under the Hong Kong Laboratory Accreditation Scheme (HOKLAS)
- ISO9001:2008 standard
- All the monitoring stations were built and operated with reference to USEPA's standards
- Comprehensive QA/QC manuals and Standard Operating Procedures



Mercury Monitoring in Hong Kong

- Routine monitoring on particulate-bound mercury through the speciation analysis of PM10 and PM2.5 sampled filters by laboratories
- Instrument used:
 - Inductively Coupled Plasma - Mass Spectrometry (ICP-MS)
 - X-ray Fluorescence (XRF) Analyzer

RSP Speciation Analysis (8" x 10" Filter)



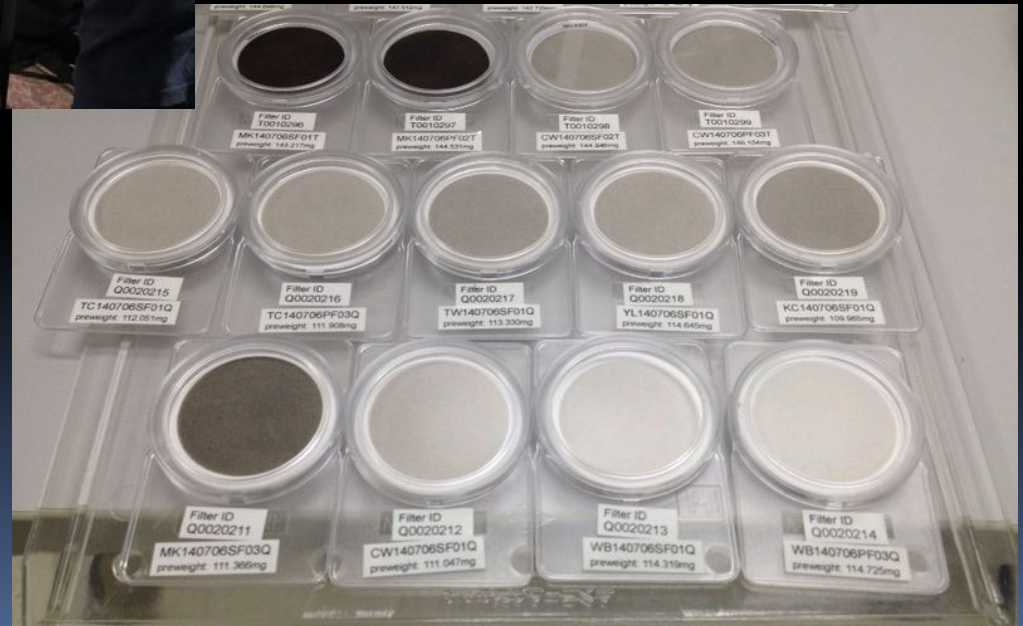
RSP Speciation Analysis (8" x 10" Filter)

AIRBORNE SPECIES CONCENTRATIONS AS DERIVED FROM RESPIRABLE SUSPENDED PARTICULATES FOR 2012

Station	RSP	As	Be	Cd	Ni	Pb	Cr	Al	Mn	Fe	Ca	Mg	V	Zn	Ba	Cu	Hg	Se	Na+	K+	Cl-	Br-	SO4=	C	THC	NH4+	NO3-	OC	EC	TC
Kwun Tong	47	3.8	0.04	0.74	4.3	31	2.3	160	14	442	461	229	9.0	138	16	46	0.19	0.6	1685	347	1142	7	9108	27661	1045	3034	3997	5761	1982	7743
Yuen Long	48	4.2	0.04	0.86	4.3	36	2.4	165	17	410	464	172	10.7	168	15	41	0.20	0.6	1171	415	672	7	9318	24543	1306	3268	3741	6566	2421	8987
Central / Western	45	4.1	0.04	0.68	4.4	31	2.1	168	15	355	488	217	10.1	128	11	41	0.20	0.6	1544	329	1013	7	8865	23350	1149	3082	4177	5134	1901	7035
Tsuen Wan	42	3.6	0.04	0.74	5.7	28	1.9	141	14	335	392	176	15.7	141	14	28	0.21	0.5	1257	328	690	7	8702	22366	1110	2813	2977	5816	2171	7988
Kwai Chung	48	3.9	0.04	0.79	8.7	32	2.4	175	14	424	455	209	23.7	125	17	38	0.20	0.6	1393	325	648	6	9823	25279	1117	3195	3481	6651	2643	9294
Tung Chung	42	3.9	0.04	0.85	4.2	31	2.1	171	13	318	378	203	10.0	112	14	47	0.19	0.7	1378	374	623	6	9490	21556	953	2914	2866	5313	1707	7020
Mong Kok	54	3.8	0.04	0.75	5.5	32	3.1	156	18	702	552	201	11.4	156	36	41	0.20	0.6	1359	363	884	7	8796	30865	2017	3146	4422	9715	3531	13246
Average	46	3.9	0.04	0.77	5.3	31	2.3	162	15	420	454	201	13.0	138	17	41	0.20	0.6	1399	354	809	7	9164	24960	1225	3063	3651	6348	2310	8658

- Note: 1. All figures are in nanograms per cubic metre except RSP which is in micrograms per cubic metre
2. All values presented are annual arithmetic means.
3. The concentrations of all species are derived from chemical analysis of respirable suspended particulates samples
4. The Chemical Elements As - Arsenic
Be - Beryllium
Cd - Cadmium
Ni - Nickel
Pb - Lead
Cr - Chromium
Al - Aluminium
Mn - Manganese
Fe - Iron
Ca - Calcium
Mg - Magnesium
V - Vanadium
Zn - Zinc
Ba - Barium
Cu - Copper
Hg - Mercury
Se - Selenium
Na+ - Sodium Ion
K+ - Potassium Ion
Cl- - Chloride Ion
Br- - Bromide Ion
SO4= - Sulphate Ion
C - Total carbon containing compounds
THC - Total cyclohexane extractable hydrocarbons
NH4+ - Ammonium Ion
NO3- - Nitrate Ion
OC - Organic Carbon
EC - Elemental Carbon
TC - Total Carbon

FSP Speciation Analysis (47mm Filter)



FSP Speciation Analysis (47mm Filter)

Appendix A. Side-by-side comparison of the six one-year studies of PM_{2.5} samples (in µg/m³) collected during 2000-01, 2004-05, 2008-09, 2011, 2012, and the current 2013 period. Carbon concentrations (in µgC/m³) are from the IMPROVE_TOR method.

	2001	2001	2001	2005	2005	2005	2005	2009	2009	2009	2009	2011	2011	2011	2011	2011	2011	2012	2012	2012	2012	2012	2012	2013	2013	2013	2013	2013	2013
	MK	TW	HT	MK	TW	YL	HT	MK	TW	YL	HT	MK	CW	WB	TC	TW	YL	MK	CW	WB	TC	TW	YL	MK	CW	WB	TC	TW	YL
Teflon Mass	58.28	34.12	25.66	53.02	38.59	41.31	28.44	41.60	30.61	31.78	24.10	43.08	35.36	31.32	35.57	35.30	38.22	34.71	29.32	28.75	29.10	31.26	27.95	36.72	28.99	26.08	28.59	29.30	31.01
QMA Mass	62.50	37.28	25.85	54.87	40.15	43.91	29.64	45.92	34.00	36.34	25.94	47.92	39.84	35.89	39.81	40.56	42.89	39.96	34.47	32.60	32.89	35.22	32.01	41.38	33.36	30.38	32.40	33.97	35.37
Cl	0.256	0.138	0.143	0.283	0.126	0.264	0.124	0.312	0.175	0.213	0.298	0.205	0.191	0.105	0.109	0.122	0.174	0.108	0.174	0.072	0.088	0.117	0.109	0.019	0.137	0.093	0.093	0.095	0.111
NO ₃ ⁻	1.65	1.34	0.71	2.40	1.64	2.86	0.76	2.81	2.03	2.42	1.51	2.45	2.39	0.93	1.90	1.80	2.59	1.01	1.85	0.84	0.95	1.38	1.09	1.31	1.42	0.58	1.36	1.17	1.76
SO ₄ ²⁻	9.50	9.17	8.64	12.84	13.17	13.91	11.91	10.41	10.48	11.04	9.66	10.91	10.91	11.13	11.09	10.91	10.85	8.88	8.16	9.56	9.82	9.59	8.25	9.14	9.08	9.25	9.08	8.88	8.96
NH ₄ ⁺	5.17	2.96	2.16	4.40	4.07	4.62	3.86	3.40	3.27	3.47	2.63	4.37	4.45	4.08	4.38	4.38	4.63	3.25	3.22	3.52	3.51	3.64	3.12	3.42	3.45	3.16	3.40	3.36	3.54
Na	0.998	0.997	0.679	0.423	0.462	0.375	0.527	0.326	0.211	0.262	0.380	0.431	0.452	0.510	0.413	0.404	0.482	0.345	0.355	0.359	0.368	0.290	0.275	0.326	0.342	0.401	0.299	0.292	0.278
K	0.457	0.492	0.403	0.479	0.486	0.562	0.433	0.278	0.348	0.365	0.259	0.467	0.463	0.483	0.534	0.492	0.598	0.275	0.326	0.336	0.358	0.385	0.276	0.319	0.314	0.318	0.350	0.309	0.285
OC	16.64	8.69	4.23	11.18	6.93	7.23	3.92	6.26	4.38	4.83	2.70	8.09	4.92	3.91	5.12	5.44	5.73	6.45	4.50	4.08	4.12	5.01	4.64	6.92	4.37	3.37	4.27	4.86	5.02
EC	20.29	5.37	1.68	14.12	6.26	6.19	2.28	10.66	3.76	3.49	1.21	8.48	3.71	2.43	3.65	4.24	4.61	9.32	4.41	2.60	2.76	3.72	3.84	9.42	3.48	1.96	3.37	4.01	3.96
TC	36.91	14.04	5.89	25.28	13.18	13.42	6.19	16.91	8.12	8.31	3.89	16.55	8.60	6.31	8.76	9.65	10.31	15.96	8.90	6.67	6.87	8.72	8.48	16.33	7.84	5.37	7.64	8.86	8.97
Al	0.1139	0.1146	0.1094	0.1408	0.1414	0.1448	0.1223	0.0986	0.0828	0.0913	0.0828	0.1942	0.2008	0.1990	0.2009	0.1910	0.2114	0.2365	0.2134	0.2260	0.2322	0.212	0.2368	0.2054	0.2054	0.2065	0.2061	0.1916	0.2115
Si	0.4778	0.3870	0.3489	0.3469	0.3141	0.3221	0.2546	0.2485	0.1853	0.2073	0.1585	0.3981	0.4209	0.3980	0.4079	0.3888	0.4349	0.4393	0.3882	0.4064	0.4175	0.3889	0.4311	0.3732	0.3787	0.3622	0.3604	0.3436	0.3779
P	0.0092	0.0050	0.0028	0.0086	0.0050	0.0117	0.0147	0.0225	0.0237	0.0228	0.0225	0.0194	0.0163	0.0150	0.0158	0.0163	0.0155	0.0211	0.0144	0.0129	0.0140	0.0138	0.0148	0.0177	0.0133	0.0124	0.0121	0.0140	0.0145
S	3.4896	3.3789	3.0534	4.3065	4.5935	4.5622	4.2099	3.3471	3.4395	3.4353	3.1650	3.6677	3.7263	3.4399	3.7318	3.7641	3.7813	3.3455	3.4259	3.1763	3.3431	3.1589	3.2280	3.1777	3.1135	3.2318	3.1359	3.1369	3.0990
Cl	0.1169	0.0874	0.1432	0.1391	0.0758	0.1590	0.0799	0.1037	0.0568	0.0941	0.0799	0.0889	0.1203	0.0720	0.0726	0.0640	0.0774	0.0386	0.0566	0.0235	0.0373	0.0491	0.0621	0.0754	0.0909	0.0954	0.0861	0.0741	0.0708
K	0.5517	0.3858	0.4892	0.4678	0.5631	0.4531	0.3064	0.3281	0.3828	0.2780	0.2780	0.4619	0.4677	0.4740	0.5192	0.4707	0.5722	0.3447	0.3324	0.3085	0.3454	0.3211	0.3882	0.3658	0.3714	0.3690	0.3931	0.3622	0.4066
Ca	0.1705	0.1262	0.1024	0.1082	0.0896	0.0891	0.0652	0.1102	0.0729	0.0738	0.0626	0.1288	0.1209	0.0914	0.0959	0.1006	0.1111	0.3461	0.1072	0.1090	0.1117	0.1253	0.1207	0.1244	0.1088	0.0853	0.0868	0.1053	0.1088
Ti	0.0092	0.0088	0.0079	0.0109	0.0102	0.0114	0.0062	0.0109	0.0084	0.0097	0.0062	0.0128	0.0118	0.0106	0.0138	0.0117	0.0156	0.0147	0.0124	0.0116	0.0147	0.0127	0.0155	0.0126	0.0116	0.0105	0.0128	0.0106	0.0139
V	0.0134	0.0137	0.0117	0.0190	0.0237	0.0195	0.0167	0.0175	0.0182	0.0144	0.0177	0.0146	0.0150	0.0119	0.0139	0.0206	0.0159	0.0197	0.0182	0.0133	0.0140	0.0208	0.0145	0.0219	0.0190	0.0145	0.0143	0.0245	0.0142
Cr	0.0010	0.0009	0.0006	0.0017	0.0015	0.0017	0.0011	0.0014	0.0012	0.0016	0.0011	0.0021	0.0020	0.0022	0.0021	0.0024	0.0021	0.0023	0.0022	0.0019	0.0022	0.0022	0.0022	0.0022	0.0018	0.0017	0.0021	0.0017	0.0020
Mn	0.0128	0.0128	0.0077	0.0170	0.0158	0.0170	0.0123	0.0127	0.0113	0.0127	0.0087	0.0214	0.0214	0.0174	0.0226	0.0186	0.0213	0.0194	0.0168	0.0132	0.0158	0.0163	0.0190	0.0163	0.0168	0.0130	0.0152	0.0156	0.0185
Fe	0.2602	0.1871	0.1219	0.2579	0.1858	0.1996	0.1190	0.2345	0.1325	0.1352	0.0947	0.2958	0.1978	0.1582	0.2094	0.1952	0.2215	0.3051	0.1881	0.1527	0.1959	0.1962	0.2223	0.2779	0.1818	0.1344	0.1777	0.1780	0.2027
Co	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0001	0.0002	0.0005	0.0005	0.0005	0.0004	0.0005	0.0004	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001
Ni	0.0055	0.0054	0.0047	0.0061	0.0071	0.0068	0.0050	0.0049	0.0052	0.0044	0.0050	0.0050	0.0050	0.0042	0.0048	0.0064	0.0049	0.0065	0.0060	0.0045	0.0048	0.0113	0.0055	0.0068	0.0062	0.0052	0.0051	0.0073	0.0049
Cu	0.0113	0.0090	0.0052	0.0110	0.0104	0.0113	0.0065	0.0210	0.0188	0.0167	0.0189	0.0252	0.0215	0.0225	0.0226	0.0207	0.0234	0.0214	0.0181	0.0177	0.0157	0.0151	0.0167	0.0230	0.0182	0.0203	0.0248	0.0212	0.0378
Zn	0.1794	0.1743	0.1067	0.2399	0.2186	0.2381	0.1727	0.1579	0.1343	0.1600	0.1177	0.2156	0.2364	0.1948	0.2909	0.1956	0.2188	0.1887	0.1596	0.1337	0.1366	0.1704	0.1879	0.1567	0.1432	0.1397	0.1301	0.1301	0.1515
Ga	0.0004	0.0004	0.0005	0.0018	0.0030	0.0024	0.0026	0.0003	0.0004	0.0003	0.0004	0.0003	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0002	0.0002	0.0001	0.0000	0.0002	0.0000	0.0002	0.0002	0.0000	0.0000	0.0001
As	0.0046	0.0055	0.0042	0.0053	0.0063	0.0064	0.0043	0.0012	0.0010	0.0016	0.0006	0.0043	0.0046	0.0053	0.0050	0.0046	0.0058	0.0030	0.0036	0.0026	0.0032	0.0029	0.0029	0.0035	0.0037	0.0040	0.0042	0.0038	0.0044
Se	0.0021	0.0022	0.0020	0.0005	0.0004	0.0005	0.0004	0.0003	0.0004	0.0004	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
Br	0.0029	0.0127	0.0121	0.0106	0.0099	0.0116	0.0108	0.0172	0.0146	0.0143	0.0174	0.0172	0.0170	0.0190	0.0159	0.0156	0.0171	0.0122	0.0124	0.0160	0.0115	0.0108	0.0122	0.0129	0.0133	0.0158	0.0133	0.0128	0.0133
Rb	0.0036	0.0043	0.0032	0.0020	0.0025	0.0029	0.0019	0.0010	0.0011	0.0013	0.0008	0.0011	0.0013	0.0014	0.0015	0.0014	0.0016	0.0007	0.0008	0.0006	0.0009	0.0006	0.0006	0.0007	0.0006	0.0005	0.0009	0.0006	0.0008
Sr	0.0013	0.0011	0.0011	0.0011	0.0011	0.0015	0.0015	0.0017	0.0019	0.0020	0.0015	0.0030	0.0032	0.0030	0.0027	0.0029	0.0030	0.0018	0.0015	0.0016	0.0016	0.0015	0.0014	0.0020	0.0018	0.0020	0.0018	0.0015	0.0017
Y	0.0001	0.0001	0.0002	0.0004	0.0004	0.0004	0.0003	0.0003	0.0004	0.0003	0.0004	0.0002	0.0002	0.0004	0.0002	0.0003	0.0004	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Zr	0.0006	0.0006	0.0005	0.0016	0.0013	0.0007	0.0010	0.0010	0.0008	0.0011	0.0010	0.0006	0.0002	0.0003	0.0004	0.0004	0.0006	0.0014	0.0008	0.0006	0.0008	0.0005	0.0007	0.0004	0.0005	0.0006	0.0006	0.0007	0.0006
Mo	0.0005	0.0005	0.0007	0.0015	0.0011	0.0017	0.0012	0.0007	0.0006	0.0007	0.0005	0.0016	0.0012	0.0011	0.0011	0.0013	0.0009	0.0001	0.0000	0.0001	0.0001	0.0002	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000
Pd	0.0012	0.0017	0.0011	0.0019	0.0014	0.0016	0.0020	0.0006	0.0007	0.0008	0.0005	0.0016	0.0018	0.0023	0.0021	0.0019	0.0018	0.0000	0.0000										

Further Exploration in Mercury Monitoring

- Keeping in view the methods used for measuring dry and wet mercury deposition
- Waiting for the announcement of protocol/method for mercury monitoring under the Minamata Convention on Mercury
- Seeking information from laboratories/ other monitoring authorities on purchase and upgrade of equipment

