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ANTHROPOGENIC SO₂/NO_x COMMITTEE
SUMMARY OF CURRENT STATUS - ANNUAL INVENTORY

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International Global Atmospheric Chemistry Programme

Global Emissions Inventory Activity

Anthropogenic SO₂/NO_x Committee

Summary of Current Status - Annual Inventory¹

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At the First GEIA Workshop on Global Emissions Inventories, held in Baltimore, MD on December 1-2, 1991, data on anthropogenic emissions of sulfur and nitrogen developed by Dignon (1992) were selected to form the basis for the GEIA SO₂ and NO_x annual inventories. The Dignon data include emissions from fuel combustion only and currently extend to 1980. The methodology used was detailed in Dignon and Hameed (1985) and consists of statistical regression models based on available emissions data from the U.S. and some other member countries of the Organization of Economic Co-operation and Development (OECD), which includes Australia, Canada, Japan and western European countries. Control regulations are incorporated via the use of different statistical parameters. The grid definition from these inventories was also adopted for the GEIA grid: origin at 180°W, 90°S, 1° x 1° resolution (i.e., 360 cells in the longitude direction, 180 cells in the latitude direction).

To upgrade the basic GEIA inventories, data for the different geographic regions are being solicited from researchers located within these areas. To date, the following upgrades have been accomplished.

The most comprehensive inventories of SO₂ and NO_x emissions for the United States and Canada has been compiled by the National Acid Precipitation Assessment Program (NAPAP, Saeger et al., 1989; Wagner et al., 1986). Version 2 of the NAPAP base year 1985 emissions inventories were selected to replace values in the basic GEIA inventories for the U.S. and Canada. Annual values for point sources were directly allocated to the GEIA 1° x 1° grid; the NAPAP spatial allocation file, which allocated area sources to the NAPAP 20 km grid was used as the basis for the allocation of area sources to the GEIA grid. Table 1 summarizes the main inventory characteristics and includes emission totals for the U.S. and Canada as compiled from the NAPAP inventory and the emissions that were replaced in the

¹ Presented at the Second GEIA Workshop on Global Emissions Inventories, Lillestrøm, Norway, June 22-24, 1992. In Proceedings.

basic GEIA inventory.

Base Inventory: Dignon (1992).	
1980 emissions from fossil fuel combustion only.	
1° x 1° resolution, (1,1) at 180°W, 90°S.	
Global SO ₂ emissions (10 ⁶ metric tons S yr ⁻¹)	62.8
Global NO _x emissions (10 ⁶ metric tons N yr ⁻¹)	21.9
U.S./Canadian Inventory: NAPAP 1985 Version 2.	
1985 emissions from all land sources. Partial emissions from shipping.	
Point sources gridded individually.	
Area sources gridded to 20 x 20 km NAPAP grid, aggregated to 1° x 1°.	
U.S./Canada SO ₂ emissions (10 ⁶ metric tons S yr ⁻¹)	12.3
U.S./Canada NO _x emissions (10 ⁶ metric tons N yr ⁻¹)	6.2
SO ₂ emissions in base inventory (10 ⁶ metric tons S yr ⁻¹)	13.0
NO _x emissions in base inventory (10 ⁶ metric tons N yr ⁻¹)	6.7
European Inventory: EMEP (1991).	
1985 emissions from all land sources. Ship traffic within Europe included.	
150 x 150 km grid reapportioned to 1° x 1° grid.	
European SO ₂ emissions (10 ⁶ metric tons S yr ⁻¹)	23.0
European NO _x emissions (10 ⁶ metric tons N yr ⁻¹)	7.6
SO ₂ emissions in base inventory (10 ⁶ metric tons S yr ⁻¹)	23.2
NO _x emissions in base inventory (10 ⁶ metric tons N yr ⁻¹)	7.1
Asian Inventory: Kato and Akimoto (1992).	
1985 emissions from transformation, industrial, transportation and misc.	
Regional based emissions for China and India, country based for all others.	
Gridded to 1° x 1° grid using population file (Dignon).	
Asian SO ₂ emissions (10 ⁶ metric tons S yr ⁻¹)	13.1
Asian NO _x emissions (10 ⁶ metric tons N yr ⁻¹)	4.2
SO ₂ emissions in base inventory (10 ⁶ metric tons S yr ⁻¹)	13.6
NO _x emissions in base inventory (10 ⁶ metric tons N yr ⁻¹)	3.6

Table 1
Summary of Current Work on Annual SO₂ and NO_x Inventories

The most comprehensive inventories of European SO₂ and NO_x emissions compiled under a unified methodology have been assembled by the Co-Operative Program for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe (EMEP, Iversen et al., 1991). Values from this inventory were selected to replace values in the basic GEIA inventories for Europe. The EMEP inventory values are available in a 150

km x 150 km polar stereographic grid; these values were transferred to the 1° x 1° GEIA grid and replaced the corresponding values in the basic GEIA inventories. Table 1 summarizes the main inventory characteristics and includes emission totals for Europe as compiled from the EMEP inventory and the emissions that were replaced in the basic GEIA inventory.

Kato and Akimoto (1992) developed inventories of SO₂ and NO_x emissions for 25² Asian countries east of Afghanistan and Pakistan for years 1975, 1980, 1985, 1986 and 1987. Transformation (electric utilities, petroleum refineries, etc.), industrial, transportation and other sectors are included in these inventories. Estimates are available on a province and regional basis for China and India; on a country basis for all other countries. Emissions for 1985 were apportioned by J. Dignon to the GEIA grid based on population, using the methodologies and data files developed for her 1992 work. Table 1 summarizes the main inventory characteristics and includes emission totals for Asia as compiled from the Kato and Akimoto inventory and the emissions that were replaced in the basic GEIA inventory.

Table 2 summarizes the current status of the GEIA work on annual emissions of SO₂ and NO_x from anthropogenic sources. Table 3 summarizes the next steps to be taken by this project.

References

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- Iversen, T., N.E. Halvorsen, S. Mylona and H. Sandnes. 1991. Calculated Budgets for Airborne Acidifying Components in Europe, 1985, 1987, 1988, 1989 and 1990, EMEP/ MSC-W Report 1/91, Meteorological Synthesizing Centre - West, The Norwegian Meteorological Institute, Oslo, Norway.
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² Countries included: Afghanistan, Bangladesh, Brunei, Cambodia, China, Hong Kong, India, Indonesia, Japan, N. Korea, S. Korea, Laos, Macao, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Phillipines, Singapore, Sri Lanka, Taiwan, Thailand, Viet Nam.

Base Inventory:	Dignon 1980 fuel combustion emissions. (Dignon, 1992).
North America:	48 Lower U.S States/Canada from NAPAP 1985 vers. 2. Alaska and Hawaii from base inventory. Mexico from base inventory.
Central America:	All countries from base inventory.
South America:	All countries from base inventory.
Europe:	EMEP 1985.
Asia:	USSR from base inventory. All others, 1985 emissions from Kato and Akimoto.
Africa:	All countries from base inventory.
Australia:	From base inventory.
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Jane Dignon (US)	Nobuo Kato (Japan)
Jozef Pacyna (Norway)	David Simpson (Norway)

Table 2
Summary of Current Status of Annual SO₂ and NO_x Inventories

Saeger, M., J. Langstaff, R. Walters, L. Modica, D. Zimmerman, D. Fratt, D. Dulleba, R. Ryan, J. Demmy, W. Tax, D. Sprague, D. Mudgett and A.S. Werner. 1989. The 1985 NAPAP Emissions Inventory (Version 2): Development of the Annual Data and Modelers' Tapes, EPA-600/7-89-012a, U.S. Environmental Protection Agency, Washington, D.C.

Wagner, J.K., R.A. Walters, L.J. Maiocco, and D.R. Neal. 1986. Development of the 1980 NAPAP Emissions Inventory, EPA-600/7-86-057a. U.S. Environmental Protection Agency, Washington, D.C.

Base inventory to be upgraded to 1985 emissions.

Australia emissions expected from Dr. F. Carnovale, EPAV, Australia.

Asian emissions from several sources to be studied and selection made:

Major point sources in Asian part of Russia compiled by NILU.

Work on Asian emissions by Arne Semb, NILU.

Work on Chinese emissions by Xu Quiang.

Work on Chinese emissions by Weng Wenxing.

Work on Japanese emissions by Tonooka.

Berlyanda report on emissions in old USSR to be studied.

Initiate/pursue contacts with researchers in Brazil, OECD representatives from African countries, Saudi Arabia, Israel.

Study the development of an inventory of DMS emissions from oceans.

Sudy the development of an inventory of sulfur emissions from volcanoes.

Table 3
Future Work on Annual SO₂ and NO_x Inventories

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