Malé Declaration 1ST emissions inventory workshop

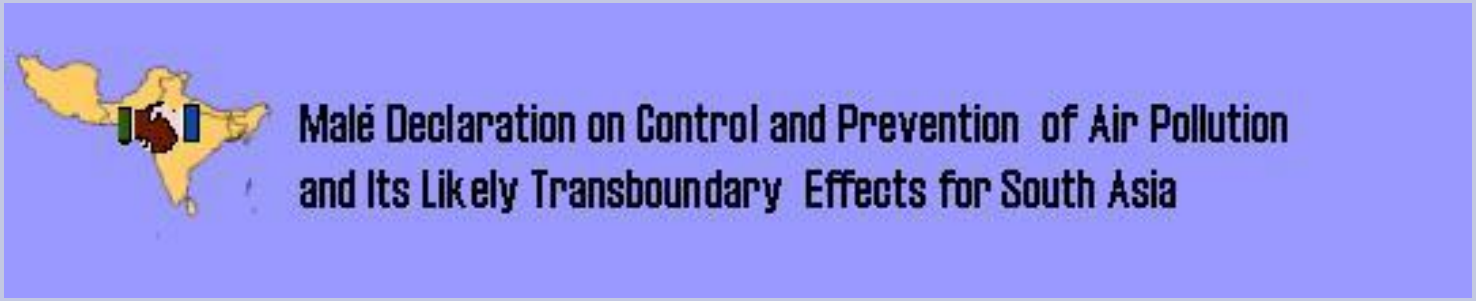
AIT, Bangkok, 3rd – 5th July 2006

Part 1 – The air pollution problem and the need for emissions inventories

Harry Vallack,

Stockholm Environment Institute (SEI)

University of York, UK



The problem

Substances emitted into the atmosphere by human activities and natural processes are the cause of many environmental problems including:

- **Damage to human health**
- **Damage to crops, animals and ecosystems**
- **Damage to and soiling of buildings and other structures**
- **Acidification of ecosystems**
- **Eutrophication of ecosystems**
- **Air quality degradation**
- **Visibility (regional haze)**
- **Global warming/climate change**
- **Stratospheric ozone depletion**

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Impacts of Air Pollution at Different Scales

Household Urban Peri-urban Regional Global

The problem:- Damage to human health

Household scale impact - mainly women and children

The problem:- Damage to human health

Urban scale impact

The WHO estimates that globally, 800,000 advanced deaths per year are being caused by outdoor air pollution.

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The problem:- Damage to human health

Regional scale impact

More than 8,000 people were admitted to hospital in Malaysia due to the Indonesian fires in September 1997

The major regional air pollutants included in the Malé Declaration emission inventory manual

- Sulphur dioxide (SO_2)
- Nitrogen oxides (NO_X)
- Particulate matter (PM_{10} and $PM_{2.5}$)
- Ammonia (NH_3)

The ozone (O_3) precursors (in addition to NO_X, SO_2 and NH_3):

- Carbon monoxide (CO)
- Non-methane volatile organic compounds (NMVOCs)

The problem:- Damage to human health

- **Carbon monoxide (CO)**

  Effects can include hypoxia, neurological deficits and increases in mortality and hospital admissions for cardiovascular diseases

- **Particulate matter (PM)**

  Can increase rates of daily mortality, hospital admissions and respiratory and cardiovascular morbidity. The 800,000 deaths per year caused by outdoor air pollution are mainly due to PM.

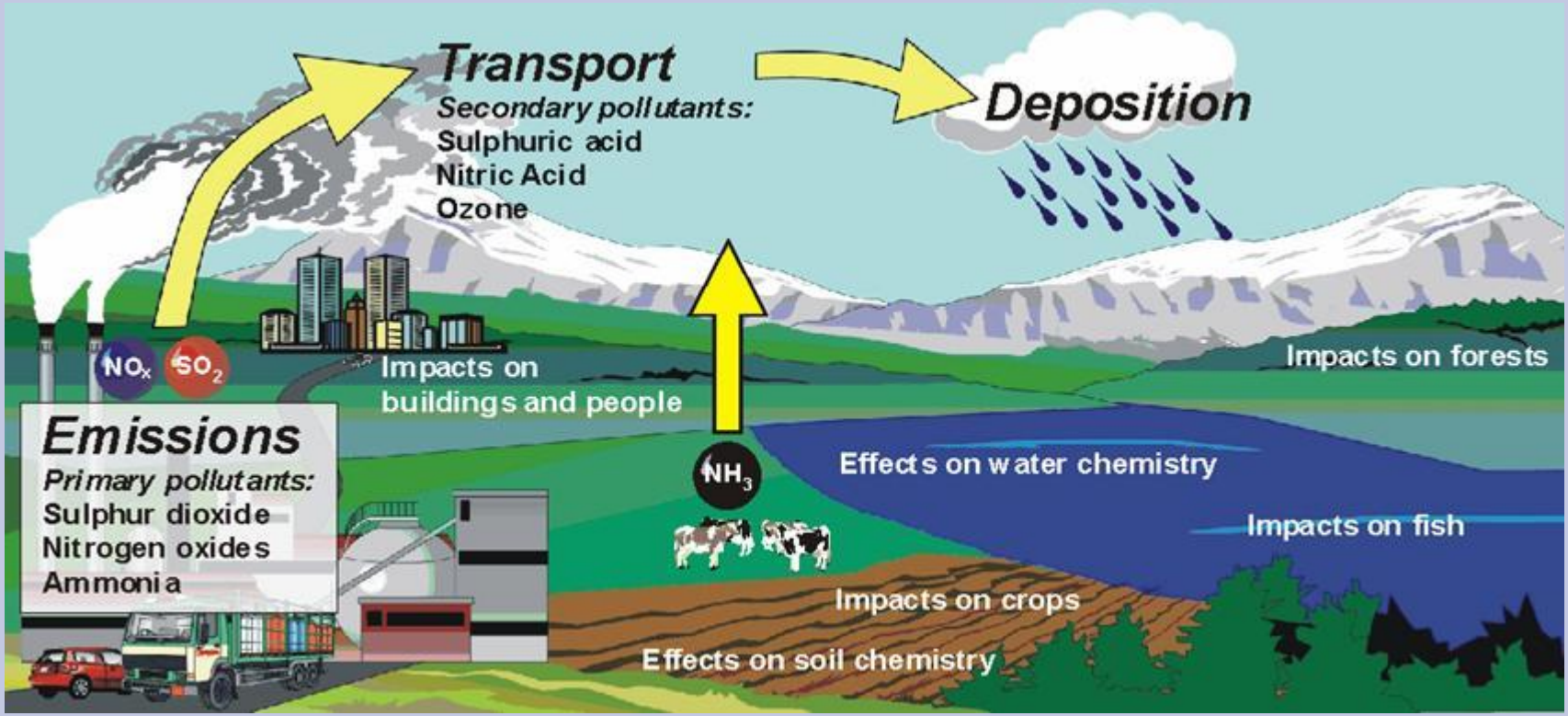
The problem:- Damage to human health

- **Ozone (O_3)**
  Reduced lung function, increased airway inflammation, aggravation of pre-existing respiratory diseases such as asthma leading to increases in hospital admissions and excess mortality

- **Sulphur dioxide (SO_2) and Nitrogen dioxide (NO_2)**
  Some studies have found adverse health effects – especially at high concentrations.

The problem:

Damage to crops, animals and ecosystems



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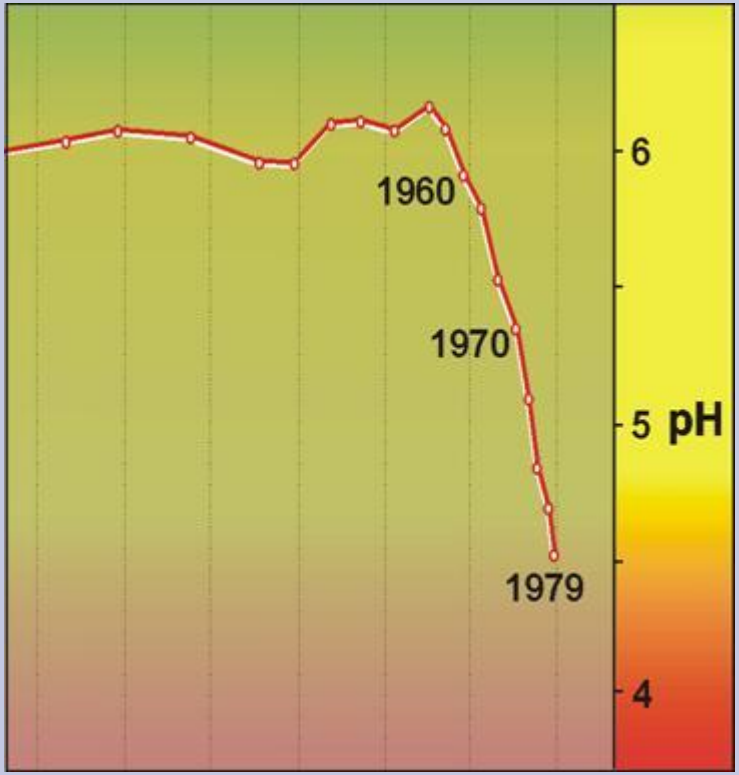
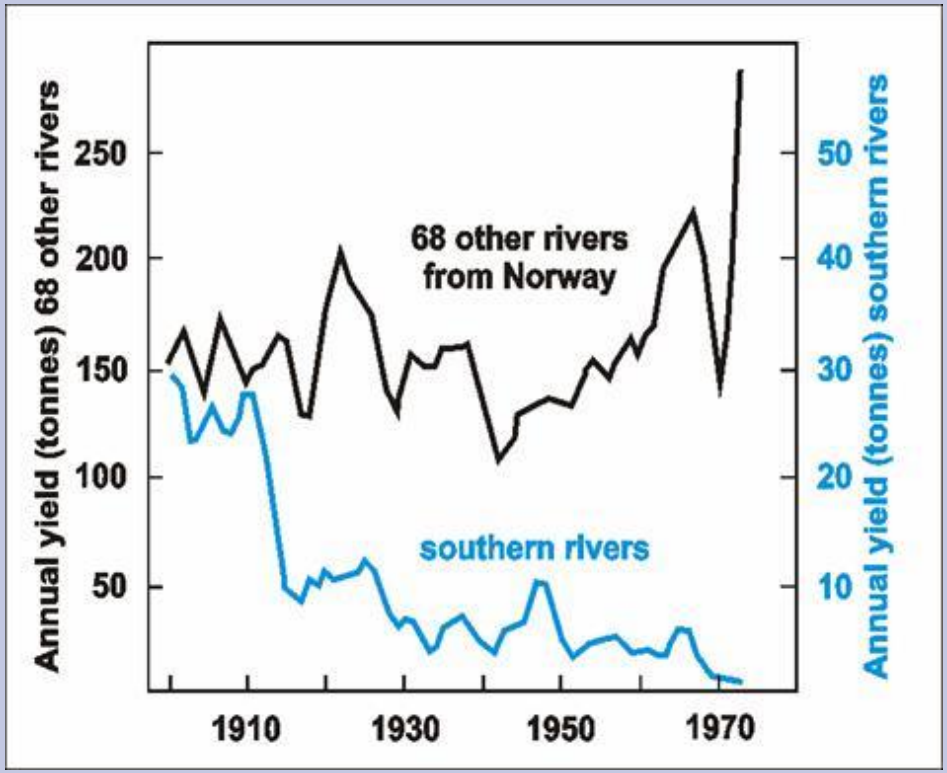
Effects of ‘Acid Rain’ in Europe

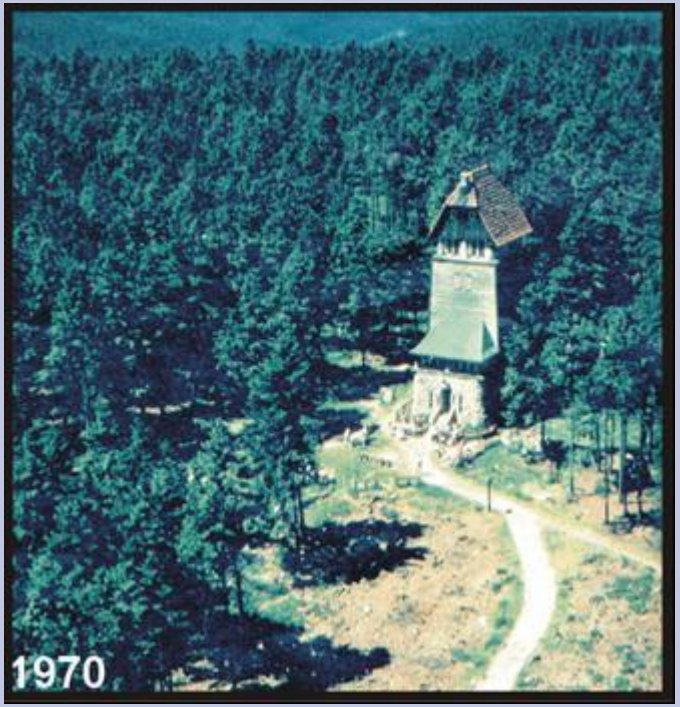


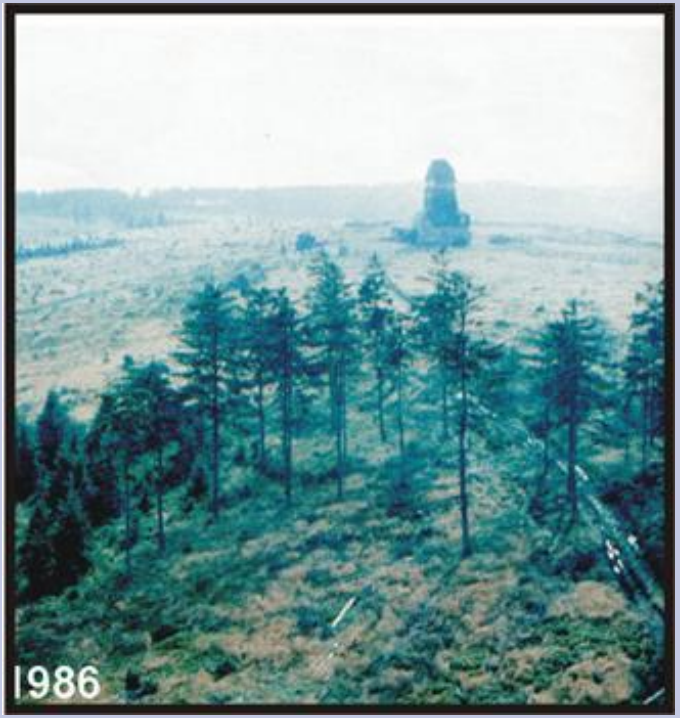
The pH of lake Gårdsjön, SW Sweden



Salmon decline in the acidified waters of southern Norway

Widespread forest decline in C Europe





Forest damage in Germany

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Forest damage in Scandinavia

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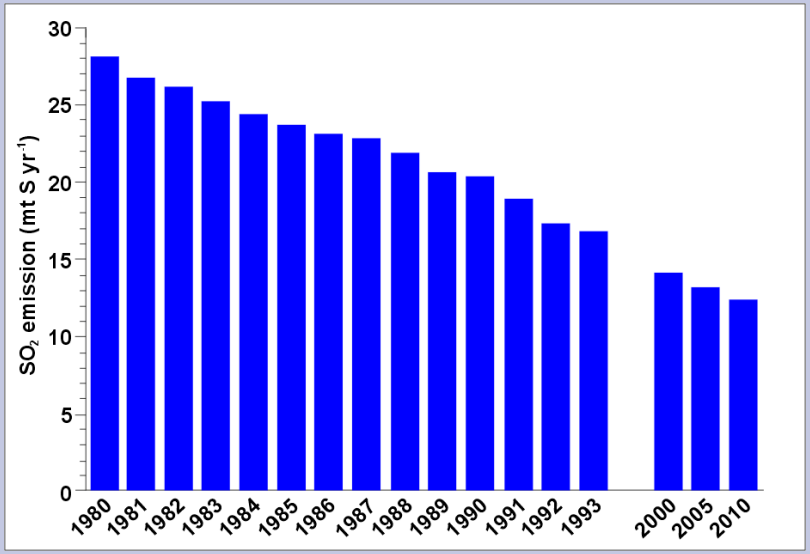
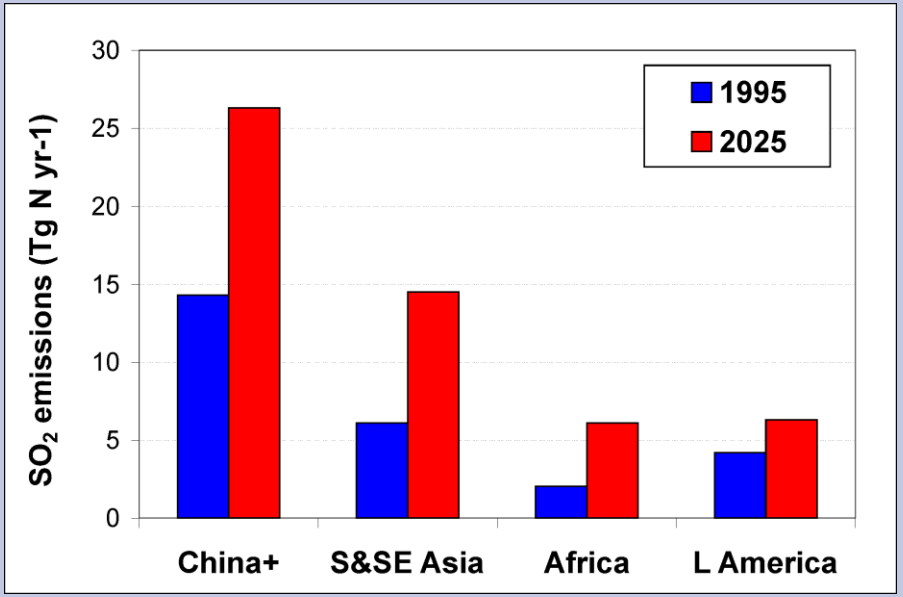
The Progression of Sulphur Emissions in Different Regions



Europe



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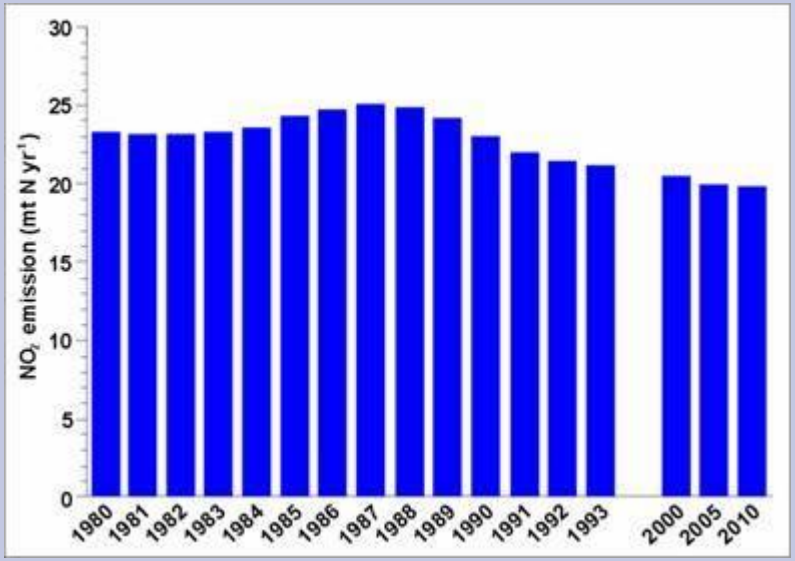
The Progression of Nitrogen Oxide Emissions in Different Regions



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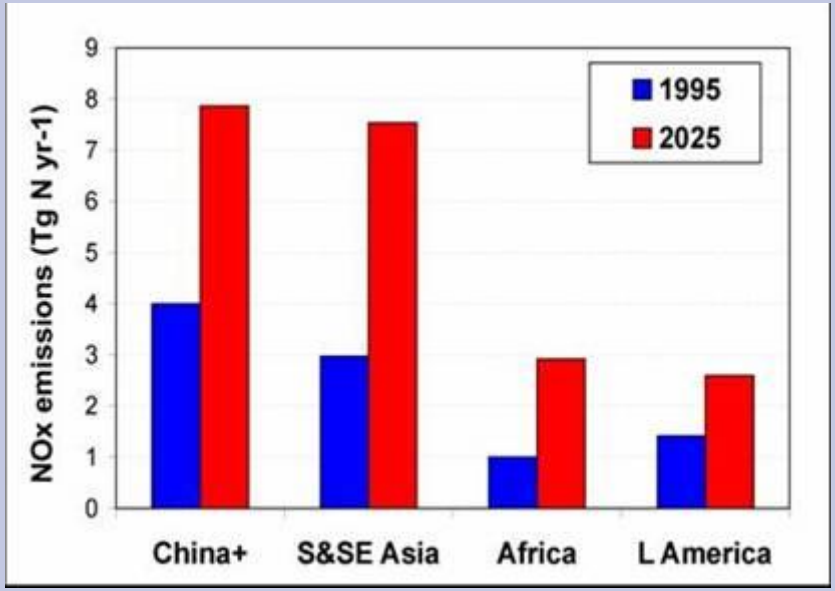

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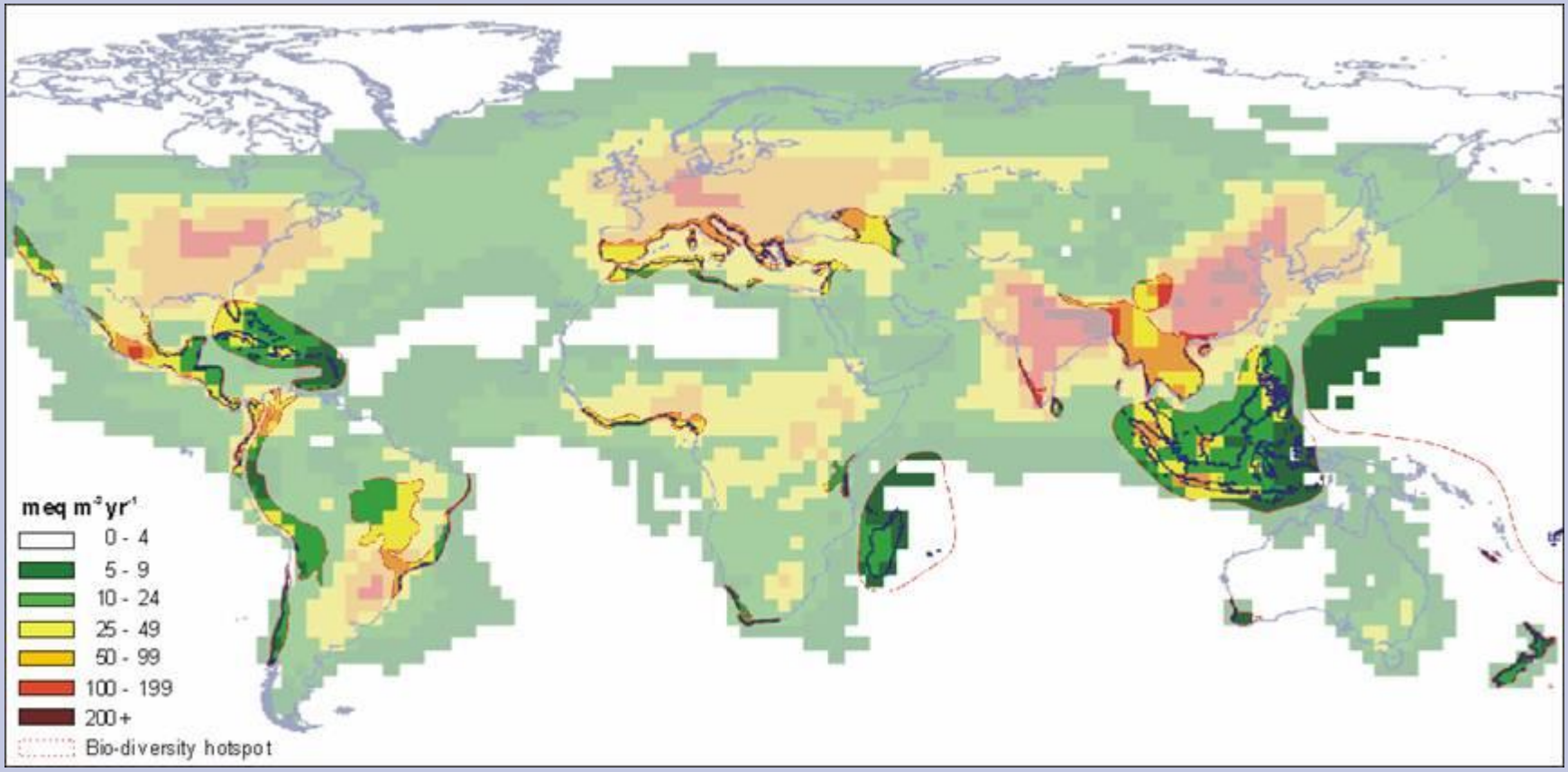
Regions of High Biodiversity Importance and High Nitrogen Deposition



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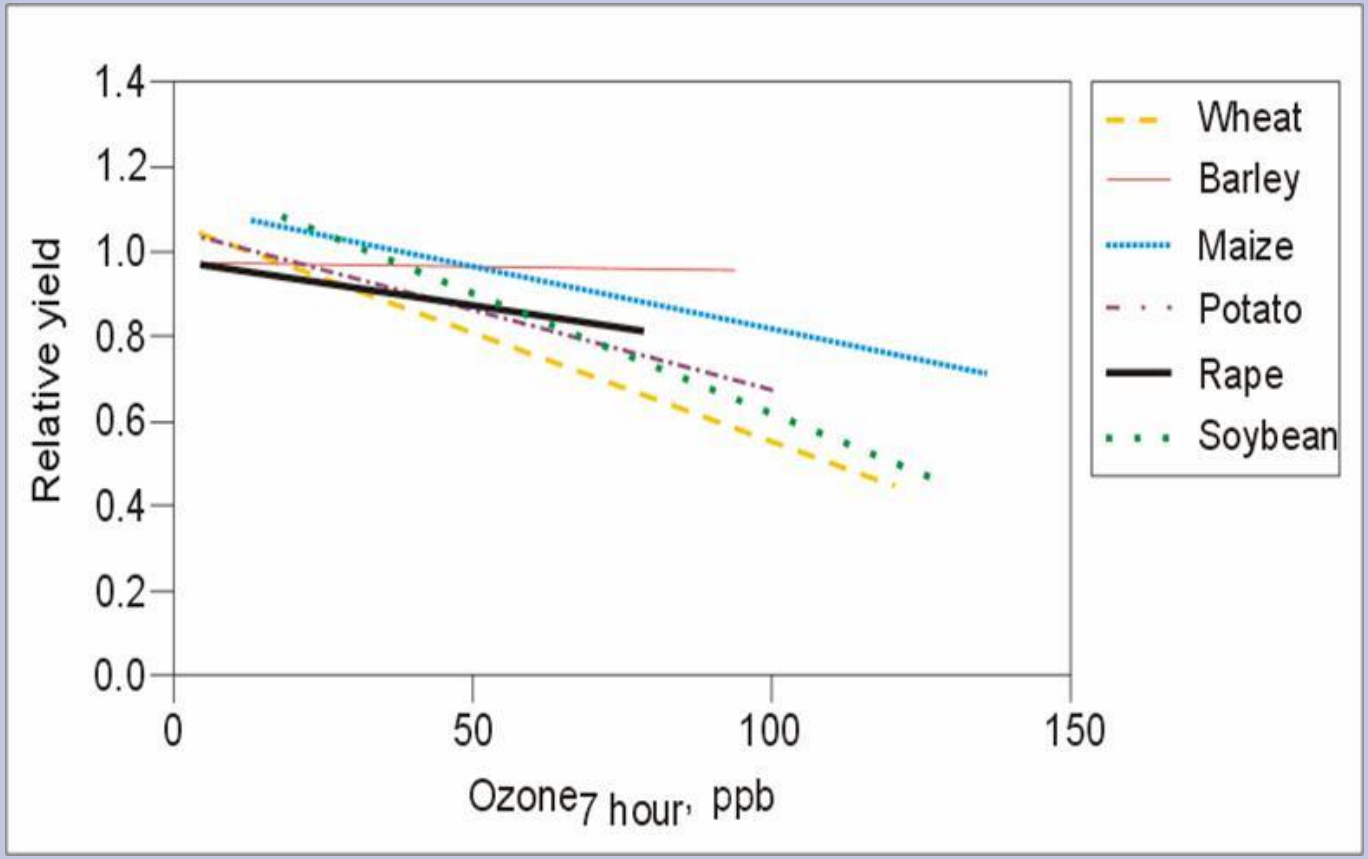
Impacts on Crops and Forests

VISIBLE INJURY

Ozone induced injury on clover and white pine

Ozone induced injury to muskmelon and peach trees in the Mediterranean region

INVISIBLE INJURY

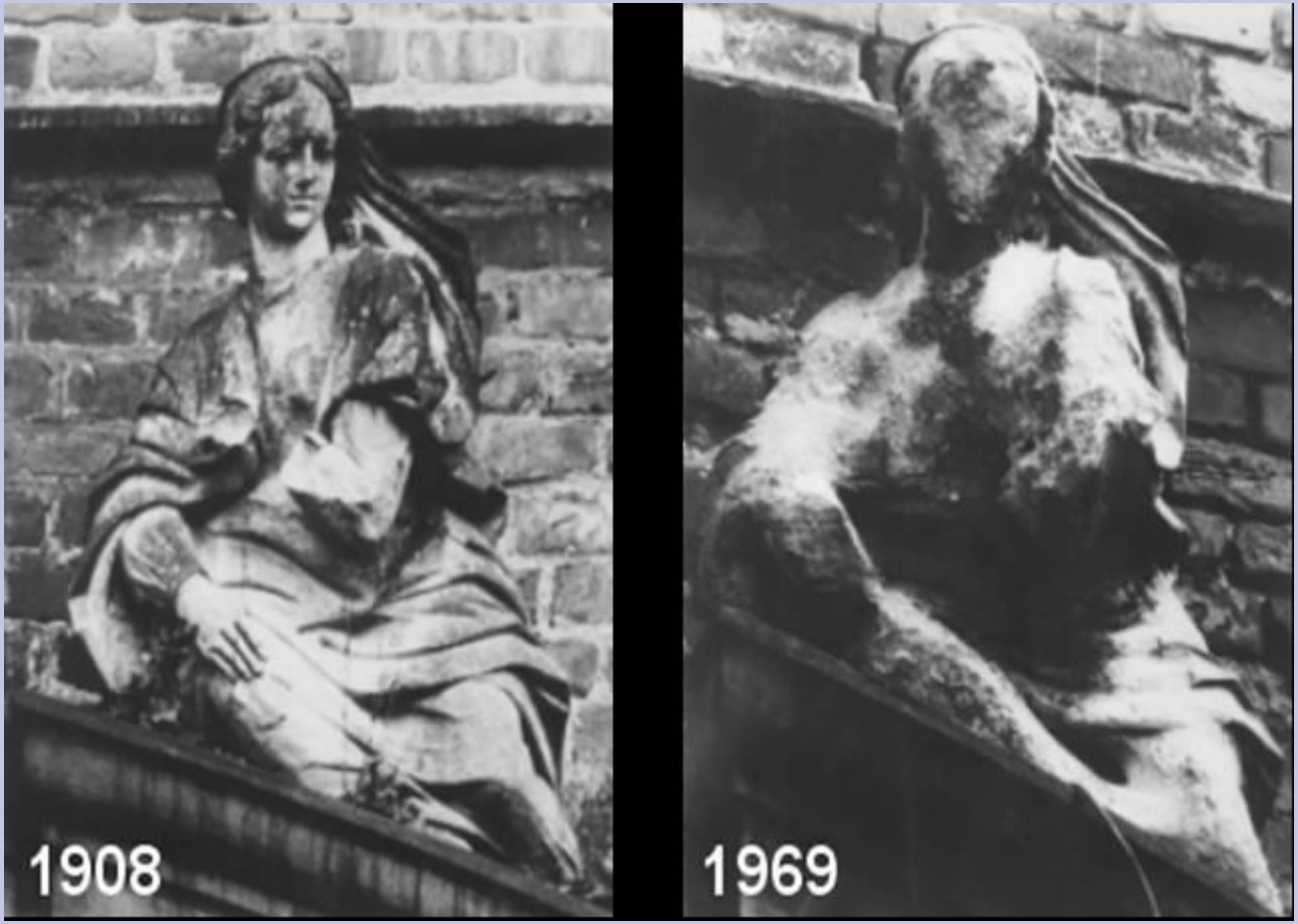


Crop yield reductions due to O_3 – synthesis of latest coordinated European research

Invisible Injury: as shown by filtration experiments

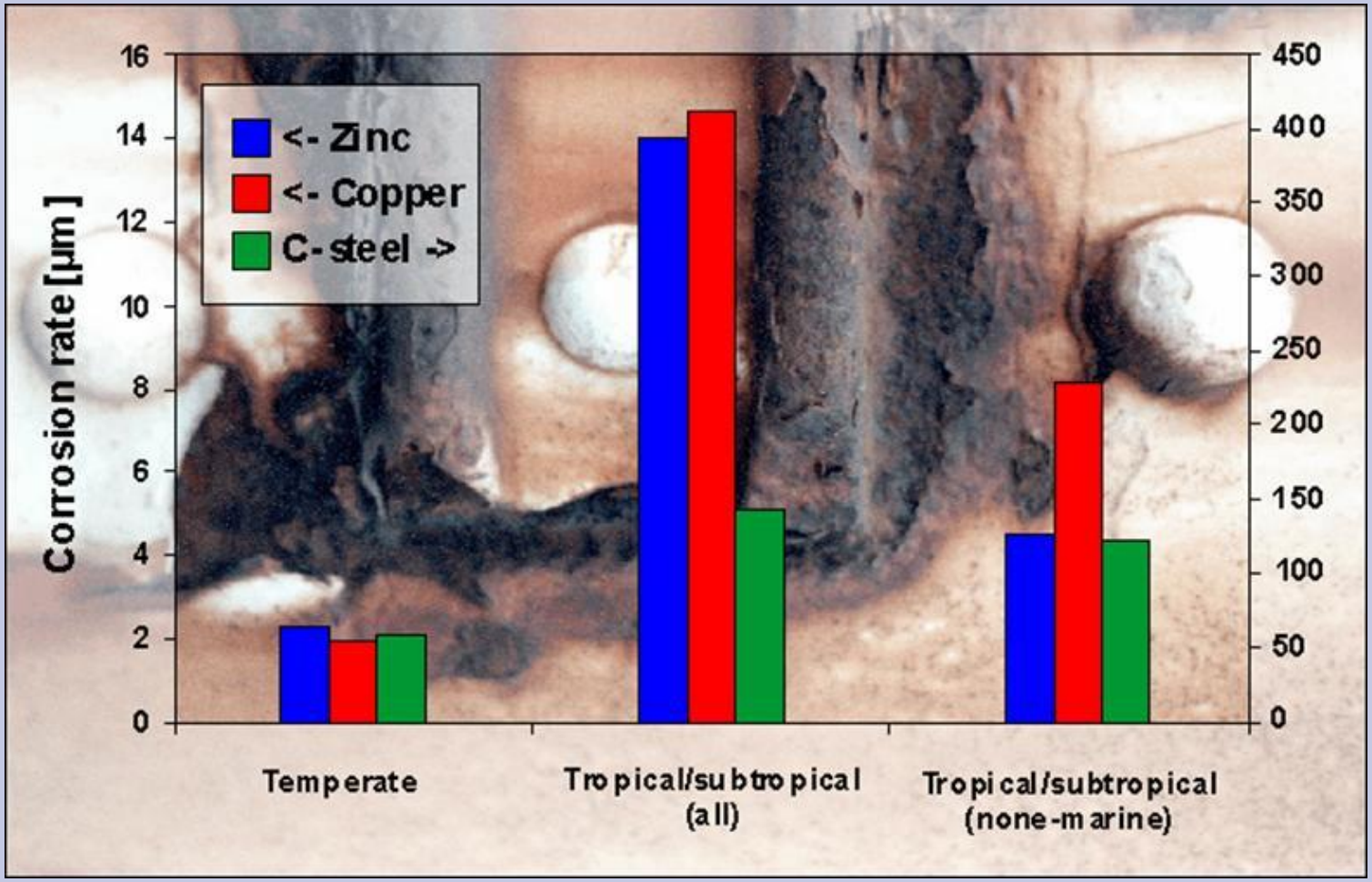
O_3 injury to wheat whole plant growth, Pakistan (courtesy of A. Wahid)

Air Pollution and Corrosion in Europe



Impacts in Central Germany

Impacts on Materials in Tropical/Sub-tropical Climates



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RAPIDC Corrosion Impact Activities in Asia/Africa

No	Country	Location	Type
1	India	Jamshedpur	Urban
2	India	Howrah, Kolkata	Urban
3	India	Bhubaneswar	Urban
4	India	Bhubaneswar	Rural
5	Thailand	Bangkok	Urban
6	Thailand	Phrapradaeng	Industrial
7	Vietnam	Hanoi	Urban
8	Vietnam	Ho Chi Minh	Urban
9	Vietnam	Tien Giang province	Rural
10	China	Chongqing	Urban
11	China	Tie Shan Ping	Rural
12	China	Hong Kong	Urban
13	Malaysia	Kuala Lumpur	Urban
14	Malaysia	Tanah Rata	Rural
15	South Africa	Johannesburg	Urban
16	Zambia	Kitwe	Urban Industrial
17	Zambia	Magoye	Rural Industrial
18	Zimbabwe	Harare	Urban

Exposures to develop the dose-response relationships for standard materials relevant to tropical and subtropical conditions

Korrosionsinstitutet
Swedish Corrosion Institute

Why produce an emissions inventory?

- **provide input data for modelling the movement, deposition and effects of air pollutants**
- **help inform the policy makers and the public**
- **help define priorities and set objectives for reducing emissions**
- **assess the potential impacts of different reduction strategies**
- **forecast future emission levels to determine which emission sources might require further controls**

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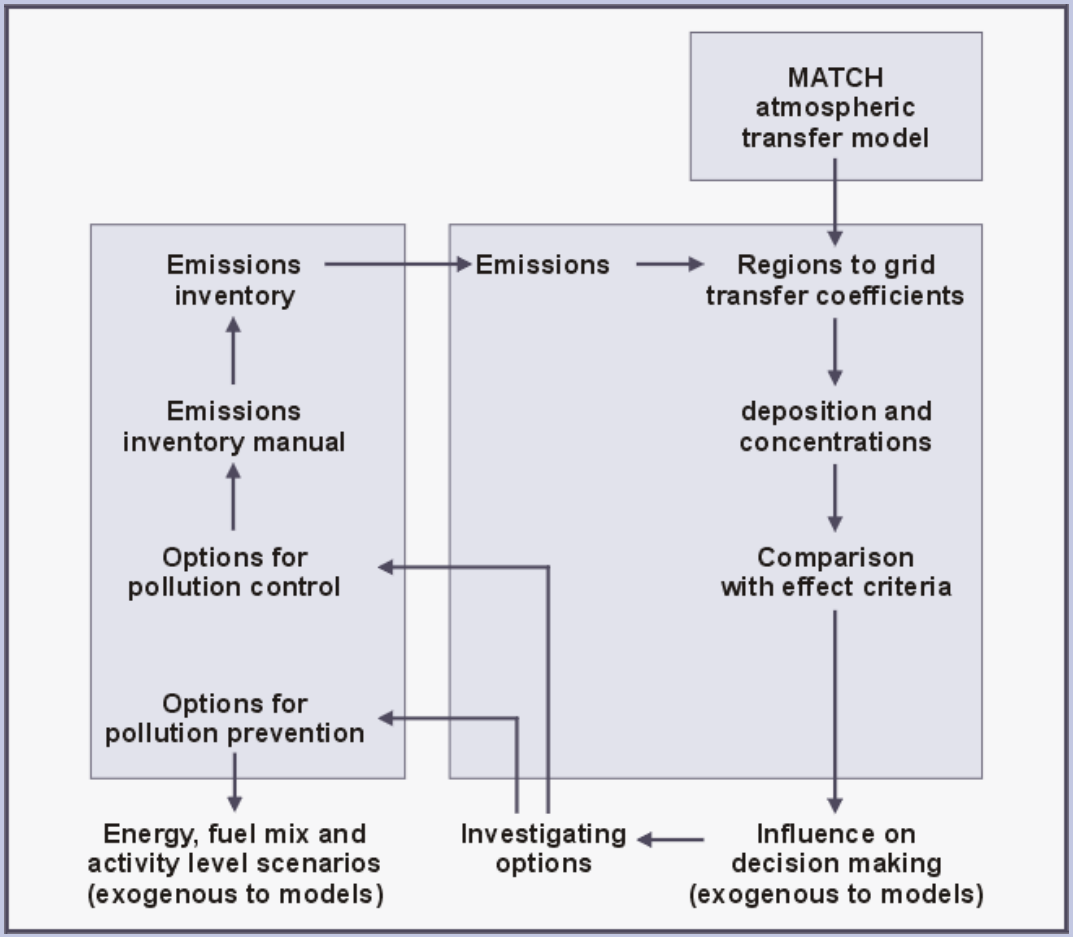
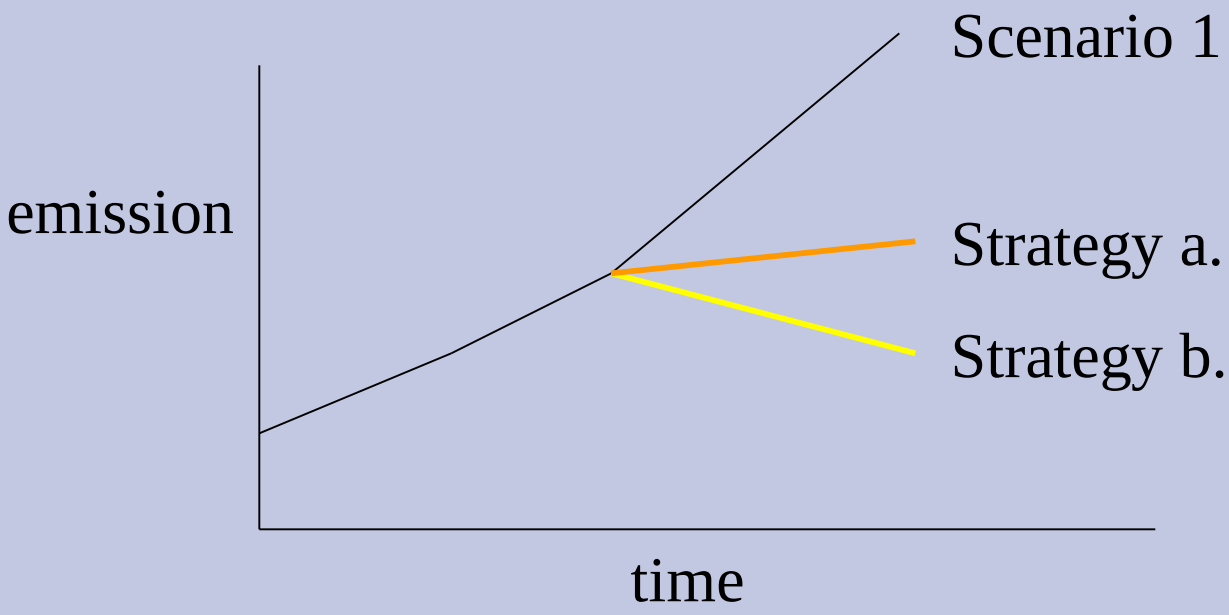


Why produce an emissions inventory?

- scenarios

Developing cost-effective strategies to limit air pollution



What is an emissions inventory?

***An air pollutant emissions inventory details the amounts and types of air pollutants released into the air by source category*.**

Some source categories consist of large point sources:

electrical power plants, metal smelters, large factories, oil refineries

Others are made up of many small or diffuse sources:

domestic households, small factories, offices and public buildings, cars and other mobile sources, vegetation fires, crop residue burning, application of fertilizers

General approach for calculation of emissions

Unless measured directly, emission are generally estimated as:

Emission = (emission factor) x (activity rate)

In practice the calculations are more complicated but the principle remains the same.

General approach for calculation of emissions

Emission = (emission factor) x (activity rate)

Emission factors **are the rate of emission of a pollutant per unit of activity (e.g. in coal-fired power stations - kg NO_X per tonne coal burnt)**

The *activity rate* is some measure of the annual level of the relevant activity (e.g. in coal-fired power stations - the annual rate of consumption of coal burnt per year (kt/yr))

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SEI STOCKHOLM ENVIRONMENT INSTITUTE

Malé Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia

The Malé Declaration Air Pollutant Emissions Inventory Manual

Draft Version 2.1
June, 2006

UNEP
RRC-AP

SACEP

SEI

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The Malé Declaration emission inventory Excel workbook: main menu

User must enter inventory details here:

Inventory year:	2000
Region:	South Asia
Country:	Someland
Province:	Somestate (optional)

MENU OVERVIEW

GO	Menu1	Sectors 1. to 4. Fuel combustion activities
GO	Menu2	Sector 5. Fugitive emissions (non-combustion) for fuels
GO	Menu3	Sector 3. Fuel combustion activities. Sector: Transport (Detailed method)
GO	Menu4	Sector 6. Industrial processes (non-combustion) emissions
GO	Menu5	Sector 7. Solvent and other product use
GO	Menu6	Sector 8. Agriculture
GO	Menu7	Sector 9. Vegetation fires and Forestry.
GO	Menu8	Sector 10. Waste
GO	Menu9	Large Point sources
GO	Sheet 9	Summary sheet - Annual emissions of each pollutant by source sector
GO	References	

The Malé Declaration emission inventory Excel workbook: Menu 4

Sector 6. Industrial processes (non-combustion) emissions

Back to Back to Main

- GO Sheet: 2.1 Process (non-combustion) emissions from the production of mineral products.
- GO Sheet: 2.2 Process (non-combustion) emissions from the production of chemicals.
- GO Sheet: 2.3 Process (non-combustion) emissions from metal production.
- GO Sheet: 2.4 Process (non-combustion) emissions of SO_2, NOx and NMVOCs from pulp and paper production.
- GO Sheet: 2.5 Process (non-combustion) emissions of NMVOC from alcoholic beverage manufacture.
- GO Sheet: 2.6 Process (non-combustion) emissions of NMVOC, PM_{10}, and $PM_{2.5}$ from food production
- GO Sheet: 2.7 Fugitive emissions of particulate matter from major building construction activities.

Worksheet for *Process (non-combustion) emissions from metal production*

Process	A Activity rate (kt product/ year)	B SO_2 emission factor (kg SO_2/t)		C SO_2 emissions (Tonnes)	D NO_x emission factor (kg NO_x/t)		E NO_x emissions (Tonnes)
			Default	(A x B)		Default	(A x D)
Pig iron production			3[a]	0		0.076[d]	0
Aluminium production			15.1[e]	0		2.15[e]	0
Copper smelting (primary)			2120[f]	0			
Lead smelting (primary)			320[g]	0			
(secondary)			40[h]	0			
Zinc smelting (primary)			1000[g]	0			
Other (please specify)				0			0
Total emissions				0			0

Sheet 9 Summary sheet - Annual emissions of each pollutant by source sector

Sector	Sub-sector	Total emissions (kilotonnes pollutant per year (kt/yr))						
		SO_2	NO_x	CO	NMVOC	NH_3	PM_{10}	$PM_{2.5}$
1. Combustion in the Energy Industries	Public Electricity and Heat	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Petroleum Refining	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Manufacture of Solid Fuels and Other Energy	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Combustion in Manufacturing Industries and construction	Iron and Steel	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-ferrous metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-metallic minerals	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Chemicals	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Pulp, Paper and print	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mining and Quarrying	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Construction	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other (Please specify in sheet 1.1.1a, 1.1.1b or 1.1.1c)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Autoproduction of electricity/heat	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Remainder (Non-specified)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Transport	Civil Aviation (Simple--not used if Detailed used)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Civil Aviation (Detailed)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Road transport (Simple--not used if Detailed used)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Road transport (Detailed)		0.00	0.00			0.00	0.00
	Railways	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Navigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Pipeline transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-specified transport	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4. Combustion in Other Sectors	Commercial/Institutional	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Residential	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Agriculture/Forestry/Fishing	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-specified "Other sectors"	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Fugitive emissions from fuels	Production of coke				0.00		0.00	0.00
	Oil exploration and crude oil production and transport				0.00			
	Oil refining	0.00	0.00	0.00	0.00			
	Distribution and handling of gasoline				0.00			
	Production and distribution of natural gas.				0.00			
	Flaring during oil and gas extraction		0.00	0.00	0.00			
6. Industrial processes	Mineral products	0.00		0.00	0.00		0.00	0.00
	Chemicals	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metals	0.00	0.00	0.00	0.00		0.00	0.00
	Pulp and paper	0.00	0.00	0.00	0.00		0.00	0.00
	Food and drink				0.00		0.00	0.00
	Major construction site activities (Fugitive PM only)						0.00	0.00
7. Solvent and other product use					0.00			
8. Agriculture	Manure management					0.00		
	Application of N-containing fertilizers		0.00			0.00		
	Burning of agricultural crop residues	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9. Vegetation fires and Forestry	On-site burning of forests and grasslands	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10. Waste	Waste incineration	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Human excreta					0.00		
Total anthropogenic		0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Chinese proverb:

‘A **clever** man learns from his mistakes….

….a **wise** man learns from other people’s mistakes’