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Parallel Studies to the Malé Declaration

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Parallel Studies to the Malé Declaration

1.1 Integrated Assessment Model (IAM)

1.2 Atmospheric transfer modelling

2 Emissions Inventory Manual and Spreadsheet

Integrated Assessment Model IAM

- Development requested as a priority action for the implementation of the Malé Declaration by NIAs during Phase I

- Decision support tool to investigate pollutant emissions, atmospheric transfer, deposition and evaluate impacts

- Tool allowing integration of the different elements relevant to transboundary air pollution to facilitate policy analysis

Process of Developing an IAM for the Malé Declaration

A. Consultation

Consult with NIAs and NFPs over their requirements, questions and information they require from this decision support tool

- ascertain needs of countries

- determine emission regions

- determine which pollutants

- which baseline year

B. Malé IAM Version 1 development

Carry out development of Version 1 of the Malé IAM tool according to the NIA requirements through activities by SEI, UNEP/RRC-AP, SMHI and SACEP

- Establish database formats and IAM structure

- SMHI develop region-to-grid transfer coefficients

- Develop acidification/crop yield/eutrophication impact criteria

- Develop model at UNEP/RRC-AP

- Consult with NIAs and NFPs over initial development and make plans for next steps

Proposed Malé IAM Structure
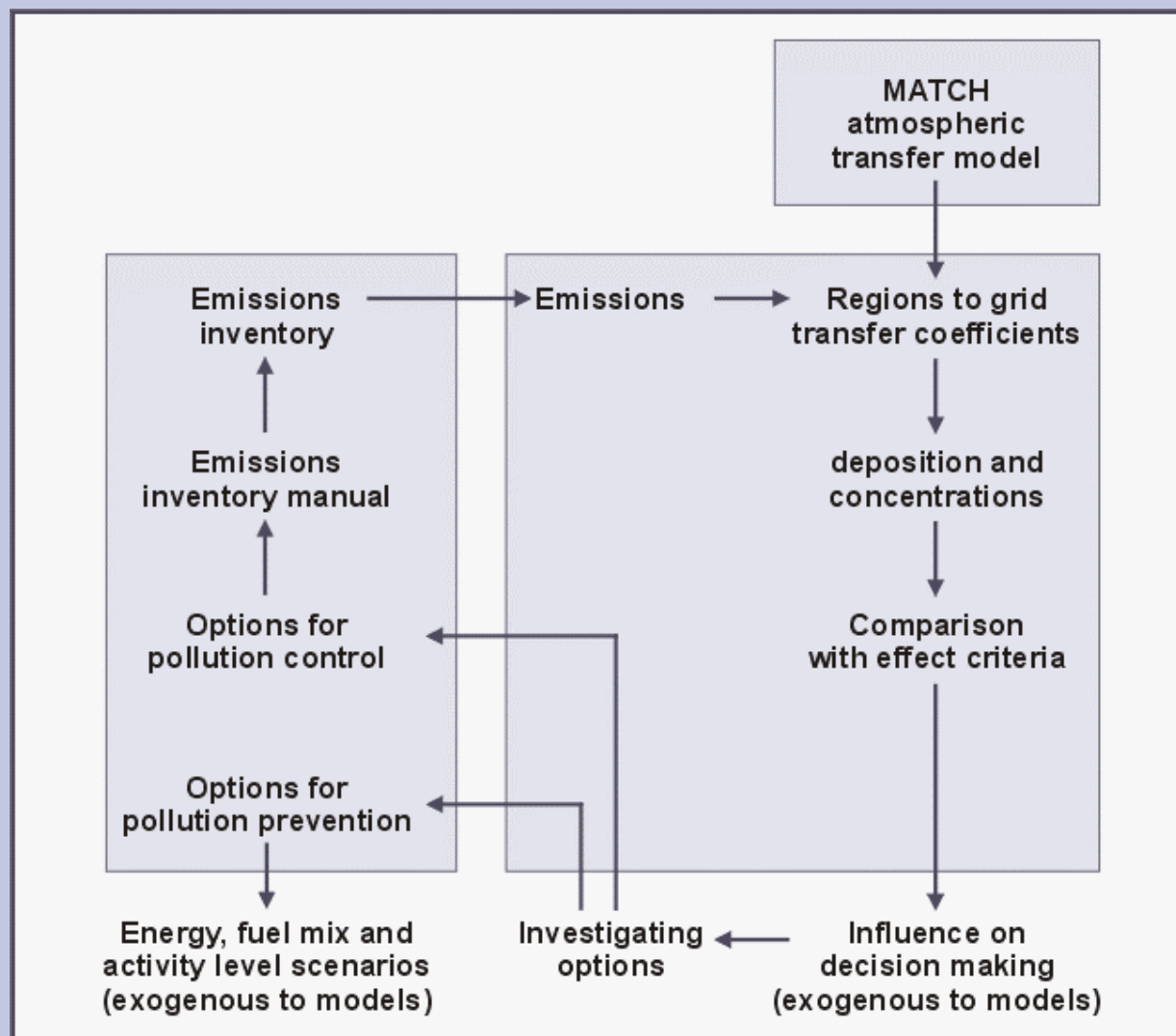
The MATCH Atmospheric Transfer Model

- Developed by SMHI in Sweden and modified for application in Asia

- Flexible research tool to investigate the atmospheric transfer of pollutants (S and N) over large distances

- Inputs are mainly weather data (every 6 hours) and emissions

- The model has a chemistry module where transformations take place

- It also has a deposition module in rainfall and as dry deposition (gases and aerosols)

- Needs to be verified by the monitoring network

Sulphur deposition calculated using the SMHI MATCH model

mg S m^{-2} yr^{-1}

	0 - 199
	200 - 499
	500 - 1999
	2000 - 4999
	5000 - 7999
	8000 - 9999
	10000+
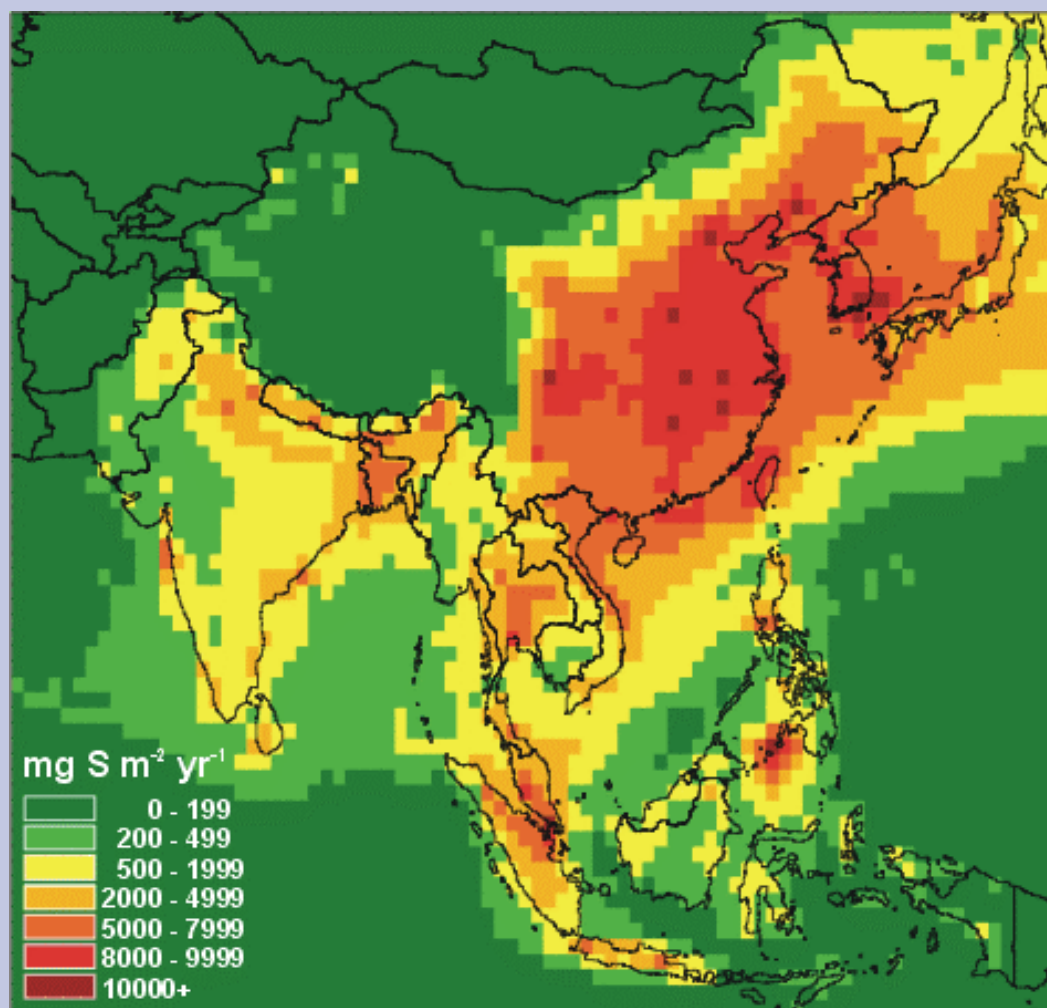
The Malé Declaration Air Pollutant Emissions Inventory Manual

Outline Draft: July, 2002

Implementation of the Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects

UNEP RRC-AP

SEI

SACEP

Aim and objective of the parallel activity on emissions inventories

Aim:

each country of the Malé Declaration to compile (during Phase III) air pollutant emission inventories which are compatible with each-other and with the Integrated Assessment Model (IAM)

Objective:

to produce, in consultation with the NIAs and S. Asian experts, a manual and associated software (Excel-based workbook) for use by the Malé Declaration countries in compiling these emission inventories

Process for developing the manual and workbook

- development of an IAM (including an emission inventory) **identified by NIAs as a priority**

- This activity **builds on earlier work** carried out during Phase I - especially the *Guidelines for the Preparation of Baseline Studies* and the *Emission Inventory Database*.

- The manual and workbook will be developed in **consultation with the NIAs** and regional experts

- An **expert workshop** will be held immediately after the July 2003 NIA meeting in order **to review and further tailor the manual to regional needs.**

- Malé Declaration countries will then use the manual to develop emission inventories in Phase III

Suggested pollutants for inclusion in manual

- Sulphur dioxide (SO_2)

- Nitrogen oxides (NO_X)

- Particulate matter (PM)

- Ammonia (NH_4)

- Non-methane volatile organic compounds (NMVOCs)

Summary of emission source categories used in the manual

Energy sources:

1   Combustion in the Energy Industries
2   Combustion in Manufacturing Industries and Construction
3   Transport
4   Combustion in Other Sectors

Other source sectors:

5   Fugitive emission from fuels
6   Industrial Processes
7   Solvent and Other Product Use
8   Agriculture
9   Vegetation Fires & Forestry
10   Waste
11   Natural sources

Breakdown of energy source sectors

Sector	Sub-sector	Sub-sub sector
1. Combustion in Energy industries	Public Electricity and Heat Production	
	Petroleum Refining	
	Manufacture of Solid Fuels and Other Energy:	Coke ovens
		Patent fuel, BKB
		Gas works
		Charcoal production
2. Combustion in Manufacturing Industries and Construction	Iron and steel	
	Non-ferrous metals	
	Chemicals	
	Pulp, paper and print	
	Food, beverages and tobacco	
	Textiles and leather	
	Other	
3. Transport	Civil Aviation	
	Road transport	
	Railways	
	Navigation	
	Pipeline transport	
	Other	
4 Combustion in other sectors	Commercial/Institutional	
	Residential	
	Agriculture/Forestry/Fishing	

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Fuel combustion sectors – *Fuel categories*

Coal	Gas	Oil	Combustible Renewables / wastes
Coking Coal	Gas Works Gas (GWG)	Crude Oil	Solid Biomass and Animal Products:
Other Bituminous Coal & Anthracite	Natural Gas	Natural Gas Liquids (NGL)	*Wood*
Sub-Bituminous Coal		Refinery Gas	*Vegetal materials and wastes*
Lignite		Liquefied Petroleum Gases (LPG)	*Other (e.g. Animal products/wastes)*
Patent Fuel		Motor Gasoline	Gas/Liquids from Biomass + wastes
Coke Oven Coke		Aviation Gasoline	Municipal Waste
Gas Coke		Gasoline type Jet Fuel	Industrial Waste
BKB (Brown coal briquettes)		Kerosene type Jet Fuel	Charcoal
Coke Oven Gas (COG)		Kerosene	
Blast Furnace Gas (BFG)		Gas/Diesel Oil	
		Residual Fuel Oil (RFO)	
		Other Petroleum Products	

General approach for calculation of emissions

Unless measured directly, emission are generally estimated using emission factors:

$$\textit{Emission} \ = \ (\textit{emission factor}) \ x \ (\textit{activity rate})$$

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Emission Factors (EFs)

EFs are the rate of emission of a pollutant per unit of activity (e.g. kg NO_x per TJ coal burnt; kg SO_2 per tonne copper smelted)

The manual and associated workbook will contain suggested default EFs

Currently, default EFs mostly derived from European or North American source documents (e.g. EMEP/Corinair; USEPA AP-42; IPCC Guidelines)

Locally-derived EFs, more appropriate to South Asia, should be used where possible

Reliable EFs for the region will be collected and incorporated into the manual (and workbook) after consultation with local experts

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Activity rates

Examples:

- For ***fuel combustion***, the "activity rate" is the annual rate of consumption of a fuel (e.g. TJ coal burnt per year) .

- For ***industrial process emissions*** the "activity rate" is the annual rate of production of the commodity (e.g. tonnes copper per year).

Sources of activity data:

- National statistical yearbooks/compendia – with state/provincial breakdown of data if possible.

- International compendia:

  OECD/IEA Energy Statistics and Balances of non-OECD Countries

  United Nations, Energy Statistics Yearbooks

  United Nations, Industrial Commodity Statistics Yearbooks

Top-down or bottom up approach?

- Depends on data availability – flexibility crucial

- If national data only – then top-down

- If state/provincial data - still top-down but better spatial allocation

- If large point source (LPS) data – bottom-up

- National and LPS sources can be inventoried together– the workbook will automatically adjust national activity data to avoid 'double-counting'.

Road transport emissions – detailed or simple method?

- Emission Factors usually depend on vehicle type, age, fuel type, emission controls and so forth.

- If only national fuel consumption data available - *simple method* using average 'bulk' emission factors allows rough estimate.

- If data on fleet composition and average distance travelled per vehicle class per year are available – *detailed method* recommended.

- Workbook will permit either method.

Mobile emissions of NO_X (detailed) for on-road vehicles

EMISSIONS INVENTORY WORKBOOK TEMPLATE

Sector: Transport (Detailed method)

Sub-sector: Road transportation

BACK TO MENU

Fuel	Vehicle class	A Number of vehicles in use	B Average distance travelled per vehicle (km/yr)	C Total distance travelled (km/yr) C = A x B	D NO_x emission factor (g/km) Default	E NO_x emissions (Tonnes) E = C x D/1000000
Gasoline	Passenger cars			0	1.89[b]	0
	Light-duty vehicles			0	2.94[c]	0
	Heavy-duty vehicles			0	6.75[d]	0
	Motorcycles < 50cc (2-stroke)			0	0.05[e]	0
	Motorcycles > 50cc (2-stroke)			0	0.08[f]	0
	Motorcycles (4-stroke)			0	0.3[g]	0
Diesel	Passenger cars			0	0.67[h]	0
	Light-duty vehicles			0	1.44[i]	0
	Heavy-duty vehicles			0	10.9[j]	0
LPG	Passenger cars			0	2.16[k]	0
	Light-duty vehicles			0		0
	Heavy-duty vehicles			0	5.7[l]	0
Total						0

Step-by-step guide to using workbook

Fuel combustion activities:

Sector 3 - Transport (detailed method)

    Sub-sector: Road transportation

    <u>Sheet 1.9.3 Mobile emissions of NO_x, CO, NMVOC, PM_{10} and $PM_{2.5}$ (detailed) for on-road vehicles.</u>

Step 1	Enter in column A the average number of vehicles in use, for each vehicle class, during the year.
Step 2	Enter in column B the average distance travelled (kilometres per year) for each vehicle class.
Step 3	Enter in column D the NOx emission factor (grammes NOx per kilometre) for each vehicle class.
Step 4	Enter in column F the CO emission factor (grammes CO per kilometre) for each vehicle class.
Step 5	Enter in column H the NMVOC emission factor (grammes per kilometre) for each vehicle class.
Step 6	Enter in column J the PM_{10} emission factor (grammes per kilometre) for each vehicle class.

Questionnaire

Expectations and requirements of NIAs for emission inventory manual and workbook including:

- Pollutants to be included
- Emissions source sector structure
- Fuel category breakdown
- Large point source (LPS) criteria
- Regional/sub-regional/grid breakdown of emissions

Questionnaires to be returned to UNEP/RRC-AP by September 2002