Emission inventories for air pollutants: Needs, status, and further development

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Emission inventory needs and clients

Emission inventories should be:

- complete
- accurate
- transparent

Types of emission inventories:

- supporting inventories
- effects inventories
- event (process) inventories
- time scale (historical and future projections)

Table 1: Examples of types of inventories

Designator	Geog Area	Spatial Resolution	Temporal Resolution
Supporting Inventories			
Vegetation	Global	1° x 1°	NA
Land cover	Global	1° x 1°	NA
Effects Inventories			
Acidification (SO_2)	Global	1° x 1°	Annual
Air toxics (metals)	UK	50 km x 50 km	Annual
Atmos. visibility (NO_x)	Global	80 km x 80 km	Hourly
Climate (CO_2)	Global	5° x 5°	Annual
Event Inventories			
Volcanic emissions	Global	None	NA
War-related emissions	Kuwait	Country	NA
Time Scaldnventories			
Historical	USA	States	Annual
Future projections	Global	Countries	Seasonal

NA = not available

Needs for environmental policy decisions:

- sector/category data reporting
- national/regional data reporting
- historical/current data reporting
- emission scenarios/projections

Needs for transport modeling

- spatial distribution & emission maps
- temporal resolution of emission data
- species resolution of emission data

Major clients in Europe:

- international policy making (conventions: UN ECE, LRTAP, OSPARCOM, HELCOM, MEDPOL, programs: AMAP, EU directives)
- national regulatory and statutory planning authorities
- international emission trading programs
- modelers of air pollutant transport and deposition (UN ECE EMEP, EU projects, national projects)
- public "right-to-know" policies (e.g. local communities)

Status of emission inventories

Assessment of emission inventories

Table 2: Status assessments of emission inventorying

Species	Global flux	European flux	Spatial resolution		Temporal resolution	
			Specific regions	Overall	Specific regions	Overall
CO_2	G[a]	G	G	P[b]	G	G
CO	F[c]	G	G	P	F	NI[d]
CH_4	F	G	F	P	P	P
VOC	P	F	F	P	F	P
PAH	P	F	P	NI	NI	NI
Chlorinated HC	F	F	F	P	NI	NI
NO_x	G	G	G	F	F	P
N_2O	P	F	F	P	F	F
NH_3	P	G	F	F	F	NI
CFC	G	G	P	P	P	F
SO_2	G	G	G	F	F	P
Reduced S	P	F	F	P	F	P
HCl	P	F	F	NI	NI	NI
HF	NI	P	P	NI	NI	NI
Radon	F	F	P	P	NA[e]	NA
TPM	P	F	F	P	NI	NI
SO^{2-}_4	NI	F	P	NI	P	NI
Metals	F	F	F	F	NI	NI
Soot	P	F	P	P	NI	NI

[a]G: good, [b]P: poor, [c]F: fair, [d]NI: no inventory; [e]NA: not applicable

Existing selected global primary data bases

(on the basis of a literature review by Graedel, Pacyna, and others, published in Global Biogeochemical Cycles, 7, 1-26, 1993)

Parameter	Spatial Resolution[a]	Temporal Resolution
	Atmosphere	
Vector wind	2.5° x 5° x 11L	monthly
Temperature	2.5° x 5° x 11L	monthly
Specific humidity	2.5° x 5° x 11L	monthly
Surface air temperature	2° x 2.5°	monthly
ΔT surface	4° x 5°	monthly
ΔT surface	hemisphere	monthly
Precipitation	2° x 2.5°	monthly
Äprecipitation	"global"	seasonal
Clouds	280 km x 280 km	3-hourly
Clouds	5° x 5°	monthly
Tropical temperature	280 km x 280 km x 5L	monthly
Tropical water vapor	280 km x 280 km x 5L	monthly
Total column O_3	280 km x 280 km	monthly
	Land	
Topog/bathymetry	1° x 1°	none
Topog/bathymetry	5' - 10'	none
Albedo	1° x 1°	none
Coal resources	Country	none
Vegetation	1° x 1°	none
Vegetation	0.5° x 0.5°	none
Land cover	1° x 1°	none
Land use	1° x 1°	none
Soils	1° x 1°	none
Soils	1° x 1°	none
Wetlands	1° x 1°	none
Wetlands	2° x 2.5°	none
Drainage basins	2° x 2.5°	none
Vegetation index	1° x 1°	none
	Ocean	
Sea surface temperature	2° x 2°	monthly
Sea surface temperature	[1024 x 512]	monthly
Marine climate	2° x 2°	monthly
Surface wind	2° x 2°	monthly
Surface wind	[1080 x 540]	monthly
Surface height	[1080 x 540]	monthly
Temperature	1° x 1° x 33L	seasonal
Salinity	1° x 1° x 33L	seasonal
Oxygen	1° x 1° x 33L	seasonal
Ocean color	[512 x 512]	seasonal
ΔpCO_2	2° x 2°	seasonal

Assessment of global emission inventories for greenhouse gases

Table 3: Status assessment for greenhouse gas global emission inventories as concluded so far from the EU EVERGREEN project

Greenhouse gas	Anthropogenic except biomass burning	Biomass burning	Rice paddies and fermentation	Ocean
CO_2	Africa P Asia P Australia G Canada + USA G South America P Europe G	Africa P Asia P Australia G Canada + USA G South America P Europe G	-	P
CO	Africa P Asia P Australia G Canada + USA G South America P Europe G	P	-	P
CH_4	Africa P Asia P Australia G Canada + USA G South America P Europe G	P	Africa NI Asia P Australia G Canada + USA G South America P Europe G	P

G = Good
F = Fair
P = Poor
NI = No inventory

Further development of emission inventories

Justification for further work (improvement)

- need for improved emission reduction plans
- need for better (more accurate and complete) emission inventories used for:
  - permitting and regulatory compliance,
  - urban and regional planning,
  - industrial technology change

Need for satellite observations

- relationships between satellite measurements and ground monitors
- use of satellite imagery for development of detailed land use data to support bottom-up emission estimates for windblown dust and agricultural sources, biomass smoke emissions, and others.

Need for an Operational Atmospheric Chemistry Monitoring Space mission

- to improve our understanding of anthropogenic and natural emissions of various gaseous and particulate pollutants, the subsequent tropospheric transport, and the impact on regional and global scale air quality and chemistry,
- to provide information on surrogate parameters used in emission inventorying,
- to improve the accuracy of some emission estimate methodologies, e.g. the smoke emission measurement methodologies using combined satellite and surface data.