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MASS CONCENTRATIONS OF CARBONACEOUS AND CONCURRENTLY MEASURED INORGANIC AEROSOL SPECIES: A COMPILATION

Part I - Surface data from marine, rural, remote and urban sites (1975 - 1997)

T. Novakov*
Lawrence Berkeley National Laboratory (MS-73)
Berkeley, CA 94720

* Phone (510) 486-5319
Fax: (510) 486-4733
E-mail: tnovakov@lbl.gov

MARINE

Location: Bermuda
Year: 1973

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
05/16 - 31/ 1973	NA	NA	0.15 - 0.47	NA	NA	NA	NA

Analytical method: Total OC of persulfate extract of filter
Sample type: Hi-Vol, glass fiber prefired, daily 24-hr, 20 m tower on the southwest coast of Bermuda, wind direction controlled sampling (from the sea)
Corrections: None
Other:
Reference: Hoffman and Duce, 1974

Location: Bermuda, Oahu, American Samoa
Year: 1975, 1976

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Bermuda, 06/1975	NA	NA	0.37 ± 0.23 (0.15 - 0.78)	NA	NA	NA	NA
Oahu, 07-08/1975	NA	NA	0.39 ± 0.03 (0.36 - 0.43)	NA	NA	NA	NA
Samoa, 06-08/1976	NA	NA	0.22 ± 0.09 (0.13 - 0.41)	NA	NA	NA	NA

Analytical method: Total OC of persulfate extract of filter
Sample type: Hi-Vol glass filter, cascade impactor with glass fiber collection surfaces
Corrections: None
Other: OC mass size distribution, 80% of OC in sizes r < 0.5 µm. Afterfilter OC in all three locations ˜ 0.5 µg m^{-3}. Na concentrations and OC/Na ratios.
Reference: Hoffman and Duce, 1977

Location: Hachijo-jima and Chichi-jima islands
Year: 1981

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-

Hachijo-jima Jan.	NA	1.0±0.3	1.4	2.4±0.7	2.2±0.6	NA	NA
Hachijo-jima Dec.	NA	0.7±0.2	1.0	1.7±0.6	1.0±0.6	NA	NA
Chichi-jima Dec.	NA	0.7±0.3	0.6	1.3±0.6	1.5±1.6	NA	NA

Analytical method: Two step thermal
Sample type: Hi-Vol no size segregation
Corrections: None
Other:
Reference: Ohta and Okita, 1984

Location: Bermuda

Year: 1982, 1983

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Aug. 1982, Jan. Feb. 1983							
N.E. US*	10.8	0.06	0.47	0.53	3.97	0.58	0.16
FL, NC*	8.6	0.02	0.51	0.53	1.90	0.36	0.14
South Eastern*	10.4	0.03	0.98	1.01	0.98	0.33	0.20

*Sorted by trajectory

Analytical method: GM
Sample type: 24-hr, dichotomous sampler, <2.5 µm
Corrections: None
Other: Trace metals, enrichment factors
Reference: Wolff et al., 1986

Location: NH: Enewetak, Sargasso, Flux Atlante; SH: Samoa, Peru, Amsterdam Island, New Zealand

Year: 1979, 1981, 1982, 1983, 1985

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Enewetak, 04/17-07/26/1979	NA	NA	NA	0.82±0.17	NA	NA	NA
Sargasso, 07/11-25/1979	NA	NA	NA	0.44 ± 0.04	NA	NA	NA
Flux Atlante, 04/30-06/13/1985	NA	NA	NA	0.35 ± 0.15	NA	NA	NA

Samoa, 1981-82	NA	NA	NA	0.11 ± 0.07	NA	NA	NA
Peru coast, 03/14-04/5/1981	NA	NA	NA	0.16 ± 0.07	NA	NA	NA
Amsterdam Island, 02/10/1983	NA	NA	NA	0.16	NA	NA	NA
N. Zealand 06/20,07/10-28/83	NA	NA	NA	0.13 ± 0.015	NA	NA	NA

Analytical method: Total C by oxidation to CO_2 followed by MS, After 1984 coulometric C analyzer.
Sample type: Hi-vol glass fiber total and cascade impactor, sampling times days to weeks. Shipboard and tower on island, wind dir. controlled
Corrections: None
Other: Stable C isotopes
Reference: Cachier et al., 1986

Location: South Coast of Japan.

Year: 1982

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
12/17-19/82[a]	12.0± 0.8	1.0± 0.2	1.8	2.8± 0.75	3.2±1.4	NA	NA
12/17/82, 12/19/82[b]	22.1	2.3	4.4	6.7	3.2	NA	NA

[a]entire cruise
[b]close to Tokyo Bay

Analytical method: Two step thermal
Sample type: <0.6 µm collected on a cruise from Tokyo bay to Hyuga and back
Corrections: None
Other:
Reference: Ohta and Okita, 1984

Location: Oki Island, Sea of Japan
Year: 1983-1988

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
41/2 year average*	NA	NA	NA	1.73 ± 0.53	3.59 ± 1.06	0.510 ± 0.28	0.114 ± 0.10
1984	NA	NA	NA	1.52	3.33		
1985	NA	NA	NA	1.33	3.23		
1986	NA	NA	NA	1.90	3.62		
1987	NA	NA	NA	1.76	3.42		

*Averages (arithmetic mean) for Dec. 1983 to May 1988

Analytical method: CHN analyzer (Yanaco, MT-2)
Sample type: <10 µm, quartz, monthly low-vol., site 200 m a.s.l.
Corrections: None
Other:
Reference: Mukai et al., 1990

Location: Corsica
Year: 1986

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Spring 1986	NA	0.4 (0.1-0.8)	1.5	1.9 (1.0-3.6)	NA	NA	NA

Analytical method: Two step combustion
Sample type: Glass fiber, no size separation
Corrections: None
Other:
Reference: Cachier et al. 1989

Location: St. Nicolas Island, California
Year: 1987

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
6/19/87-9/3/87[a]	9.7	0.10	0.81	0.91	2.77	NA	0.46
6/19/87-9/3/87[b]	17.4	0.16	1.53	1.69	3.57	NA	1.58

[a] < 2.5 µm

b < 10 µm
Analytical method: DRI
Sample type: $PM_{2.5}$, PM_{10}, 24-hr samples
Corrections: 10-30% OC on backup, not used to correct OC
Other:
Reference: Chow et al., 1994

Location: Anacapa Island (32 km west of Ventura, CA)
Year: 1989

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
01/10/89 - 12/30/89	NA	NA	NA	3.1 ± 0.45	3.6± 0.64	0.8±0.9	2.3+0.74

* nss = 2.8± 0.86 µg m^{-3}

Analytical method: DRI
Sample type: 24 hr, Hi-Vol, < 10 µm, every sixth day. 70 m above sea level.
Corrections: None
Other: Na, Cl, Si
Reference: Chow et al., 1996

Location: East China Sea and Western Pacific Ocean
Year: 1990, 1991, 1993
Cruise 1, 125°-128° E and 28°-32°N;Cruise 2, 124°-128° E and 27 -32°N;
Cruise 3, 126°-129° N and 27-30°N

	Concentration (ng m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Cruise 1 12/07 -20/90		133 ± 43			?		
Cruise 2 10/24/91 -11/18/91		505 ± 316			?		
Cruise 3 04/24/93/-05/06/93		355 ± 127			?		

Analytical method: Aethalometer

Sample type:
Corrections: None
Other:
Reference: Parungo et al., 1994

Location: Mace Head, Ireland
Year: 1993

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
September 1993 (4 samples)	NA	0.04	0.40	0.44	NA	NA	NA

Analytical method: Optical/thermal
Sample type: Lo-vol, Hi-vol
Corrections: None
Other:
Reference: Castro et al., 1999

Location: Areão, Portugal,
Year:1993-94

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
1993-94 (118 samples)	NA	0.65	2.61	3.26	NA	NA	NA

Analytical method: Optical/thermal
Sample type: Lo-vol, Hi-vol
Corrections: None
Other: Secondary OC = 45-78%
Reference: Castro et al., 1999

Location: South Uist, Outer Hebrides
Year: 1993 - 1994

	Concentration BC (ng m^{-3}), SO_4^{2-} in µg (S)m^{-3}						
Sampling time(s)*	Mass**	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Marine winter	3.9 (0.4-8.4)	16 (7-55)	NA	NA	0.139	NA	NA
Marine summer	1.4 (0.5-3.5)	26 (9-63)	NA	NA	0.249	NA	NA
Contin. winter	4.5 (0.1-10.5)	328 (36-1174)	NA	NA	2.011	NA	NA
Contin. summer	1.9 (0.6-5.7)	82 (20-553)	NA	NA	1.356	NA	NA

* Nov. 1993 - Aug'94; results sorted by trajectories, ** From dry accumulation mode

Analytical method: Aethalometer, bulk composition
Sample type: PM_{10} for bulk analyses
Corrections: None
Other: In situ volatility, size distributions
Reference: Lowe et al., 1996

Location: Cheju Island, Korea (126°10'E, 33°17'N)

Year: 1994

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/20/94 - 08/01/94[a]	29.2± 4.6	0.38± 0.06	4.58± 0.49	4.96	13.56±2.16	4.24±0.5	0.10±0.10
08/02-10/19/94[b]	6.62± 0.84	0.08± 0.02	2.36± 0.16	2.44	< 1.30	0.47±0.07	2.16±0.19

[a] polluted air from Japan and Korea
[b] marine background North Pacific Ocean

Analytical method: BC, OC by oxidation on MnO_2
Sample type: <2.5 µm
Corrections: None
Other: HNO_3, HCl, NH_3
Reference: Kim et al., 1998

Location: Point Reyes, California

Year: 1993, 1994

	Concentration (**ng m^{-3}**)						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NaCl
06/27-28/1994*	NA	BD	249.8	TC = OC	160.0	63.4	198.0
06/28-29/1994*	NA	BD	374.2	TC = OC	283.9	97.2	194.1

07/05-06/1994*	NA	BD	121.3	TC = OC	524.7	88.8	1211.7
10/20-21/1993**	NA	149.4	894.5	1044	395.6	189.0	NA
10/22-23/1993**	NA	78.4	778.0	856.4	247.1	83.4	NA

* Oceanic air
** Stagnant air, no wind
BD below detection limit

Analytical method: EGA, IC
Sample type: MOUDI, total from 0.05 to 3.2 µm. No afterfilter
Corrections: None, no filters used
Other: CCN apportionment, size distributions
Reference: Rivera-Carpio et al., 1996

Location: Areão, Portugal (40° 30' N; 8° 47 W)

Year: 1993 - 1994

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
11/93 - 08/94 Total	15.3	0.82	2.73	3.55	2.29	0.76	0.42
Marine	7.0	0.18	0.52	0.7	0.87	0.18	0.05
Contam. marine	9.7	0.45	1.23	1.68	1.32	0.38	0.15
Modif. marine	12.1	0.19	0.74	0.93	2.07	0.69	0.03
Cont. North	31.8	2.04	7.70	9.74	3.67	1.53	0.40
Cont. South	21.8	1.49	5.49	6.98	3.05	1.35	0.36

Analytical method: Thermo-optical
Sample type: < 0.95 µm, sampling at 10 m tower, ~300 m from beach.
Corrections: None
Other:
Reference: Pio et al., 1996

Location: Haha-jima, Ogasawara Islands (140°10'E, 26°38'N)

Year: 1994 - 1997

	Water soluble mass concentration (µg m^{-3})				
Sampling date(s)	BC	WSOC	nss SO_4^{2-}	NH_4^+	NO_3^-
Dec. '94 - Jan. '97 [a]	NA	0.383	1.13	0.236	0.0157
Dec. '94 - Jan. '97 [b]	NA	1.00	0.626	0.0157	0.576
By air masses					
Continental[a]	NA	0.466	1.58	0.345	0.022
Continental.[b]	NA	0.095	0.865	0.0238	0.843
Marine [a]	NA	0.234	0.303	0.0408	0.005
Marine [b]	NA	1.20	0.249	0.0197	0.176

[a] <1.1 µm, [b] >1.1 µm

Analytical method: TOC for water-soluble organic C (WSOC), IC for ions
Sample type: Andersen Hi-Vol, <1.1 µm (afterfilter) and >1,1 µm
Corrections: None
Other: CCN
Reference: Matsumoto et al.1988

Location: Cape San Juan, Puerto Rico

Year: 1995

	Concentration (µg m^{-3})						
Sampling dates	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Feb. 12-17	NA	< 0.05	381±145		257±76	NA	NA
March 13-17	NA	< 0.05	339±78		256±46	NA	NA
May 30-June 2	NA	<0.05	456±34		316±75	NA	NA
Average			391±106		274±66		

Analytical method: EGA, IC
Sample type: Quartz, Teflon, <0.5µm
Corrections: YES, Reported as Filterable particulate OC_P,
Other: Semi-volatile OC?
Reference: Novakov et al. 1997

Location: Pico del Ingles, Tenerife (28.50°N, 16.3, 0°W)

Year: 1995, 1996

	Concentration in cloud water (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	nss SO_4^{2-}	NH_4^+	NO_3^-

06/10 - 07/07/1995 07/04- 07/25/1996		0.53±0.40 (0.07-2.4)	NA NA	NA NA	3.7±2.6 (0.3-9.0)	1.00±0.6 (0.2-2.4)	2.1±1.2 (0.2-5.0)

Analytical method: DRI for BC (no OC), and IC
Sample type: Cloud water collected by active strand collector. Filtered water on quartz used for BC
Corrections: None but problems in BC measurement in cloud water discussed.
Other: Na^+ = 3.5±2.6; Cl^- = 6.5±5.5; MSA = 0.080±0.066
Reference: Borys et al., 1998

Location: Eastern Atlantic, ACE 2 (29° to 41° N and 7° to 15° W)

Year: 1997

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/20/ - 07/25/1997[a]	?	0.4±0.3	0.8±0.7	1.3±1.0	5.1±2.0	?	?
06/20/ - 07/25/1997[b]	?	not measured		0.8±0.3	?	?	?

[a] < 1µm

[b] > 1µm

Analytical method: EGA, IC
Sample type: <1µm and >1µm, double quartz, shipboard
Corrections: Yes for OC and BC
Other: Water-soluble C
Reference: Novakov et al., Tellus, in press 1999?

RURAL

U.S. LOCATIONS

Location: G. Smoky Mnt. Nat. Park (35°40'N; 83°36'W)

Year: 1978

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
09/20-26/78	24.0	1.1	2.2	3.3	11.2		

Analytical method: OGI for TC, OC; XRF for S
Sample type:37 mm quartz, dichotomous <2.5 µm
Corrections: None
Other:
Reference: Stevens et al., 1980.

Location: Atlantic coast, Lewes, DE

Year: 1982, 1983

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
08/01-31/82	16.7 ± 11.0	0.7 ± 0.5	4.0 ± 1.7	4.7	7.2 ± 5.0	NA	NA
01/25/83-02/28/83	15.3 ± 6.9	1.1 ± 0.7	2.4 ± 0.9	3.5	5.4 ± 3.6	NA	NA

Analytical method: OC, BC by GM method
Sample type: Dichotomous sampler <2.5 µm.
Corrections: None

Other:
Reference: Wolff et al. 1986.

Location: Allegheny Mtn., Laurel Hill
Year: 1983

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
08/05-28/83[a]	64	1.2	2.0	3.2	18.7	3.1	0.5
08/05-28/83[b]	59	1.4	2.3	3.7	19.8	3.1	0.6

[a]Allegheny Mtn
[b]Laurel Hill

Analytical method: OGI
Sample type: <5.5 µm, Hi-Vol.
Corrections: None
Other: SO_2, O_3, NO_x, PAN, HNO_3
Reference: (40) Keeler et al.

Location: Northern Michigan (45°30' N; 84°42'W)
Year: 1983/84; 1984/85

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
12/09/83 - 04/06/84	NA	0.72 (0.07-3.5)	1.72 (0.66-5.7)	2.44	2.70 (0.59-10.8)	NA	NA
12/05/84 - 04/17/85	NA	0.48 (<0.04-2.0)	2.2 (0.12-5.6)	2.68	2.48 (0.18-14.2)	NA	NA

Analytical method: GM (Cadle et al., 1980)
Sample type: 47 mm quartz, open face
Corrections: None
Other:
Reference: Cadle and Dasch, 1988.

Location: Grand Canyon region
Year: 1984 - 1989

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	NA	NA	NA	0.78±0.23	0.70 ± 0.08	NA	NA
Spring	NA	NA	NA	0.90±0.31	0.91 ± 0.14	NA	NA
Summer	NA	NA	NA	1.30±0.48	1.4 ± 0.18	NA	NA
Fall	NA	NA	NA	0.93±0.22	0.96 ± 0.20	NA	NA

Analytical method: ERT (MnO_2)
Sample type: 47 mm, quartz, <2.5 µm.
Corrections: None
Other: Crustal, humidity
Reference: Vasconselos et al., 1994

Location: Southern Ontario
Year: 1986

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/29/86 - 08/09/86	20.1	0.8	5.2	6.0	13.0	NA	NA

Analytical method: OGI
Sample type: <2.5 µm, quartz
Corrections: None
Other: Coal burning influences
Reference: Keeler et al., 1990

Location: Tanbark Flats, Angeles National Forest, California (870 m elevation)
Year: 1986

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual average	32.4	1.2	6.4	7.6	3.9	1.9	3.1

Analytical method: Sunset lab.

Sample type: <10 µm, 47 mm quartz, 24-hr samples every 6th day.
Corrections: None
Other: Max. min., monthly means, mass balance.
Reference: Solomon et al., 1989

Location: San Joaquin Valley, California
Year: 1988 - 1989

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/14/88 - 06/09/89[a]	20.0± 12.6	1.46± 0.83	3.30± 2.38	4.76	1.97±1.19	NA	6.28±11.43
06/14/88 - 06/09/89[b]	23.29 ±20.3	1.32± 0.85	2.66± 1.72	3.98	2.50±1.41	NA	8.52±11.30

[a] Crows Landing - agricultural

[b] Kern - National Wildlife Refuge

Analytical method: DRI
Sample type: $PM_{2.5}$, 47 mm quartz, 24-h samples
Corrections: Quartz denuder in the 2.5 µm channel two filters back - to -back. OC on backup filter within 1 or 2 SD of OC on field blanks.
Other: Trace elements; Mass concentration time series
Reference: Chow et al., 1993

Location: U.S. National Parks (IMPROVE)
Year: 1988 - 1991

Denali Nat. Park, Alaska

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	1.6	0.1	0.43	0.53	0.51	NA	0.1
Spring	2.4	0.1	0.50	0.60	0.65	NA	0.1
Summer	2.7	0.1	1.1	1.2	0.36	NA	BD
Fall	1.2	0.1	0.43	0.53	0.30	NA	0.1
Annual	1.9	0.1	0.64	0.74	0.44	NA	0.1

Great Smoky Mountains and Shenandoah National Parks, TN, VA

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-

Winter	6.5	0.4	1.4	1.8	2.2	NA	0.8
Spring	10.6	0.5	1.9	2.4	4.4	NA	0.8
Summer	16.6	0.5	3.1	3.6	7.6	NA	0.3
Fall	9.7	0.5	1.9	2.4	4.1	NA	0.5
Annual	10.9	0.5	2.1	2.6	4.6	NA	0.6

Isle Royale and Voyageurs National Parks, MN, MI

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	5.2	0.2	1.0	1.2	1.5	NA	1.4
Spring	5.4	0.2	1.3	1.5	1.9	NA	0.4
Summer	6.2	0.3	2.2	2.5	1.6	NA	0.1
Fall	4.3	0.2	1.3	1.5	1.2	NA	0.4
Annual	5.3	0.2	1.5	1.7	1.5	NA	0.6

Mount Rainier National Park, WA

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	3.8	0.5	1.8	2.3	0.43	NA	0.1
Spring	5.2	0.5	1.9	2.4	1.0	NA	0.2
Summer	6.7	0.5	2.1	2.6	1.7	NA	0.4
Fall	5.3	0.5	2.2	2.7	0.95	NA	0.2
Annual	5.1	0.5	2.0	2.5	0.95	NA	0.2

Arches, Bryce Canyon, Canyonlands, Grand Canyon, Mesa Verde and Petrified Forest National Parks, UT, NM, AZ, CO

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	2.9	0.2	0.78	0.98	0.65	NA	0.5
Spring	3.4	0.1	0.71	0.81	0.65	NA	0.2
Summer	4.1	0.2	1.1	1.3	0.95	NA	0.2
Fall	3.2	0.2	0.85	1.1	0.87	NA	
Annual	3.4	0.2	0.85	1.1	0.80	NA	

Rocky Mountain and Yellowstone National Parks, Bridger Wilderness and Weminuche Wilderness Areas, Great Sand Dunes National Monument, WY, CO

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-

Winter	2.0	0.1	0.64	0.74	0.36	NA	0.2
Spring	3.4	0.1	0.78	0.88	0.65	NA	0.3
Summer	4.8	0.2	1.7	1.9	0.73	NA	0.1
Fall	2.9	0.1	0.92	1.0	0.58	NA	0.1
Annual	3.3	0.1	1.1	1.2	0.58	NA	0.2

Pinnacles National Monument, Point Reyes National Seashore, and Redwood National Park, CA

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	5.6	0.4	1.6	2.0	0.65	NA	1.9
Spring	4.2	0.2	1.1	1.3	1.0	NA	0.8
Summer	4.5	0.1	1.0	1.1	1.4	NA	0.8
Fall	5.7	0.4	1.9	2.3	1.0	NA	1.0
Annual	5.0	0.3	1.3	1.6	1.0	NA	1.1

Everglades, FL

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	5.5	0.4	1.3	1.7	1.7	NA	0.7
Spring	7.7	0.3	1.5	1.8	2.8	NA	0.9
Summer	9.1	0.3	2.1	2.4	1.8	NA	0.5
Fall	6.9	0.4	1.6	2.0	2.3	NA	0.5
Annual	7.1	0.4	1.6	2.0	2.1	NA	0.7

Jarbridge Wilderness Area, NV

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	1.1	BD	0.35	0.35	0.22	NA	0.1
Spring	2.4	BD	0.64	0.64	0.36	NA	0.1
Summer	4.5	0.1	1.2	1.3	0.51	NA	0.1
Fall	3.1	0.1	1.0	1.1	0.44	NA	0.1
Annual	2.8	0.1	0.78	0.79	0.36	NA	0.1

Hawaii Volcanoes National Park, HI

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-

Winter	4.0	0.1	0.64	0.74	2.0	NA	0.1
Spring	3.6	0.1	0.57	0.67	1.8	NA	0.1
Summer	1.6	BD	0.36	0.36	0.65	NA	0.1
Fall	3.4	0.1	0.57	0.67	1.8	NA	0.1
Annual	3.2	0.1	0.50	0.60	1.6	NA	0.1

Acadia National Park, ME

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	6.6	0.5	1.3	1.8	2.4	NA	0.8
Spring	6.1	0.3	1.1	1.4	2.6	NA	0.4
Summer	8.6	0.4	2.1	2.5	3.3	NA	0.3
Fall	5.6	0.4	1.1	1.5	2.2	NA	0.4
Annual	6.7	0.4	1.4	1.8	2.6	NA	0.5

Badlands National Monument, SD

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	3.4	0.1	0.78	0.88	0.87	NA	0.6
Spring	5.0	0.1	0.92	1.0	1.4	NA	0.6
Summer	5.6	0.2	1.6	1.8	1.3	NA	0.2
Fall	4.0	0.1	1.1	1.2	0.87	NA	0.2
Annual	4.5	0.1	1.1	1.2	1.1	NA	0.4

Glacier National Park, MT

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	5.3	0.5	2.1	2.6	0.73	NA	0.6
Spring	4.6	0.3	1.7	2.0	0.80	NA	0.2
Summer	5.4	0.3	2.1	2.4	0.65	NA	0.2
Fall	6.7	0.6	3.1	3.7	0.65	NA	0.3
Annual	5.5	0.4	2.2	2.6	0.70	NA	0.3

San Gorgonio Wilderness Area, CA

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	4.6	0.2	0.85	1.1	0.36	NA	2.2
Spring	13.6	0.6	2.3	2.9	1.2	NA	6.9
Summer	13.8	0.8	3.0	3.8	1.7	NA	4.6
Fall	8.1	0.4	1.4	1.8	0.80	NA	3.1
Annual	9.8	0.5	1.8	2.3	1.0	NA	4.2

Yosemite National Park, CA

Concentration (µg m^{-3})

Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	2.5	0.1	0.78	0.88	0.29	NA	0.3
Spring	4.3	0.2	1.2	1.4	0.75	NA	0.3
Summer	7.2	0.5	2.6	3.1	1.2	NA	0.2
Fall	4.4	0.3	1.5	1.8	0.65	NA	0.2
Annual	4.5	0.3	1.5	1.8	0.7	NA	0.3

Crater Lake and Lassen Volcanoes National Parks, OR, CA

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	1.7	0.1	0.71	0.81	0.15	NA	0.1
Spring	3.0	0.1	1.0	1.1	0.44	NA	0.2
Summer	4.0	0.3	1.6	1.9	0.51	NA	0.2
Fall	2.8	0.2	1.2	1.4	0.29	NA	0.1
Annual	2.9	0.2	1.1	1.3	0.36	NA	0.2

Big Bend National Park and Guadeloupe Mountains National Monument, TX

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter	3.6	0.1	0.78	0.88	1.1	NA	0.2
Spring	6.4	0.2	1.2	1.4	1.6	NA	0.3
Summer	6.6	0.1	1.2	1.3	1.8	NA	0.3
Fall	4.8	0.2	1.0	1.2	1.7	NA	0.2
Annual	5.4	0.1	1.1	1.3	1.5	NA	0.3

Analytical method: DRI
Sample type: <2.5 μm, quartz
Corrections: None
Other: Visibility, extinction apportionment
Reference: Malm et al., 1994

EUROPEAN LOCATIONS

Location: Abastumani, Georgia (FSU)

Year: 1979

	Concentration (μg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-

07/03-24/79	12.05 ± 3.6	0.98 ± 0.11	1.71 ± 0.73	2.69	4.6 ± 0.34	1.4±0.18	<0.07

Analytical method: BC, OC by OGI method
Sample type: <2.5 µm
Corrections: None made but recognized
Other:
Reference: Dzubay et al., 1984

Location: Background, Exelberg, Austria
Year: 1978

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
December Avg.	27.5	NA	NA	6.3	7.1	2.3	0.6

Analytical method: Combustion for TC
Sample type: 0.1 - 6.5 µm, Berner impactor
Corrections: None
Other: Trace metals
Reference: H. Draxler, Dissertation, Technical University of Vienna)

Location: Regional background K-Puszta, Hungary
Year: 1981/1982

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
June 81- July 82*		0.81			9.6		

*annual averages

Analytical method: Optical for BC, PIXE for S
Sample type: Nuclepore, 0.4 µ pore size
Corrections: None
Other:
Reference: Heintzenberg and Mészáros, 1985

Location: K-puszta, Hungary
Year: 1996

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
07/29/96-08/19/96	21.1	0.42	10.6	11.0	4.0	1.7	0.02
N - NE*	17	0.51	9.35	9.86	3.2	1.20	0.17
N - NW*	25	0.50	11.8	12.3	4.75	2.25	0.25

*grouped by trajectories

Analytical method: ACPM (Ambient Carbon Particulate Monitor) ??, capillary electrophoresis for w.s. ions
Sample type: <2.5 µm, substrate ??
Corrections: None
Other: Diurnal, no day - night difference
Reference: Molnár et al. 1999

Location: K-puszta, Hungary (46°58'N - 19°33'E)
Year:1996

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
July - Aug. 5 days	24.0	0.6	5.0	5.5	2.5		1.9

Analytical method: TC by a CHN analyzer; OC-BC by two step French method, Mass by TEOM ambient particulate monitor and gravimetric on Hi-Vol.
Sample type: Hi-vol prefired quartz (450°C), PM_{10}, 20 - 48 hr samples.
Corrections: None
Other: WSOC = 48%, Carbonate
Reference: Zappoli et al. 1999

Location: Aspvreten (background), Sweden (58°48'N - 17°23'E)
Year: 1996

Concentration (µg m^{-3})

Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
June -July 5 days	5.9	0.10	2.2	2.5	1.4		0.3

Analytical method: TC by a CHN analyzer; OC-BC by two step French method, Mass by TEOM ambient particulate monitor and gravimetric on Hi-Vol.
Sample type: Hi-vol prefired quartz (450°C), PM_{10}, 20 - 48 hr samples.
Corrections: None
Other: WSOC = 77%, Carbonate
Reference: Zappoli et al. 1999

Location: San Pietro Capofiume, Italy (44°39'N - 11°37'E)
Year: 1996

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Sep. 1996, 6 days	39	1.0	6.2	8.5	7.7		6.3

Analytical method: TC by a CHN analyzer; OC-BC by two step French method, Mass by TEOM ambient particulate monitor and gravimetric on Hi-Vol.
Sample type: Hi-vol prefired quartz (450°C), PM_{10}, 20 - 48 hr samples.
Corrections: None
Other: WSOC = 64%, Carbonate
Reference: Zappoli et al. 1999

Location: Tábua, Portugal
Year: 1994 - 1996

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
July 1994 - August 1996 (25 samples)	NA	1.17	5.83	7.0	NA	NA	NA

Analytical method: Optical/thermal
Sample type: Lo-vol, Hi-vol
Corrections: None
Other: Secondary OC = 68%

Reference: Castro et al., 1999

Location: Anadia, Portugal
Year: 1996

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
August 1996 (25 samples)	NA	1.60	3.5	5.1	NA	NA	NA

Analytical method: Optical/thermal
Sample type: Lo-vol, Hi-vol
Corrections: None
Other: Secondary OC = 41%
Reference: Castro et al., 1999

REMOTE

Location: Hotel Everest View (3900 m)
Year: 1981, 1982

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Dec. 81 - Jan. 82	NA	<3.0	4.4 ±1.2	~7.4	0.90 ±1.06	NA	1.8 ±2.4

Analytical method: OGI
Sample type: 47 mm quartz no size segregation
Corrections: None
Other:
Reference: Davidson et al. 1988

Location: Antarctica, Syowa Station (69°00'S; 39°35'W)
Year: 1991

	Concentration (μg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
03/19/91 - 04/29/91	NA	NA	NA	0.57	NA	NA	NA
05/13/91 - 06/09/91	NA	NA	NA	0.98	NA	NA	NA
08/29/91 - 10/29/91	NA	NA	NA	0.44	NA	NA	NA
11/28/91 - 12/31/91	NA	NA	NA	1.02	NA	NA	NA

Analytical method: TC analyzer
Sample type: <0.7 μm, Hi-vol impactor
Corrections: None
Other: Organic acids
Reference: Kawamura et al. 1996

Location: Antarctica, Halley 5 station (75°35'S, 26°14'W)
Year: 1992 - 1995

	Concentration (**ng m^{-3}**)						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Average	NA	1	NA	NA	NA	NA	NA
Min. (May -July)	NA	0.6	NA	NA	NA	NA	NA
Max. (Sep.-March)	NA	1.7	NA	NA	NA	NA	NA

Analytical method: Aethalometer
Sample type: Data "filtered" to exclude local contamination
Corrections: Use $\sigma = 14\ m^2\ g^{-1}$
Other: Similar data for Amsterdam Island. Mean BC = 8 ng m^{-1}; Max = 21.5, Min = 3.5
Reference: Wolff and Cachier, 1998

Location: Background, Sonblick (3104 m), Austrian Alps

Year: 1995, 1996

	Concentration (mass %)			
Sampling time(s)	BC	OC	TC	Total water-soluble ions
September 1995	3.8	16.2	20.0	19.9
July 1996	5.0	53.7	58.7	21.9

Analytical method: IC for inorganics, TC by combustion, OC by integrating sphere
Sample type: 7 stage low-pressure Berner impactor; 0.1 - 1.0 µm
Corrections: None - impactor used
Other: CCN
Reference: Hitzenberger et al., 1999

Location: Background, Jungfraujoch, Switzerland (3454m elev., 46.548°N; 7.984°E)

Year: July 1995 - June 1996

Month	6	8	9	10	11	12	1	2	3	4	5	6
BC (ng $m^{-3)}$	118	54.6	17.6	20.1	11.6	5.9	12.0	19.0	14.0	43.2	23.4	74.6

Analytical method: Aethalometer, using 19 as the apparent cross section
Sample type: < 2.0 µm, RH ˜ 20%
Corrections: BC from σ_{AP} = BC x 10 (550nm)
Other: σ_{AP}(550nm), σ_{SP} (450,559, 700 nm); σ_{BSP} (450, 550, 700 nm); CN, Epiphanometer
Reference: Nyeki et al., 1998

Location: Background, Mount Gibbes, NC (35.78°N, 82.29°W, elev. 2006m)

Year: 1996 - 1997

	BC concentration (ng m^{-3})				
Month	Polluted	Marine	Continental	Maximum	Minimum
June 1996	308.2	113.4	285.7	989	9.3
July	168.0	62.6	129.2	553.1	2.2
Aug.	257.3	71.3	185.2	716.0	1.0
September	173.9	36.3	148.9	507.7	1.0
October	196.0	60.0	119.3	743.7	1.0

March 1997	146.4	37.8	130.5	526.7	1.2
April	227.5	55.3	186.1	757.4	1.3
May	227.7	59.0	181.3	680.9	3.4
June	244.0	94.8	154.1	565.8	7.8
Average 1996-97	216.6	65.6	169.9		
Std. deviation	47.8	23.5	50.6		

Analytical method: Aethalometer, using $\sigma = 19\ m^2\ g^{-1}$
Sample type: Date by sector: continental 290-240°, polluted 290-65°, and marine 65-240°
Corrections: None
Other: (7/18 - 8/9/ 96) LWC = 0.25 g m^{-3}, Tot. BC = 101.2 ng m^{-3}, Interst. BC = 88.3
Reference: Bahrmann and Saxena, 1998

URBAN

ASIA

Location: Katmandu, Nepal (1300 m)

Year: 1981, 1982

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Dec. 81 - Jan. 82	280±12	17 ±1.3	44±1.07	61.0	1.7 ±1.6	NA	7.4 ±1.3

Analytical method: OGI
Sample type: 47 mm quartz no size segregation
Corrections: None
Other:
Reference: Davidson et al. 1988

Location: Sapporo, Japan
Year: 1982

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Jan. - Dec. 1982	32.3 (16.7-46.1)	5.1 (2.3 - 8.0)	4.15	9.23 (4.4 - 14.5)	4.24 (2.8 - 5.3)	1.15±0.38 (0.6 - 1.72)	0.95±0.52 (0.11-1.55)

Analytical method: Two step thermal
Sample type: 24-h, <8µm
Corrections: None
Other: Cl^-, Na^+, Ca^{2+}, Al.
Reference: Ohta and Okita, 1990

Location: Sapporo, Japan
Year: 1982

	µg m^{-3}					
Sampling date(s)	Mass	BC	OC	TC	**WSOC**	SO_4^{2-}
January	36.4	7.5	4.5	12	1.9	4.8
February	33.5	7.9	3.9	11.8	2.1	4.9
March	43.2	5.6	4.6	10.2	1.9	5.4
April	46.1	4.2	4.8	9.0	1.6	5.0
May	35.4	4.0	2.8	6.8	1.6	4.6
June	26.9	3.7	2.3	6.0	1.4	4.0
July	21.0	2.7	1.9	4.6	1.0	4.4
August	16.7	2.2	2.1	4.3	0.8	3.8
September	28.6	4.2	3.5	7.7	1.2	2.8
October	31.8	5.4	6.4	11.8	2.4	3.3
November	31.1	6.1	5.5	11.6	1.8	3.9
December	43.0	6.9	7.6	14.5	2.4	4.2
Annual	32.3±9.3	5.0 ± 1.8	4.2 ± 1.8	9.2 ± 3.3	1.7 ± 0.5	4.3 ± 0.8

Analytical method: TC combustion at 850°C, OC removed at 300°C for 30 min in air
Sample type: <8µm pallflex quartz, 20 l/min. Site 26 m above ground.
Corrections: None
Other:
Reference: Ohta and Okita, 1984; 1990

Location: Beijing, China
Year: 1983-84

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
March	NA	NA	NA	52.5	17.1	NA	NA
July	NA	NA	NA	31.7	15.9	NA	NA
December	NA	NA	NA	106.7	18.5	NA	NA

Analytical method: TC - combustion, S and elements XRF
Sample type: <12 µm, Quartz for TC, Millipore for XRF
Corrections: None
Other: Trace elements. S-C correlated in winter but not in summer. S/C increases with RH
Reference: Dod et al. 1986

Location: Nagoya, Japan
Year: 1984 - 1986

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Spring	114 (70.5-160)	10.7 (6.1-13.0)	15.2 (10.8-20.7)	25.9 (16.9-32.6)	NA	NA	NA
Summer	87.2 (63.6-131)	9.8 (7.2-13.6)	12.6 (9.8-17.5)	22.4 (22.4-31.0)	NA	NA	NA
Fall	119 (68.5-187)	17.9 (6.6-30.9)	22.0 (10.7-34.1)	39.9 (17.3-64.0)	NA	NA	NA
Winter	102 (30.9-195)	13.7 (5.3-34.4)	15.1 (7.2-30.4)	28.8 (12.5-64.8)	NA	NA	NA
Average	106	13.0	16.2	29.3	NA	NA	NA

Analytical method: Two step thermal.
Sample type: Quartz, 24-h Hi. Vol. Site semi-urban.
Corrections: None
Other: Annual averages (%) TC/TSP=27.5; BC/TSP=12.2; OC/TSP=15.3; OC/TC=56; TC/BC=2.3.

Reference: Kadowaki, 1990

Location: Tokyo, Japan
Year: 1986

	Concentration ($\mu g\ m^{-3}$)						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Oct. - Nov., 1986	105.0	NA	NA	27.0	6.1	0.78	4.6

Analytical method: TC by combustion
Sample type: Hi- Vol, daily (9:00 - 15:00).
Corrections: None
Other:
Reference: Okamoto et al. 1990

Location: Sendai, Japan
Year: 1986 - 1987

	Concentration (% mass)					
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	H_2O
Spring	NA	15.8	26.8	42.6	16.5	22.6
Summer	NA	11.6	19.5	31.1	18.3	39.0
Fall	NA	19.5	32.9	52.4	10.9	19.5
Winter	NA	15.8	25.6	41.4	15.8	20.7

Analytical method: Two stage combustion
Sample type: < 1µm
Corrections: None
Other:
Reference: Hayasaka et al. 1992

Location: Sapporo, Japan
Year: 1986 - 1987

	Concentration (% mass)					
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	H_2O
Winter	NA	20.7	30.5	51.2	12.8	24.4

Analytical method: Two stage combustion
Sample type: < 1µm
Corrections: None
Other:
Reference: Hayasaka et al. 1992

Location: Sapporo, Japan
Year: 1987-1988

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/87 - 12/88[a]	25.4	3.3	3.4	6.7	4.1	0.79	1.2
06/87 - 12/88[b]	24.1	3.6	3.6	7.2	4.0	0.64	0.9

[a]Shinoro site
[b]Higashi - Tsukisamu site

Analytical method: TC and BC by two step method (Ohta and Okita, 1984)
Sample type: Hi-Vol, <10 µm (12 samples)
Corrections: None
Other: Anions, cations, Gas phase NO_x and ammonia., seasonal variation
Reference: Kaneyasu et al. 1995

Location: Tokyo, Japan
Year: 1992

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	**WSOC**	TC	SO_4^{2-}	NH_4^+	NO_3^-
24-25, February	166	NA	3.2	11.3	NA	NA	NA
25-26, February	186	NA	3.4	10.6	NA	NA	NA
22-23, July	389	NA	21.3	64.0	NA	NA	NA
23-24, July	216	NA	13.2	42.0	NA	NA	NA

Analytical method: TC - CHN analyzer, WSOC Shimadzu TOC on filtered water extracts.
Sample type: Hi-vol (30 km from city center)
Corrections: None
Other: Organic acids
Reference: Sempéré et al. 1994

Location: Lahore, Pakistan
Year: 1992-93

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
09/21/92 - 10/01/93[a]	607±403	17.6 ± 10.2	76.9 ± 39.1	94.5	18.4 ± 13.5	NA	12.9 ± 8.50
09/21/92 - 10/01/93[b]	590±386	17.7 ± 14	64.3 ± 37.6	82.0	21.2 ± 13.6	NA	12.0 ± 7.55
09/21/92 - 10/01/93[c]	838±631	17.3 ± 7.52	82.9 ± 38.9	100.2	18.6 ± 9.43	NA	13.3 ± 7.05

[a]City center
[b]Industrial site
[c]Rural site

Analytical method: TC and BC by optical/thermal method (Pio et al. 1994)
Sample type: Hi-Vol
Corrections: None
Other:
Reference: Smith et al., 1996

Location: Seoul, Korea
Year: 1994

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/13-22/94[a]	NA	8.39 ±0.67	11.05±0.69	19.44	NA	NA	NA
06/13-22/94[b]	NA	7.57±0.67	9.97±0.74	17.54	NA	NA	NA

[a]<10 µm
[b]<2.5 µm

Analytical method: Oxidation over MnO_2
Sample type: Two size cuts <10 µm and <2.5 µm
Corrections: None
Other:
Reference: Kim et al. 1999

AMERICAS, mostly U.S.

Location: Denver, CO
Year: 1973

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Nov. 73, 7 days	93	NA	NA	15.7	6.9	NA	NA

Analytical method: Combustion for TC, soxhlet extraction for unextractable C - substitute for BC.
Sample type: 24-hr, Hi. Vol. (glass fiber?)
Corrections: none
Other:
Reference: Pierson and Russell, 1979.

U.S. Cities
Averages for Year: 1975
CA. OR, WA, AK (10 cities)

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual average	87.9±34.1	4.2±2.9	7.5±2.9	11.5±4.3	9.5±5.0	NA	NA

CO, MT, AZ, UT, SD, WY (6 cities)

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual average	72.8±39.0	2.7±1.5	6.2±4.0	8.9±5.5	4.3±1.7	NA	NA

MA, MI, NJ, NY, PA, RI (9 cities)

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual average	72.7±12.0	4.4±1.3	5.2±1.7	10.6±2.9	11.9±1.5	NA	NA

AR, AL, FL, GA, LA, MS, NC, TN, TX, SC (13 cities)

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual average	70.4±21.5	3.2±1.2	6.3±2.3	9.6±3.2	10.2±2.5	NA	NA

IL, IN, MO, OH, WI (7 cities)

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual average	97.4±21.1	4.4±0.9	6.8±1.4	11.2±1.8	14.0±3.5	NA	NA

Analytical method: OGI
Sample type: NASN hi-vol (TSP), glass fiber, collected every 12th day (from Jan. 6th, 1975). Analyzed in 1980-81. Stored at room temp.
Corrections: None
Other:
Reference: Shah et al., 1986

Location: New York

Year: 1978-79

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Annual averages	26.5	3.12	5.14	8.27	6.35	NA	NA

Analytical method: OGC
Sample type: Weekly <3.5 µm samples, 42 total. Prefired glass fiber.
Corrections: none
Other:
Reference: Shah, et al. 1985.

Location: Denver, CO

Year: 1978

	Concentration (µg m^{-3})						
Sampling date)s	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
11/11/78 - 12/21/78	NA	6.4 (1.6 - 14.0)	7.5 (3.7 - 14.2)	13.9	3.1 (1.6 -5.2)	2.2 (0.7-4.2)	5.8 (1.0-8.5)

Analytical method: GM automated (App. OC, App. BC)
Sample type: <2.0 µm
Corrections: None
Other:
Reference: Countess et al. 1981.

Location: Houston, TX

Year: 1980

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
09/11-19/80 Day	42.5±4.2	NA	NA	7.6±0.5	16.7±1.4	4.3±0.4	NA
09/11-19/80 Night	29.8	NA	NA	5.6	10.9	3.4	NA

Analytical method: TC combustion on MnO_2
Sample type: Dichotomous sampler <2.5 µm
Corrections: None
Reference: Dzubay et al. 1982.

Location: Detroit, MI

Year: 1981

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/01/81 - 08/01/81	24.75±13.47 (4.46-72.51)	2.32±1.01 (0.65-5.06)	5.38±2.20 (1.08-12.58)	7.7	9.22±7.43 (0.54-31.53)	NA	NA

Analytical method: GM combustion
Sample type: Virtual impactor, <2.5 µm, 24-h samples, continuous.
Corrections: None
Other:
Reference: Wolff et al. 1985.

Location: Detroit, MI
Year: 1981

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
One week in July	42.4±17.4 (13.8 - 74.5)	1.6±0.9 (0.2 - 4.1)	7.1±1.9 (4.3 - 11.2)	8.7	13.8±12.3 (0.4 - 41.5)	NA NA	NA NA

Analytical method: GM combustion
Sample type: Dichotomous sampler, <2.5 µm., every 4 hour, ~ 40 samples analyzed.
Corrections: None
Other:
Reference: Wolff and Korsog, 1985.

Location: Phoenix, AZ
Year: 1983

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Jan. 1983	NA	8.3 ±4.6	10.0	18.3 ± 8.5	3.0 ± 2.1	2.6 ± 1.7	6.0 ± 4.3

Analytical method: TC/BC by GM two step method.
Sample type: <2.8 µm, 10 cm diam. quartz
Corrections: None
Reference: Solomon and Moyers, 1986

Location: Detroit, MI
Year: 1984, 1985

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
01/09/84 - 04/06/84	NA	2.4±1.3	5.5±2.0	7.9	NA	NA	NA
12/21/85-04/22/85	NA	2.1±1.1	5.7±2.1	7.8	NA	NA	Na

Analytical method: TC and BC by GM automated two step method
Sample type: Open face 47-mm quartz, 10 l/min, sampling times 50 - 100 hours.
Corrections: None
Other:
Reference: Muhlbaier-Dasch and Cadle, 1989.

Location: Southern California (SCAQS)

Year: 1987

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
6/19/87-9/3/87							
Burbank	42.6	2.21	9.13	11.34	8.72	NA	5.11
Dtn. Los Angeles	41.1	2.37	8.27	10.64	9.41	NA	4.33
Hawthorne	30.5	0.70	3.35	4.05	9.67	NA	1.25
Long Beach	25.4	0.99	3.35	4.34	7.42	NA	1.44
Anaheim	26.8	1.20	4.72	5.92	6.49	NA	2.36
Rubidoux	63.9	1.73	8.47	10.2	7.13	NA	21.19
Azusa	47.1	2.64	9.53	12.17	8.28	NA	5.09
Claremont	41.0	1.92	9.59	11.51	6.79	NA	4.89
11/11/87-12/11/87							
Burbank	78.3	6.32	19.55	25.87	3.76	NA	22.02
Dtn. Los Angeles	90.2	7.28	18.46	25.74	4.38	NA	22.64
Hawthorne	68.9	5.81	14.00	19.81	4.93	NA	16.57
Long Beach	72.7	6.00	17.84	23.84	4.42	NA	19.36
Anaheim	83.5	5.45	13.88	19.33	4.28	NA	30.56
Riverside	85.8	5.54	13.61	19.15	3.13	NA	29.04

Analytical method: DRI
Sample type: <2.5 µm

Corrections: Backup quartz used, 10-30% OC on backup, not used to correct OC.
Other:
Reference: Chow et al., 1994

Location: San Joaquin Valley, California
Year: 1988 - 1989

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/14/88-06/09/89							
Stockton	29.45	3.85	5.42	9.27	2.27	NA	6.42
Fresno	39.22	6.27	8.05	14.32	2.75	NA	9.43
Bakersfield	39.80	5.44	6.50	11.94	3.91	NA	10.82

Analytical method: DRI
Sample type: <2.5 µm; quartz, 47-mm; 24-hr
Corrections: Quartz denuder in the 2.5 µm channel two filters back - to -back. OC on backup filter within 1 or 2 SD of OC on field blanks.
Other:
Reference: Chow et al., 1993

Location: Rio de Janeiro
Year: 1985

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
06/29/85 - 07/07/85[a]	NA	21.05 ± 10.0	30.2 ±14.3	51.3	10.9 ± 6.5	NA	5.44 ± 3.9
07/08/85 - 07/10/85[b]	NA	4.92 ± 2.2	9.68 ± 7.0	14.6	4.47 ± 1.90	NA	2.30 ± 1.25

[a]Central
[b]Residential

Analytical method: BNL two step method.
Sample type: Hi-vol, quartz, 12 hour day and night time samples.
Corrections: None

Other: $^{13}C/^{12}C$; ^{14}C
Reference: Tanner and Miguel, 1988

Location: Mexico City
Year: 1990, 1991

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
09/12-25/90	NA	NA	NA	8.1±0.06 (2.39-11.0)	11.4±1.14 (3.96-19.8)	NA	NA
02/12/ - 03/01/91	NA	NA	NA	9.1±0.5 (6.0-14.8)	5.97±1.65 (1.44-29.5)	NA	NA

Analytical method: Proton Elastic Scattering and Laser Integrating Plate Methods
Sample type: 6-HR, <2.5 µm
Corrections: None
Other: Trace elements, reconstructed mass
Reference: Miranda et al. 1994

EUROPE

Location: Vienna, Austria
Year: 1978

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
December 1978	92.0	NA	NA	23.3	17.5	5.8	7.0

Analytical method: TC by combustion
Sample type: 0.1 - 6.5 µm, impactor
Corrections: None
Other: Trace elements
Reference: Puxbaum and Wopenka, XXXX

Location: Athens, Greece
Year: 1982, 1983

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
June - Aug., 1982	44.0*	8.2	25.7	33.9	2.9		
Jan.- Feb., 1983	48.3*	11.0	16.1	27.1	9.3		

*Reconstructed mass

Analytical method: Oregon Graduate Center
Sample type: 47 mm glass fiber filter, no size segregation.
Corrections: Yes. Back-up filters treated as blanks
Other:
Reference: Valaoras, G. et al., 1988.

Location: Paris, France
Year: 1984, 1985

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Fall 1984	NA	1.6	4.2	5.8	NA	NA	NA
Winter 1985	NA	5.9	14.6	20.5	NA	NA	NA

Analytical method: Two step combustion
Sample type: Glass fiber, no size separation
Corrections: None
Other:
Reference: Cachier et al. 1989

Location: Helsinki, Finland
Year: 1985

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Jan. / Feb.	51.8	5.0	NA	NA	14.7	NA	NA
Apr. / May	81.0	4.9	NA	NA	11.2	NA	NA
June / Aug.	35.9	2.7	NA	NA	7.0	NA	NA
Sep. / Nov.	44.0	6.4	NA	NA	10.9	NA	NA

Analytical method: BC from optical transmission through glass fiber filters. Calibrated against "free" carbon (Kukreja and Bove, EST, 10, 187, 1986).
Sample type: 24-hr Hi-vol glass fiber.
Corrections: BC, some speculation about accuracy
Other: Pb, TSP, BC vs. SO_4^{2-} correlation (r>0.61) high in every season.
Reference (35) : Viisanen et al.

Location: Gif sur Yvette, France
Year: 1985 - 1987

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Winter 1986	NA	2.4 (0.9-5.4)	6.7	9.1 (3.4-19.0)	NA	NA	NA
Spring 1986-87	NA	1.9 (0.9-4.6)	6.5	8.4 (3.7-20.2)	NA	NA	NA
Summer 1984-87	NA	1.5 (1.0-2.3)	4.8	6.3 (4.6-9.5)	NA	NA	NA
Fall 1985	NA	4.0 (2.5-5.1)	18.9	22.9 (13.3-33.7)	NA	NA	NA

Analytical method: Two step combustion
Sample type: Glass fiber, no size separation
Corrections: None
Other:
Reference: Cachier et al. 1989

Location: Coimbra, Portugal
Year: 1992, 1993

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Oct. 1992 - Mar. "93	NA	4.22	8.88	13.1	NA	NA	NA
Aug. Sep. 1993	NA	1.78	5.32	7.1	NA	NA	NA

Analytical method: Optical/thermal (Pio)
Sample type: Quartz, low vol. 50 l/min
Corrections: None
Other: Prim/Sec OC
Reference: Castro et al., 1999

Location: Oporto, Portugal
Year: 1992 - 1993

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
Apr. - Sep. 1993	NA	2.67	7.22	9.9	NA	NA	NA
Oct. 92-Mar.93	NA	5.33	9.06	14.4	NA	NA	NA

Analytical method: Optical/thermal (Pio)
Sample type: Quartz, low vol 50 l/min,
Corrections: None
Other: Prim/Sec OC
Reference: Castro et al., 1999

Location: Birmingham, England
Year: 1993, 1994

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
May 1993	NA	1.38	4.82	6.2	NA	NA	NA
January 1994	NA	3.42	4.78	8.2	NA	NA	NA

Analytical method: Optical/thermal (Pio)
Sample type: Quartz, low vol 50 l/min
Corrections: None
Other: Prim/Sec OC
Reference: Castro et al., 1999

Location: Leipzig, Germany
Year: 1995-1997

	Concentration (µg m^{-3})						
Sampling date(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
07/01/95 - 04/30/95	38±21 (1.6-130)	2.3±2.3 (0.13-11.0)	NA	NA	6.8±5.5 (0.62-33.0)	3.4±2.4 (0.08-14.0)	4.9±4.4 (0.22-32.0)

Analytical method: BC: reflectance and a two step combustion in air. Estimated uncertainty for both 20%.
Sample type: PM_{10}, Hi-Vol
Corrections: None
Other: Annual change 1993 to 1995
Reference: Heintzenberg et al., 1998

Location: Aveiro, Portugal
Year: 1996

	Concentration (µg m^{-3})						
Sampling time(s)	Mass	BC	OC	TC	SO_4^{2-}	NH_4^+	NO_3^-
August 1996	NA	1.26	3.04	4.3	NA	NA	NA

Analytical method: Optical/thermal (Pio)
Sample type: Quartz, low vol 50 l/min
Corrections: None
Other: Prim/Sec OC
Reference: Castro et al., 1999

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