

海外における有害金属の環境監視手法

1. 海外における環境監視手法の概要

国・モニタリングプログラム	項目	サンプリング期間	サンプリング頻度	サンプリング方法	分析方法
EMEP ¹⁾	ガス状水銀(Hg)	24 時間	週 1 回	Gold traps	CV-AFS
	降水中水銀(Hg ²⁺)	1 週間 又は 1 ヶ月間	週 1 回 又は月 1 回	wet only IVL sampler	CV-AFS
	Cd,Pb(first priority) Cu,Zn,As,Cr,Ni(second priority) (粒子中)	1 週間	週 1 回	EN12341	ICP-MS / GF-AAS
	Cd,Pb(first priority) Cu,Zn,As,Cr,Ni(second priority) (降水中)	1 週間	週 1 回	wet only	ICP-MS / GF-AAS
CAMNet ²⁾	ガス状水銀(TGM)	1 時間		Tekran 2537A	CV-AFS
	降水中水銀				

¹⁾ 「EMEP manual for sampling and chemical analysis」(November 2001)

²⁾ 「CANADIAN ATMOSPHERIC MERCURY MEASUREMENT NETWORK(CAMNet)」WEB ページ
http://www.msc-smc.ec.gc.ca/arqp/camnet_e.cfm

2. 欧州監視評価計画 (EMEP) における監視内容

欧州監視評価計画 (European Monitoring Evaluation Program; EMEP) は、長距離越境大気汚染条約(1979)に基づいて、欧州における大気汚染物質の広域移流を監視し、評価するための協力計画であり、SO_x、NO_x、VOC など大気汚染物質の排出データの収集、汚染物質の沈着と大気質濃度や、大気拡散モデルに関する研究などを定めている。2003年11月現在、加盟24カ国に約100ヶ所の測定所が設置されている。

(1) マニュアルの測定方法

Components	Measurement period	Measurement frequency	Sampling methods in field	Methods in laboratory
Gas				
SO ₂	24 hours	daily	KOH impregnated filters	IC / (Thorin)
NO ₂	24 hours	daily	Nal impregnated glass frit	IC / Griess
O ₃	hourly means stored	continuously	UV absorption	
HNO ₃	24 hours	daily	denuder	IC / Griess after reduction
NH ₃	24 hours	daily	denuder	IC / Indophenol
Light hydrocarbons C2-C7	10-15 mins	twice weekly	steel canisters	GC
Ketones and aldehydes (VOC)	8 hours	twice weekly	DNPH cartridge	HPLC
Hg	24 hours	weekly	Gold traps	CV-AFS
Particles				
SO ₄ ²⁻	24 hours	Daily	aerosol filter	IC / (Thorin)
NO ₃ ⁻	24 hours	Daily	aerosol filter after denuder	IC / Griess after reduction
NH ₄ ⁺	24 hours	Daily	aerosol filter after denuder	IC / Indophenol
Na ⁺ , Mg ²⁺ , Ca ²⁺ , K ⁺ , Cl ⁻	24 hours	Daily	aerosol filter	IC / AAS / AES
PM ₁₀	24 hours	Daily	EN 12341	micro balance
PM _x	24 hours	Daily	To be decided	micro balance
Mineral dust	24 hours	Daily	EN 12341	INAA, PIXE, XRF
EC and OC	24 hours	Daily	EN 12341	Thermo desorption and oxidation
OC-speciation	24 hours	once a week	EN 12341	LC-MS
Cd, Pb (first priority), Cu, Zn, As, Cr, Ni (second priority)	weekly	weekly	EN 12341	ICP-MS / GF-AAS
Gas + particles				
HNO ₃ (g)+NO ₃ ⁻ (p), NH ₃ (g)+NH ₄ ⁺ (p)	24 hours	daily	Filter pack	IC / Griess after reduction
POPs (PAH, PCB, HCB, chlordane, lindane, a-HCH, DDT/DDE)	25 hours	daily	Filter pack	IC / Indophenol
	to be decided	to be decided	PUF (polyurethane foam) sampler	GC-MS

Components	Measurement period	Measurement frequency	Sampling methods in field	Methods in laboratory
Precipitation				
Amount	24 hours (weekly)	daily (weekly)	rain gauge	By weight
SO ₄ ²⁻	24 hours (weekly)	daily (weekly)	wet only	IC
H ⁺	24 hours (weekly)	daily (weekly)	wet only	titration
pH	24 hours (weekly)	daily (weekly)	wet only	pH meter
NH ₄ ⁺	24 hours (weekly)	daily (weekly)	wet only	IC / Indophenol
NO ₃ ⁻	24 hours (weekly)	daily (weekly)	wet only	IC / Griess after reduction
Na ⁺	24 hours (weekly)	daily (weekly)	wet only	IC / AES
Mg ²⁺	24 hours (weekly)	daily (weekly)	wet only	IC / AAS
Cl ⁻	24 hours (weekly)	daily (weekly)	wet only	IC / Thiocyanate
Ca ²⁺	24 hours (weekly)	daily (weekly)	wet only	IC / AAS
K ⁺	24 hours (weekly)	daily (weekly)	wet only	IC / AES
κ (conductivity)	24 hours (weekly)	daily (weekly)	wet only	Cond-meter
Cd, Pb (first priority)	weekly	weekly	wet-only	ICP-MS / GF-AAS
Cu, Zn, As, Cr, Ni (second priority)	weekly	weekly	wet-only	
Hg ²⁺	weekly (1 sampler) (or monthly (2 samplers))	weekly (or monthly)	wet only IVL sampler	CV-AFS
POPs (PAH, PCB, HCB, chlordane, lindane, a-HCH, DDT/DDE)	to be decided	to be decided	wet-only	

出典)「EMEP manual for sampling and chemical analysis」(November 2001)

(2) 各国の測定方法

Country	Precipitation		Air and aerosols		Laboratory method	Participate in EMEP lab. Intercomp. ¹
	Field method	frequency	Field method	frequency		
Austria			High-vol, PM10	24h a week	ICP-MS	yes
Belgium	Bulk/Wet-only	Monthly	Filter-1 pack		AAS	no
	Hg wet only	Monthly			CV-AAS	
Czech Republic	Bulk	Weekly	Filter-1 pack	24h a week	Cr, As: ICP-MS Ni, Cd, Cu, Pb: GF-AAS, Zn: F-AAS	yes
Germany	DE1,9: Wet-only	Weekly	High Vol., PM10	10 days	ICP-MS	yes
	DE2,4: Bulk	daily at DE2,				
	Hg wet only	Weekly			CV-AFS	
Denmark	Bulk	Monthly	Filter-3 pack	daily at DK5,8,31 and weekly at DK10,11	Precip: ICP-MS Aerosols: PIXE	no
	Hg Bulk (Hg)	Monthly	Hg-monitor (Tekran)	hourly		
Estonia	Bulk	Monthly			GF-AAS, Zn: F-AAS	yes
Spain			High-vol, PM10	24h a week	GF-AAS	yes
Finland	Bulk	Monthly	Teflon, Millipore, Fluoropore, 3 µm, 50 l/min, cut off 15 µm	weekly	ICP-MS	yes
	Hg Bulk (Hg)	Monthly	Hg: gold traps (TGM)	2 days weekly	CV-AFS	
			Hg: mini traps (TPM)	weekly	CV-AFS	
France	Bulk	Monthly			GF-AAS	yes
Great Britain	Bulk	Monthly	Filter-1 pack	Monthly	ICP-MS	yes
Ireland	Bulk	Monthly			ICP-MS	no
	Hg Bulk	Monthly			ICP-MS	
Iceland	Bulk	Weekly	High vol.	Biweekly	ICP-MS	(yes) ²
	Hg				CV-AAS	
Lithuania	Bulk	Weekly	Filter-1 pack	Weekly	GF-AAS	yes
Latvia	Bulk	Monthly	Filter-1 pack	Weekly	GF-AAS, Zn: F-AAS	yes
Netherlands	Wet-only	Monthly	Filter-1 pack	24h every 2 days	ICP-MS	yes
	Hg Wet-only	Weekly			CV-AAS	
Norway	Bulk	Weekly	NO42: High Vol, 20 l/h, W40	48h a week	ICP-MS	yes
			NO99: Filter-2-pack (PM10 & PM25), 10 l/min, Zefluor teflon	Weekly		
	Hg Bulk (Hg)	Monthly	NO42: Tekran monitor	5-30min	CV-AFS	
			NO99: gold traps	24h a week		
Poland	Wet-only	Biweekly			GF-AAS, Zn: F-AAS	Yes
Portugal	PT10: Wet-only, PT1,3,4: bulk	weekly bulk			GF-AAS, Zn: F-AAS	no
Sweden	Bulk	Monthly			ICP-MS	(yes) ²
	Hg Bulk (Hg)	Monthly	gold traps	2 X 24 h a week	CV-AFS	
Slovakia	Wet-only	monthly	Filter-1 pack, Nitrocellulose filters Sartorius 47mm, 5-25 m3/day	Weekly	GF-AAS, Zn: F-AAS	yes

¹ Countries participated in the intercomparison in 2002, (Uggerud et. al, 2003)

² Samples shipped to NILU, Norway for analysis

AAS: Atomic Absorption Spectroscopy

GF-AAS: Graphite Furnace Atomic Absorption Spectroscopy

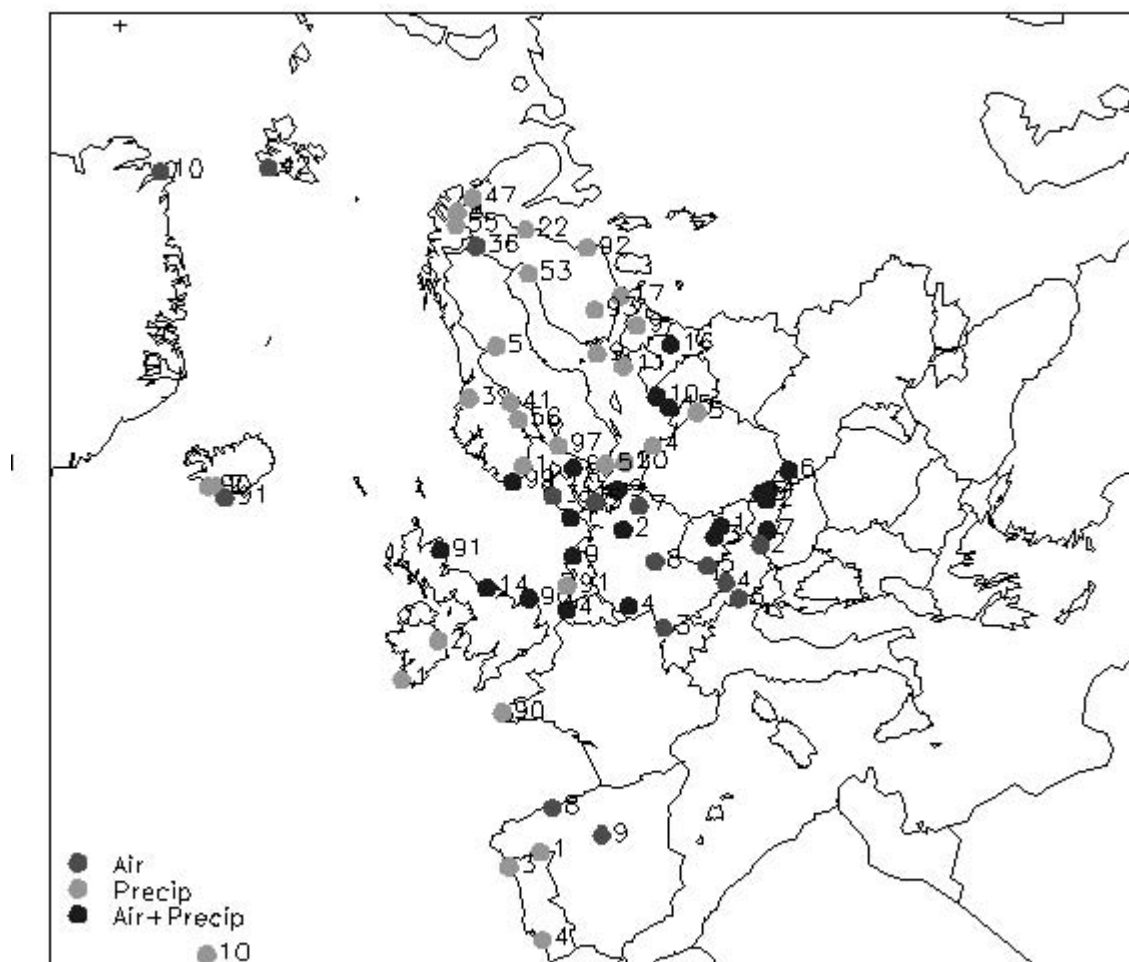
F-AAS: Furnace Atomic Absorption Spectroscopy

ICP-MS: Inductively Coupled Plasma - Mass Spectrometry

CV-AAS: Cold Vapor Atomic Fluorescence spectroscopy

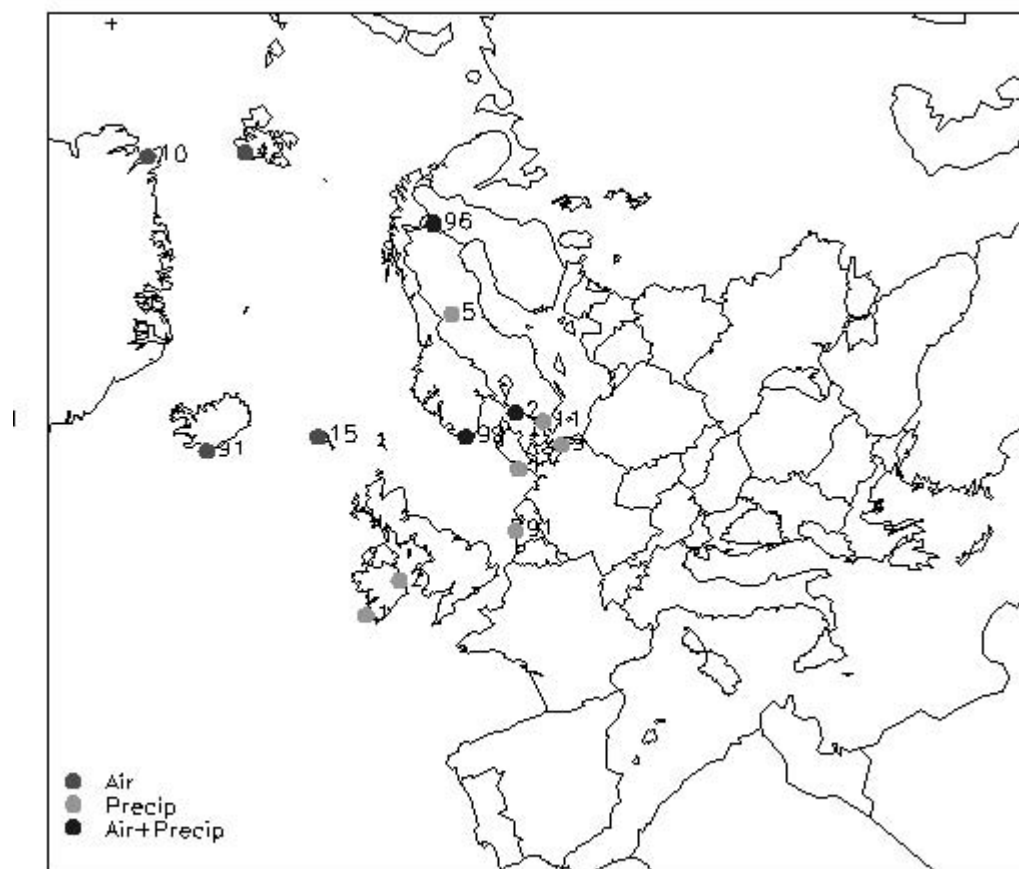
出典) <http://www.nilu.no/projects/ccc/emepdata.html>

(3) 重金属測定地点



出典) <http://www.nilu.no/projects/ccc/emepdata.html>

(4) 水銀測定地点



出典) <http://www.nilu.no/projects/ccc/emepdata.html>

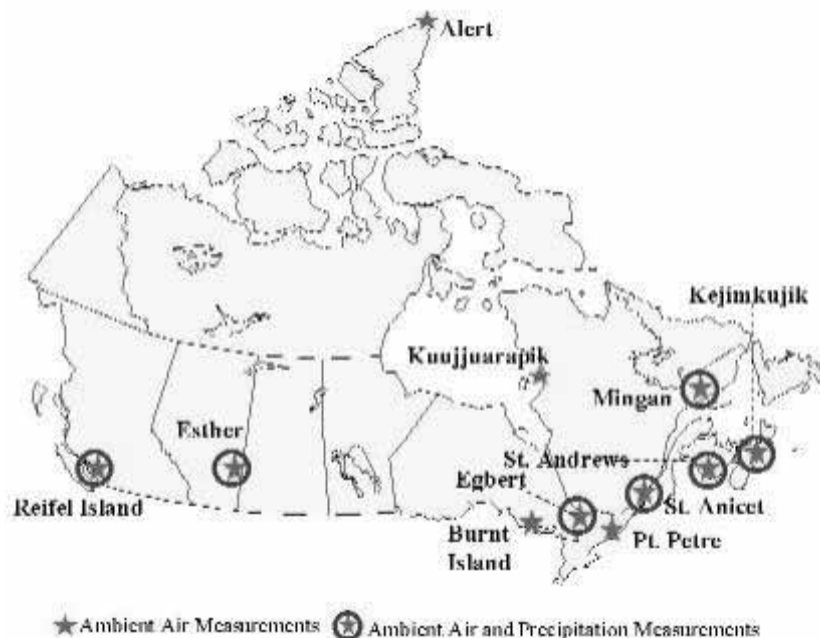
3. カナダの大気中水銀測定ネットワーク (CAMNet) における監視内容

1996年にカナダ環境省は、環境中の水銀の状況を把握するための大気中水銀測定ネットワーク (Canadian Atmospheric Mercury Measurement Network)を開始。

(1) 測定方法

- ・大気中ガス状水銀濃度(TGM)は冷蒸気還元気化原子蛍光法(CVAFS)による分析機器(Tekran 2537A Ambient Mercury Vapour Analyser)を用いて測定。
- ・サンプリング時間は1時間。
- ・降水中水銀の測定方法は Mercury Deposition Network(MDN)と同じ。

(2) 測定地点



出典) http://www.msc-smc.ec.gc.ca/arqp/camnet_e.cfm